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Identifying Opportunities for
Environmental Sustainability:
A Grounded Study of the New Zealand
Road Construction Industry

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of
Philosophy in Civil Engineering, The University of Auckland.

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Abstract

The scale of the challenge presented by sustainable development is substantial. The required transformations are complex and multi-hierarchical, involving many different agents and significant social, institutional, and technological change. This thesis identifies opportunities to leverage institutional advancement towards environmental sustainability in the road construction industry in New Zealand.

Legislative changes in the early 2000s had established sustainable development as a policy objective for local government and the land transport sector in New Zealand. However, in 2007, there existed an institutional and operational gap between these high-level policy objectives and the prioritisation and delivery of environmental sustainability outcomes in on-the-ground road construction activities. In response to this practical problem, this thesis examines the factors which motivated and influenced the greening of road construction firms and their activities, and the procurement of environmental outcomes by local road-controlling authorities.

The thesis argues that road construction firms were motivated to explore environmental sustainability initiatives for several reasons, but predominantly adopted initiatives when these were expected to result in tangible outcomes for the firm. The commercial relationship between road construction firms and their clients was the key determinant with respect to the adoption of environmental sustainability initiatives by road construction firms. With respect to the purchase of environmental outcomes by local road-controlling authorities, it is argued that there had been no significant institutionalisation of environmental sustainability within the industry's procurement and funding regimes. The existing ways of doing things and existing institutional structures still dominated how road-works were funded, procured, and constructed. Consequently, local asset managers did not feel justified in procuring beyond-compliance environmental outcomes in road-works.

The thesis applies an exploratory, grounded theory method to develop empirically grounded and theoretically justified models of firm-greening behaviour and green public procurement in this industry. These models provide the credible basis on which to identify opportunities to leverage institutional advancement toward environmental sustainability. Opportunities are identified with respect to improving road construction firms' capabilities and performance, and with respect to enabling the funding and prioritisation of environmental outcomes in the procurement of road-works by road-controlling authorities. The thesis argues that these opportunities remain relevant in the present context.

The possession of knowledge does not kill the sense of wonder and mystery.

There is always more mystery.

- Anais Nin

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Glossary

ALPURT	Northern Gateway Albany to Puhoi Realignment
BCR	Benefit-cost Ratio
C&D	Construction & Demolition
CPP	Competitive Pricing Procedures Manual
EEM	Economic Evaluation Manual
EMS	Environmental Management System
GPP	Green Public Procurement
ISO	International Standards Organization
LGA	Local Government Act
LTMA	Land Transport Management Act
LTNZ	Land Transport New Zealand
NGA	Northern Gateway Alliance
NZTA	New Zealand Transport Agency
NZTS	New Zealand Transport Strategy
PFM	Procurement and Funding Manual
SPP	Sustainable Public Procurement
TNZ	Transit New Zealand

Chapter 1

Introduction

The late 20th Century produced a growing awareness across developed and developing societies that predominant rates of production and consumption and forms of technology were giving rise to global social and ecological problems of such magnitude that they posed significant risks to the continued development of societies everywhere (Carson 1962; Steffen et al. 2004; Weaver et al. 2000; WCED 1987). Key challenges were identified spanning population growth and human resources, food security, loss of species and ecosystems, energy security, water scarcity, and urban development and poverty (WCED 1987). These problems were seen to have arisen out of the industrialisation of society and warnings were sounded that achieving “sustainable” human societies, locally, regionally, and globally, would require substantial, even radical, changes in technologies, policies, markets, attitudes, and behaviours; especially the restructuring of production and consumption patterns in both amount and type (Lafferty and Meadowcroft 2000; UNDPI 1993; Weaver et al. 2000, pp 20 - 22). The vision for a sustainable future was encapsulated in the concept of Sustainable Development as development which “meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p. 43).

The scale of the sustainability challenge is significant. It requires the reorientation of industrial systems away from traditional “end-of-pipe” technologies to new technologies and modes of production and consumption which achieve significant improvements in eco-efficiency (Weaver et al. 2000). This is not just a matter of scientific and engineering research. The development of technologies that achieve substantial improvements in resource- and eco-efficiency require long timeframes and co-transformations in values, norms, and institutions at all levels of society (Berkhout 2002; 1996; Geels 2004; Kemp and Rotmans 2005; Rotmans 2002; Rotmans et al. 2001; WCED 1987; Weaver et al. 2000). This is because transitions in the technological base of society must necessarily be accompanied, and in some cases preceded by transitions in knowledge and values, and the organisational and institutional arrangements within society (Geels 2007; Kemp et al. 2005; Rotmans et al. 2001). In other words, technological innovation for sustainability does not occur in a vacuum:

Successful action depends on a combination of advances in scientific understanding, appropriate political programmes, social reforms and other institutional changes, as well as on the scale and direction of new investment. Organisational and social innovations would always have to accompany any technical innovations and some would have to come first.

(Freeman 1992, p. 124)

Sustainable development requires society to value the environment and want to protect it. Critical challenges with respect to enabling the transition to sustainability include achieving fundamental shifts in cultural values, attitudes and behaviours (Robinson 2004); seeking a more ethical basis for commerce (Hawken 1993); repositioning the environment as a strategic objective in public policy, particularly for local authorities (UNDPI 1993; WCED 1987); establishing new forms of governance and redefining what is acceptable, and what is not, with respect to the relationship between society and the environment (Diamond 2005; Kemp et al. 2005); finding new modes of scientific endeavour which can cope with the complexity and socio-political wickedness of sustainability problems (Funtowicz and Ravetz 1993; Kates et al. 2001) reshaping decision-making processes in both private and public sector organisations to enable more systematic consideration of the environment, and particularly, developing capabilities to measure and account for the environment in decision making (Ekins et al. 2003; UNDP 1993; WCED 1987).

Ultimately, progress toward sustainability is a matter of the degree to which more sustainable ways of doing things become institutionalised in policies, strategies, capabilities, practices, routines, systems, and processes within organisations (March and Olsen 1989; O'Connor 2011; Shrivastava 1995; Shrivastava and Hart 1995). The starting point in this journey is always the status quo. Alternative paths of development can only be entertained within the context of existing cultural, political, and economic arrangements. These arrangements define what is acceptable, and proposals which deviate too far from these norms are unlikely to reach implementation, regardless of whether they may be necessary and desirable for long-term sustainability. In this regard, change for sustainability is necessarily constrained by the existing cultural, political, and economic context, and particularly the local policy and decision-making processes to which that change will be subjected.

This thesis seeks to advance the institutionalisation of sustainable development in New Zealand. It does so by identifying strategic opportunities to leverage the institutional advancement of environmental sustainability outcomes in the New Zealand road construction

sector. These opportunities are identified through an exploratory study of the state of the sector in 2007.

Throughout the late 1990s and early 2000s, New Zealand policy and legislation had undergone continued reorientation towards sustainable development. In the land transport sector, legislative changes had instituted sustainable development as a policy objective for road-controlling authorities (see page 7). While embedded within a major road construction firm in 2006, the author observed that firm and the road construction industry, more generally, to be proactively seeking to improve their environmental performance with respect to road construction activities. The anecdotal evidence suggested that these proactive behaviours were motivated, at least in part, by managerial perceptions of strategic opportunities as a result of the broader shifts in the transport sector. However, road construction managers were also complaining that their clients – the road-controlling authorities – were not adequately rewarding this proactive behaviour in the procurement of road works.

This early evidence suggested that in the New Zealand road construction sector in 2007, there existed a gap between the newly instituted policy objectives for sustainable development and the purchase and delivery of improved environmental performance in on the ground road construction activities. This is the central problem addressed by this thesis: how was the institutional impetus for sustainable development being translated into practice by the New Zealand road construction sector, what barriers and constraints existed with respect to this translation, and how might these be overcome?

The thesis engages with this problem through the following questions:

- Why are road construction firms pursuing and adopting environmental sustainability initiatives?
- What challenges are road construction firms experiencing in their attempts to adopt and develop environmental sustainability initiatives?
- Are road-controlling authorities prioritising environmental outcomes in procurement of services from the road construction sector?
- What challenges are road-controlling authorities facing in their attempts to prioritise the environment in public procurement of road construction services?
- Thus, where are the opportunities in the road construction industry to leverage change towards environmental sustainability?

In this thesis, the term “environmental sustainability” is used to broadly refer to:

- Attempts by road construction firms to improve their environmental compliance, to achieve reductions in energy and resource use, and to develop the use of alternative materials such as waste products; and
- The purchase of environmental outcomes in road-works by road-controlling authorities whether for compliance reasons or otherwise (i.e. beyond-compliance).

This is an explicitly practical interpretation of sustainability which does not impose any normative expectation with respect to the scale of improvement in environmental performance either sought or actually achieved. Although this use of the term may be criticised as relatively weak, it was practically necessary to allow the research to proceed. Specifically, a broad concept of environmental sustainability was necessary to enable the identification of the research object, namely those actions explicitly associated with the concept of sustainability the research participants themselves. It is these specific actions by the research participants that constitute the practical manifestation of sustainable development in the road construction sector. This approach acknowledges both the socially constructed and politically contested or negotiated nature of the concept of sustainable development, and that its institutional advancement is fundamentally constrained by and, therefore, grounded within the status quo.

The substantive findings of the thesis are grounded in the particular context of the New Zealand road construction industry in late 2007. However, the thesis also engages extensively with the literatures on firm greening and green public procurement (GPP) up until 2012 to position the empirical findings of this study within those domains of knowledge more generally. Thus the academic findings of this study are generalizable beyond the specific research context. Practically, the thesis continues to inform the challenge of addressing environmental sustainability in the New Zealand transport sector, and in New Zealand, more generally. The land transport sector has undergone another shift in its governance structure, and while environmental outcome may be considered, economic efficiency continues to remain as the primary approach to evaluation funding requests. Capacity development with respect to enabling the public sector to consider broader environmental outcomes has also not been advanced. The explicit objective for local government to seek environmental sustainability outcomes looks likely to be stripped from the Local Government Act 2002 (LGA) and the Land Transport Management Act 2004 (LTMA). Regardless, environmental sustainability (and the four well-beings more generally) are deeply embedded in local governments across New Zealand. Thus, the capacity to undertake full cost-benefit assessment of decisions is an issue with which local government continues to grapple (e.g. undertaking Resource Management section 32 evaluation reports for plan making).

The first section of this chapter briefly highlights the key environmental effects of road-works. The second section describes the context of the New Zealand road construction industry in 2007, and frames up the practical problem which motivated this research. The last section of this chapter explains how the thesis addresses this problem.

The Environmental Effects of Road Construction Activities

Environmental impacts in road construction arise from two primary sources. First, the principal raw materials used in road construction – aggregates and bitumen – are non-renewable and are often sourced from locations distant to the road construction site. The extraction, processing, transport, and use of these raw materials in road construction result in environmental impacts throughout the supply chain. Second, particularly in greenfield areas, the physical road construction activities result in a range of environmental impacts, including the destruction or degradation of local ecosystems and habitats, altered drainage patterns, and the degradation of water quality from soil erosion and siltation.

Bitumen is a key input to the road construction process. It is produced from the distillation of crude oil during petroleum refining, and is used as a binder in road pavements and surfacings. The main use of bitumen for road construction in New Zealand is as the binding layer for thin chipseal surfacings. The cut-back bitumen or bitumen emulsion is sprayed on to the top of the basecourse layer creating a waterproof binding seal onto which aggregate chips are spread to form the wearing surface of the road. Chipseals are the main road surfacing used in New Zealand due to the largely rural nature of the road network. Bitumen is also used as the binding matrix in asphaltic concrete, for both structural and surfacing layers. The bitumen and aggregate are heated and mixed together in an asphalt plant to produce the hot mix asphalt, which is then transported to site and formed into pavement layers and/or surfacings. In New Zealand, the use of asphalt for structural or surfacing purposes occurs largely in urban areas where the higher cost of asphalt is justified by the need for quieter, longer-life pavements and faster construction times.

The main environmental impacts associated with bitumen arise from the extraction, distillation, and transport of bitumen products, and the consumption of energy and emission of volatile compounds to air in the production and laying of asphalt pavements and surfacings (Ashley 2011; Gambatese and Rajendran 2005; Hassan 2009). Once constructed asphaltic concrete is stable and does not leach contaminants to the environment (Kriech et al. 2002). Structural asphalt pavements are, however, considerably faster to construct than conventional

multi-layer aggregate pavements, and have better lifecycle performance (Iskander and Donnelly 2003; Rajendran and Gambatese 2007; Zapata and Gambatese 2005).

The other primary input into road construction is aggregate. Rock aggregates are produced in various qualities and grades and used to form the structural sub-base and base-course layers in flexible road pavements. The majority of roads in New Zealand are constructed in this way. The main environmental impacts associated with road aggregates arise from their quarrying and transport (e.g. noise, dust, vibration, loss of biodiversity). In New Zealand and internationally high quality aggregate sources near large urban centres have been exhausted, requiring these aggregates to be transported from distant quarry sources (Black and Costello 2004; Grattan-Bellew et al. 1978; Robinson and Brown 2002). In the United Kingdom (U.K.) aggregate levies were introduced in 1992 as a means to reduce the production of primary aggregates, promote more environmentally friendly aggregate extraction, address environmental impacts incurred from aggregate extraction, and to compensate local communities for aggregate extraction (DEFRA 2007).

The construction of roads in greenfield areas can result in a range of environmental impacts due to the need to clear soil and vegetation. Clearing activities can for example result in soil erosion, degradation of water quality due to soil erosion and siltation, ecosystem and habitat damage, altered drainage patterns. To a significant extent however, the greenfield impacts of road construction are mitigated during the design and consenting phase of road works projects. It is during these stages that the major effects of road works can be mitigated through changes to the route and design of the road pavements and infrastructure (e.g. tunnels, bridges, retaining walls, stormwater infrastructure). For instance, due to the ecological significance of the area through which the Northern Gateway Albany to Puhoi Realignment (ALPURT) motorway was constructed, stringent environmental compliance conditions were imposed on the project through the resource consent process. Tunnels and viaducts were used to avoid the environmental impacts of major earthworks (van Barneveld 2004), and the project included specific provisions for the protection of flora and fauna, including capturing and relocating native lizard and fish populations (NGA 2005; Snijders 2009).

During the construction process itself there are opportunities for environmental impacts from accidental spills, compaction of the area, and poor waste disposal practices. The major environmental impact to be managed during road construction is usually soil erosion and sediment runoff to watercourses. These effects are typically managed through the use of silt fencing or dedicated stormwater treatment ponds or devices on larger projects (e.g. NZTA

2010b Erosion and Sediment Control Standard). Worldwide public environmental agencies have produced best practice guidelines for addressing environmental impacts from construction processes (e.g. EPA 2012; Transport SA 2001). The development and adoption of environmental management plans is one way in which environmental effects in road construction projects can be managed. The adoption of environmental management systems (EMS) has been studied in various case studies of the construction industry, for example in Hong Kong (Shen and Tam 2002; Shen et al. 2006), the U.S.A. (Christini et al. 2004), Singapore (Kein et al. 1999).

In New Zealand and internationally there has been considerable research into the opportunities presented by the road construction process for the utilisation of waste products from other sectors. Some countries have mandated the recycling of construction and demolition waste into road aggregates, such as Japan (Japanese Government - Ministry of Land Infrastructure and Transport 2006a; b; OECD 2010; Tam et al. 2010; Tam 2009), and U.S. (EPA 2004; 2012; US Government 2007). Christchurch City formerly imposed a levy on the disposal of construction and demolition (C&D) waste to landfill, which incentivised C&D waste recycling in road construction in that region. Other wastes which have been investigated include glass in asphaltic pavements (e.g. Su and Chen 2002), municipal solid waste fly ash as a substitute for sand or cement in cement stabilised bases and subbases (e.g. Ferreira et al. 2003), steel slag as an aggregate substitute (e.g. Lind et al. 2001; Mäkikyrö 2004; Maslehuddin et al. 2003; Motz and Geiseler 2001), tyre rubber in asphalt mixtures (e.g. Cao 2007; Chiu 2008), and waste polymers in asphalt (e.g. Kalantar et al. 2012).

Evolving Institutional Context of the New Zealand Road construction Industry

This thesis was conducted in the New Zealand road construction industry after the government had passed a series of legislative acts which instituted sustainable development as a key public policy objective. This shift in institutional policy objectives began with a directive from the centre-left Labour-Alliance government to the Ministry of Economic Development to investigate how “*economic development strategy could incorporate the principles of social, environmental and economic sustainability*” (MED 2000).

In 2002, the Parliamentary Commissioner for the Environment (PCE) published a report which identified a set of future recommendations for New Zealand’s transition to sustainable development (PCE 2002). The report found that while the introduction of the Resource

Management Act in 1991 had already introduced the concept of sustainable management of resources into legislation, its focus on environmental effects limited the consideration of sustainability principles in broader practices (PCE 2002). The PCE recommended that both central and local government take steps to develop a vision and framework for sustainable development, and to monitor and review the public sectors' development of the necessary policies and strategies in this regard (PCE 2002).

By 2003, the government had developed a Sustainable Development Programme of Action as a means of ensuring that all government activities are underpinned by sustainable development principles (MFE 2003). With respect to the environment these principles proposed that government policy and decision-making should: consider the long-term implications, seek innovative solutions, address risks and uncertainty and take a precautionary approach in the case of irreversible damage, consider implications from a global as well as national perspective, respect environment limits, protect ecosystems, promote integrated resource management, and finally work in partnership with other agencies and stakeholders (MFE 2003).

Principles of sustainable development also began to shape transport policy in the public sector (see Figure 1, note that LNTZ and TNZ have since amalgamated). The New Zealand Transport Strategy 2002 (NZTS 2002) envisions “*an affordable, integrated, safe, responsive, and sustainable transport system*” (MOT 2002).

The NZTS 2002 is underpinned by four principles (sustainability, integration, safety, responsiveness), where the policy is:

To ensure that transport is underpinned by the principles of sustainability and integration, transport policy will need to focus on improving the transport system in ways that enhance economic, social and environmental well-being, and that promote resilience and flexibility. It will also need to take account of the needs of future generations, and be guided by medium- and long-term costs and benefits.

Source: (MOT 2002)

The NZTS 2002 also states that for long-term environmental sustainability, two broad approaches should be taken. First, that the transport system will have to reduce its negative impacts on land, air, water, communities and ecosystems, and second, that the transport system will have to make more efficient use of its resources, reduce its use of non-renewable resources, and shift over time from non-renewable to renewable resources (MOT 2002). The NZTS 2002 also requires land transport planning and funding in all public-sector agencies of

the land transport sector to be justified in terms of its contribution to addressing sustainable development (i.e. in the SHP and NLTP see Figure 1).

The Land Transport Management Act 2003 states that the purpose of the act is to “*contribute to the aim of achieving an integrated, safe, responsive, and sustainable land transport system*” (LTMA 2003, s3). The LTMA 2003 required both Land Transport New Zealand (LTNZ) and Transit New Zealand (TNZ) to ensure that they plan and allocate funding to projects and initiatives that are deemed to be sustainable embedded. LTNZ was the agency that allocated funding to road-controlling authorities. Note that in New Zealand the road network is split into state highways and the local road network. State highways were administered by TNZ, while local roads are administered by local government authorities. The LTMA 2003 also requires LTNZ and road-controlling authorities to take into consideration the National Energy Efficiency and Conservation Strategy 2003 in their planning activities.

In addition to giving effect to the LTMA 2003, local government road-controlling authorities were also required to address sustainable development as set out in the Local Government Act 2002 (LGA 2002). The LGA 2002 requires all local government authorities (including all councils that are road-controlling authorities) to ensure that local development is undertaken in a sustainable manner. The Auckland Region has its own Local Government (Auckland) Amendment Act 2004, which grants local authorities greater autonomy in determining developments at the district level. It states that the Act “*provides for local authorities to play a broad role in promoting the social, economic, environmental, and cultural well-being of their communities, taking a sustainable development approach*” (LGA 2002, s3d). The LGA 2002 requires local government to produce a long-term council community plan (LTCCP), which identifies the outcomes which the authority seeks to achieve and describes the actions it will undertake to achieve these outcomes. Overall, all road controlling authorities have to ensure that their plans and programmes meet with the objectives of the LGA 2002, NZTS 2002, the LTMA 2003, the direction set by the Ministry of Transport, and the plans and objectives of LTNZ if they are to secure funding from LTNZ.

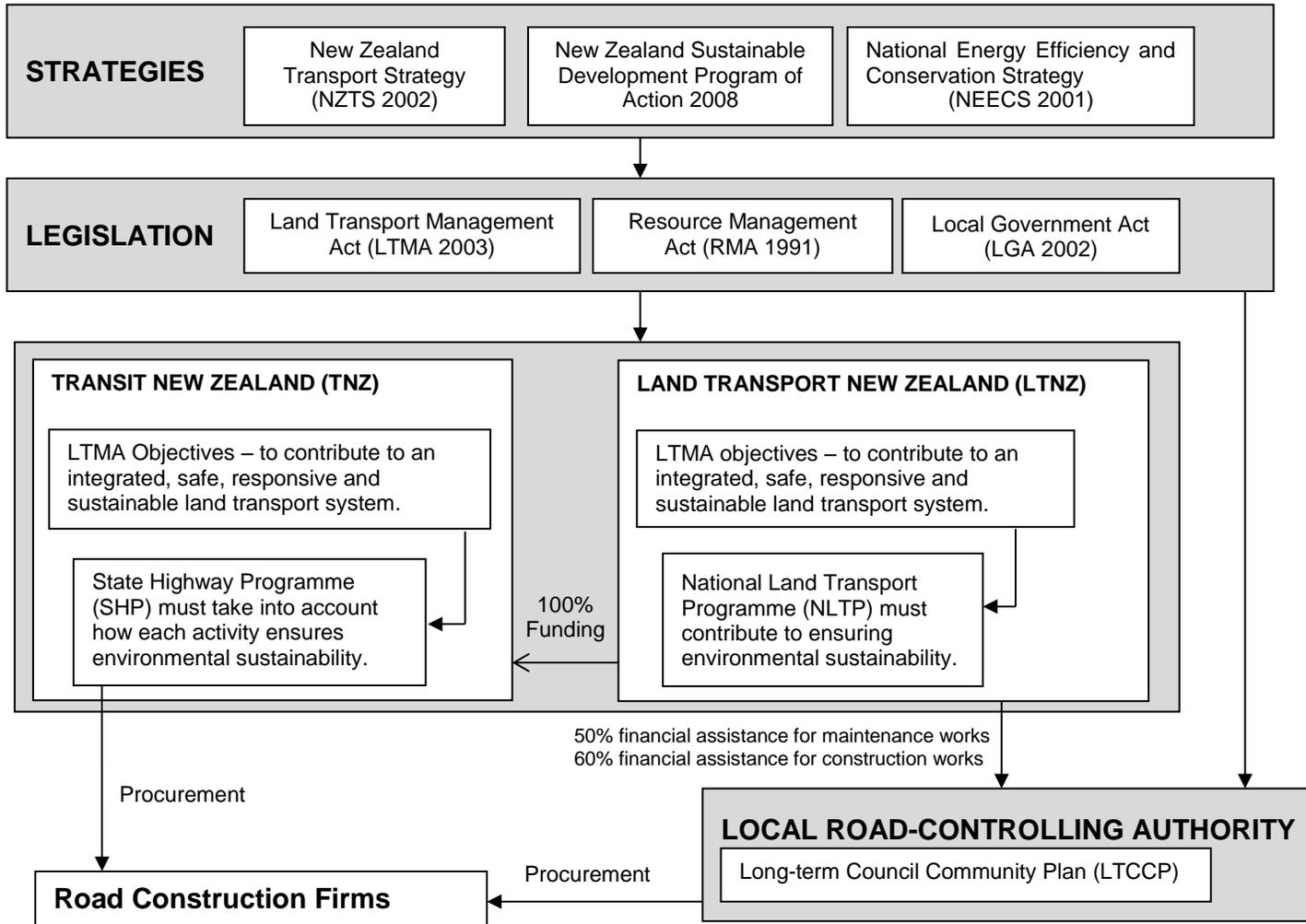


Figure 1. Translation of Sustainable Development Drivers to Agencies in the New Zealand Land Transport Sector in 2007

The Genesis of this Research

The preceding section has described the institutional context of the New Zealand road construction sector at the time in which this study took place. The introduction of the concept of sustainable development into the institutional field led to an expectation by road construction firms that road-controlling authorities would give effect to this through the procurement of more sustainable outcomes in road works.

Preliminary insights into the road construction sector suggested that some road construction firms were willing to act on this expectation by voluntarily improving their environmental performance. They were engaging in firm-greening activities, where this refers to firms which undergo internal change in response to environmentalism (Shrivastava 1992). The changes are not merely superficial, but reflect changes to a firm's "values, products, technologies, and systems" (Shrivastava 1992, p.13). By 2007, the road construction firms had adopted a range of environmental sustainability initiatives such as pursuing the development of alternative materials, technologies, adoption of environmental systems and processes, engagement in environmental programs, membership in sustainable networks, as well measurement and reporting of their environmental performance. However, there was anecdotal evidence that public sector procurement practices were constraining the successful adoption of more sustainable products and practices by road construction firms.

Prior to commencing the research which underpins this thesis, the author was investigating the development of a sustainability assessment tool for one of the larger road construction firms in Auckland. The development of the tool was supported by the firm as a means to demonstrate the sustainability of alternative road construction products and methods. During this time a number of managers from both that firm and others personally communicated their frustration at not being able to convince their clients to pay a premium for environmentally friendlier products due to the clients' focus on least-cost. These communications took place prior to the commencement of the research and were not formally recorded.

However, taken within the broader context of the New Zealand road construction sector at that time, they pointed to a problem worth investigating. That is, how was the institutional impetus for sustainable development being translated into practice by the road construction sector and what barriers and constraints existed with respect to this translation? This question was given significance by the economic scale of the sector. The New Zealand road-network at the time of the initial research totalled 93,459km, of which 10,894km were state highways and 82,565km were local roads (LTNZ 2006). By mid-2006, LTNZ had allocated just over NZ\$1.5billion for expenditure on the New Zealand road-network. TNZ was allocated

NZ\$1billion for maintenance and construction of the state highway network, while the remaining NZ\$500 million was shared between local road-controlling authorities (LTNZ 2006).

This section has described the context of the New Zealand road construction industry at the time in which this study took place. The introduction of the concept of sustainable development into the institutional field led to an expectation that road-controlling authorities would give effect to this through the procurement of beyond-compliance environment outcomes in road-works. This implies a range of changes in road-controlling authorities in terms of their policies, objectives, systems and processes, and budgets in order to procure environmental outcomes. Within road construction firms, addressing environmental sustainability implies the development of technical and managerial capabilities to deliver such outcomes. The anecdotal evidence, however, indicated that some road construction firms were struggling to deliver such outcomes. Road construction managers attributed these challenges to their clients' procurement practices.

What this Thesis Does

The preceding section has described how in 2007 there existed an institutional and operational gap between the sustainable development objectives which had been established in government policy and the prioritisation and delivery of environmental sustainability outcomes in on-the-ground road construction activities. This thesis addresses this practical problem, and identifies opportunities to leverage change for institutional advancement towards environmental sustainability in the New Zealand road construction industry. It achieves this through an enquiry of firm-greening amongst road construction firms and of GPP in local road-controlling authorities.

Chapter 2 explains the structure of the enquiry and describes the grounded theory methodology that was used. The decisions to use the exploratory, grounded theory method and to include both the procurement of road construction services and the behaviour of the road construction firms within the scope of the enquiry were necessitated by a number of specific factors. First, the review of the scholarship identified that there has been little research into firm-greening in road construction industries internationally, and none in the New Zealand context. Second, the New Zealand road construction industry was characterised by a very close commercial relationship between the road construction firms and their clients, which was relatively unique compared with other industries which have been studied

internationally. Third, the New Zealand road construction industry was still in the process of developing an understanding of how to address environmental sustainability. These features of the research context created a degree of uncertainty about the relevance and significance of existing scholarship with respect to this context. It was for these reasons that an exploratory grounded theory approach research method was deemed appropriate for achieving the thesis objective.

Chapter 3 reviews the existing scholarship on firm-greening and GPP to support the empirical analyses. Chapters 4 and 5 present the empirical results and the analysis of the research. Chapter 4 presents the analysis of greening of New Zealand road construction firms. The questions that are examined in this chapter are:

- Why are road construction firms pursuing and adopting environmental sustainability initiatives?
- What challenges are road construction firms experiencing in their attempts to adopt and develop environmental sustainability initiatives?

Chapter 5 presents the analysis of the procurement and funding of environmental outcomes by local road-controlling authorities in New Zealand. The questions that are examined in this context are:

- Are road-controlling authorities prioritising environmental outcomes in procurement of services from the road construction sector?
- What challenges are road-controlling authorities facing in their attempts to prioritise the environment in public procurement of road construction services?

The chapters provide the key interview results, describe the categories which were developed through the analysis, and integrate relevant literatures to support the analysis. The chapters develop conceptual models of firm-greening and GPP in the New Zealand road construction industry. The models are developed through an inductive methodology which integrates the substantive findings from the analysis with theory from relevant domains. These substantively and theoretically justified conceptual models provided the credible basis on which to identify opportunities to leverage change for environmental sustainability within the New Zealand road construction industry. These opportunities are framed up in Chapter 6.

Chapter 6 applies Scott's (1995) institutional pillars as a lens to reflect on the degree to which environmental sustainability had been institutionalised within the road construction industry. It is argued that although weak institutionalisation had occurred in the regulative and normative dimensions, there had been no significant institutionalisation in the industry's procurement and funding regimes. The existing ways of *doing things* and existing institutional structures still dominated how road-works were funded, procured, and constructed. Consequently, road-controlling authority managers did not feel justified in procuring beyond-compliance environmental outcomes in road-works. Chapter 6 draws on the findings and models from Chapters 4 and 5 to argue that there are a number of opportunities to leverage institutional advancement toward environmental sustainability in the road construction industry. Opportunities are identified with respect to improving road construction firms' environmental capabilities and performance, and with respect to enabling the funding and prioritisation of environmental outcomes in procurement of road-works by road-controlling authorities. Chapter 6 also reflects on the relevance of these opportunities in the present context of the New Zealand road construction industry.

Chapter 7 presents the key conclusions and contributions of the thesis, and reflects on opportunities for future research.

Chapter 2

Grounded Theory as the Research Methodology

The practical problem that this thesis addresses is that of sustainable development. The introduction gave some sense of the scale of the challenge: significant factor reductions in resource consumption and waste production, and multi-scale organisational, institutional, and societal changes in behaviour. The objective of this research was to seek out opportunities to address environmental sustainability in the road construction industry in New Zealand. The two questions that the research sought to answer were:

1. Where are the opportunities in the road construction industry to leverage change toward environmental sustainability?
2. How can we identify them?

The enquiry adopted an exploratory, inductive methodology based on the Grounded Theory method (Glaser and Strauss 1967). Grounded Theory is a method for inductively building theory based on a grounded exploration of a phenomenon:

A grounded theory is one that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, then prove it. Rather, one begins with an area of study and what is relevant to that area is allowed to emerge.

Source: (Strauss and Corbin 1990, p. 23)

The grounded theory research method is appropriate where the phenomenon to be studied is not clearly defined or is in a relatively early stage of development, or the study context is relatively unexplored and therefore without a dominant theory (Glaser and Strauss 1967). It

was adopted for this enquiry over more traditional hypothetico-deductive approaches for the following reasons:

- The New Zealand road construction industry was in the early stages of a strategic reorientation toward sustainable development; and
- The research context was relatively novel such that there was no dominant theory considered applicable to the domain in question.

Coping with Uncertainty and Novelty in the Research Context

The research context was characterised by a degree of institutional uncertainty as a result of recent legislative changes. The period 2002 – 2007 was a time of institutional progress around sustainability for the road construction industry in New Zealand. The government of the time had passed legislation which established sustainable development as a primary objective for both local government and the land transport sector (i.e. LGA 2002 and the LTMA 2003). This policy shift toward sustainability, which was described in Chapter 1, had only just begun to be operationalised by road-controlling authorities and LTNZ. Some firms within the road construction sector had picked up on this policy shift and were looking for ways to capitalise on what they anticipated would be changes in their clients' requirements for "more sustainable" outcomes in road construction and maintenance. Thus, at the time this research was conducted, the local government and land transport sectors were in the early stages of a strategic reorientation toward sustainable development. The possibility of new institutional forces or arrangements, and innovative responses by public and private sector organisations meant that it was not possible to be certain, a priori, what would be relevant with respect to understanding the behaviour of private and public sector organisations in this context.

The research context was also academically novel, with little precedent in the literature. Some researchers argue that every industry will affect the environment differently and may, therefore, tackle environmental issues differently (Alvarez Gil et al. 2001). As a result they consider it prudent to investigate drivers of greening in different industries rather than attempt to generalise a set of generic drivers across all industries. Various studies have examined the drivers of, and challenges to the adoption of environmental sustainability initiatives in a range of industry contexts, internationally as well as in New Zealand (see the literature review in Chapter 3). Although this includes the construction sector generally (e.g. Kein et al. 1999; Sakr et al. 2010; Tam et al. 2010), no studies have looked at the uptake of sustainability

initiatives specifically in the road construction sector, internationally or in New Zealand. Further, compared with other industries which have been studied, the New Zealand road construction industry was characterised by a relatively unusual market arrangement (see below). Existing studies of industry greening predominantly treat the phenomenon as a firm-level strategic response to the firm's drivers, stakeholder pressures, and operating context (see the models of firm greening reviewed in Chapter 3). While firm-level decision-making is an important aspect of the greening phenomenon, early exposure to New Zealand's road construction industry led to the conclusion that this study would likely have to encompass decision-making by other industry actors in order to fulfil its objectives. Thus, while existing models of firm-greening were of some general relevance, they could not be relied upon a priori as directly applicable for developing assumptions or hypotheses for the research.

The New Zealand road construction industry is a hybrid of private and public sector agencies. The actual road construction and maintenance works are undertaken by private sector, for-profit construction firms. However, the roads are owned and funded by local authorities and TNZ which commission the construction and maintenance works. While a number of road construction firms operated nationally, the industry was really organised on a regional basis. The roads in each city, district, or region of the country were controlled by either the local road-controlling authority or by TNZ in the case of state highways. This meant that in any particular geographical area there were only two clients purchasing road works. The road construction firms operating in that area bid competitively for contracts from either or both of those clients depending on their capabilities (TNZ projects tended to be larger and more complex and were, therefore, only undertaken by those larger firms with the necessary capabilities). Typically the firms' operational capabilities were geographically constrained by the physical locations of their aggregate quarries and asphalt plants. As these production capabilities are not easily transportable, the ability of firms to carry out works outside the geographical area in which they were located was limited by their ability to access the necessary resources (i.e. aggregates and asphalt). Firms which did establish aggregate and asphalt production capabilities in different regions tended to operate autonomously at branch level (i.e. each branch of the firm pursued contracts on an autonomous basis).

This institutional arrangement is quite different to other industries in which greening activities have been studied internationally. Other industries are characterised by multiple providers who supply to a market of multiple clients or a broad retail customer base e.g. wine sector (Gabzdyllova et al. 2009; Marshall et al. 2005), airline industry (Lynes and Andrachuk 2008; Lynes and Dredge 2006), forestry sector (Sharma and Henriques 2005). In contrast, the

road construction industry in New Zealand was characterised by multiple providers, each with geographically constrained areas of operation, offering services on a competitive basis to a single, or at most two clients in each geographical area. Understanding this feature of the sector suggested that the public sector procurement procedures and mechanisms would be an important factor enabling or constraining the pursuit and adoption of environmental sustainability initiatives by road construction firms. Indeed, road construction managers expressed the view that their principal challenge to adopting sustainability initiatives was the lack of drivers and incentives offered by their clients (see Chapter 4).

The institutional uncertainty in the road construction industry between 2002 – 2007, the lack of prior scholarship on firm greening in road construction, the relatively unique market arrangement which characterises the road construction industry in New Zealand and cross-industry perspective positions this research as fundamentally unique in terms of its context and scope. Thus, rather than attempt to translate and test existing theoretical models in this context, it was decided that an exploratory research method would yield more credible results. The Grounded Theory method was selected as appropriate because it explicitly adopts a stance of analytical naivety suited to novel situations, because it provides a methodology for exploring the research setting to discover what is important and relevant based on the realities of the participants who inhabit that setting, and because it seeks out theory to add insight based on empirical relevance (Charmaz 2002; Glaser and Strauss 1967).

Research Design & Sampling

The purpose of this section is to describe the research design and sampling. The design of the research refers to the approach developed to address the research questions. This includes the development of the specific interview questions, the identification of individuals to be interviewed, and the secondary data to be collected.

The data collected for the research came from two sources. Interviews with individuals from the road construction industry were the primary source of data. Secondary sources of data included legislation, regulations, policy documentation, electronic information (webpages). The research participants in the interviews referenced a variety of documents such as the LTNZ funding and procurement manuals, as well as organisational policies. These documents were secured in order to contextualise participants' responses and clarify their testimony.

Interviews were conducted with managers from road construction firms, road-controlling authorities, LTNZ, and engineering consultants. Managers from road construction firms were

interviewed to ascertain why their firms were pursuing environmental sustainability initiatives and the challenges they were encountering. Managers at road-controlling authorities were interviewed to ascertain whether they were procuring beyond-compliance environmental outcomes in road-works and the challenges they were facing in that regard. Managers at LTNZ were interviewed with respect to the inclusion of environmental costs and benefits in the funding applications for road-works. Engineering consultants were interviewed for their perspectives on the risks of alternative materials and construction methods. The sections below describe the sampling method in each case and the issues which emerged which framed the enquiry with respect to the other participant groups.

The interview process did not follow a pre-given structure in terms of the questions that were asked or the participants who were interviewed. Rather, starting with managers from the road construction firms the interview program evolved based on the concepts which emerged and indications of connections between the industry organisations. The interviews were semi-structured and flexible in order to allow research participants to discuss issues that were important to them rather than seeking to collect answers or limit the discussion around pre-conceived questions. During the interviews, follow up questions were asked of the research participant in order to clarify issues or to provide more detailed information. As concepts begin to emerge from the collected data, these concepts guide any further decisions that need to be made about participants, sample size, settings, and the type of data that is to be collected (Glaser 1978). Thus, the interview program evolved in a non-linear fashion as issues of significance to the research participants became apparent and were investigated further. Interviews with road construction managers led to interviews with road-controlling authority managers and back to other road construction managers and so-forth. In some instances participants from the various government agencies provided the “other side” of the story with respect to a specific environmental sustainability initiative that a road construction firm had adopted. This back-and-forth movement between interviewing road construction managers, local road-controlling authority managers, Northern Gateway ALPURT managers, LTNZ managers, and engineering consultants allowed me to identify further questions to ask as well as to compare, contrast and address contradictions identified from interviews. Data collection continued in this fashion until *theoretical saturation* had been achieved (Glaser 1978). McCann and Clark (2003) note that “*the quality of the data is more important in theoretical saturation than the frequency with which it occurs*” (McCann and Clark 2003, p.11). Data collection continued until no new significant issues emerged from the interviews and there was a strong degree of stability i.e. the same points were being raised over and over by research participants.

The process of convincing organisations to agree to participate in a research project of this type needs to be handled with sensitivity. Research participants need to be made to understand that the goal of the research is not to criticise managers and their organisations, and that they will be treated with dignity and respect. The study followed the University of Auckland ethics requirements regarding interview and protocol. As part of the University of Auckland ethics procedures, each participant received a consent form that included the objective of the research and the interview process. In the letter to each potential research participant it was indicated that the participants' identity would remain confidential should they not wish to be identified. All participants were offered confidentiality agreements which were signed by both the participant and the author. The interviews were taped using a digital voice recorder. At times, the digital recorder was switched off to allow the research participant to discuss issues that were sensitive in nature, but which would provide greater insight into the issues discussed. On average each interview lasted between one to one and half hours. Following the interviews, the recordings were transcribed, and imported for analysis into QSR Nvivo software package.

Process of Pursuing and Adopting Environmental Sustainability Initiatives

The research inquiry began by focussing on the experiences of road construction firms in pursuing and adopting environmental sustainability initiatives. These included for example the adoption of recycling initiatives, engagement with voluntary energy minimisation programs, or the adoption of EMSs. The two questions that guided the research design in this regard were:

1. Why are road construction firms pursuing and adopting environmental sustainability initiatives?
2. What challenges are road construction firms experiencing with respect to adopting environmental sustainability initiatives?

The sample of cases must be based on their theoretical usefulness (Eisenhardt 1989), and the sample of research participants *need to be individuals who have taken an action or participated in a process that is central to the study* (Creswell 1998, p.114). The phenomenon of interest in this study is the pursuit and/or adoption of sustainability initiatives by road construction firms, including where firms may have been unsuccessful. The research design is also based on multiple cases of a specific event i.e. the adoption of a sustainability initiative

by a road construction firm – allowing for “replication” logic (Yin 1984). Each event represents a case, which are treated as a series of independent experiments that confirm or disconfirm emerging conceptual insights (Yin 1984). A single case study of a sustainability initiative within a single road construction firm would not allow for generalisation to other road construction organisations in the road construction industry because it would not provide enough material and depth to address the research question. Multiple cases would cover a wider range of environmental strategies across different organisations.

Roading New Zealand is the industry representative for construction firms whose core business is related road construction. All Roothing New Zealand member organisations were sent a letter asking for their participation in the research study. Eight road construction organisations out of a total of twenty agreed to participate in the research. These road construction organisations are labelled A to H to maintain anonymity. Due to the relatively small nature of the road construction sector and the ease with which they could be identified, potentially identifiable features of the participating firms are not disclosed, except to note that the participating firms consist of relatively larger road construction firms within the sector, and which operate nationally across the country. Since the road construction firms operate in multiple regions across New Zealand, the adoption of a sustainability initiative is regional, rather than firm specific. This stems from the fact that different regions are dominated by slightly different issues, and as a consequence different branches of the same road construction firm tend to adopt different sustainability initiatives depending on the local context. Road construction branches are denoted by an alphabet corresponding to that region:

a = Auckland
c = Christchurch
n = Northland
p = Palmerston North
t = Tauranga

The notation #12Aa refers to research participant 12, from road construction firm A, from the Auckland region.

A total of 19 road construction managers were interviewed for the research. The sample of research participants from road construction firms, therefore, consisted of those individuals that participated in a sustainability initiative regardless of their position on the organisational hierarchy.

The initial interviews began with road construction managers who were involved or had knowledge of the process by which the firm pursued and adopted an environmental

sustainability initiative. Participants from road construction firms were asked to trace the pursuit and adoption of each environmental sustainability initiative and to identify why these initiatives were adopted. In some cases, road construction managers indicated that an initiative was investigated but was eventually not adopted, or only partially implemented. Road construction participants were asked to describe in more detail any challenges that they perceived with respect to adopting environmental sustainability initiatives. Examples of the type of questions that were asked:

Why did the firm/branch initially pursue the initiative?

On what basis was the initiative justified and finally adopted?

What additional factors were important and influenced the decision to adopt the initiative?

What challenge did the managers experience in adopting the initiative?

How was the manager involved in the pursuit and adoption of the initiative?

These questions helped to identify both motivating reasons for pursuing and adopting environmental sustainability initiatives as the reason for pursuing was not necessarily the same for adopting. It also helped to identify the challenges that the road construction managers were facing. The procurement criteria used by road-controlling authorities were a significant challenge identified by road construction managers. The key issues they identified in this regard were:

- **Price:** Tenders by road construction firms are evaluated on the basis of both price and non-price attributes. Road construction managers indicated that the dominant focus on price (70% of the weighting) meant that any action that would increase the cost of road-works would jeopardise the road construction firm's ability to win the project. Road construction firms would not win work if the proposed materials, methods and designs (that could address environmental sustainability outcomes) increased the cost of the work for the client.
- **Non-price attribute:** Road construction managers indicated that firms that had developed superior environmental performance were not scored higher as part of the non-price attributes. In addition, they noted that even if road construction firms with superior environmental performance were scored higher as part of the non-price

attribute, this scoring had an insignificant effect on their overall placing given the low weighting assigned to non-price attributes (typically only 30%).

Another challenge faced by road construction firms was the perception that engineering consultants (and their clients) tended to be conservative/risk averse with respect to the application of new materials, methods, and designs. Two engineering consultants agreed to be interviewed for the research. Engineering consultants and local road-controlling authority managers were asked to describe the difficulties that they perceived with the use of new or alternative materials, methods, or designs proposed by road construction firms.

The grounded theory approach encourages researchers to pursue issues that are important to the research participants. Given this methodological rationale and the emphasis that the participants placed on procurement process, the enquiry also examined procurement practices in road-controlling authorities.

Process of Procuring Services from the Road Construction Sector

(a) Local Road-controlling Authorities

Relevant managers from local road-controlling authorities across New Zealand were approached to participate in the research. This was achieved by accessing the Local Government New Zealand webpage and identifying Road Asset Managers (or similar job titles). In total, 14 city councils and 44 district councils were sent a letter requesting their participation in the research. Managers in 3 city councils and 1 district council agreed to participate (see Table 1 below).

Table 1. Local Road-controlling authority characteristics

Road-controlling Authority	Number of Interviews	Length of road-network (km)
Christchurch City Council	2	2269.1
Rodney District Council	2	1693.3
North Shore City Council	2	680.3
Tauranga City Council	1	495.1

Source: (LTNZ 2006)

By following the guidelines set out by the grounded theory approach, the enquiry attempted to focus on procurement practices by local road-controlling authorities. The interviews with

the local road-controlling managers highlighted that they faced two challenges with respect to procuring environmental sustainability outcomes. These were:

- Funding pressures from their operating contexts on limited budgets
- A fear of jeopardising their ability to qualify for funding subsidies from LTNZ due to the funding regime.

Road-controlling authorities are eligible for financial contributions from LTNZ. However, in order for road-controlling authorities to qualify for funding, LTNZ has to evaluate their asset management plans and proposed projects against criteria set out in the LTNZ manuals e.g. Programme and Funding Manual (PFM), Economic Evaluation Manual (EEM), and Competitive Pricing Procedures Manual (CPP). Analysis of the local road-controlling managers' interviews indicated that these managers felt that environmental sustainability would likely be costly, and that such cost increases jeopardised the ability of road-controlling authorities to qualify for funding from LTNZ. The emphasis that the local road-controlling managers placed on the LTNZ funding regime led the enquiry to focus on LTNZ.

(b) Northern Gateway ALPURT Project

Transit New Zealand (TNZ) was also approached to participate in the research. Specifically, managers involved in the Northern Gateway Albany to Puhoi Realignment (ALPURT) project were invited to participate in the research in order to better understand the drivers of this project. At the time, the Northern Gateway ALPURT project was a prominent project due to its size and construction across a significant sensitive environmental area. It was promoted as upholding principles of environmental, social, and economic sustainability in practice. However, the planning, design, construction, and project management of the project was carried out through an Alliance which included TNZ, Fulton Hogan (road construction), Leighton Contractors (construction), URS New Zealand (engineering and project management), VSL International (bridge engineering), Tonkin & Taylor (engineering geology and pavement design) and Boffa Miskell (environmental). In response to my request, three engineering consultants, two road construction managers, and two senior-level managers from TNZ agreed to participate in the research.

Process of Allocating Funding to Road-controlling Authorities

Due to the insights developed from the interviews with the local road-controlling authority managers, LTNZ was also included in the research enquiry. Procurement and funding managers at LTNZ were approached to participate in the research. A total of 3 managers agreed to participate, who had the following individual roles: procurement manager, funding evaluator for maintenance programs, and funding evaluator for projects. The interviews with LTNZ managers focussed on the PFM, EEM, and CPP. The managers provided insights into how environmental sustainability was incorporated into the LTNZ funding regime through these manuals.

Table 2 below summarises the key guiding topic areas and questions which the thesis sought to clarify.

Table 2. Guiding topic areas/questions

Guiding Topic Areas/Questions
<p>Road Construction Firms</p> <p>What do managers understand by environmental sustainability?</p> <p>Has the organisation attempted to adopt environmental sustainability initiatives?</p> <p>Why did the firm/branch pursue the initiative?</p> <p>On what basis was the initiative justified and finally adopted?</p> <p>What additional factors were important and influenced the decision to adopt the initiative?</p> <p>What challenges did the managers face in adopting the initiative?</p> <p>What was the role of the interviewee in the adoption of the initiative?</p>
<p>Local Road-controlling Authorities</p> <p>How do RCA managers interpret environmental sustainability in the context of road construction activities?</p> <p>Are road construction interviewees correct that local road-controlling managers are unwilling to pay more for environmentally superior products and services?</p> <p>What are the challenges facing road-controlling authorities' ability to procure more environmental sustainable outcomes in road-works?</p>
<p>Land Transport New Zealand</p> <p>Are road-controlling authority managers correct in asserting that LTNZ manuals constrain their ability to procure environmental sustainability outcomes?</p> <p>What do LTNZ manuals dictate with respect to funding beyond-compliance environmental outcomes?</p> <p>What do LTNZ managers understand by the LTMA requirement to ensure that funding for road works takes into account how the works ensures environmental sustainability?</p>
<p>ALPURT</p> <p>Why is ALPURT a frequently cited example of a project where environmental sustainability has been considered?</p> <p>What factors enable ALPURT to address environmental sustainability, when local road-controlling authorities appear to struggle in this regard?</p>
<p>All Interviewees</p> <p>Who else should I interview?</p>

Data Analysis

The process of analysing the data was an iterative process, involving the following stages:

- Analysis of the interview transcripts using the grounded theory approach
- Rereading relevant documents identified by research participants and comparing interview data with secondary data sources
- Comparing the emerging categories with the existing literature

Analysis of the Interview Transcripts using the Grounded Theory Approach

The first step in the analysis involved importing all possible data into the NVivo software package. NVivo is a qualitative data analysis (QDA) computer software package used by qualitative researchers to sort unstructured, non-numerical data. This software does not analyse the data for the researcher, rather it merely acts as a database for storing and sorting information.

At the heart of the grounded theory method is *comparative analysis*. Comparative analysis refers to the comparison categories to develop theory, that is, it is concerned with the development of categories and their properties, and understanding of the relationships among the categories and their properties (Glaser and Strauss 1967). Strauss and Corbin (1990) identify three stages involved in the data analysis, which are open coding, axial coding, and selective coding.

Open coding is “*the analytic process through which concepts are identified and their properties and dimensions are discovered in the data*” (Strauss and Corbin 1998, p. 101). In practice, the open coding phase consisted of examining the text (i.e. interview transcripts) for concepts. Initially, the list of codes was lengthy and tended to be descriptive, for example, *perceived as risky, it was the right thing to do, need to stick to LTNZ manuals*. NVivo was useful in this process in that it was possible to label relevant texts in the interview transcripts with codes and then categories, using either *in vivo* terms (i.e. concepts used by the participants themselves), or labels that I derived myself.

Axial coding is the “*process of reassembling data that were fractured during open coding*” (Strauss and Corbin 1998, p.124). The process of axial coding, therefore, involved establishing the relationships between categories and subcategories. For example, the codes of *non-compliance, seeking credibility, improving compliance-ability, building relationships with stakeholders* were identified as sharing the same overarching category of *legitimacy*.

Thus, over time it became possible to refine the substantive codes into broader categories which reflected a range of motivating codes. It was through this process that codes and categories were generated that addressed the research questions.

Selective coding is “*the process of integrating and refining the theory*” (Strauss and Corbin 1998, p.143). Here the researcher chooses a single category and establishes how it relates to all the other categories (Charmaz 2006). Having developed a list of categories, it was necessary to establish their relationships, for example, establishing how categories of *accountability, fiscal constraint, and managerial attitudes* related to one another. It was through this process that the core categories of *motivations* and *influencing factors* began to emerge for both road construction firms and road-controlling authorities.

During the analysis, it was also possible to link assertions by research participants to tangible objectives or outcomes within their contexts. For example, the research participants referenced various documents during their interviews, such as:

- Organisational sustainability policies
- Road-controlling authority policies, community plans, annual plans, asset management plans
- LTNZ funding (PFM, EEM) and procurement policies (CPP)

Some of these documents were read as part of the process of preparing for the interviews. This provided a degree of sensitivity and awareness of the topic areas that were raised during the interviews. During the analytical process, relationships or contradictions between a research participant’s testimony and secondary documents were revealed. By comparing the participants’ testimonies with these documents it was possible to establish a greater degree of credibility of the assertions, and thereby the categories derived from the data.

As categories became more stable it was possible to begin to compare and contrast these with the existing literature. Categories developed from the interviews with road construction managers and engineering consultants were compared with the literatures on firm-greening (e.g. organisational, construction management, and innovation literatures). Categories developed from the interviews with road-controlling managers, LTNZ managers, and Northern Gateway ALPURT related-managers were compared with the green (and sustainable) public procurement literature. It was possible to compare and contrast both the substantive nature of the categories, as well as the logic used to establish the relationships

between categories. In this way it became possible to identify where the thesis supported or contradicted the existing scholarship.

Even though the process of collecting data and analysis is meant to take place simultaneously, my personal experience was that the development of categories evolved over time given that it takes time and experience to see through ones prior assumptions. Theoretical sensitivity refers to the researcher's ability to recognise important information from the empirical data (Strauss and Corbin, 1998). My ability to be theoretically sensitive to important information in the empirical data was related to prior exposure to the existing theoretical literature, as well as to the degree of my understanding of the system I was examining.

Research Quality

An important component of research lies in establishing its quality. If the research is uneven and lacks rigor it makes it difficult to proceed confidently. This is important, particularly where the findings are used to justify further, for example, interventions or changes to policy. The standards for evaluating quantitative research tend to focus on establishing objectivity, reliability, and validity. Qualitative researchers, however, suggest that these criteria are not the most appropriate standards by which to judge qualitative research (Rubin and Rubin 1995). Instead, qualitative researchers suggest that credibility is a more appropriate standard by which to evaluate research for quality (Rubin and Rubin 1995).

Credibility refers to an evaluation of whether the research findings represent a "credible" conceptual interpretation of the research participants' constructed realities (Lincoln and Guba 1985). Credibility of the thesis narrative was developed through a number of strategies:

- Multiple sources of data
- Following emergent concepts that were important to research participants
- Developing stable categories
- Peer review
- Comparing emerging categories with the existing literature

Multiple sources of data were collected for the research. The primary source of data was the interviews, while secondary sources of data consisted of reports, manuals, and legislations. Multiple points of views on the topic areas also provided a range of data sources. For

example, environmental sustainable initiatives adopted by road construction firms were discussed by multiple managers from within the firm. With respect to the challenges facing road-controlling authorities, the interviews with LTNZ managers about LTNZ manuals and procedures provided contrasting external sources of data. This provided corroborating evidence lending credibility to the testimony. One type of data that was not collected were tender documents. This was because the research participants indicated that environmental sustainability criteria had not been specified in tender documents.

The credibility of the categories emerging from the data was established through the remaining four practices identified in the list above. The categories were established from issues that were important to the research participants. Thus, while the sample of local road-controlling authorities, LTNZ managers, Northern Gateway ALPURT managers, and engineering consultants is not as extensive as the sample of road construction managers, credibility was established on the basis that no new issues were emerging from subsequent interviews, that is, theoretical saturation was achieved. For example, the analysis of the interviews with local road-controlling authority managers repeatedly identified themes of *asset management pressures* and *funding constraints*. These themes were also corroborated when compared with the secondary data.

Peer review of the research was undertaken to address issues of consistency and coherence. An independent research colleague was asked to review quotes and the associated codes to determine whether they agreed with the codes used by the author, thereby establishing consistency of the coding scheme. Note that the author's codes were provided to the independent reviewer merely as a starting point, and at no point was the reviewer constrained to the author's own coding scheme. This allowed the reviewer to develop their own categories were they disagreed with the author. The colleague and the author discussed the codes for each specific initiative according to case firm, and discussed any differences where they arose. Differences between the author and the colleague were reconciled by discussing the reasons for our differences, and re-reading relevant passages in the transcripts to more clearly establish commonalities and contradictions or differences in participant testimonies. The peer review and subsequent discussions between the author and peer reviewer was a lengthy and iterative process. It occurred multiple times during the course of the analysis, requiring an independent reviewer who was fully engaged in the analytical process.

The analysis also involved comparing the emerging categories with the categories identified in the literature. This process provided an opportunity to examine how others have generated their categories. For example, comparing how they defined categories, the nature of the

substantive findings supporting each category, and the relationship of the categories to one another.

This analytical process is the basis on which the opportunities to leverage change for environmental sustainability in the New Zealand road construction industry were identified. In this respect, it was important to ensure that the analytical findings of the study are credible. The categories and conceptual models developed during the analytical process are the outcomes of this process and lend credibility to the opportunities identified in Chapter 6.

As part of the interviewing process, tactics were pursued to ensure honesty from the research participants. It was indicated to the research participants that Roading New Zealand had supported the research and made a small financial contribution to the study. I worked hard to establish rapport. For example, in introducing the research topic to the research participant, it was stressed that there were no right or wrong answers, and that the objective was not to judge or criticise their understanding of environmental sustainability, but rather that it was their point-of-view which was of interest. Where I was unsure, research participants were asked to clarify what they meant until I felt confident that I had understood their intended meaning.

Chapter 3

Literature Review

This chapter reviews the existing literature on firm-greening and green public procurement (GPP), and examines two aspects of this literature. First, it examines the substantive findings with respect to firm-greening and GPP. The second section examines the theoretical models that have been developed to explain each phenomenon. The third section of the literature review identifies where the key knowledge gaps lie.

Firm-greening has been widely studied by organisational researchers for the past 30 years, leading to the development of a broad knowledge base on the subject of firm-greening. However, while organisational studies have examined a broad range of industries, the literature contains few studies that focus specifically on the construction sector or road construction sector. Greening of construction firms has, however, been the subject of a number of construction management studies due to the recognition that the field of engineering has an obligation to address environmental issues in construction activities (Ofori 1992). Thus, this literature review examines both organisational studies and construction management literature to establish the current state of knowledge about firm-greening.

The organisational studies literature brings both substantive and theoretical insights to facilitate our understanding of firm-greening. Both domains of knowledge have provided substantive findings about the relevant factors involved in firm-greening e.g. stakeholders, internal drivers, role of management and organisational characteristics, and challenges. The substantive section on firm-greening summarises the key findings from the literature for each factor. However, the organisational studies literature differs from the construction management literature because its theoretical underpinnings provide the necessary conceptual categories by which to theorise about firm-greening. It is for these reasons that this review examines both organisational studies and construction management literature.

It is essential that this literature review also examines GPP for two reasons. First, the road construction industry in New Zealand is characterised by public procurement of private-sector services. There is, therefore, a very close relationship between the public sector agencies and the large private-sector industry that provides the products and services. Second,

it is asserted that greening of the road construction industry cannot be fully understood without understanding GPP. The thesis adopted an inductive Grounded Theory approach (see Chapter 2) and it is a key finding that one cannot fully understand firm-greening or GPP without reference to the other. For these reasons, the literature review examines green (and sustainable) public procurement.

The literature on GPP has identified that internationally public sector authorities have been, to varying degrees, pursuing stronger environmental outcomes as part of their procurement processes. The GPP literature has also identified that public authorities are facing a number of challenges in this endeavour including fiscal constraint, managerial commitment, lack of knowledge and expertise, lack of information and guidance. The literature review on GPP summarises the key findings with respect to these challenges.

This thesis does not adopt any specific theoretical perspective offered by organisational studies as it adopts an exploratory, inductive research approach (see Chapter 2). However, the existing literature on firm-greening is presented here in order to highlight factors that are considered to be important. This section will deal with each of these factors in turn. Table 4, page 54 provides a summary of the key aspects of existing firm-greening studies in organisational management literature, while Table 5, page 56 summarises key construction management literature.

Firm-greening

The following section summarises the key findings from the literature with respect to the factors relevant to understanding firm-greening. These are:

- Stakeholder pressures
- Internal drivers & influencing factors
- Challenges

Stakeholder Pressures

Firms exist and operate in a context in which their activities impact on stakeholders, and in which stakeholders in turn impact on the firm (Freeman 1984). Stakeholders are both external and internal to the firm. They consist of a range of agents and organisations that include the government, clients, community and environmental interest groups, and industry/trade associations, shareholders, and employees (Delmas and Toffel 2004; Hoffman 2001;

Newman and Breeden 1992). Stakeholders exert a range of pressures on firms which will be examined in the following section.

Government

The literature has identified government and its various agencies as key stakeholder of firm-greening. They can play an important role in bringing about firm-greening due to the range of instruments that they can adopt to achieve the objectives set out in national policy. Government instruments may be in the form of legislations, policy, regulations, licenses, permits, informative programs and certification standards (public service information, ministry developed energy savings programs), taxes, and subsidies.

Regulation

Governments exert direct pressure on industry through the development and enforcement of regulations. Environmental regulations are considered as one type of government instrument to improve environmental performance of firms by requiring firms to address externalities which they would not be inclined to voluntarily address (Henriques and Sadorsky 1996). By their nature, environmental regulations can be understood as coercive instruments which can result in the government withholding a firm license to operate unless it adopts certain practices (Frooman 1999). Some argue that this is necessary because the voluntary motivation for firm-greening cannot be solely relied upon (Newton and Harte 1997). Firms can therefore feel coerced to comply with existing regulations or act voluntarily to pre-empt future regulations (Khanna et al. 2009; Marshall et al. 2005).

Regulatory pressure was identified as an important driver in a number of studies e.g. German and British pharmaceuticals industry (Blum-Kusterer and Hussain 2001), small and medium-sized manufacturing firms in the United Kingdom (Williamson et al. 2006), Standard and Poor (S&P) 500 firms (Khanna and Anton 2002b). Regulatory pressures play an important role there is an absence of voluntary motives for firms to pursue firm-greening (Blum-Kusterer and Hussain 2001; Williamson et al. 2006). Where the decision-criteria are dominated by least-cost concerns, the managerial priority lies in identifying cost-savings. The managers' focus is on identifying cost-savings and not on pursuing environmental initiatives for their own sake (Williamson et al. 2006).

Regulatory pressures are also not homogeneous, that is regulatory pressures manifest themselves in a variety of ways. For example, regulatory pressures that have been shown to be drivers of firm-greening include the following: number of regulatory inspections that a firm experiences (Khanna and Anton 2002a), directors/officers liability (Sharma and Henriques 2005), regulations on water and air quality versus waste and emissions (Sharma and Henriques 2005). In their study of the Canadian forestry industry Sharma and Henriques (2005) found that Canadian forestry firms were more likely to engage in fundamental changes to their products and processes (eco-design) versus less fundamental changes (e.g. pollution control). They attribute this to the focus of Canadian regulations on water and air quality and not at waste and emissions as was the case for the United States. This provided the firms with the opportunity to identify the most appropriate means of meeting such standards (Sharma and Henriques 2005).

In addition to actual regulatory pressures, the threat of becoming externally regulated by the government can stimulate firm-greening. Firms and industries may voluntarily improve their environmental performance in order to discourage the government's perceived need to develop regulations for the sector. The threat of facing greater regulatory pressures and firm-greening has been identified in a number of different studies e.g. 500 U.S. S&P firms (Anton et al. 2004), U.S. wine sector (Marshall et al. 2005), Scandinavian Airlines (Lynes and Andrachuk 2008; Lynes and Dredge 2006), German pharmaceuticals sector (Blum-Kusterer and Hussain 2001), and Japanese business sector (Ikkatai et al. 2008). In addition, firms may be motivated to undertake firm-greening in anticipation of the impending regulation and a desire to be compliant. For example, a study of 500 S&P firms showed that the anticipation of environmental regulations were more effective at motivating firms to adopt pollution prevention technologies compared with existing regulations (Khanna et al. 2009). Neither does regulatory pressure need to be directly focussed on a specific industry in order for that sector to pursue green initiatives. In their study of 500 U.S. S&P firms Reid and Toffel (2009) found that firms located in U.S. states that were experiencing regulatory pressures, but which the firms were not directly targeted by, were more likely to voluntarily disclose environmental information.

Research on the construction sector confirms that regulatory pressures are important drivers for firm-greening in this particular sector. For example, regulation has been identified as important in the following construction sectors Netherlands (FHWA 2000), U.K. (Adetunji et al. 2003; Fergusson and Langford 2006), Singapore (Kein et al. 1999; Ofori et al. 2000), Japan (Tam 2009), and China (Qi et al. 2010). Some studies identified a desire to avoid

regulatory non-compliance as a driver for firm-greening (e.g. Kein et al. 1999; Ofori et al. 2000), while others showed that regulations around construction, material recycling, and energy saving such as in Japan (Tam 2009) and China (Qi et al. 2010) were driving firm-greening.

In the Netherlands, there is widespread public opposition to landfills (FHWA 2000). This is coupled with government policy that minimises use of natural resources and encourages recycling (FHWA 2000). The result is that they recycle as much as 100% of asphalt and C&D wastes for road works (FHWA 2000).

Government Endorsement

Government endorsement of environmental programs, certifications, standards can also be a factor that influences adoption by firms as legitimate behaviour. In a study of ISO14001 practices in Europe and the United States, Delmas (2002) found that the European Commission's support for ISO14001 encouraged European firms to adopt the standard because it provided European firms with clear signals of legitimacy, and in effect legitimised those firms that chose to adopt this system and become certified (Delmas 2002). The European Commission also provided support to European firms by reducing the costs associated with adopting and certifying ISO14001 (Delmas 2002). The European Commission's endorsement of ISO14001, and the support provided meant that European firms were more likely to pursue ISO14001 when compared to U.S. firms (Delmas 2002).

Influence of Government Pressure over Time

While government regulations represent a coercive pressure, firms which pursue environmental performance beyond-compliance are considered to be taking into consideration forces other than government stakeholders (Gladwin 1993). Empirical studies have highlighted that stakeholders vary in importance to firm-greening (e.g. Buysse and Verbeke 2003). The importance of stakeholders varies according to issue, and changes over time (Mitchell et al. 1997). For example, studies have shown that firms operate in organisational fields that experience institutional change (e.g. Hoffman 2001). Environmental regulations act to raise awareness about environmental impacts when this issue is less prominent (Sharma 2001). However, as environmental sustainability takes on greater legitimacy within an institutional field, the firms operating within that field who are compliant may go further and take on proactive environmental strategies. Regulatory

pressures provide firms with a baseline standard with which they have to comply (Sharma 2001). However, they may view the regulation merely as a baseline above which they can begin to differentiate themselves from their competitors (Marshall et al. 2005). Marshall et al. (2005) note that government regulators will need to revisit their role in the institutional field for those firms that are attempting to make the move from compliance to beyond-compliance. In their study of Spanish firms, González-Benito and González-Benito (2006) found that managerial perception of government pressure was not relevant to proactive environmental initiatives, whereas non-government pressures (e.g. community groups) were positively linked to the uptake of environmental logistics practices. They suggest that this is consistent with Henriques and Sadosky's (1999) conclusions that regulatory pressures are more important for firms focussed on a reactive environmental strategy, where the firms focus on complying with government standards as opposed to exceeding such standards.

Customers/Clients

Fineman and Clarke (1996) identify customers as a powerful stakeholder on firms through their demand for quality goods and services. They describe customers as a type of stakeholder that *“do not sponsor environmental protection as an end in itself, but are happy to enjoy the rewards of greener services, processes or products if they serve their own needs or profits”* (Fineman and Clarke 1996, p. 717).

A number of studies have identified customer pressure as a driver of firm-greening in a number of different contexts. For example, customer pressure was an influencing factor in Canadian firms (Henriques and Sadosky 1996), Finnish industrial firms (Kautto and Melanen 2004), Chinese firms (Christmann and Taylor 2001), New Zealand wine sector (Gabzdylova et al. 2009) as well as within the U.K. construction sector (Adetunji et al. 2003), and the U.K. road construction/maintenance sector (Adetunji et al. 2008). In addition, the degree to which customers are important influences can vary according to industry type. For example, customers in the context of the supermarket sector, chemicals industry, and automotive and power industries were not a significant forces for firm-greening (Fineman and Clarke 1996). In contrast, a survey of large Canadian firms showed that customer pressure was cited by managers as influencing the firm's uptake of environmental management plans (Henriques and Sadosky 1996).

Customer pressure is also linked to the adoption of beyond-compliance environmental initiatives. During the 1990s, the European Community and the Finnish government were

developing and implementing a range of waste regulations (Kautto and Melanen 2004). The researchers anticipated that the Finnish firms were responding to the waste regulations, however, findings from the research found that firms were adopting proactive and beyond-compliance initiatives suggesting that the new waste regulations were not driving this trend (Kautto and Melanen 2004). Rather the trend was attributed to customer pressure (Kautto and Melanen 2004).

Firms may also utilise environmental initiatives as a means to signal to their customers their environmental performance. Chinese firms who exported a large portion of their output to international customers (predominantly in developing countries) showed better environmental compliance and were more likely to adopt ISO14001 than other Chinese firms (Christmann and Taylor 2001). They suggest that foreign customers have no way of monitoring the environmental performance of Chinese suppliers, and internationally recognised standards such as ISO14001 provide a means of providing legitimacy to those firms (Christmann and Taylor 2001). Similarly, New Zealand wine firms indicated that customers, in particular international customers, expect the wines to be sustainably produced (Gabzdylova et al. 2009). However, the managers interviewed noted that they were challenged in their efforts to pursue greater sustainability on account that the customers were not willing to pay a premium for sustainably or organically grown wines (Gabzdylova et al. 2009). This relates to cost which is discussed later in this chapter (see Cost, p.47).

A number of studies were also able to show that the degree of contact that firms had with their customers was an important factor to firm-greening (Anton et al. 2004; Khanna and Anton 2002a). For example, Khanna and Anton (2002a) hypothesise that firms that are in closer contact with their customers would feel greater pressures to address environmental issues or would benefit more from improving their environmental performance. Their statistical analyses of 500 S&P firms showed that firms that were involved in selling a final product and had closer contact to their customer base had adopted more comprehensive EMS than firms located in an intermediate position in the supply chain (Khanna and Anton 2002a).

In the context of the construction sector, the client is a very important stakeholder for construction firms. In their study of the adoption of sustainability practices in the U.K. construction sector, respondents highlighted that the client was the most important stakeholder (Adetunji et al. 2003). This is because the clients' objectives and expectations set the terms of the work to be undertaken by the contractor (Tam 2009; Varnas et al. 2009). In their study of the U.K. road construction industry Adetunji et al. (2008) client demand for better environmental performance was a major influence to convince firms' boards to adopt

ISO14001. Importantly, when these studies refer to the client in the context of the construction sector, the studies are also referring to the government which is the single biggest client in the construction sector. This highlights the dual role that the government plays in the construction sector, namely by being both a regulator and a customer of products and services (Ofori 1999). While the government has a dual role as both a regulator and a client, it is important to consider that it is likely for regulation and procurement to be the functions of two separate agencies or departments within the public sector.

Clients can specify environmental requirements that contractors have to meet in order to win work (Seaden and Manseau 2001). One study has examined the consideration of environmental requirements in public procurement in the context of the road construction sector (Faith-Ell 2005). Faith-Ell (2005) examined the Swedish construction sector as they developed and specified environmental requirements for trucks and construction vehicles in maintenance contracts. The reason for including environmental requirements in road maintenance contracts was because the Swedish National Road Association wanted to reduce the environmental impact of their sector and due to a belief that doing so would reduce public pressure to improve environmental performance (Faith-Ell 2005). The environmental requirements were that trucks and construction vehicles were to meet certain European and U.S. environmental standards e.g. emission standards. What was very interesting was that these requirements were escalating over time, that is, the tender requirements did not stipulate that the firms would be penalised today, but rather in the future should they chose to adhere or ignore the client's performance outcomes. Based on her interview and questionnaire data, Faith-Ell (2005) was able to show that contracting firms were upgrading their trucks and vehicles in response to their clients tender requirement. However, many of the contractors only chose to upgrade their trucks and vehicles to meet European Union and U.S. standards once these reached end-of-life (Faith-Ell 2005). This means that the firms did not immediately upgrade the vehicles in response to the clients' requirements, but only did so once the trucks had reached their end-of-life.

The construction sector is also characterised by the opportunity for construction firms to be certified by the client as pre-qualified. Pre-qualification means that the firm has achieved a preferential status as a preferred supplier of construction services. The existence of a pre-qualification category in the construction sector has led some firms to use their environmental performance record to support their application to be pre-qualified (e.g. Fergusson and Langford 2006). These are examples of a direct strategy by the client to influence firm

behaviour by identifying behaviours that would accommodate and address the stakeholders' objectives (Frooman 1999).

Other Stakeholders

Other stakeholders have also been shown to be influencing factors on firm-greening. These include shareholders (Henriques and Sadorsky 1996; Reid and Toffel 2009), employees (Blum-Kusterer and Hussain 2001), industry or trade associations (Kollman and Prakash 2002; Ramus and Montiel 2005), public-community groups (Henriques and Sadorsky 1996), environmental interest groups (Lawrence and Morell 1995), and owners and shareholders (Gabzdylova et al. 2009).

Industry mimetic pressures were shown to be an important factor in industry wide environmental policies (Ramus and Montiel 2005). Similar environmental policies were adopted by firms within a single industry (Ramus and Montiel 2005). However, because different sectors do not face the same environmental impacts and costs, the policy commitment seen across the board by firms represents pressures from stakeholders even though they may not result in actual change in practice (Ramus and Montiel 2005). They indicate that a business rationale is still critical for ensuring that the environmental policy translates into practical deliverables rather than merely appearing as a form of greenwashing (Ramus and Montiel 2005).

Internal Drivers & Influencing Factors

Government and customers represent two of the main external pressures on firms to pursue firm-greening. However, not all factors influencing firm-greening are externally imposed on the firm (Howard-Grenville et al. 2003). Some factors are internal to the firm, and can act by addressing and dealing with external pressures. This section examines a range of internal drivers and factors influencing firm-greening.

Strategic Drivers

The literature on firm-greening considers strategic drivers as important for improving our understanding of firm-greening. Scholars have suggested that pollution reflects inefficiencies in a firm's operation, such that firms can generate profits by voluntarily reducing pollution

(Hart 1995; Porter and van der Linde 1995; Russo and Fouts 1997; Shrivastava 1995). Walley and Whitehead (1994) questioned the suggestion that such a win-win scenarios really exists for a majority of firms. However, the empirical literature shows that competitive advantage has been identified as a key driver of firm-greening in a number of different contexts, for example in multiple industries in both the United Kingdom and Japan (Bansal and Roth 2000), 500 U.S. S&P firms (Khanna and Anton 2002b), Europe (Delmas 2002), United States wine sector (Marshall et al. 2005), Spanish industrial firms (Fraj-Andres et al. 2009), and New Zealand wine sector (Gabzdylowa et al. 2009).

Competitiveness manifests itself in a variety of ways, such as a desire to develop a firm's environmental image or brand, enter into more or different markets (improve market position), develop stakeholder relationships, or engage in a market differentiation strategy. Managers perceive that by improving their firms' environmental image (brand) as a responsible environmental performer they will experience advantages over their competitors.

Developing a firm's social capital through the use of environmental initiatives can be seen throughout the literature. For example, in their study of 500 S&P firms Khanna and Anton (2002b) found that these firms sought to develop an environmental friendly image and to improve the firms' relationships, particularly with investors and consumers. Similarly, Scandinavian Airlines sought use their image to improve stakeholder relationships (Lynes and Andrachuk 2008; Lynes and Dredge 2006). They sought to develop their credibility in order to effectively lobby regulators (Lynes and Andrachuk 2008; Lynes and Dredge 2006). In New Zealand, wine firms have also been shown to pursue sustainability practices as a means of improving their reputation, improve access to domestic and international markets, and improve their ability to attract suppliers and other industry partners (Gabzdylowa et al. 2009).

Environmental sustainability initiatives may also be used as a means to differentiate a firm from its competitors. Market differentiation was a driver for greening in several U.K. construction firms (Fergusson and Langford 2006), as well as in the U.S. wine industry (Marshall et al. 2005). They found that in addition to cost-saving, wine quality was considered to be an important driver in the U.S. wine industry for proactive environmental behaviour (Marshall et al. 2005). Firms can also gain a competitive advantage if they have explored and tested environmental initiatives ahead of their competitors in the market place, that is, to capitalise through first-mover advantage (Nehrt 1998; Porter and van der Linde 1995). As customers/clients in the market begin to request improved environmental

performance, those firms that have pursued the development of environmental initiatives may find themselves in a competitively advantageous position (Porter and van der Linde 1995).

Studies conducted in construction sectors also show that competitiveness is an important driver of greening in construction firms, for example, Japan (Tam et al. 2010), Hong Kong (Shen and Tam 2002; Tam et al. 2010), Hong Kong and the Egyptian construction sector (Sakr et al. 2010). In Hong Kong, construction firms were adopting EMS as a means of improving their firms' environmental image by (Shen and Tam 2002). While Japanese and Hong Kong construction firms view the use of recycled materials as a means of developing a competitive advantage and added business opportunities (Tam et al. 2010). In Egypt, contracting firms that had already adopted ISO9001 noted that this accreditation alone was not sufficient to pre-qualify with foreign clients and that ISO14001 would help them win more work in this regard (Sakr et al. 2010). While both ISO9001 and ISO14001 are quality management systems, ISO14001 is specific to the environmental aspects of the organisation's processes.

Construction firms are also using environmental initiatives as means of increasing their market share. Several studies have shown that construction firms' market share increased on pursuing environmental initiatives, which they attribute to the firms' improved reputation (e.g. Shen and Tam 2002; Zeng et al. 2003). Similarly, when a large U.S. construction firm adopted ISO14001 it found that clients were requesting the firm to submit bids on construction projects because of their reputation as a high environmental performer (Christini et al. 2004). The clients requested these bids even though projects were not being won on the basis of the EMS (Christini et al. 2004).

Monetary Drivers

In addition to strategic drivers, firms have also been shown to pursue greening in order to develop monetary benefits (money saved or money earned) (Lynes and Andrachuk 2008). Benefits to the financial bottom line can occur where the firm is able to generate a cost-saving from environmental initiatives (Gonzalez-Benito and Gonzalez-Benito 2005a; Sangle 2010). Cost-savings from environmental initiatives can be generated in a number of ways such as through the reduction of resource use, reduction of waste and energy generation, and the reuse of waste products as substitutes for traditional materials and energy products. Cost-savings can be generated when firms improve their environmental performance and hence

their compliance with environmental regulations and thereby reduce the risk of fines and penalties from non-compliance.

Managerial perception that cost-savings could be generated from EMS was identified as a driver of ISO14001 adoption in European firms (Delmas 2002). Similarly, cost-savings was the second most important driver for environmental pro-active behaviour in the U.S. wine industry (Marshall et al. 2005). In their study of ISO14001 adoption in Spanish firms Gonzalez-Benito and Gonzalez-Benito (2005a) found that managers that perceived opportunities to improve the efficiency of operations and derive a cost-savings were more likely to pursue ISO14001. They note that managers in these firms perceive these benefits even though the ISO14001 standard does not guarantee such outcomes (Gonzalez-Benito and Gonzalez-Benito 2005a). However, as Williamson et al (2006) points out, the cost-savings generated from eco-efficiency initiatives translates into cost-savings for the consumer/client and consequently allows the firm to respond to market pressures (Williamson et al. 2006).

Monetary drivers can also be framed in terms of short- and long-term benefits. The introduction of cleaner production technologies in Scandinavian Airlines was found to be driven by cost-savings (Lynes and Andrachuk 2008). Here, the managers noted that the short- and long-term paybacks from capital investments into cleaner production were an important consideration by the airline (Lynes and Andrachuk 2008; Lynes and Dredge 2006).

Ethical Drivers

There are a range of ideas about the role that firms should play in society. For example they may be understood in very narrow terms as a means of wealth creation for shareholders (Friedman 1970), or alternatively as being responsible to a range of broader stakeholders i.e. not just shareholders. In the latter view, firms' decisions are understood to exert impacts and benefits to stakeholders beyond the firms' boundaries, such that firm actions should be motivated by ethical and moral concerns. Corporate citizenship is therefore not merely engaging in philanthropic initiatives, but is broader than that in that it is about the firm *doing the right thing*. A range of different studies have found that firms pursue greening even in the absence of any benefit to the firm. Rather, the firm pursues greening because managers feel that it is "the right thing to do" (Bansal and Roth 2000). There are many variations of this phrase by firm managers, and can be found throughout academic and practitioner literature where ethics has been identified as a key driver of firm-greening. For example, managerial values and the emphasis placed on the environment was a key driver for firm-greening in

Spanish firms (Gonzalez-Benito and Gonzalez-Benito 2005a), the New Zealand wine sector (Gabzdylova et al. 2009), the U.S. wine sector (Cordano et al. 2010). In the context of the construction sector, research by Shen and Tam (2002) in the Hong Kong construction sector found that contracting firms were motivated to implement EMS in order to reduce environmental impacts.

Ethical drivers can also lead to added benefits for a firm. For example, *being a good corporate citizen* was an important motivating driver for the Scandinavian Airlines to pursue environmental initiatives (Lynes and Andrachuk 2008; Lynes and Dredge 2006). Senior managers interviewed for their study highlighted that they wanted their firm to be seen as responsible and taking care of the environment (Lynes and Andrachuk 2008). Engaging in activities that helped to preserve the environment was perceived as a way to create a positive image of the firm which was seen to be culturally important in Sweden (Lynes and Andrachuk 2008). It means that the firm was adhering to cultural standards, improving its image and thereby its legitimacy within society (Lynes and Andrachuk 2008).

Some firms also appear to engage in environmental initiatives to reduce environmental impact, but which provides no clear strategic or monetary benefit to the firm (Banerjee 2001). Banerjee (2001, p. 509) poses the following question “*what happens when what's good for the environment is not good for the company?*” It is possible that over time the firms’ perceptions of engaging in an environmental initiative may change if they do not experience a win-win scenario.

Managerial Perceptions

Earlier in the section on firm-greening, the literature review highlighted that stakeholders are one important factor in better understanding the reasons for firm-greening. However, while stakeholders may exert a range of direct or indirect pressures on firms what also matters is the managerial perception of those stakeholders and the legitimacy they credit to their stakeholders concerns (Fineman and Clarke 1996; Henriques and Sadosky 1999; Mitchell et al. 1997). Fineman and Clarke (1996) note that managers prioritise stakeholders and frame stakeholder concerns in specific ways. They argue that the stakeholder theory approach to explaining firm-greening objectifies the stakeholder without providing greater insights into how managers within firms act to interpret and shape the stakeholder influence (Fineman and Clarke 1996). The manager is seen as exercising agency by selectively prioritising certain stakeholders and developing firm responses to them (Fineman and Clarke 1996). The

importance that a manager attaches to specific stakeholders is seen to be ultimately determined by managerial values (Buysse and Verbeke 2003; Freeman et al. 2000).

Who within a firm has also been identified as an important factor to firm-greening. For example, organisational firm-greening studies have frequently highlighted the importance of senior management commitment to firm-greening (Berry and Rondinelli 1998; Ghobadian et al. 1998; Hunt and Auster 1990; Michael et al. 2010; Post and Altman 1994; Starik and Rands 1995). While senior managers have been prominently discussed in the literature, less has been written about with respect to middle managers (Porter 2006). Porter (2006) argued that middle managers play a critical role in firm-greening too due to their role within the firm and specific departments, their values and attitudes as well as their autonomy within that role.

Managerial commitment to environmental causes has also been identified as a very important factor on firms' development of environmental strategies (Andersson and Bateman 2000; Bansal and Roth 2000; Fraj-Andres et al. 2009; Lee and Ball 2003). In the context of the construction sector Qi et al. (2010) identified that managerial concern for the environment was a driver of greening in Chinese construction firms.

In their study of Spanish industrial firms Fraj-Andres et al., (2009) showed that senior management who showed a high degree of commitment and support for environmental initiatives strongly influenced the firm's environmental orientation and corporate environmental strategy. In addition, individuals who act as champions for environmental issues are also considered to exert an important influence on firm-greening (e.g. Andersson and Bateman 2000; Lawrence and Morell 1995; Lynes and Dredge 2006; Post and Altman 1994; Prakash 2001). Empirical findings show that firm managers and environmental champions within the firm have a more significant role on the degree to which a firm pursues an environmental strategy than previously believed (Prakash 2001).

The *perception* that firm managers have of various environmental sustainability initiatives has also been identified to be an important factor on firm-greening (Bansal and Roth 2000; Cordano and Frieze 2000; Flannery and May 2000). Empirical research has shown that managers have different perceptions of the benefits and challenges associated with environmental initiatives influences firm greening. For example, managerial environmental attitudes towards the environment were found to be linked to the degree to which firms choose to be environmentally proactive (Cordano and Frieze 2000; González-Benito and González-Benito 2006; Marshall et al. 2005; Sangle 2010). Survey studies conducted on New Zealand firms support these international studies and show that the managers values and beliefs are important drivers of greening in firms (e.g. Collins et al. 2010; Gabzdylova et al.

2009). In firms where environmental preservation is seen as a legitimate issue, and managers view environmental issues as opportunities for the firm then the firm is more likely to pursue greening (Sharma 2000; Sharma and Nguan 1999; Sharma et al. 1999). Thus, firms are more likely to take a proactive environmental strategy if they perceive environmental issues as opportunities rather than threats, compared to firms that view the same pressures as threats (Cordano and Frieze 2000). A survey of Canadian firms found that firms that viewed the environmental as an important issues in the subsequent 5 years were more likely to have developed an environmental management plan (Henriques and Sadorsky 1996).

González-Benito and González-Benito (2006) were able to show that in the context of the uptake of environmental logistics practices in Spanish firms, environmentally aware managers more strongly perceive stakeholder's environmental pressures and responded to satisfy these stakeholders compared to environmentally less aware managers. In addition, managers who perceived greater pressures from customers with respect to environmental performance and whose firms experienced greater environmental regulatory pressures tended to more strongly pursue environmental protective measures (Fraj-Andres et al. 2009). A study by Delmas and Toffel (2008) identified that firms whose managers were more receptive to market stakeholders were more likely to adopt EMS such as ISO14001, compared to those firms where managers were focussed on non-market stakeholders. The latter group were more likely to adopt government initiated voluntary programs (Delmas and Toffel 2008).

Managers also appear to recognise that pursuing their ethical values can be good for reasons for which they actually do not have quantifiable information (i.e. it is a perception that there will be future benefits from such behaviour) as well as immediate and direct benefits (whether these are in terms of financial benefits or in terms of improved stakeholder relationships) (Lynes and Andrachuk 2008).

Other Factors

Industry-type

Organisational context has been identified in the literature as being a significant influence on firm-green strategy as well. Dutton and Duncan (1987) develop a theoretical model that highlights the role of organisational context in influencing firm managers' perceptions of environmental issues and hence the subsequent actions these managers choose to take.

The nature of the work in which firms operate can also influence their pursuit of firm-greening. Firms that operate with particularly hazardous materials face greater legal liability and are therefore more likely to pursue greater environmental management practices. For example, in their statistical analyses of 500 U.S. S&P firms, Khanna and Anton (2002a) found that firms with greater on-site toxic releases were more likely to improve their environmental performance even though there were no mandatory regulations covering toxic releases. They hypothesise that this is due to such firms facing greater community pressure to address their environmental impacts on the site (Khanna and Anton 2002a). Firms that operate in contexts where there are a lot of opportunities for improvements e.g. firms that handle a large range of chemicals will be more likely to pursue pollution prevention techniques (Khanna et al. 2009). In addition, studies have found that firms with poor environmental performance, that is, those firms that produce high levels of pollution are more likely to participate in voluntary self-regulation programs compared to low polluting firms (Potoski and Prakash 2005; 2005b).

Firm size

Larger construction firms appear to be more inclined to engage in sustainability practices (Adetunji et al. 2003; Qi et al. 2010), and are more likely to be proactive (King and Lenox 2000; Potoski and Prakash 2005; 2005b; Sharma 2000; Videras and Alberini 2000). The reasons for this are attributed to large firms having access to more resources to devote to environmental management while smaller firms have less access to similar resources (Barney 1991). Large firms allow for economies of scale (Pfeffer and Salancik 1978), and are also more visible to the public and therefore experience greater pressures from stakeholders (Westley and Vredenburg 1996). Sharma and Henriques (2005) also found that over time, as environmental sustainability became more established within a sector, firm size became less important. They attribute this to innovation and knowledge, which they do not consider to be limited to larger firms (Sharma and Henriques 2005).

Firm Structure, Assets & Capabilities

Firms have internal characteristics that influence their ability to pursue, and influences the costs associated with pursuing firm-greening (Delmas and Toffel 2004; Sharma 2000; Sharma 1999; Sharma et al. 1999). Access to discretionary slack can be an important influencing factor on firm-greening (Sharma 2000). There are a number of internal factors

that influence firm-greening, these include the degree of firm innovativeness (Florida 1996), presence of complementary assets (such as R&D intensity) practices (Christmann 2000; Khanna et al. 2009; Sharma and Vredenburg 1998), the presence of Total Quality Environmental Management (Khanna et al. 2009), and organisational learning capabilities (Marcus and Nichols 1999).

Challenges

The organisational and construction management literature identifies a number of challenges to the successful adoption and development of environmental sustainability initiatives. They include issues around cost, lack stakeholder support and pressure, lack of knowledge and information, and conservatism. These challenges are examined and summarised in turn in the following section.

Cost

The costs associated with firm-greening practices have been identified in the literature as a challenge to firms' pursuit of these initiatives. Cost has been identified as an issue for firm-greening in European and U.S. firms (Delmas 2002), Swedish firms (Park and Brorson 2005), small and medium-sized U.K. manufacturing firms (Williamson et al. 2006), the New Zealand context (Collins et al. 2010), and the New Zealand wine industry (Gabzdylova et al. 2009). It was also extensively reported as an issue in the construction sector (Adetunji et al. 2003; Adetunji et al. 2008; Kein et al. 1999; Sakr et al. 2010; Shen and Tam 2002; Shen et al. 2006; Tam 2008; Tam et al. 2009; Tam et al. 2010; Tam 2009; Tse 2001; Zeng et al. 2003; Zutshi and Sohal 2004).

One challenge for firms in integrating environmental impacts lies in their ability to remain competitive in the market place. Firms are typically faced with consumers who are unwilling to pay a premium for environmentally friendlier products and services. This is an issue that was identified in the context of the New Zealand wine industry (Gabzdylova et al. 2009). In their study they found that while a consumer demand exists for wines to be more sustainably or organically grown, consumers were unwilling to pay a premium for the benefit (Gabzdylova et al. 2009). Thus, firms are unlikely to voluntarily pursue beyond-compliance initiatives unless driven to do so by the market (Williamson et al. 2006).

The costs associated with environmental sustainability initiatives is a dominant concern of firm managers. Williamson et al. (2006) showed that small and medium sized U.K. manufacturing firms were predominantly concerned either with market pressures (identifying cost-savings and responding to cost) and responding to the supply chain (in this case customer demand) (Williamson et al. 2006). Thus, adopting environmental sustainability initiatives that result in added cost to the production process is problematic for firms if they are competing against others that are not engaging in these same environmental initiatives because of the competitive disadvantage involved (Collins et al. 2010).

Cost is a key challenge facing the construction sector in their attempts to pursue environmental sustainability initiatives. Studies have shown that construction firms are hesitant to implement EMS because of the costs associated with its adoption and certification (Adetunji et al. 2003; Kein et al. 1999; Ofori et al. 2000; Sakr et al. 2010; Shen and Tam 2002; Tse 2001; Zeng et al. 2003; Zutshi and Sohal 2004). In the construction sector, the issue of cost is closely linked to the client's expectations and demands. For example, the adoption and certification of EMS was problematic given that construction firms tend to win work on the basis of least-cost (Shen et al. 2006). Innovative solutions can be more costly and also more risk associated. Where the client is concerned with budget and completing times they tend not to be supportive where solutions are more costly than standard practice (Lim and Ofori 2007). Implementing EMS increases the operational costs for construction firms, which they may be unable to pass on to their clients for fear of becoming uncompetitive. For example, respondents from the Singaporean construction sector highlighted that while environmental protection provided the firm with a positive image it did not address either the client's needs or generate cost-savings (Kein et al. 1999). While in their study of ISO14001 in the Chinese construction sector Zeng et al. (2003) noted that there was no mandatory regulatory driver for ISO14001. In the absence of an external force and the inability to generate cost-savings Chinese firms prefer to take a passive approach and wait for stakeholder pressures before pursuing ISO14001 (Zeng et al. 2003).

Several studies have also examined the use of C&D wastes by the construction sector. Construction and demolitions waste recycling initiatives face barriers, particularly where it is less costly to extracting and utilise virgin aggregates over alternatives such as C&D wastes. For example, the dumping of C&D wastes can be cheaper than attempting to recover and recycle the waste materials (Hyder Consulting et al. 2011; Leigh and Patterson 2004; Rao et al. 2007; Tam et al. 2009). The development of a system for collecting, sorting, and processing waste materials can be costly (Tam et al. 2010; Tam 2009). The cost of sending

and transporting C&D waste to recyclers can be high (Tam 2009). In addition, the development of sufficiently large stockpile and a steady supply of C&D waste materials is important for the cost-effectiveness of becoming engaged in C&D waste recycling (Tam 2008).

In addition to cost, the uncertainty about the benefits of pursuing environmental sustainability initiatives is also a challenge facing firms' pursuit of greening. In a study of U.S. and European firms, Delmas (2002) found that firms faced with the cost of adopting ISO14001 but faced with a lack of certainty about the benefits from ISO14001 were less likely to pursue the adoption of ISO14001. In contrast, the European Commission provided legitimacy and facilitated support systems for European firms to adopt ISO14001 in a manner that reduced the transactions costs (Delmas 2002). A similar concern about the uncertainty regarding the value of environmental initiatives was found in a study of 28 Swedish firms who were voluntarily producing corporate environmental/sustainability reports (Park and Brorson 2005). Their study found that firm managers were hesitant to invest in third-party assurance of annual environmental and sustainability reports given the costs involved and the lack of certainty with regards to added benefits to the firm (such as in the form of enhanced credibility with stakeholders) (Park and Brorson 2005).

The empirical literature also shows that not all construction firms are experiencing cost-savings or competitive advantages by engaging in environmental initiatives (Kein et al. 1999; Shen and Tam 2002). In their study of Hong Kong construction firms, Shen and Tam (2002) found that contracting firms were actually experiencing a net cost because the cost-savings generated were outweighed by the increased management costs associated with investments into equipment, staff training, human resources and technology. And while some of the firms interviewed also highlighted that they experienced a reduction in the fines from environmental non-compliance, the managers noted that this was still offset by the implementation costs (Shen and Tam 2002). Thus, the development of financial incentives from the client may be necessary to facilitate and drive the adoption of environmental initiatives in the construction sector (Ofori et al. 2000).

Lack of Stakeholder Support and Pressure

Lack of pressure and support from stakeholders can also present challenges to firms' pursuit of environmental sustainability initiatives. This issue was repeatedly highlighted from studies of the construction sector, where the primary concern is that there is a lack of support from

the industry's clients. Lack of client support manifests itself in terms of lack of requirements by the client to address environmental issues in contracts (Kein et al. 1999).

Studies of Asian construction sectors show that construction firms had taken a passive strategy towards addressing environmental issues (Kein et al. 1999; Tse 2001). Several studies were able to show that construction managers in Singapore (Kein et al. 1999; Tse 2001) and Hong Kong (Shen and Tam 2002; Tse 2001) felt that there was a lack of support from the clients and government for the adoption of environmental sustainability initiatives. Construction managers felt that any attempts to adopt environmental sustainability initiatives would not be appreciated or incentivised by the clients (Ofori et al. 2000; Shen and Tam 2002). The adoption of EMS was not perceived to yield clear financial benefits to the firm, and in the absence of stakeholder pressure, construction firms do not perceive a need to pursue such initiatives (Tse 2001). Thus, the Asian construction sector is characterised by a passive strategy towards the environment with contracting firms preferring to follow market trends and demands (Kein et al. 1999; Tse 2001).

To overcome these barriers, construction managers have suggested that a range of stakeholder pressures are necessary if they wish to see the construction sector address environmental issues. For example, Singaporean construction managers suggested the need for economic incentives (such incentives for ISO14001 certified firms, government financial support, client demand, adoption by competitors), and regulatory requirement from the Construction Industry Development Board to encourage the adoption of ISO14001 in the Singaporean construction sector (Kein et al. 1999; Ofori et al. 2000). There was also a perceived lack of information from the government on how to apply ISO14001 in construction projects (Kein et al. 1999). Addressing this information gap would be necessary to improve the adoption rates of EMS.

Studies from Australia also show that contracting firms there would welcome clearer legal specifications regarding C&D requirements in construction projects (Tam 2009). Tam (2009) cites a lack of regulatory pressure for C&D use in Australia as a challenge to its adoption by contracting firms. In contrast to the Australian example, C&D recycling is common in Japanese construction firms (Tam 2009). This is driven by the fact that the Japanese government had put out a regulation governing waste recycling (Tam 2009). Contracting managers from both Australia and Japan also noted that the initial costs of implementing C&D recycling can be high for the firms (Tam 2009). The Australian and Japanese respondents both suggested that government financial support would help to kick-start C&D recycling initiatives by contracting firms in a voluntary manner (Tam 2009).

Lack of Knowledge & Information

Firm managers are focussed on addressing several objectives, of which a key objective is to work towards addressing the profitability of the firm (Henriques and Sadorsky 1996). Additional objectives such as addressing the environmental performance of the firm requires the manager to juggle multiple objectives, and the ability to effectively engage in this pursuit may be hampered by a lack of information regarding the firm's environmental performance (Henriques and Sadorsky 1996). A lack of knowledge and information can present firms with challenges with respect to the greening process (Collins et al. 2010; Sakr et al. 2010). Finding the information necessary to make business decisions can be difficult if that information is not already being collected, or is incomplete e.g. data on the wastes generated by a firm. Similarly, a lack of knowledge about environmental systems and processes that may be relevant to a particular firm or industry can make it difficult for managers to find traction on greening of the firm (Collins et al. 2010). For example, a study from the U.K. construction sector showed that a lack of awareness and information regarding available tools was the third most cited barrier to more sustainable practices (Adetunji et al. 2003).

A lack of understanding of the requirements of various environmental initiatives can also present a barrier to the adoption of environmental initiatives in firms (Kein et al. 1999). Ofori et al. (2000) identified that lack of knowledge was a barrier to contracting firms decision to pursue ISO14001 adoption and certification. Lack of trained staff has been shown to be a problem for the implementation of EMS in the Hong Kong construction sector (Shen and Tam 2002). Staff within firms may require training in order for the implementation and development of environmental initiatives to be successful (Kein et al. 1999).

Similarly, a lack of experience in using recycled materials by firms can also limit the utilisation of recycled materials (Shen and Tam 2002; Tam et al. 2009; Tam et al. 2010; Tam 2009). Since it is unclear whether the materials will achieve the same level of performance as traditional products, engineering consultants and clients will need to be convinced about the performance of alternatives before agreeing to its use in contracts. Construction firms will therefore need to show that these alternative products meet the technical requirements for a specific purpose if they are to instil confidence in the client and their engineering consultants of the efficacy of their products. The academic and industry literature on using alternative products is extensive and all work towards proving the technical performance of these products.

Conservatism

The literature has also highlighted that clients and engineering consultants are characteristically conservative. This conservatism of project stakeholders has been identified as a barrier to greening in construction activities (Adetunji et al. 2003; Adetunji et al. 2008). Conservative behaviour in construction industry stakeholders typically takes the shape of risk averseness when procuring work. Risk averseness is a characteristic feature of public sector clients (Seaden and Manseau 2001) due to the need to appear transparent and fiscally disciplined.

In the construction sector, technical standards describe the characteristics that materials need to exhibit for use in products. However, the absence or rigidity of regulations, standards, codes, specifications can all create challenges to the use of alternative materials, designs, methods in construction projects (Adetunji et al. 2003; Tam 2009). For example, one major challenge facing the utilisation of C&D waste relates to its perceived inferior quality when compared to virgin aggregates (Rao et al. 2007; Tam et al. 2009; Tam 2009). The use of recycled materials can therefore be limited to low-grade applications such as drainage filling or any activity for which there is no technical specification requirement (Tam et al. 2009; Tam 2009). Tam (2009) found that in Australia technical specifications for the use of recycled aggregates is limited to sub-base materials and road construction. Similarly, the use of recycled aggregate is limited to low-grade applications in Hong Kong (Rao et al. 2007). This limits contractors' ability to utilise recycled materials to specific work activities. A lack of information about the technical properties of recycled materials can be a barrier to its use substitution in construction projects. In order for recycled materials to become viable substitutes they need to be accepted as part of the technical specifications. However, clients who allow the use of substitutes which are not technically specified, risk the possibility of having to undertake repairs or maintenance much earlier as part of their asset management program. Engineering consultants, who advise clients are therefore unlikely to accept the use of alternative products unless they have been shown to be technically acceptable to existing standards (Knoeri et al. 2011). Developing specifications for the use of recycled materials is therefore necessary if the use of alternative materials is to become more widespread (Hyder Consulting et al. 2011; Rao et al. 2007; Tam et al. 2009; Tam 2009).

In order to overcome the conservatism of the project stakeholders, contracting firms have two avenues available to them if they wish to pursue alternative options that are considered to be more environmental sustainable. First, they can focus their attention towards addressing the technical concerns of the project stakeholders. Second, some clients can, in some cases,

utilise certain procurement methods that allocate risks to the contractor over which the contracting firm has little control (Miller et al. 2009), but which the contractor is willing to bear in order to win the work. In such a context, the risk of failure of an alternative product is borne by the contractor.

Conservatism can also present itself from within the firm that is pursuing green initiatives. Environmental initiatives such as EMS and sustainability reporting can leave firms fearful of being open to criticisms from the public. For example, Delmas (2002) found that firms in the United States were more fearful of criticisms associated with developing ISO14000 versus European firms where the European Commission was lending credibility to the standard, and actively facilitating the adoption of ISO14000.

Other Challenges

A range of other challenges have been identified in studies of firm-greening. These are listed in Table 3.

Table 3. Other challenges identified

Category	Examples
Managerial & Culture	A lack of qualified personnel (Ofori et al. 2000) Resistance from firm employees to new practices (Sakr et al. 2010) Lack of sub-contractor co-operation (Shen and Tam 2002) Communication between contractors and waste recyclers is weak (Tam 2009) Lack of staff participation (Tam 2009)
Bureaucratic	Increased paperwork (Zeng et al. 2003). Time consuming (Shen and Tam 2002). Distinct nature of construction projects makes generic environmental initiatives difficult to apply easily (Zeng et al. 2003).
Context	Not all construction firms necessarily also do business in recycling, so, including recyclers in construction projects is necessary (Tam 2009) Poor profitability of the construction sector (Zeng et al. 2003). Difficulties of placing recycling machines on construction sites was a problem identified by both Australian and Japanese contracting managers (Tam 2009). Difficulties in forming concrete recycling teams (Tam 2009).

Table 4. Summary of key organisational studies examining firm-greening

Authors	Research focus	Research Approach	Hypothesis testing	Research domain	Context	Drivers (D) or challenge (C) identified
(Sharma and Vredenburg 1998)	Environmental strategies and organisational firm capabilities	Mixed method - case Study method and survey	Yes	Strategic choice theory – natural resource based view	Single industry, Canada	D: Managerial perceptions
(Henriques and Sadorsky 1996)	Firm determinants of development of environmental plan.	Quantitative: mail questionnaire and statistical analyses	Yes	Strategic choice theory Stakeholder theory	Multiple industries: 400 largest Canadian firms	D: government regulatory pressure, customer pressure, shareholder pressure, and neighbourhood and community group pressure
(Henriques and Sadorsky 1999)	Managerial perceptions of stakeholders and environmental commitment	Mixed method – Survey method and statistical analyses	Yes	Strategic choice theory Stakeholder theory	Multiple industries in Canada	D: Managerial perceptions of stakeholders
(Sharma et al. 1999)	Corporate environmental responsiveness strategies	Qualitative theory building – Open-ended unstructured interviews and content analysis	No	Institutional theory Strategic choice	Single industry, multiple cases – Canadian oil & gas	D: Managerial perceptions
(Bansal and Roth 2000)	Motivations and contextual factors influencing corporate ecological responsiveness	Qualitative – Analytic induction	Yes	Institutional theory – micro processes	Across multiple industries – oil, automotive	D: Managerial values, competitive advantage, legitimacy, ethical motivations
(Flannery and May 2000)	Factors affecting managers ethical decision making	Qualitative – interviews Quantitative	Yes	Theory of planned behaviour Moral intensity	Single industry – US metal finishing industry	D: Managerial values
(Blum-Kusterer and Hussain 2001)	Incentives for sustainability initiatives in firms	Questionnaire survey	Yes	Organisational change theory	Multiple countries: Germany, British; Single industry: pharmaceuticals	D: Regulation, threat of regulation, new technology C: lack of support by regulator, poor or unsupportive regulatory-industry relationship
(Khanna and Anton 2002b)	Incentives for the adoption of EMS	Quantitative: statistical analyses	Yes	Environmental Economics	Single country: USA, 500 Standard & Poor Firms	D: regulatory threats, competitive advantage (market opportunities)
(Khanna and Anton 2002a)	Examining factors influencing diversity of EMS adopted	Quantitative: statistical analyses	Yes	Environmental Economics	USA, 500 Standard & Poor Firms	D: threat of environmental liability, high cost of compliance, market pressures, public pressure
(Buysse and Verbeke 2003)	Stakeholder management and environmental strategy	Quantitative - questionnaire survey using Likert scale	Yes	Strategic choice theory Stakeholder theory	Multiple industries in Belgium	D: Managerial perceptions of stakeholders
(Lee and Ball 2003)	Investigating link between managerial perception and firm greening	Qualitative: Case study method, questionnaire, interviews	No	Strategic choice theory	Single country/industry: South Korea, chemicals industry	D: regulation, competitive edge, top management commitment
(Anton et al. 2004)	Incentives for voluntary EMS adoption	Quantitative – statistical analyses	Yes	Environmental Economics	USA, 500 Standard & Poor Firms	D: Threat of liabilities, market based pressures

Authors	Research focus	Research Approach	Hypothesis testing	Research domain	Context	Drivers (D) or challenge (C) identified
(Kautto and Melanen 2004)	Industry response to waste regulation	Qualitative: case study method, interviews	No	Public Policy	Single country: Finland Multiple industries	D: Customer C: Limitations of current technologies reached, lack of economically profitable recovery options for some waste materials e.g. plastics
(Marshall et al. 2005)	Exploring individual and institutional drivers of proactive environmentalism	Qualitative – Interviews and focus groups	Yes	Institutional theory Theory of reasoned action	Single industry – US wine	D: Employee health, competitive advantage (cost, wine quality) Managerial values,
(González-Benito and González-Benito 2006)	Motivations influencing environmental transformation	Questionnaire survey	Yes	Strategic choice theory	Multiple industries	D: Managerial values, competitive advantage
(Lynes and Andrachuk 2008)	Examining motivations for corporate social and environmental responsibility	Qualitative: Case study analyses, interviews	No	Organisational studies	Single country, single firm: Scandinavian Airlines	D: range of financial benefits, corporate citizenship, image enhancement, competitive advantage, stakeholder pressure, pre-empt or avoid regulation
(Khanna et al. 2009)	Examining pollution prevention adoption in firms	Statistical analyses	Yes	Environmental economics	Single country/multiple industries: U.S. S&P 500	D: Threat of regulations Importance of complimentary assets
(Reid and Toffel 2009)	Examining role of stakeholders in corporate disclosure	Statistical analysis	Yes	Social movements theory	Single country/multiple industries: U.S. S&P 500	D: Threat of liability to sector, regulations aimed at other sectors
(Fraj-Andres et al. 2009)	Factors influencing environmental strategy	Quantitative – Analysis of questionnaire survey through structural equation model	Yes	Political–economic theory Stakeholder theory	Single country: Spain; Multiple industry: 235 firms	D: Competitive advantage, management commitment
(Gabzdylva et al. 2009)	Drivers of sustainability practices and role of stakeholders	Mixed method – interviews & publicly available information	No	Strategic choice theory Stakeholder theory	Single industry, multiple cases – NZ wine industry	D: Managerial values, employee satisfaction, product quality, customer demand C: Lack of price premium
(Sangle 2010)	Drivers of proactive greening in Indian firms	Mixed method – content analysis, quantitative survey using Likert scale	No	Strategic choice theory Institutional theory	Multiple	D: Managerial perceptions, pollution prevention, cost-savings, risk reduction
(Michael et al. 2010)	Executive perceptions of adopting an environmental certification program	Quantitative - Questionnaire survey using a five point Likert scale	No	Strategic choice theory	Single country/industry – North American kitchen cabinet industry	D: Managerial perceptions
(Collins et al. 2010)	Trends in sustainability practices in NZ firms	Mixed method – quantitative survey, qualitative interviews & focus groups	No	Organisational studies	Multiple NZ industries	D: Managerial values and beliefs C: Cost, management time, knowledge & skills

Table 5. Summary of key construction management studies examining firm-greening

Authors	Research focus	Research Approach	Hypothesis testing	Context	Drivers (D) or challenge (C) identified
(Kein et al. 1999)	Investigation into awareness and practice of ISO14001.	Questionnaire survey	No	Single country/industry: Singapore, construction	D: Avoid regulatory non-compliance C: lack of government support, high cost of implementation, lack of understanding, lack of tangible benefits, difficulty in assessing environmental costs, lack of client requirements
(Ofori et al. 2000)	Investigation into awareness, drivers and challenges to ISO14001	Questionnaire survey	Yes	Single country/industry: Singapore, construction	D: potential savings (reduce waste & avoid regulatory fines), protect environment, enhance public image, improve health & safety. C: cost-benefit concerns
(Tse 2001)	Barriers to EMS adoption	Questionnaire survey	No	Single country and industry: Hong Kong, construction	C: lack of government pressure & client requirement/supports; expensive implementation cost; and incompatible sub-contracting systems.
(Shen and Tam 2002)	Identification of benefits and barriers to environmental management systems	Mixed method: questionnaire survey, individual interviews	No	Single country/industry: Hong Kong, construction	D: Contribution to environmental protection, reduction of environmental risk, improving environmental image and cost saving due to the reduction of environment-related convictions C: Increasing management cost, lack of trained staff and expertise, lack of sub-contractor cooperation, lack of client support, time-consuming.
(Adetunji et al. 2003)	Examination of sustainability practices in construction sector	Questionnaire survey	Yes	Single country/industry: United Kingdom, construction	D: Government & regulation, competitive edge, enhanced reputation, client's procurement policy, enhancing relationship with suppliers, enhancing shareholder value, long-term survival C: Industry culture fragmented, short term focus conservatism of industry, rigid specification
(Zeng et al. 2003)	Examining motivations and obstacles of ISO14001 adoption	Questionnaire survey	No	Single country/industry: China construction sector	D: Entry to international construction market C: Cost, lack of regulations, increased paperwork, distinct unique nature of construction activities.
(Christini et al. 2004)	Examining firm use of EMS to collection information to inform decision-making	Mixed method: case study method, questionnaire survey	No	Single country/firm: USA, Beers Skanska construction firm	D: competitive advantage, fulfil environmental policy
(Faith-Ell 2005)	Examining introduction of environmental requirements for trucks and construction vehicles	Mixed method: case study, observations, questionnaire survey	No	Single country: Sweden; Single industry: road construction sector	D: Vehicles reached end of life, client's future tender penalties C: Tender criteria based on cost, environmental training not comprehensive enough
(Tam 2009)	Examination motivations and challenges to concrete recycling.	Mixed method: questionnaire survey, individual structured interviews	No	Multiple countries: Japan, Australia. Single industry: construction	D: Requirement by law, prescribed in contracts C: High cost of recycled materials, difficult to place recycling machines on-site, limited applications for recycled concrete, lack of regulatory requirements & specification, insufficient investment in recycling research, lack of client & government support.
(Qi et al. 2010)	Investigation drivers of greening in construction	Statistical analysis of questionnaire survey	Yes	Single country/industry: China, construction	D: Managerial concern, government regulatory pressure Influencing factors: business size (access/ development of capabilities)

Authors	Research focus	Research Approach	Hypothesis testing	Context	Drivers (D) or challenge (C) identified
(Sakr et al. 2010)	Examining awareness and obstacles to ISO14001 adoption.	Questionnaire survey	No	Single country/industry: Egypt, construction	D: Potential to improve competitiveness, entry into markets C: Increased costs, changing traditional practices, non-awareness and resistance of company's employees, resistance of suppliers, and lack of adequate awareness.
(Tam et al. 2010)	Examining concrete recycling	Mixed method: questionnaire survey, individual structured interviews		Multiple countries: Japan, Australia, Hong Kong Single industry: construction	D: Competitiveness C: Lack of clients' support, 'increase in management cost, increase in documentation workload

Green Public Procurement

While no specific definition has been established, procurement has generally been referred to as the acquisition of products and services. Procurement was originally considered primarily as clerical and tactical tasks, however, Kraljic (1983) in his seminal paper on purchasing redefined it in terms of a highly strategic organisational activity. Purchasing activities became viewed as something more than an isolated activity of the overall firm, and instead more as a core aspect of organisational strategy (Kraljic 1983). Within the context of the public sector, procurement is viewed as one instrument by which the government can address public policy and objectives (Coggburn and Rahm 2005; Marron 2003; McCrudden 2004). As such, procurement has already been used to address social issues such as racial inequality in the U.S. and human rights internationally (McCrudden 2004). However, Thai (2001), a Professor of Public Administration, has noted that the study of public procurement is itself a neglected area of study.

Public procurement is considered as one of the four major economic functions of governments (Stiglitz 2000). While private sector procurement serves the interests of the shareholders, public procurement is designed to serve the interests of the public at large. Procurement is concerned with a range of criteria that need to be addressed, such as cost, quality, past performance of the supplier, which can also be understood as value for money. According to the New Zealand Transport Agency (NZTA 2009, p. 1-11), value for money *refers to achieving desired land transport outcomes and quality at the lowest overall whole-of-life cost*. The environment has now become another criterion which purchasing has to consider as part of the value for money equation. Carlsson and Waara (2001, p. 240) highlight that procurement that takes the environment into consideration has been referred to in several different terms such as “*eco-procurement (Erdmenger 2003), environmentally preferable purchasing (Coggburn and Rahm 2005), environmental public procurement (European Commission 2004), greener public purchasing (Marron 2003), green procurement, and sustainable procurement, addressing both environmental and social issues (McCrudden 2004)*).

The private sector has been addressing environmental issues through green (or sustainable) supply chain management by taking into consideration environmental issues during the product or service life-cycle (Lippman 2001). Green purchasing is an important component of the greening of a supply chain. It has been implemented in practice internationally, and has also been extensively studied from various perspectives (Srivastava 2007). However, the

supply chain management literature's focus on green purchasing tends to focus on the private sector and not in terms of public sector procurement.

Over the past 12 years, the environment has become another criterion which public procurement practitioners have been called on to address through procurement practice (Preuss 2009). The practice of green public procurement (GPP) refers specifically to the integration of environmental criteria in procurement, whereas sustainable public procurement (SPP) is broader in that it covers both environmental and social criteria (Preuss 2009; Walker and Brammer 2009). GPP is an emerging phenomena, such that research on GPP is still in its nascent stages (Preuss 2009). This section of the thesis examines the existing state of knowledge on green public procurement (GPP). In addition, due to the insights and relevance to understanding GPP, the literature review also examines findings from studies on sustainable public procurement (SPP).

Current Practice

The academic literature on GPP is not extensive, however, empirical studies show that public agencies internationally are becoming more aware of the concept of green procurement e.g. United Kingdom (Preuss 2007; 2009; Sourani and Sohail 2011; Thomson and Jackson 2007; Walker and Brammer 2009; Warner and Ryall 2001), European Union (Bouwer et al. 2005), Norway (Dolva 2007; Michelsen and de Boer 2009), Sweden (Carlsson and Waara 2001), and internationally (Brammer and Walker 2011). The studies also show that while the public sector is familiar with GPP, its implementation is still patchy for a range of reasons which will be discussed in the following section. Many of the empirical studies of GPP are framed in terms of the procurement of products rather than service e.g. paper and stationary, IT and electrical equipment, textiles, vehicles, office furniture, energy, telecommunications, and catering.

Many of the studies adopt a broad scope to their enquiry into GPP by examining local authorities as a whole, rather than focussing on a specific departmental unit. A few exceptions exist, in which procurement studies provide insights into construction procurement, for example, in Greece (Manoliadis and Tsolas 2006), Sweden (Carlsson and Waara 2001; Faith-Ell 2005; Varnas et al. 2009), and the United Kingdom (Preuss 2007; 2009; Sourani and Sohail 2011).

Green public procurement is important in the construction sector because the public sector is the main client for the construction sector. However, a review of the literature shows that

public sector managers are experiencing difficulties in translating GPP from policy into practice. This is examined further in the next section.

Challenges to Green Public Procurement

The literature examining GPP and SPP point to a range of significant challenges that the public sector faces in terms of integrating environmental criteria in procurement. The challenges identified refer to issues such as fiscal constraint, management commitment, knowledge and expertise, and the buyer-supplier relationship. The following section examines these challenges in turn. See Table 6 (page 67) for a summary of the key aspects of GPP and SPP studies.

Fiscal Constraint

Procurement managers have indicated that they seek to include environmental criteria in tender specifications because this can result in cost savings for the public authority (Varnas et al. 2009). The consideration of environmental issues over the lifecycle of a product can result in an overall decrease in the costs associated with the purchase and maintenance of that product (Varnas et al. 2009). However, while environmental considerations could reduce the lifecycle costs to a client, the predominant concern raised by procurement managers was that green products and services are more costly, and the payback period is long (Coggburn and Rahm 2005). This means that in order for the client to benefit from purchasing environmentally friendlier products and services, the client may have to consider a much longer timeframe as part of the cost-benefit analysis. This may represent a challenge where decisions are made on much shorter time-frames (e.g. traditionally 5 years, or 20 years for procurement of large assets). This perception that more environmentally sustainable products and services are more costly has been repeatedly identified in the various research studies of both GPP and SPP (e.g. Brammer and Walker 2011; Carlsson and Waara 2001; Dolva 2007; Thomson and Jackson 2007; Walker and Brammer 2009; Warner and Ryall 2001). Fischer (2010), however, points out that the cost of green products and services can be real, merely perceived by managers, or hidden at the outset. This suggests that there is a scarcity of environmental information about alternative products and services.

Procurement managers have indicated that they are unlikely to be willing to pay a premium for environmentally (or socially) better performing products and services over conventional

or traditional ones (Carlsson and Waara 2001; Preuss 2007; 2009). This supports the firm-greening literature which highlighted that firm managers perceive their clients as unwilling to pay a premium for products and services that were more environmentally sustainable.

Research from the Swedish construction sector showed that both public and private clients would limit their requirements for environmental outcomes if they feared that it would increase project costs (Varnas et al. 2009). The reason for this is that public authorities operate in fiscally constrained contexts in which additional costs are difficult to justify if they are not a priority (Brammer and Walker 2011; Walker and Brammer 2009). Yeow et al. (2011) also highlighted that silo budgeting was an issue in procurement practice. While different departments within a single authority are allocated and accountable for a slice of the fiscal pie, benefits may transcend departmental boundaries. Thus, procuring environmentally more expensive outcomes may be difficult to justify when the financial analyses is framed in terms of a single department.

In their study of the United Kingdom construction sector, Sourani and Sohail (2011) were able to show that public authorities are constrained by both their budgets as well as by the rules governing how those funds are to be spent. Public authorities were held accountable and restricted in their spending decisions by financial auditors and central government i.e. the U.K. Treasury Department (Sourani and Sohail 2011). In addition, their study highlighted that policies and regulations could be insufficient to drive SPP, and also contradictory to sustainable procurement (Sourani and Sohail 2011). Public authorities face competing pressures to reduce spending, while also expected to integrate sustainability considerations into procurement (which are potentially more expensive) (Sourani and Sohail 2011). Managers felt that the integration of sustainability considerations in procurement would lead to greater spending which was a source of tension given the expectation to keep costs down (Sourani and Sohail 2011).

A number of studies have shown that public authorities may engage in GPP only to find that the cost-increases create financial difficulties which they need to address. For example, Dolva's (2007) found that a Norwegian public authority had for one year considered environmental criteria by which potential suppliers were evaluated (Dolva 2007). For example, 30% of the evaluation is focussed on non-price criteria such as quality and experience, while the remaining 70% is dominated by price. In this case, the changes they made led them to procure a product which met the environmental criteria but which was more costly (Dolva 2007). In the following year, the authority reversed their approach and choose to completely exclude environmental criteria from the tender specifications (Dolva 2007). In

another example, Norwegian public authorities (driven by the requirements of the Public Procurement Act) put out a request for suppliers to provide environmental information as part of their bids (Michelsen and de Boer 2009). However, in the end this environmental information did not influence the selection process (Michelsen and de Boer 2009). In another study, Preuss (2007) found that attempts to procure environmentally friendlier energy sources proved to be more expensive for an English public authority. This led them to question whether, and where, to reduce spending on social services in order to purchase greener energy (Preuss 2007). Thus, while environmental criteria may be included in the cost-benefit analysis, the weighting assigned to the environmental criteria may be secondary to other outcomes sought such as quality, functionality, and cost (Dolva 2007; Walker and Brammer 2009). In contexts where environmental sustainability procurement directives are merely voluntary, the environment can become particularly difficult to address when other outcomes (such as price) continue to be prioritised (Brammer and Walker 2011).

Influence of Management

Studies have identified managers as important influencing factors on the institutionalisation of GPP (and SPP) in public authorities. Procurement managers have frequently indicated that they experience a lack of support for considering environmental criteria in procurement. Lack of support can manifest itself in a variety of ways such as lack of employee commitment (Warner and Ryall 2001), lack of senior management or political support (Dolva 2007; Thomson and Jackson 2007), lack of leadership/environmental champion of GPP (Carlsson and Waara 2001), as well as cognitive difficulties when dealing with procurement and associated challenges (Preuss and Walker 2011).

There is a perception among procurement managers that the consideration of environmental criteria in procurement requires leadership to drive the practice of GPP (Carlsson and Waara 2001). They suggest that there is a need for pressure and support, such as a GPP champion, within the organisation in order to encourage procurement officers to consider the environment as part of procurement practice (Carlsson and Waara 2001). An enthusiastic and self-motivated manager can therefore make a difference. In their study of a U.K. government department Yeow et al. (2011) found that the procurement manager was actively engaged in collaborating with the supplier to develop innovative solutions.

Top management commitment to sustainable procurement was identified as important for local authorities in the U.K. (Walker and Brammer 2009), and the Australian construction

sector (Miller et al. 2009). Brammer and Walker (2011) note the importance of senior managers in that they provide legitimacy for procurement officers to pursue sustainability in procurement. The literature suggest that support could be in terms of top-down commitment (Brammer and Walker 2011; Walker and Brammer 2009), as well as political pressure and support (Dolva 2007). Preuss and Walker (2011) suggest that it is important to provide senior management with training in terms of commitment and knowledge around green procurement.

Knowledge & Expertise

Jennings and Zandbergen (1995) point out that the challenge to institutionalising sustainability in practice can come about when managers lack skills, training, and knowledge. However, the literature shows that the challenge to GPP manifests itself in multiple ways, such as a lack of awareness, understanding or misperceptions of GPP, how to apply GPP, gaps in understanding about environmental impacts among procurement practitioners, and a lack of information about the benefits from environmentally friendlier products and services (Brammer and Walker 2011; Dolva 2007; Fischer 2010; Michelsen and de Boer 2009; Preuss and Walker 2011; Thomson and Jackson 2007; Varnas et al. 2009; Walker and Brammer 2009). Similar findings were reported from a study of the U.K. construction sector, which identified a low level of understanding of sustainable procurement among both senior procurement managers in public authorities as well as within contracting firms, funding agencies and other users (Sourani and Sohail 2011). Walker and Brammer (2009) point out that GPP is still very much an emerging concept for which not a lot of information is available, and for which the benefits of engagement are not clear.

In terms of addressing GPP in practice, Warner and Ryall (2001, p. 42) note that the most important part of GPP is contract specification, as this is the stage where “*all relevant environmental considerations are explicitly spelled out at the outset*”. However, procurement managers in public authorities appear to struggle in this regard because they lack the product specific knowledge required to construct appropriate environmental criteria. Procurement managers are faced with the difficult task of determining how to formulate and integrate environmental preferences into tender documents in a legitimate manner (Carlsson and Waara 2001; Dolva 2007; Varnas et al. 2009). Dolva (2007) found that not only did procurement managers in her study not feel confident about how best to specify environmental requirements, they were also unsure about how to effectively evaluate tenders

for environmental issues. Varnas et al. (2009) proposes that environmental preferences have to be stated in a manner that is specific, measurable, and verifiable in order to be meaningful. In their study, Carlsson and Waara (2001) discovered that procurement managers found it difficult to assess whether a product or service was more environmentally friendly over others. In order to resolve these problems, procurement managers would pursue a simple criterion which is easy to evaluate. For example, procurement manager would examine whether a supplier had an environmental management system or not – this would be the basis of the evaluation (Carlsson and Waara 2001).

Procurement managers were also concerned that prescribing environmental performance requirements which suppliers were unable to fulfil would lead potential suppliers to drop out of the tendering process (Brammer and Walker 2011; Dolva 2007; Walker and Brammer 2009). This may be an issue in contexts where the technology is still rapidly changing (Fischer 2010), or in contexts where substitute products are not readily available (Walker and Brammer 2009). Over time, suppliers can become environmentally certified in increasing numbers, thus providing a solution to this particular problem. For example, English public authorities were requiring timber suppliers and products to be certified with the newly introduced Forest Stewardship Council standard (Preuss 2007; 2009). However, when the standard was first introduced, few suppliers or products were certified with the standard (Preuss 2007). This changed with time as more suppliers and products were certified with the standard, making it easier to adhere to the procurement policy (Preuss 2007).

Procurement managers are also concerned with the legality of introducing environmental criteria in tender documents as this may eliminate certain firms, and/or result in protests from unsuccessful bidders on account of lack of fairness (Carlsson and Waara 2001; Thomson and Jackson 2007; Varnas et al. 2009). Thus concerns over the legality may cause some clients to limit their environmental criteria in tenders (Varnas et al. 2009). This issue has been tested in the courts where examination of the use of environmental criteria by the City of Helsinki in the procurement of fleet of buses was used (Kunzlik 2003). The public authority had adopted a “*system of awarding points to tenderers whose bus fleets met specified nitrous oxide emissions and noise levels*” (Kunzlik 2003, p. 195). The issue centred on the interpretation of the directive for the public sectors’ procurement procedures, that is, whether it was appropriate for the public agency to specify environmental criteria as part of the tender. The court ruled in favour of the public authority on the basis of its interpretation of the procurement directives and contract requirements, and on the basis that this did not threaten the need for a non-discriminatory and transparent procurement regime (Kunzlik 2003).

Information & Guidance

The lack of knowledge and expertise in undertaking GPP means that there is a significant demand for information and guidance on GPP from procurement managers. In their study of Norwegian public procurement Michelsen and de Boer (2009) found that 70% of the municipalities surveyed felt that they needed guidance from national authorities because GPP was seen as being very complex. In addition, Thomson and Jackson (2007) reported that a lack of information about the cost-benefit of green products was a barrier to green procurement. They note that arguments for the use of greener products and services can be more easily made if the benefits are measurable and identifiable (Thomson and Jackson 2007).

A lack of information, and incomplete or imperfect environmental information are also a barrier to the practice of GPP (Fischer 2010; Warner and Ryall 2001). Procurement managers also experience conflicting rules, priorities, regulations, and standards creating confusion about how to address GPP in practice (Fischer 2010; Walker and Brammer 2009; Warner and Ryall 2001). Researchers have therefore suggested that there is a need to establish standards, develop a checklist of approved green products and services, provide structure guidance/demonstrations and best practice as a means of supporting the public sectors' pursuit of GPP (Bouwer et al. 2005; Dolva 2007; Geng and Doberstein 2008; Michelsen and de Boer 2009; Preuss 2007; Preuss and Walker 2011; Sourani and Sohail 2011). Dolva (2007), for example, suggested the use of environmental labels as a means of providing buyers with environmental information that can be easily compared and understood.

Other Challenges

Buyer-Supplier Relationship:

The buyer-supplier relationship has tended to be adversarial due to the buyers focus on purchasing goods and services at the lowest possible price (Yeow et al. 2011). In their study, Yeow et al. (2011) found that developing a good working relationship between the buyer and supplier was key to enabling innovations to emerge. Positive relationships reduced uncertainty and increased trust allowing both parties to engage in a discussion about how to best meet the client's objectives (Yeow et al. 2011). In the context of the construction sector, design and build contracts are a means for providing contractors with more opportunities to contribute to the decision-making process (Varnas et al. 2009).

Risk Averseness

Carlsson and Waara (2001) found that Swedish procurement managers identified the Swedish Environmental Code 1998 as limiting the procurement of environmentally friendly technologies due to risk-averseness on the part of the managers. The Environmental Code of 1998 regulates how environmental issues are addressed in practice e.g. which building materials are allowed to be used. The Environmental Code and liability concerns combine to create a context in which it is easier for procurement managers to continue with the status-quo rather than procuring alternative technologies (Carlsson and Waara 2001).

Time-consuming

Procurement managers face a range of work pressures to achieve the objectives of the organisation. For a manager to becoming knowledgeable and familiar with GPP may take time. Also the process of formulating environmental criteria for inclusion in tenders represents additional work on an already overworked manager (Dolva 2007; Varnas et al. 2009).

Table 6. Summary of key GPP and SPP studies

Authors	Research focus	Research Approach	Hypothesis testing	Research domain	Context	Challenges identified
(Carlsson and Waara 2001)	Examining environmental public procurement	Qualitative: Interviews	No	Procurement & Law	Single country: Public sector Sweden	Swedish environmental code leads to risk averse behaviour. Cost - not willing to pay price premium. Lack of information about environmental benefit, Difficulties in determining environmental procurement criteria, legal concerns.
(Warner and Ryall 2001)	Examination of GPP	Survey questionnaire	No	Interdisciplinary research	Single sector: Local government England and Wales	Cost of green products, lack of national guidance.
(Dolva 2007)	Examination of GPP	Mixed method: document analysis & interview method	No	Interdisciplinary research	Single country: Norway	Lack of knowledge, focus on economic considerations & product functionality, lack of support & management focus, work pressure
(Preuss 2007)	Examining the range of sustainability initiatives undertaken through public procurement	Exploratory approach – case study method	No	Management research	Single sector – Local government England	Lack of a strategic approach to sustainability, financial constraints & cost of sustainability initiatives.
(Thomson and Jackson 2007)	Examination of SPP	Mixed method – survey questionnaire, qualitative interviews	No	Interdisciplinary research	Single industry – Local government England	Lack of priority at senior level, cost & insufficient cost/benefit data and guidance, concerns over legality.
(Michelsen and de Boer 2009)	Examination of GPP	Mixed method – semi-structured interviews, survey questionnaire	No	Industrial research	Single industry – Norway public sector and suppliers	Lack of environmental awareness and limited knowledge in public agencies.
(Preuss 2009)	Examination of SPP	Exploratory approach - case study research – semi-structured interviews	No	Management research	Single sector – Local government England	Better understanding of sustainable supply chain management is required.
(Varnas et al. 2009)	Environmental consideration in Swedish procurement of construction services	Mixed method – survey, qualitative interviews	No	Construction management	Single industry – Clients in Swedish construction sector	Concerns over cost of sustainability initiatives, time consuming, concerns of legality, lack of knowledge & ability to formulate environmental preference is difficult
(Walker and Brammer 2009)	Examination of SPP	Quantitative & qualitative survey	No	Management research	Single sector – UK public sector	Cost, budget limitations, lack of substitute products, lack of awareness, emerging phenomena with little information on measurable benefits, decentralised purchasing, conflicting priorities
(Fischer 2010)	Examination of GPP	Desktop study	No	Public Administration	Single country: Public sector United States	Incomplete & imperfect information, lack of common standards, real/perceived & hidden costs, market and technical uncertainties
(Brammer and	Examination of SPP	Mixed method:	No	Management	International study: 280	Financial constraints, lack of managerial support, lack of

Authors	Research focus	Research Approach	Hypothesis testing	Research domain	Context	Challenges identified
Walker 2011)		Questionnaire survey method, statistical analyses		research	procurement officers from 20 countries	knowledge
(Preuss and Walker 2011)	Examination of psychological barriers to sustainable public procurement	Qualitative research method – group and individual interviews	No	Management research	Single sector – Local government England	Psychological barriers
(Sourani and Sohail 2011)	Barriers to addressing sustainable construction in public procurement	Mixed method - Delphi exercise, open-ended interviews, questionnaire survey and case studies	No	Construction management research	Single industry – UK construction sector (both professional organisations and public agencies)	Lack of funding, restrictions on expenditure and reluctance to incur higher capital cost when needed. Lack of awareness, understanding, information, commitment and demand. See paper for more.

Theoretical Models

This section of the literature will summarise conceptual models that have been developed for firm-greening and SPP. Five models of firm-greening will be examined, while one model of SPP will be examined. No models for GPP were identified through an extensive literature review.

Theoretical Models of Firm-greening

Construction management literature has tended to focus on providing substantive insights into firm-greening. Only one model of greening has been developed for the construction sector (see Qi et al. 2010). The remaining conceptual models of firm-greening were developed by organisational scholars (see Bansal and Roth 2000; Lynes and Andrachuk 2008; Mair and Jago 2010; Marshall et al. 2005).

The Bansal and Roth (2000) model differs from the other firm-greening models in that it was inductively and theoretically generated based on Japanese and U.K. firms across different sectors. The other models were theoretically developed and tested in a number of industry and firm contexts: the U.S. wine sector (Marshall et al. 2005), Scandinavian Airlines (Lynes and Andrachuk 2008), Australian business events tourism sector (Mair and Jago 2010), and the Chinese construction sector (Qi et al. 2010).

The following section will begin by summarising the organisational firm-greening models in chronological order, followed by a summary of Qi et al., (2010) model for the construction industry. A summary table of the different conceptual models of firm-greening can be found in Chapter 4 (Table 23, page 126).

Bansal and Roth (2000)

Bansal and Roth's (2000) model of firm-greening was derived through theory, and inductively through in-depth interviews with managers across a variety of industry sectors in Japan and the U.K. The model is composed of two key categories: context and firm motivations (see Figure 2). The model identifies contextual dimensions which influence the firm's motivations which determines the respective ecological initiatives that the firm is likely to adopt.

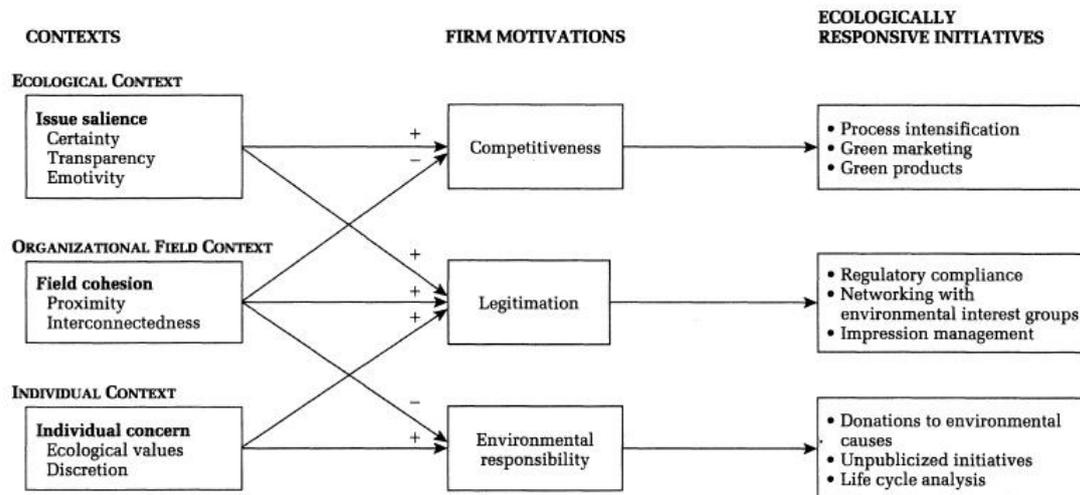


Figure 2. Bansal and Roth's (2000) generic conceptual model of firm-greening

Starting with the firm motivations, the model indicates that firms may choose to pursue green initiatives as a way to gain competitiveness, legitimacy, or environmental responsibility. The adoption of environmental initiatives because of competitiveness refers to decisions that are motivated by the search for improved long-term profitability. Here, the decision is made on a financial cost-benefit basis. The adoption of environmental initiatives for legitimacy is predominantly associated with the firm's desire to ensure the appropriateness of the firm's actions with regulations, norms, values, or beliefs (Bansal and Roth 2000; Suchman 1995, p. 726). This motivation is primarily concerned with avoiding non-compliance with stakeholders. The last motivation is environmental responsibility, which is the pursuit of environmental initiatives because they align with managers' values in terms of ecological responsibility.

Contexts of issue salience, field cohesion, and individual concern influence the above mentioned motivations. Where environmental issues are viewed as salient, this meant that the issue and the impact of the firm on the environment was easily understandable, compelling firm decision makers to act to address the issue (Bansal and Roth 2000). Environmental issues that were identified as salient were characterised, for example, by being proven, quantified, or easily costed.

Field cohesion is the second contextual factors which is defined as the *"intensity and density of formal and informal network ties between constituents in an organizational field"* (Bansal and Roth 2000, p. 730). The inclusion of field cohesion is an acknowledge of the importance of institutional theory for understanding firm behaviour (DiMaggio and Powell 1991). Here, Bansal and Roth's (2000) model implies that firms do not operate in isolation, but rather exist

in an organisational field context which can vary between being cohesive (a high degree of connectedness between stakeholders and hence the degree of scrutiny the firm faces) versus less cohesive contexts (Bansal and Roth 2000).

The third contextual condition is the individuals' concern for the environment, as well as the degree of discretion to pursue ecological initiatives. Here, managerial values for the environment are seen as an influencing factor on the decision to ecological initiatives. It acknowledges the importance of the bounded rationality of the human condition, the importance of personal values and experiences to firm decision-making (March and Simon 1958), and the limited time and attention experienced by firm managers (Dutton and Ashford 1993).

Marshall et al. (2005)

Marshall et al. (2005) developed a conceptual model of the drivers of proactive environmental behaviour (see Figure 3). This model was theoretically derived and tested in the U.S. wine sector. The model is composed of individual drivers (managerial attitudes/values, subjective norms) and external institutional drivers (local community groups, market differentiation, and regulations). These internal and external drivers exert pressure on firms which drives their proactive environmental behaviour.

The Marshall et al. (2005) model was developed with reference to concepts from institutional theory. These include such concepts such as organisational fields, institutional forces, the development of consensus around meanings of emerging issues, and the pursuit of legitimacy by firms (DiMaggio and Powell 1991; Hoffman 2001; Jennings and Zandbergen 1995; Scott 1995; Zucker 1983). Their model recognises that firms operate within an organisational field which is defined as *'a community of organizations that partakes in a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field'* (Scott 1995, p. 56). This organisational field is composed of constituents that share common issues, rather than common technologies or industry sectors. The constituents within the organisational field determine the range of legitimate actions that a particular firm can pursue. Institutional forces are not static rather they emerge and evolve thereby altering the range of legitimate actions that a firm may pursue.

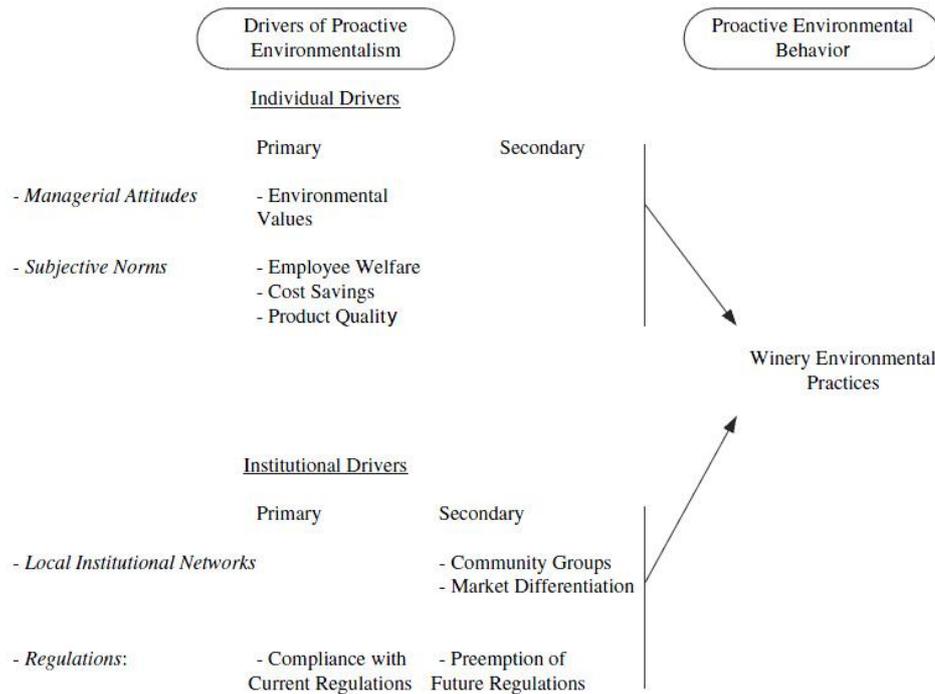


Figure 3. Marshall et al., (2005) Conceptual Model of Firm-greening in the Wine Sector

The Marshall et al. (2005) model was also developed with reference to the theory of reasoned action. The theory of reasoned action focusses attention on the influence of managerial attitudes and subjective norms on firm strategic choice (Ajzen and Fishbein 1980). In this way, the model by Marshall et al (2005) follows in the footsteps of Bansal and Roth (2000) by also highlight the importance of the individual manager’s attitudes and values with respect to firm adoption of environmental initiatives.

Their model proposes that firms will engage in proactive environmental practices due to the presence of individual and institutional drivers. Their study found that the relevance and importance of drivers varied, in that a manager’s environmental attitude was a key individual driver of proactive firm behaviour. They also identified that existing regulations were key institutional drivers for proactive firm behaviour compared with attempts to pre-empt future regulations (Marshall et al. 2005). Marshall et al. (2005) suggested that this could be explained with reference to the broader context in that the U.S. wine industry was at that time in the early stages of an environmental movement.

Lynes and Andrachuk (2008)

Lynes and Andrachuk (2008) developed a conceptual model for corporate social and environmental responsibility (CSER) which they examined in the context of a single firm, namely Scandinavian Airlines. They derived the conceptual model with reference to the literature on firm-greening. There are four parts to the model, which are the four systems of influence, motivations, catalysts, and level of commitment.

The system of influence refers to the contexts (market, political-institutional, scientific, and social systems) in which firms exist (Lynes and Andrachuk 2008). For example, by describing the market system, the analyst can begin to understand the nature of the market in which the firm operates. This may include such aspects as the nature of the price mechanisms that operate in the particular sector.

The model identifies firm motivations for environmental and social responsibility (Lynes and Andrachuk 2008). They identify a range of motivations that the firm would seek by pursuing CSER, such as a long-term financial strategy, eco-efficiency, competitive advantage, good Corporate Citizenship, image enhancement, stakeholder pressure, or a desire to avoid or delay regulatory action (Lynes and Andrachuk 2008). The motivations identified here have also been identified in Bansal and Roth's (2000) model of firm-greening. However, Bansal and Roth (2000) combined these types of motivations to develop their three higher level categories of motivations (i.e. competitiveness, legitimation, Corporate Citizenship), each of which is associated with a dominant stakeholder (e.g. customer, government, society/community).

Catalysts are the third component of the Lynes and Andrachuk (2008) model of CSER. They define the catalyst as helping *"shape influences by acting as a medium for encouraging/discouraging corporate social and environmental responsibility"* (Lynes and Andrachuk 2008, p. 380). Mair and Jago (2010) note that the catalyst is similar to Bansal and Roth's (2000) *issue salience* in that its decisions to pursue actions are determined by the degree to which an environmental issue is perceived. The fourth component of the model identifies the level of commitment that the firm undertakes (Lynes and Andrachuk 2008). This refers to the specific course of action, and level of involvement in various environmental (and social) initiatives that the firm chooses to pursue in reality.

Their application of the model to Scandinavian Airlines found that the catalyst had an important influence on the airline's level of commitment to CSER. They found that employees and executive managers stressed the Scandinavian culture towards the

environment (and social responsibility) as an important influence on the firm's engagement with CSER. The study found that environmental champions within the firm were another important catalyst for the firm's engagement with CSER.

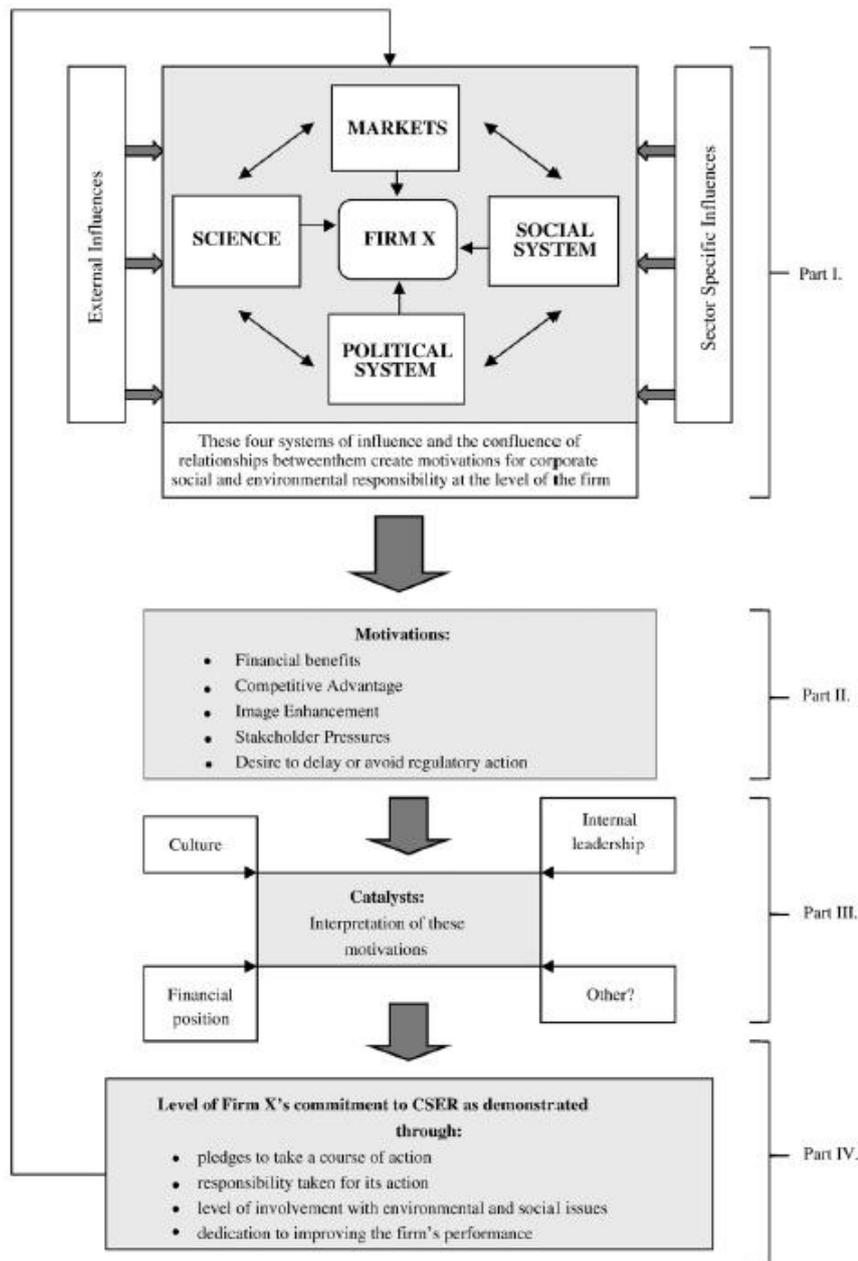


Figure 4. Lynes and Andrachuk's (2008) Conceptual Model of Corporate Social and Environmental Responsibility (CSER)

Mair and Jago (2010)

Mair and Jago (2010) developed a conceptual model of firm-greening for the business events tourism sector which they examined in the context of Australian firms (see Figure 5). They developed a preliminary conceptual model with reference to the literature on firm-greening, and subsequently tested and refined the model based on the empirical insights.

Mair and Jago (2010) identified that existing firm-greening models had not included barriers to firm-greening. This was attributed to the fact that most organisational researchers were focussed on identifying the drivers or motivations for firm-greening (Mair and Jago 2010). Their model is composed of four elements which are context, drivers, barriers, and catalysts (Mair and Jago 2010).

In terms of the context, the model distinguishes between the organisational context of the firm (e.g. size, sector), and the external context (e.g. economic situation, consumer trends) of the firm (Mair and Jago 2010). Drivers of firm-greening are categorised in terms of internal and external drivers. Internal drivers are referred to as internal pressures on the firm to pursue greening, for example, to pursue financial benefits or due to the presence of an internal CSR policy (Mair and Jago 2010). External driver are those pressures that originate externally from the firm, and include regulation, competitive advantage, image enhancement, stakeholder pressure, supply chain/customer Corporate Social Responsibility policies (Mair and Jago 2010). Barriers to firm-greening include such aspects as lack of time/resources/knowledge/awareness and skills, and operational timeframe (Mair and Jago 2010). Their model includes a catalyst for action, which is conceptually similar to the catalyst in Lynes and Andrachuk's (2008) model, and issue salience in Bansal and Roth's (2000). They identify three types of catalysts which is the media, culture, and a firm eco-champion (Mair and Jago 2010).

Applying the model to the Australian business events tourism sector led them to make a number of findings with respect to the relative importance of various factors in the model. They found that firm-greening in this sector was strongly driven managerial/personal values (Mair and Jago 2010). Customer CSR policies were an important external drivers on the firms to pursue greening (Mair and Jago 2010). Gaining a competitive advantage was also identified as important external driver, although the authors acknowledged a contradiction given that their participants also indicated that there was less of a demand of green products and services than assumed (Mair and Jago 2010). Firms were also motivated by two additional external drivers which were firm image manipulation and demands for a basic level of service, which in this context was referred to as the hygiene factor (Mair and Jago

2010). Their study identified two primary barriers to firm greening, which were lack of regulations for greening, and limited time and resources (Mair and Jago 2010). With respect to the catalyst, their study found that the media's role in emphasising climate change and related sustainability issues was an important factor in instigating the pursuit of firm-greening in this sector (Mair and Jago 2010).

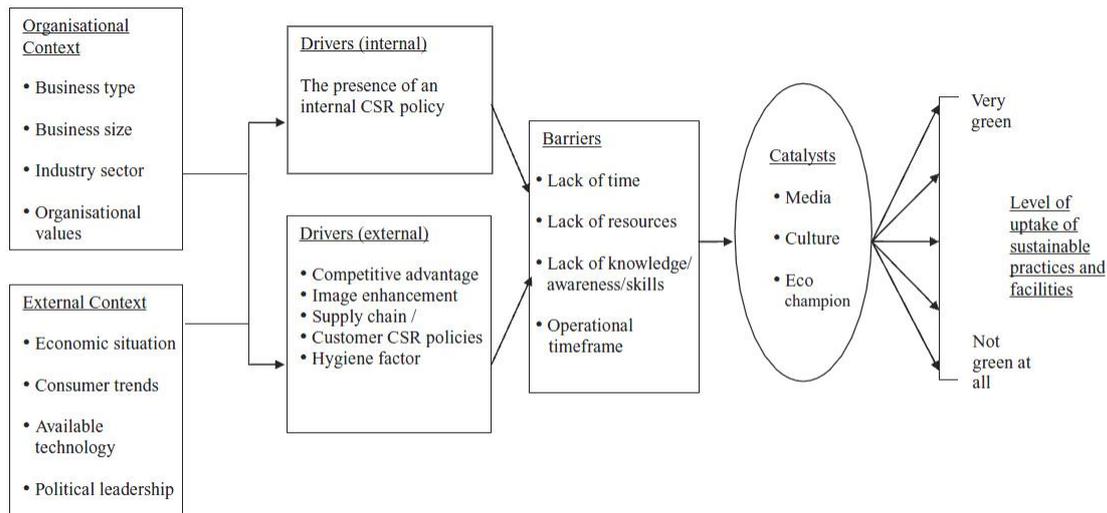


Figure 5. Mair and Jago's (2010) Conceptual Model of Firm-greening in the Business Events Sector

Qi et al. (2010)

A model of greening has recently been developed within the construction management literature (Qi et al. 2010). Unlike the previously described models, this model is much simpler in that it focuses solely on the drivers of green construction innovation in construction firms (Qi et al. 2010). They define green construction practices to encompass such aspects as: (1) improving the efficiency of the construction process, (2) conserving energy, water, and other resources during construction, and (3) minimizing the amount of construction waste (Qi et al. 2010, p. 1359). Their model was theoretically developed with reference to the organisational literature and construction management literature and was subsequently tested in the context of the Chinese construction sector (Qi et al. 2010).

Qi et al. (2010) identify three primary drivers which exert pressures on construction firms to adopt green construction innovation practices, which are environmental regulations, managerial concern, and project stakeholder pressures. Through their review of the literature

the authors identified government environmental regulations as important drivers of firm-greening, which led to its inclusion in their model (for examples see section on Government, p.33). Managerial concern referred to the perception that managers hold of stakeholder pressures, and how those perceptions influence the pursuit of different environmental initiatives (Qi et al. 2010). Project stakeholders refers to the range of other stakeholders that may exert pressure on the firm e.g. clients, community, non-government organisations, and employees (Qi et al. 2010).

By testing their model in the Chinese construction sector, the authors found support for the role of environmental regulations and managerial concern in driving firm-greening in contracting firms. Even though clients are a key stakeholder, their study found that they were not important drivers of firm-greening because they did not require improved environmental performance from the construction firms (Qi et al. 2010).

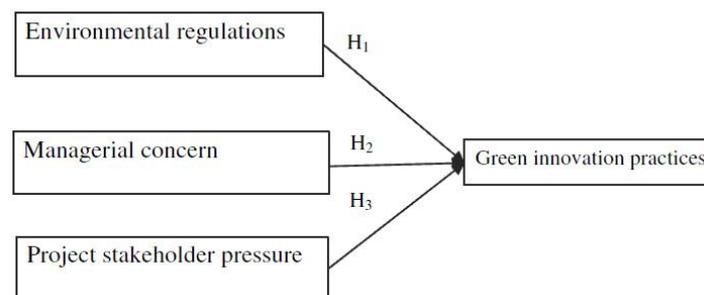


Figure 6. Qi et al. (2010) Conceptual Model of Greening of Construction Firms

Theoretical Model of SPP

While no conceptual model for GPP exists in the literature, a conceptual model for sustainable public procurement (SPP) does exist (Brammer and Walker 2011; Walker and Brammer 2009). The conceptual model for SPP was originally developed with reference to a previous model (Gelderman et al. 2006) and from the theoretical literature. The model is composed of five elements, which include national policy context, perceived costs/benefits of policy, familiarity with policies, supplier availability/resistance, and organisational incentives/pressures (Brammer and Walker 2011).

Gelderman et al. (2006) had developed a model to explain non-compliance to the European Union's tendering directives in procurement practice. Their model was theoretically derived

and tested in the context of the Dutch Ministry of Defence (Gelderman et al. 2006). The model was composed of familiarity with rules, perceived inefficiency, organisational incentives, and supplier resistance to explain compliance and non-compliance with EU tendering rules (Gelderman et al. 2006). Walker and Brammer (2009) drew on this model, and from theoretical insights from stakeholder theory, resource-based theory, and power-dependence perspectives to elaborate on their SPP model. These theories act to highlight the importance of the organisations' relationships with stakeholders, the role of internal organisational factors, as well as the role of the distribution of power on SPP (Walker and Brammer 2009).

The model of SPP begins by considering the national policy context in which the public authority operates (Brammer and Walker 2011; Walker and Brammer 2009). The national policy context provides the public sector agency with the objectives and guidelines to which it needs to adhere (Brammer and Walker 2011). This may include requirements to ensure fairness, competition, value for money, or buy-local in procurement practices by the public sector.

With respect to the four influences on SPP, the model identifies familiarity with policies as one factor which needs to be considered (Brammer and Walker 2011). Managers need to be familiar with the concept of SPP, as well as with specific government policies around SPP in a given context (Brammer and Walker 2011; Walker and Brammer 2009).

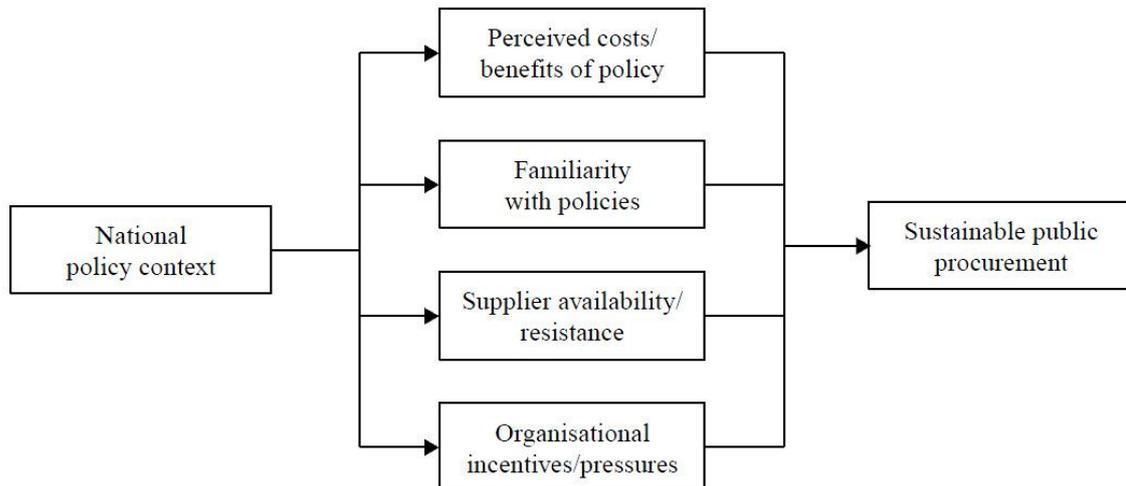
The procurement managers' perceived costs and benefits of the sustainability policy is another influencing factor (Brammer and Walker 2011; Walker and Brammer 2009). Public sector agencies operate in fiscally constrained contexts, in which there exist many pressures on the available budget (Brammer and Walker 2011). Procurement managers are anticipated to pursue SPP where they perceive win-win situations, but not in cases where there are financial uncertainties which affect their ability to derive value for money (Brammer and Walker 2011).

Their model also considers supplier availability/resistance which refers to the availability of more sustainable products and services in the market (Brammer and Walker 2011; Walker and Brammer 2009). They note that some products and services are not easily substitutable, and that some suppliers are not yet sustainably certified leading to challenges from the supply-side.

Organisational incentives and pressures refers to the organisational culture and support for SPP within the public sector agency (Brammer and Walker 2011; Walker and Brammer 2009). Managerial commitment may be necessary in order to pursue SPP, while the existence

of relevant systems and processes may be necessary to internalise SPP into the practices and procedures of the public agency (Brammer and Walker 2011; Walker and Brammer 2009)..

The authors tested their model by surveying procurement managers in 25 different countries. They found that the consideration of environmental outcomes in procurement was low in these cases even though sustainability was an important feature of the national policy contexts in these countries (Brammer and Walker 2011). They found that where the requirement to address sustainable procurement was voluntary, the degree of SPP was low due to competing priorities (Brammer and Walker 2011). Public sector budgetary arrangements were seen as a barrier to SPP, because the benefits accrued over the long-term which was outside the scope of current decision-making timeframes. Managerial leadership was also found to be an important influencing factor on SPP (Brammer and Walker 2011).



Source: Adapted from Gelderman *et al.* (2006)

Source: (Brammer and Walker 2011, p. 456)

Knowledge Gap

The literature review shows that organisational research and construction management literature have examined firm-greening internationally. While both literatures have examined drivers of firm-greening, less attention has been focussed on challenges to firm-greening by the organisational management literature. The literature review also highlights that very few studies have examined firm-greening in the New Zealand context, and that none have been undertaken in the New Zealand road construction industry, and that only one study has been undertaken internationally.

With respect to GPP, the literature review shows that there have been no studies of GPP in the New Zealand context. There have also been no studies of GPP specifically in the context of procuring road-works locally or internationally. Generally, the road construction industry has been included within construction management studies, but has rarely been studied as a sector in its own right in terms of firm-greening and GPP.

The literature review shows that there are five key conceptual models of firm-greening:

- Generic - (Bansal and Roth 2000)
- U.S. wine sector - (Marshall et al. 2005)
- Swedish Airlines - (Lynes and Andrachuk 2008; Lynes and Dredge 2006)
- Australian business events tourism sector - (Mair and Jago 2010)
- China construction sector - (Qi et al. 2010)

None of the models were developed out of research into the road construction industry. While four of the conceptual models are firm or industry specific, only Bansal and Roth's (2000) conceptual model is generic. All of the conceptual models were a priori theoretically derived, which were then empirically tested, and the models refined.

With respect to GPP, a comprehensive search of the literature failed to locate a conceptual model of GPP. However, a review of the literature did find a conceptual model of SPP (Brammer and Walker 2011; Walker and Brammer 2009). This conceptual model was theoretically derived by Walker and Brammer (2009) and subsequently tested within public authorities in the U.K. (Walker and Brammer 2009) and internationally (Brammer and Walker 2011). No models have been developed in the context of the road construction industry.

Chapter 4

Greening of Road Construction Firms in New Zealand

The road construction firms considered in this study pursued a range of initiatives and innovations to improve their environmental performance and reputation (see Table 7), with most firms investigating or adopting one or more initiatives. The research participants were not asked to identify initiatives in accordance with a predefined definition of environmental sustainability, and the interviews took the form of open discussions about what the firm was doing to address environmental sustainability.

Table 7. Environmental sustainability initiatives pursued and adopted by New Zealand road construction firms by 2007

Initiatives	Category	Description
Environmental management system (EMS)	Pollution-control	End-of-pipe environmental control measures to improve environmental management.
ISO14001 Enviromark	Quality control & external accreditation	The systematisation, formalised documentation, and external accreditation of environmental management systems to improve and standardise environmental management.
Sustainable Business Network (SBN) Sustainability Reporting	Public relations	Establish and manage the firm's image as environmentally caring.
Recycled asphalt pavement (RAP) Marginal aggregates Construction & demolition (C&D) recycling Recycling waste oil Energy minimisation initiatives Waste management	Eco-efficiency	Undertaking practices which result in the reduction of resource use, the utilisation of existing waste streams, the utilisation of inferior products, and the reuse of resources.

The interviews with the road construction managers showed that the concept of environmental sustainability was emerging within the road construction industry. Road construction managers expressed an awareness of the growing prominence of environmental sustainability in the context of their firms, their public-sector clients, public/community, and in government policy and legislations (see Table 8, p. 83). This includes:

- The emergence of an environmental sustainability ethos within some firms

- Perception that environmental sustainability was becoming an issue for road-controlling authorities, as well as an awareness of the evolving legislative context for environmental (and social) sustainability, and
- Sensitivity towards public opinion in the communities in which road construction firms operated.

Senior-level managers and the Chief Executive Officers (CEO) interviewed for the research were aware of the evolving legislative context towards environmental and social sustainability in which their firms were operating. During the initial stages of this research project, Roding New Zealand was in the process of developing an industry self-governance approach to health and safety to improve the baseline performance of the industry in that regard. The association was also interested in developing the same self-governance approach for environmental sustainability (Chris Olsen, personal communication).

Road construction managers were beginning to discuss environmental sustainability concepts within their respective firms, and to explore more sustainable construction practices. One manager (#05Aa) noted that his decision to join the firm was also motivated by the commitment the recruiting manager showed to addressing the firm's environmental sustainability performance. That employees are motivated by a prospective firm's environmental commitment has been identified in the literature (e.g. Greening and Turban 2000).

During their interviews participants identified and discussed a range of initiatives which they related to the concept of environmental sustainability (see Table 7). The initiatives include formal voluntary systems and programs such as ISO14001 and Enviromark that have been established to assist firms in their engagement with environmental issues. Firms also pursued initiatives independently from formalised programs that are already available to industry. For example, one firm (Fa) adopted an environmental management system but which was not associated with the formalised ISO14001 standard. Two firms (Hc and Aa) reported on their environmental sustainability performance but were not externally accredited. Only firm Hc made their reports publicly available.

Firms also pursued initiatives that are categorised here as eco-efficiency initiatives. This category of initiatives reflects initiatives that result in the reduction of energy use, the utilisation of existing waste streams (waste oil, C&D materials, asphalt), the utilisation of inferior resource inputs which are plentiful (marginal aggregates), and the management of

waste streams. The reuse of asphalt and the use of C&D and marginal aggregates reflect attempts by road construction firms to use alternative resource inputs into the production process. While some of these approaches to producing products had been established in practice internationally (e.g. Kandhal and Mallick 1997; Symonds et al. 1999), they were relatively new in the New Zealand context and therefore represented new capabilities for these case firms.

The following sections discuss why New Zealand road construction firms were pursuing and adopting environmental sustainability initiatives and the challenges that they were encountering. The discussion is framed by a conceptual model which explains greening within the firm as a strategic response to the firm’s motivating drivers and pressures exerted by the firm’s stakeholders. The response is moderated by a range of factors which influence the firm’s ability to develop new capabilities. The model is inductively derived from the empirical data presented in this chapter and the review of firm greening literature in Chapter 3. The model is presented in Figure 7 (p.123).

Most of the case study firms operated in more than one geographical region. Although all of the firms had established environmental policies, and most had common systems and practices for ensuring compliance with regulatory requirements, none of the firms exhibited a co-ordinated, nation-wide strategy with respect to environmental sustainability. Rather, regional branches autonomously pursued their own bespoke strategies in response to the unique drivers, opportunities, and constraints in their operating contexts. In nearly all cases the branches operated independently, and unless otherwise indicated the term firm refers to the branch level entity.

Table 8. Managerial quotes about the emergence of environmental sustainability

Context	Example Quotes
Firm	#05Aa: I mean, he’s the key reason I took the job, cos when I met with him in March to talk about the job, X said to me you know, we’re doing some good stuff environmentally. On a scale of 1-10 we’re at about 2, and he wanted someone with some passion and skills to take us closer to the ten. So, I thought, if he’s genuine about what he’s saying he’s the kind of guy I want to work for.
	#09Aa: It’s [sustainability] becoming more prevalent, there’s a lot more people talking about. Our environmental manager, and certainly that’s filtering through. We’ve had two or three people [consultants] coming in and talking to us about it. The end goal is to raise the whole profile of this business that we’re in, the asphalt plant and off course sustainability is something we want to promote to a lot of our customers and clients that this is where we’re at, we are using recycled materials, there is a cost benefit for you, and you know, it’s better for everybody.
	#46Gp: We’re doing a brand refresh at the moment and sustainability’s everywhere in there. It is a very, very widely used word and can be used in a lot of areas. I think you’ve got to identify environmental sustainability and personal sustainability. What came through to us loud and clear was that there was no link between the word sustainable and what our guys, because of our culture, what our guys would understand and how they would interpret that. So we actually have to break the word sustainable down into environmentally sustainable, and sustainable health and

Context	Example Quotes
	safety.
Public-sector Clients	<p>#03Aa: There's a lot of changes happening. And Transit finally are being pretty amenable, where they got the message from somewhere within the government, they actually being much more approachable, going along there saying "let's have a look at this whole issue about using marginal aggregates." So, they're allowing glass to be used back into basecourse now, and they're allowing through a process of a different regime of testing to use different types of aggregates. So, it's changing, it is slow but it's changing and I think Transit is starting to see and the government since signals coming through to pay up front for a decent pavement that can be done, that it's there, that you're not mucking around and digging it up in 10 years' time that it's there in 30 years' time.</p> <p>#41Fa: Obviously as these things [environmental sustainability] become more prominent in the public sector you need to be aware of these things because that's part of your, your work and, and if that's, if it's highly prominent out in the public then it affects how your clients perceive and how they evaluate you as a provider. So, it has to be flagged.</p> <p>We're always open to what is happening and very aware of what the perceptions of clients are because that's basically what drives us, so, what is important to our clients is naturally important to us and if its flagged that something is of importance and that we need to be looking at things in a different way or having different processes or getting involved in something else, that's something that we look at because we rely on our clients for work.</p>
Public/Community	<p>#32Ac: Corporate Citizenship has come within the company and it goes back to you know, when I first started. We, they would sponsor local organisations. We'd behave responsibly, keep the, the fleet in good condition and not create a nuisance by our activities. Compliance wise, yes, taking on environmental compliance officers as part of our operation is good because they then can check on it and produce facts because a lot of, when you talk environmentally there's a lot of emotion gets in it, no one wants industry around their house. So, there's a lot of pressure on. So, we have to been seen to be act responsibly to our neighbours and that's good business as well, if they see that then they for future consents there's no objections, so that's good. So, it's good we get money out of the community and a little bit goes back in terms of you know both sponsorship and also the way we behave.</p> <p>#03Aa: If you want to look at the term sustainability, I mean you've really got to be aware of what's happening out there, gotta be aware of public opinion, you gotta be aware of your image, all right. You gotta be aware of what the government is saying and what the changes are going to be, and you need to be fairly proactive about making some changes in the organisation towards sustainability. You can only exist in a community of people allowing you to exist basically at the end of the day. You can't battle people all your life. So, your activity has got to be reasonably acceptable to the average population to survive. That gets back to the question of sustainability, if people don't want you there, you're not going to last that long really even five years, carry one, but the history shows that you can't survive if you're out of step of the values of the community you exist within.</p> <p>#35At: this whole thing about sustainability and at the time there was a little bit of stuff in the paper about sustainability you know, three years ago. Like you could pick up the Herald and you might find the course of a week, there might be say, there might be three articles a week, maybe around, related some way to sustainability or the environment. Well, in the last twelve months you can pick up the Herald any day of the week and there's three articles in every issue about sustainability, so, there's been a connect between people who said this is what we need to do and this is the way the world's heading, we've got a position here to take a, a trailblazing sort of leadership role in our industry and as a result we should, we should be able to gather for ourselves some sort of, you know, competitive advantage around differentiating ourselves.</p>
Government	<p>#03Aa: there's a lot of change going on in New Zealand isn't there. I mean the government is sending us some pretty clear signals about what the future is going to be. There's a lot of anxiety, everyone's a bit anxious about global warming and sort of saying, well looks like its happening. But they're feeling a bit anxious about the impact it's going to have on their lives. We're feeling sort of a bit useless about what are they gonna do, you know, that sort of thing, and so, there's a huge amount of signals going on at the moment and the recycling is really just picking up on those signals and say it's gonna happen.</p>

Motivating Drivers

Road construction firms in New Zealand were motivated to adopt environmental sustainability initiatives for three reasons: competitiveness, legitimacy, and Corporate Citizenship. Following Bansal and Roth (2000), these three drivers are defined here in terms of the outcomes that are sought, the means by which those outcomes are achieved, and the associated stakeholder(s) to which the firm's motivations are oriented in each case.

Legitimacy

Firms seek to legitimise their actions in terms of the norms, values, standards, and regulations against which stakeholders measure and judge the firm's performance (Bansal and Roth 2000; Suchman 1995). This motivation is about the firm's desire to do what is right with respect to the normative standards that external stakeholders expect to be upheld. Legitimacy is achieved through compliance with relevant standards and regulations, or building credibility by adopting acknowledged best practices, gaining membership in industry networks, or supporting worth-while causes (Bansal and Roth 2000; DiMaggio and Powell 1983; Dowling and Pfeffer 1975). The legitimacy driver is oriented primarily towards government and community stakeholders (see Table 9, p.88).

Amongst the case study firms, the motive of legitimacy was associated with the adoption of ISO14001, internally developed EMS, membership and participation in industry networks or accredited environmental programmes, and relationship-building with regulators. The road construction firms adopted these kinds of initiatives as a means of achieving a range of legitimacy outcomes, including achieving and maintaining compliance, developing credibility with other actors in the organisational field, and building relationships with key stakeholders. The firms were observed to respond to both threats and opportunities.

The road construction firms adopted EMS, or participated in externally accredited programs (Enviromark) or networks (SBN) as a means of signalling to their stakeholders that the firm could be trusted, thereby establishing credibility. In these cases the firms were seeking legitimacy from a range of stakeholders, including recognition from regulatory authorities, the Ministry for the Environment, clients, and the broader community. The use of environmental initiatives to signal organisational attention to issues of concern has been observed elsewhere (Johnstone and Labonne 2009). In particular, the adoption of ISO14001 by firms in Europe, China, Taiwan and Australasia to signal environmental legitimacy and

build trust with stakeholders has been widely cited (Christmann and Taylor 2001; Delmas 2002; Wu et al. 2007; Zutshi and Sohal 2004).

One firm (At) became a member of the SBN on the basis that it generate a reinforcing internal driver for the firm to continuously address its environmental performance. In their first year as members of the SBN, the firm was given a commendation for its commitment to addressing its environmental performance. Internally, this had the following effects *“help build momentum, generate more awareness, gather more support for sustainability”* and *“a really high degree of buy-in from the senior management team”* (#35At). However, as the interview progressed the manager indicated that there are risks associated with developing a reputation as a high environmental performer:

#35At: Like you could pick up the Herald and you might find the course of a week, there might be three articles a week related some way to sustainability or the environment. Well, in the last twelve months you can pick up the Herald any day of the week and there's three articles in every issue about sustainability. So, there's been a connect between people who said this is what we need to do and this is the way the world's heading. We've got a position here to take a, a trailblazing sort of leadership role in our industry and as a result we should be able to gather for ourselves some sort of, you know, competitive advantage around differentiating ourselves.

GS: Has it actually helped?

#35At: It has.

GS: In terms of getting projects? Maintenance work?

#35At: Not, not really. Not yet. If anything, its possibly had negative effect.

GS: How?

#35At: Take for example the regulatory authority. Their compliance officers now have a much higher level and expectation in terms of the level of performance level that we will maintain on our sites and that can be quite difficult for us. It's difficult when we are subjected to that sort of, it's not overt pressure, but it's there, it's stated occasionally. Yet you can see over here, there's another contractor who's doing things which is clearly non-compliant and having a sort of significant impact in the environment. Sort of saying, well what's going on here? Why are we getting a hard time about a little bit of stuff going down stormwater grate, and here's you know, a huge

subdivision exposed and some stream being very heavily, you know, huge sediment load in it, why aren't they getting the hard?

The manager's response illustrates that initiatives that are aimed at developing a firm's brand, in this case, as a high environmental performer can attract unwanted attention to the firm and actually put it at risk of greater scrutiny. The firm was successful at engaging in environmental sustainability initiatives, to the degree that they were publicly commended for their engagement. However, in this particular case the publicity attracted the attention of regulatory authorities which can be risky if the firm does not have the relevant EMS and processes in place to support and reaffirm this reputation.

One firm adopted an environmental management system (though not ISO14001) in order to improve the firm's compliance record in response to explicit concerns from an environmental regulator. This type of firm greening response to regulatory pressure has been noted by others in the literature (Kein, Ofori et al. 1999; Ofori, Briffett et al. 2000; Shen and Tam 2002). For instance, firms have been shown to adopt EMS in order to improve compliance and ensure legal certainty (Morrow and Rondinelli 2002) (Marshall et al. 2005), mitigate the threat of liabilities (Anton et al. 2004), deflect or avoid regulatory action (Lynes and Andrachuk 2008) (Wu et al. 2007), or pre-empt future regulation (Qi et al. 2010).

Three road construction managers highlighted the importance of maintaining good working relationships and communication with regulators (see Table 10, p.90). Engaging and building relationships with regulators was employed as a strategy to move the regulators away from a principle focus on identifying and penalising infringements to working with contractors to improve practices. The contractors perceived that by increasing the regulator's visibility and understanding of the contractor's practices, they achieved greater credibility and trust with regulators, thereby reducing the risk around non-compliance. In one case, the firm perceived that being open and up-front with the regulator eased the process of gaining a resource consent to burn waste-oil products. This emphasis on developing a good relationship with environmental compliance officers and regulatory agencies has been reported elsewhere (Liu et al. 2010).

Table 9. Initiatives associated with the legitimacy motive

Initiatives	Case	Motivation	Description	Stakeholder	Quote
Environmental management system	Fa	Non-compliance	To achieve compliance	Environmental regulatory authority	#41Fa: What happened was that the company was receiving too many infringement notices, and we just think you know something's going wrong out in the field there, this is ridiculous. This is probably going back now three and a half years and it just hit a head. We had a lot of infringement notices mainly because as a contractor we probably did most of the earthworks type work, so, naturally we were more exposed with the regulator and were given obviously more infringement notices. So we thought "this is blimbling stupid" and then we ended up getting, way back then, an abatement notice, so we thought, okay things are going too far. What the hell is happening?
ISO14001	Hc	Credibility	To seek credibility within the road-construction industry.	Road - construction industry	24Hc: We had to be twice as credible to be half as accepted by the contracting industry. So we had to prove that our environmental systems were well and truly up to date. That's why we got ISO14001. You know, our whole drive was to have external certification of us as an organisation. GS: So the council was disadvantaging you? 24Hc: No. The other contractors were, didn't believe that we were real contractors. They saw us as a proactive company. So what they were saying is that, well when everything goes wrong the council will just put some more money in. Or they don't have to be commercially driven because they don't need a return on investments. So we had to prove that that was not the case. It's the dynamics of being an SOE or a council controlled trading organisation. You know, you're not taken as seriously when you first start out. Now it's a different story. They can't BUT take us seriously. So therefore our driver was about getting external organisations to credit and validate us as an organisation. So hence the triple bottom line, hence the ISO14000.
Enviromark	Aa	Improve compliance	To reinforce the firm's compliance-ability	Regulatory authority	#05Aa: I guess in the EnviroSMART programme they saw the opportunity to make sure we're doing things right in terms of compliance and things like that.
	Aa	Relationship-building	Establish and or maintain relationships with key stakeholders	Regulators Ministry for the Environment	#05Aa: Also use it as an avenue to form some sort of relationship with Central Government, maybe the Ministry for the Environment as part of their Govt3 programme and their drive for sustainable procurement.
Sustainable Business Network	At	Credibility	Improve firm's credibility in the community and among	Clients Community	#35At: One of our motivations for doing that was that (a) obviously that recognition, that we recognised that investment was fairly modest given the value of the coverage that we eventually, that we've had in particular in the print media and that we also wanted to put ourselves up on a,

Initiatives	Case	Motivation	Description	Stakeholder	Quote
			clients and industry		not wanting to sound conceited, but if we put ourselves up on a pedestal, in typical kiwi fashion everyone else around us will try knock the tall poppy over, so that will, that'll provide a very strong internal motivator. To continue to perform at a higher level and to really keep our nose clean cos the last thing we'd want would be to be a cornerstone sponsor for example of the Sustainable Business Network and then be in some hideous environmental incident for example, or some very negative community related incident somewhere, so it's a way of self-regulating.
Energy Minimisation Initiative	At	Credibility	Improve credibility by being seen to engage in actual green initiatives	Clients Community	#35At: We're looking at energy and few things that we could do, we've got an energy audit coming up very shortly but we thought why don't we look at putting some solar water heating cos that, that, that would look pretty, cos we do this quite unashamedly in some instances for the greenwash, well we'll put some solar water heating in.

Table 10. Relationship building

Example Quotes

Example 1: #41Fa: X our owner got on the phone with them, said right this is and I'm just going to just use, excuse my language, we're going to sort out all this shit cos its just stupid because both parties thought on, on the Company Fa side our project manager thinking that the regulatory authority was a bunch of Nazis coming in and doing things and on the regulators side they, they thought that the Project Manager's just weren't doing what they were supposed to and were useless. And so, okay we need to sort it out and we got our project managers in a room and ARC inspectors and ARC people in a room, we said, okay lets lay all this shit out on the table and sort out what our differences are and everybody just let rip... and put out all their frustrations on either side and we sorted it out.

The regulatory inspectors came onsite and they didn't know and they though well okay we're supposed to be doing things and making changes if the guys never let us know when they're coming on, if they don't walk around with us on our site and explain what's wrong how are we ever going to learn and change. That was a, that was a key thing, that, and the ARC thought that well we should just be able to come on, we don't owe any, have any obligations to you guys, we're inspectors, we just go in there, we write our thing and we send you an infringement notices. So, we sorted all that out, because to us the logical way of moving forward as an industry not just as a company was that we're all going after the same thing and we're all heading toward the same direction so why not work together instead of being adversaries.

Well, we had a, basically we've had a change around in the perception from the ARC on how we do our business so it's, it's worked very well. Contractors are actually trying hard to do well and, and its really beneficial if the regulatory agencies come on board with that kind of training component as well. Okay, you're stuck but here's how you can do better and work with people to up the standard. And it must give the regulatory guys much better satisfaction from their role rather than coming in and waving a stick to actually be partners in the industry.

Example 2: #29Ec: If you want change the best way to get change is to be nice about it not to enforce rules and be nasty and, and for an compliance manager, to come on site and say, I'm not an engineer all I'm going to do is read this piece of paper and see if you conform to it, and if you don't I'm going to shut you down, and I'm not, and I'm not an engineer, so I can't give you and won't give you any advice as that's, that's crazy!

We've got a very good relationship with the guy we're working with, with the consultant, the client, us the contractor and ECAN we insisted that he come along to weekly site meetings. He came for the first month, now he doesn't come because he's so happy with what we're doing, basically not because he's being a jerk but because we've shown him that we're to be trusted and that if he wants something done it will be done on the spot, but then he needs to talk, we tell them, if you, if you're writing a nasty letter you make the, you make the phone call as you're putting it in the letter box. You say, it's coming, you know, but yeah, just to, to blindly say you're supposed to have one bale of straw there, it's not there you got three seconds to get it in or you're closed.

Example 3: #32Ac: I mean, if you get to know them, you know, talk to them and, and you'll always be doing something wrong, there's always, you know this, there's always going to be a time when you're non-compliant but if you try to manage it and they see you try to manage it. I mean, even if we spill we've got procedures in place, we'll have a spill, we'll get the, we'll get the, the clean-up, you'll always going to get the clean up there's no two-ways, you can't get away from that, so you're going to have that cost but you won't be prosecuted with, chances are you won't be prosecuted if you're taking the right steps and that's fair, I mean they're not unreasonable about that but if, if you, they come onto your site and they give you some warnings and you don't take any notice, then you have a problem... then they'll just roll it out and say, here we are, we visited on this day and this date and this date and you haven't done anything. Now you've had a spill, we're going to punish you, that's fair.

The issue was with the fuel. We wanted to use waste oil and then all of a sudden, oh no we can, that's a consented activity, you're managing your oil okay so we'll allow you to continue, and it's amazing just be a bit upfront and be a bit proactive rather than saying, oh they're just going to knock us back, and, and I, I think they'll have a better response.

I mean, they've got a job to do, they get, they get, local, local ...laws to uphold and also governmental laws so unless you get you know, a drag in there that's, they're just black and white down the middle, no you won't do this then most people are open to discussion.

Competitiveness

Firms seek profit by achieving and maintaining competitive advantage, and by improving efficiency of production (Hart 1995; Porter and van der Linde 1995; Russo and Fouts 1997; Shrivastava 1995). The competitiveness driver is oriented towards a firm's shareholders (to whom profits accrue), customers (from which revenue is derived), and competitors (who define the state-of-the-art in product or service delivery). Both competitive advantage and efficiency have been identified as drivers of firm greening in a range of industries (Bansal and Roth 2000; Delmas 2002; Flanagan et al. 2007; Fraj-Andres et al. 2009; Gabzdylova et al. 2009; Gonzalez-Benito and Gonzalez-Benito 2005b; Green et al. 2008; Khanna and Anton 2002b; Lim and Ofori 2007; Lynes and Andrachuk 2008; Mair and Jago 2010; Marshall et al. 2005; Shen and Tam 2002; Tam et al. 2010).

In this study, the primary motivation that the road construction firms expressed for pursuing and adopting environmental sustainability initiatives was to improve economic performance (eco-efficiency). All but one of the initiatives associated with the competitiveness driver were driven by perceived opportunities to reduce costs by reducing waste or utilising cheaper production inputs (see Table 11, p.92). The adoption of eco-efficiency initiatives to reduce costs has also been found in other industries (e.g. Bansal and Roth 2000; Kasim 2007; Lynes and Andrachuk 2008; Williamson et al. 2006). Examples in this study included:

- Energy minimisation
- Recycling C&D waste (concrete, glass) to develop cost-competitive alternatives to conventional virgin aggregate sources,
- Using marginal aggregates in combination with alternative construction methods (e.g. stabilisation) as an alternative to the use of virgin aggregates
- Recycling asphalt to reduce consumption of bitumen in asphalt pavement construction

Two of the C&D recycling initiatives were trials that were being conducted by the firms to test the technical reliability of the products (Gp, Ac). One case (Gp) was trialling the inclusion of waste glass into road pavements, which was financially supported by the Glass Packaging Forum. In the other case (Ac), the firm undertook a recycled road demonstration project. The purpose of which was to showcase the firm's recycling capabilities, and to derive acceptance by the industry's clients and consulting engineers. Brick, glass, asphalt, metal, clay, plaster, rubber, wood, organics, and asbestos were chosen as part of the recycled materials. Another two cases (At, Bc), firms were stockpiling C&D wastes because it was not yet cost-competitive to utilise these alternative products in actual road works.

Table 11. Initiatives associated with the competitiveness motive

Initiatives	Case	Driver	Description	Stakeholder	Quote
ISO14001	Dc	Reputation Capital	Improve the firm's non-price attributes by adopting systems and processes to address client's compliance concerns.	Clients	27Dc: We took a strategic view. A lot of our clients were asking for Environmental Plans, they're asking for these considerations to be put into our quality documentation.
ISO14001	Hc	Efficiency	Perception of potential cost-savings from the adoption of best environmental practices.	Shareholder	24Hc: If you use what we've termed environmental management parameters and instead of looking at it from the good of the environment, look at it as good for the balance sheet, from a financial point of view, it's very easy to justify.
Enviromark	Aa	Efficiency	Generate a cost-savings from energy efficiency	Shareholder	Also possibly to look at other opportunities around resource efficiency, the way we manage waste, the way we use energy, water and that sort of thing. There's business benefits in terms of saving money by reducing the amount of waste we send to landfill and using energy more efficiently
Energy minimisation	Aa	Efficiency	Generate a cost-savings from energy efficiency	Shareholder	05A: So it's a matter of selling it as good business sense to spend that money to protect the environment. And, I'm lucky cos there a lot of situations here where we can spend some money to save some money. I mean we have initiated an energy audit of this site and that's costing us eight and a half thousand dollars but we spend five hundred thousand dollars in energy every year, so we can identify a 10% saving. Fifty thousand dollars a year. So the cost of the audit is nothing.
Glass recycling (trial)	Gp	Cost-competitive alternative	Engage in a green business activity that generates a profit for the firm	Clients	#46Gp: I probably sort of hung around in the background to make sure that commercially it was going to stack up and that the council didn't take us to the cleaners. Which I don't think they did. I want to try and make money out of it.
C&D recycling (trial)	Ac	Efficiency	Perception that C&D materials were more appropriate for low-quality requirements rather than utilising increasingly depleting scarce good quality virgin aggregates.	Shareholder	#02Ac: You go to UK, and this is where I got my inspiration from. Is it quarries over there, rock is valuable. They're using that rock for high quality product – there is concrete, aggregate and sealing aggregate and sealing chip that sort of thing. But, they're recycling a lot of other material for lesser quality, and therefore they're not using good rock for low quality.
C&D recycling (stockpiling)	At	Cost-competitive alternative	Perception that there will be future financial incentives from stockpiling concrete now.	Clients	32At: We're stockpiling certain materials [concrete and asphalt] which we know we will be reprocessing at some stage in the future. So we're basically banking those materials into little stockpiling until we have economic volumes and the equipment we would require to reprocess them.
C&D	Ec	Cost-	Perception that a cost-savings could	Clients	#29Ec: To add value to the contract for the client because they're a very good

Initiatives	Case	Driver	Description	Stakeholder	Quote
recycling		competitive alternative	be generated through the use of a cheaper alternative.		client and we know there's ongoing work. Wherever we can help them we do. So to suggest something that might save them a hundred thousand dollars. It [concrete] was already there. So, instead of paying dump fees, so you lose the dump fees and you don't have to import the metal. So, it's got a double whammy if, if there was enough to make it viable.
C&D recycling (stockpiling)	Bc	Cost-competitive alternative	Perception that there will be future financial incentives from stockpiling concrete now.	Shareholder	#01Bc: Okay at the moment the market isn't paying us to do it but it's just stupid. And, the rules will change at some stage. But hopefully that gives you some small competitive edge because if everybody's compelled to do it then the market will have to pay for it. So, what will happen is there will be a charge made for dumping the concrete, when it arises, okay we are going to have had some experience by then cos we going to have gone through a process.
Marginal aggregates	Cn	Cost-competitive alternative	Maximise the firm's marginal aggregate quarries	Clients	#20C: For example if the Council wants a road they'll approach the construction companies and they'll come and see me, and I'll say, you know, I can make this but it's going to cost you so much more, because I have to do so much with it, or we can supply one that meets the spec (specification) or one that's three dollars per cubic meters cheaper which doesn't quite meet the spec but it's easy for us to make, and it makes a good road or they kind of stabilise it anyway so why not use it?
Recycled asphalt pavement	Aa	Efficiency	Recycle high-cost bitumen component and generate a savings	Clients	#09Aa: There's a cost-benefit if you're using recycled products and the second one is obviously it's sustainable. It's reusing a [valuable] resource. Reusing a source of material that isn't impacting on the local aggregates. #02Ac: Recycling asphalt is not for the stone, recycling asphalt the value is in the retention of the bitumen reusing it.
Recycling waste oil	Ac	Resource efficiency	Perception that there was a significant waste oil supply in the community that was not being utilised by anyone else.	Shareholder	#32Ac: We were looking for fuel. what we're doing is ringing round the garages saying we'll pick your oil up. They're saying the oil agencies that are supposed to do this aren't doing it or they want to charge them a fortune for it, and we said we'll pay for it as long as you give us good oil. We will actually pay you for the oil but you gotta keep all the solvents out of it, and antifreeze, all the nasties out of it that we can't deal with and we'll even give you containers to put it in. And we went in there and cleaned up a lot of garages

In half of the cases where eco-efficiency initiatives were adopted, the expressed motivation was to generate cost-competitive alternative material sources which would lead to competitive advantage. The procurement structures used by the New Zealand road-controlling authorities provide explanation for this motive. The majority of road works in New Zealand were, and still are, tendered under least-cost or cost-dominated procurement structures (e.g. the 70:30 weighted attribute method). Only very large road works projects utilised more value-oriented structures (e.g. alliancing). Cost dominated procurement decision-making and reliable environmental performance by contractors was not a significant source of competitive advantage compared with other non-price attributes. In this context, road construction managers perceived significant strategic value in the above initiatives as ways to meet their client's concerns around cost, while at the same time developing a competitive advantage in the tendering process. Tam (2009) demonstrated a similar motive underlying the development of concrete recycling initiatives in the Australian construction industry. In the remaining cases, the expressed motivation was to derive operational cost-savings for the firm.

Only one firm (Dc) linked the adoption of an environmental sustainability initiative to the creation of competitive advantage through a non-cost related mechanism. In this case, the client's expressed concerns about the firm's environmental performance presented an opportunity to generate reputation capital by improving performance through the implementation of an EMS. The firm perceived the potential for competitive advantage on the logic that improved environmental performance would lead to better non-price attribute scores during future tendering processes. The association between improved environmental reputation or image and competitive advantage has been demonstrated in the construction industry (Christini et al. 2004; Tam et al. 2010) and elsewhere (Lynes and Andrachuk 2008; Lynes and Dredge 2006; Gabzdylova et al. 2009). However, as was just mentioned, it is not likely that the firm could have actually realised that competitive advantage due to the limited effect of environmental non-price attributes in the majority of tender structures.

Corporate Citizenship

Firms pursue actions which align with the firm's internal environmental and social ethos. This motivation is about the desire of the firm's directors, managers, and employees to do what is right with respect to their own values and those of the firm (Carroll 1998; Marsden 2000; Rondinelli and Berry 2000). The firm fulfils this motivation by engaging in activities which fit with the firm's value system and beliefs about how it ought to operate within society (Rondinelli and Berry 2000). The Corporate Citizenship driver is oriented towards the firm's people. Firm-greening models have identified Corporate Citizenship as a motivating driver of firm greening (Bansal and Roth 2000; Lynes and Andrachuk 2008; Mair and Jago 2010), though it is not consistently identified in all models (Marshall et al. 2005; Qi et al. 2010). Table 23 (p.126) provides a comparison of the different models of firm-greening.

In some of the case study firms, an explicit environmental ethos was evolving and becoming more visible. This was evidenced in the verbal assertions of firm managers as to the cultural transformations which were taking place in their firms, as well as by reporting on environmental performance in their annual reports, the development of environmental policies, and the hiring of managers with strong environmental values and who had practical experience with managing the environmental impacts of construction activities.

Amongst the case study firms, a range of initiatives were associated with the motivation to fulfil commitments to environmental values (see Table 12, p.96). These included the adoption of ISO14001, EMS, the development and publication of Sustainability Reports, and the adoption of energy minimisation and C&D recycling. The firms also engaged in a range of discretionary philanthropic behaviours such as funding wildlife parks and student scholarships, and building infrastructure for local communities. Note that these types of discretionary activities were originally used to represent corporate social responsibility (Carroll 1979; Carroll 1999). While they are still relevant, these broader activities are beyond the scope of this discussion as they do not directly affect a firm's environmental performance.

Some managers expressed strong environmental values and desires that their firms should improve their environmental performance. In some cases, managers identified their personal values as motivating their search for initiatives within the firm or ways the firm could improve the firms' environmental performance. For example, one Regional Branch Manager (#04Aa) had expressed a strong commitment to addressing the firm's environmental sustainability performance (see #05Aa in Table 8, p.83).

Table 12 Initiatives associated with Corporate Citizenship

Initiatives	Case	Driver	Description	Quote	Other motives
ISO14001	Dc	CEO & board environmental values	Helps the firm become a good corporate citizen. CEO has green values.	#27Dc: CEO and the board took a strategic view to be a good corporate citizen as well it's nice to have that framework around you if, we are going to be, industry has got the potential to have quite a large impact on the environment and sustainability, so, it's quite nice to do everything possible that we can do to achieve that, and also to leave something here for our future generations. #28Dc: Because I'm a bit green.	Competitiveness
ISO14001	Aa	Regional manager values & best practice	Ensure that environmental (and social) performance outcomes were being addressed by the firm.	#04Aa: I think we actually set our own, well, personally I set my own standards way above the demands of those processes anyway whether its 9000 or 14000. #04Aa: It goes back to when I first took this job I'm in now, is that I wanted to as a business. I set up our vision for this region, for this business and I wanted to get equal balance across the range of factors that were important to the business. #04Aa: We're doing a lot of work anyway. It wasn't going to be a big hurdle for us to get that certification. The 14000 was an easy decision because we felt we were pretty much doing it anyway.	-
Sustainability Report (publicly available)	Hc	Previous CEO's environmental values and firm owners	Provides the public with information on the firm in terms of financial, social and environmental parameters.	#24Hc: It started because our owners suggested that it might be a nice way of reporting the impact that we have as an organisation. So that started back, what, I think our first one. So that's in 2000, it was a triple bottom line report which the CEO drove. He was the previous Chief Executive. And we have kept it going ever since.	-
Sustainability Report (not publicly available)	Aa	Regional manager environmental values	Elevate environmental values in the company.	#04Aa: But, my primary driver is internal at this moment. It will be structured in such a way that we can go outside the organisation with it. And, the reason why we're doing that is I want to elevate the sustainability area within the business. And, I see this as a tool that will allow me, that will facilitate that process.	-
Sustainable Business Network	At	Regional quality and environmental	Manager has green values.	35At: I came along and found myself being basically accountable for our performance in that area, had no tertiary qualifications in either	Legitimacy

Initiatives	Case	Driver	Description	Quote	Other motives
		manager's environmental values		quality management or environmental management for that matter but have pretty, consider myself reasonably green, so was keen to do the decent thing.	
Energy minimisation initiative	At	Regional quality and environmental manager's environmental values	Helps align the firm's activities with its environmental values.	#35At: It was probably fair to say that there was some recognition of the moral imperative, the moral driver behind all of this but when we're able to demonstrate just in some of the small things that we had done it was reasonably, what's the word, attractive cost savings and potential efficiencies to be made through embarking on these sorts of initiatives, they certainly helped to sell them and to get people's engagement.	Legitimacy
C&D recycling	Bc	CEO environmental values	Helps the firm become a good corporate citizen – seen as the responsible thing to do.	#01Bc: It's not going to be cost effective but it's the responsible thing to do. I guess you could say it's part of the corporate citizenship thing really at the moment. And we're slightly ahead of legislation.	Competitiveness

The manager had a vision to ensure that the firm could address its performance across all three aspects of performance i.e. financial, social, and environmental. He noted that for him *“The reason why we’re doing all this is so that we can leave the world in a better place than when we arrived, and we’re in a high impact industry. So, that’s the reason why we’re chasing these initiatives, so that we can make less of a mess.”* This highlights the link between managerial attitudes toward the environment and firm environmental proactiveness which has been established elsewhere (Cordano and Frieze 2000; González-Benito and González-Benito 2006; Marshall et al. 2005; Sangle 2010). There is no guarantee that positive managerial attitudes will translate into better environmental performance, but others have shown that managers who have positive environmental attitudes are more likely to perceive environmental issues as opportunities, and be responsive to stakeholders environmental concerns (Cordano and Frieze 2000; González-Benito and González-Benito 2006; Sharma 2000).

The Corporate Citizenship driver was not strongly associated with any particular type of initiative. With the exception of Sustainability Reporting and the adoption of ISO14001 by firm Aa, all of the initiatives which were associated with the Corporate Citizenship motivation were also associated with either the legitimacy or competitiveness drivers. The likely explanation for this is that Corporate Citizenship offered the weakest benefits for the road construction firms in that the values-based motivation was not likely to sustain significant expenditure by the firms in the absence of other, more tangible benefits, e.g. cost savings, competitiveness, or avoidance of penalties (legitimacy). Sustainability Reporting could be sustained because it did not involve significant costs compared with the other initiatives (e.g. C&D waste recycling). ISO14001 can have substantial costs associated with it (see section Cost and Subsidies, p. 104). However, the manager’s response indicates that it was perceived as a good investment based on the relative ease with which it would overlap with existing firm management systems.

Factors Influencing Adoption of Environmental Sustainability Initiatives

The analysis found that the successful adoption of environmental sustainability initiatives by road construction firms was moderated by a number of internal, external, and inter-organisational factors.

Organisational Context

In New Zealand, local transportation infrastructure is managed by region and district by the respective local government road-controlling authorities. At the time of this study, the national highway infrastructure was managed on a regional basis by the central government agency LTNZ. In each region or district a number of road construction firms competed for road works projects tendered by the road-controlling authority. Although a number of firms operated nationally, their regional branches autonomously pursued their own bespoke environmental strategies in response to the unique drivers, opportunities, and constraints in their operating contexts. The analysis of the data collected from the case study firms showed that the particularities of the firm's operating context was an important influence on the adoption of environmental sustainability initiatives. The relevance of organisational context has also been identified in the literature on firm-greening (e.g. Mair and Jago 2010).

A number of firms investigated recycling of waste materials, including glass, concrete, and asphalt, in an effort to generate alternative resources for road construction. One firm utilised waste oil as fuel for the firm's asphalt plant. These investigations were motivated both by the idea that using waste material streams for road construction was the right thing to do environmentally, and perceptions of economic opportunities as a result of the increasing cost of fuel oil, bitumen and virgin aggregates. Particularly in the Auckland region, high quality virgin aggregates have become increasingly scarce within economical distance from the main urban areas.

Although recycled concrete and glass were technically viable as road construction materials, the firms that pursued these initiatives were unable to make them economically successful on a sustainable basis. This was because the waste resource streams were not reliably available and because the price points for the resulting materials were not competitive compared with virgin aggregates or stabilised marginal aggregates (see Table 14, p. 102). Recycled glass was only economically viable in the context of a subsidised trial. Multiple firms investigated recycled concrete in Christchurch, paradoxically given the relative low cost and availability

of virgin aggregates in that region. This is attributable to the Cleanfill Licensing Bylaw of 2003, which artificially created a low-cost waste resource stream through a levy on the disposal of C&D waste. However, the economic incentive disappeared with the repeal of that regulation in 2006, making it too expensive for firms to recycle C&D waste in Christchurch.

While the potential for recycled concrete production was greater in Auckland due to the relative scarcity of high quality virgin aggregates and greater supply of C&D waste, there was little interest in concrete recycling from the Auckland-based firms. This was because firms did not perceive a significant opportunity compared with more well-established alternatives such as stabilising marginal aggregates. However, it is noted that the lack of opportunity in Auckland was perceived rather than proven to be actual as there had not been any significant investigation of concrete recycling by Auckland firms. One Auckland firm did use limited quantities of recycled concrete for road construction, but noted that they had to acquire a relatively large stockpile of waste concrete in order to generate a cost difference.

The construction management literature indicates that cost concerns were also issues facing the construction sector internationally with respect to C&D recycling (Tam et al. 2010; Tam 2009). The literature shows support for the importance of regulatory pressures in Japan (Tam 2009) and China (Qi et al. 2010) as facilitating widespread C&D recycling practices. It seems unlikely that the use of waste materials in road construction can become widespread without government intervention in the economy, to either incentivise or penalise certain activities (such as disposal) or to impose mandates for recycling.

One Auckland firm purchased a new asphalt plant that was capable of utilising waste asphalt as a production input (see Table 13, p.101). Recycling asphalt (RAP) is attractive because it reduces the quantity of new bitumen required in the asphalt mix. However, asphalt plants have to be specially designed or modified to accommodate the waste input. This means that the acquisition of asphalt recycling capabilities is a considerable capital investment. In this case, the business case for the investment was viable because of the firm's unique circumstances. The firm was forced to either upgrade or replace its old asphalt plant which was nearing the end of its useful life and to achieve compliance with air emissions regulations. This meant that the firm could acquire the asphalt recycling technology for marginal additional investment which the firm believed would generate an economic return because of expectations that bitumen prices would continue to rise in the future. It should also be noted that asphalt recycling was viable in the urban areas of Auckland due to the widespread use of structural and surfacing asphalt.

Table 13. Factors influencing development of RAP capability

Factor	Quotes
Emission compliance	#04Aa: Our Asphalt plant was up for new consent, and we decided that we would build a new asphalt plant to improve our emissions. So, we've got an Asphalt plant that can stand there for 40 years, and were saying this milestone comes along which happens to be in this case a resource consent, so this milestone comes floating by (which) triggers a whole, a decision-point really, do we look to consent the old plant or do we look to consent a different plant? At that time we choose to consent a new plant. We could see the plant was ageing, we could also see that there was gonna be some potential issues about, we didn't feel likely that we would obtain to gain consent with emissions standard that our plant could. The actual issue we've got is that we live on the border of an industrial air quality zone. So, our border, just on our northern border is...is the boundary for industrial and residential air quality. What's its emissions are an important thing. We've got to be able to live here next to our neighbours, what have you.
Capacity	#04Aa: So, we looked at the old plant and what's its life, and what's its capacity.
Cost of bitumen	#02Ac: Recycling asphalt is not for the stone, recycling asphalt the value is in the retention of the bitumen reusing it. #32Ac: Now we recycle that because there's a financial benefit. Because of the bitumen component mainly, and the, and the aggregate. I mean, generally they price the aggregate is eaten up in the reprocessing of the RAP, but the bitumen is still, is still the essence, that's a valuable component.

One firm recognised an opportunity to achieve both environmental and economic gains following publication of a newspaper article about the handling of waste oil in the Christchurch region. The initiative was economically successful because the firm was able to burn waste oil to fuel its asphalt plant, and there were viable quantities of waste oil available within the firm's immediate vicinity which could be sourced on a reliable basis at very low cost.

These case examples highlight that waste recycling was critically dependent on the cost and reliability of the input waste streams. The waste streams cannot be sustainably utilised unless they are cost-competitive with traditional resource inputs, and reliably available in the necessary quantities. This is particularly important since utilising waste materials requires a different set of technologies and capabilities which have to be acquired and maintained by the firm alongside its traditional construction capabilities (Huang et al. 2007). The availability of virgin aggregates has been identified as a barrier to the use of C&D waste in Australia (Hyder Consulting et al. 2011).

Table 14. Issues constraining C&D recycling

Issues	Description	Example Quotes
Volume of concrete	Contractor needs access to large volumes of C&D wastes.	<p>#23Ac: The actual supply of material like concrete isn't huge. We don't have great big stockpiles of old concrete without steel in it.</p> <p>#29Ec: We didn't end up saving money. It was neutral. Had there been a lot more concrete then yes, that would have started to save. But, we needed to triple the volume that we had.</p> <p>#32Ac: You gotta wait till buildings are pulled down and to get the concrete out of them. We probably don't use as much concrete in our buildings, we as they do overseas. And they're not as big, so, when they demolish a building overseas, you could probably keep the crusher running for a couple of weeks but over here no, they're pretty small.</p> <p>#01Bc: We are building a big enough stock pile to at least make it more efficient to bring in special gear, cos we haven't got the gear to handle it. So, we're going to have to bring in a special crusher and we are building a big enough mountain of concrete rubble to make it worthwhile setting up that operation.</p>
Cost-competitiveness	C&D waste recycling is not cost-competitive compared with traditional resource inputs.	<p>#01Bc: You know, aggregate for instance, if you want to recycle concrete or asphalt or any of those things it is still significantly cheaper to just dig more rock out of the ground and crush it than it is to reprocess.</p> <p>#20Cn: I'd say that the difficulty in New Zealand from my experience, it's cheaper to make the newer than grind up concrete. The concrete you've got, especially if you want to wash it, cement paste, water come out, you might have reinforcing in that, it's easier, unfortunately in New Zealand's it's easier to chuck it in a landfill and dig out some new stuff. It's a lot cheaper.</p> <p>#23Ac: One of the big issues in NZ is because of earthquake all the concrete has reinforcing through it so it adds.</p> <p>#24Hc: The thing is, at the moment, we buy here in Canterbury, we buy aggregate, well crushed M4, say, for around about \$12 a tonne and in Auckland I think it's around \$40 a tonne. And in Wellington I think it's the same. So what's happening is that, you know, in Auckland it's worth using because virgin material is so expensive. Here, you know, they're almost giving it away. So therefore there is no financial benefit there. But, you know, I think that from a Canterbury point of view there are no financial drivers until somebody makes it financially viable, either through a levy which is the bylaw or where the council's paid us a premium to use recycled products. Now of course they're saying 'no bloody way'. What's happened though is that most of the companies have gone back to just dropping it in the hole because the bylaw changed. So nobody can be bothered separating it out, so therefore nobody is stockpiling concrete. Not until we have a financial driver for doing it.</p> <p>#29Dc: Up until recently, metal was too cheap in Christchurch, it's too cheap, you hear in Auckland about you know a minimum of \$24/m3 for metal, here up until recently we got it crushed and we still got it \$4/m3, and that is a disincentive for looking at other sustainable methods.</p> <p>#32Ac: Taking material straight out of river and processing is cheaper than collecting concrete, trying to crush it. Trying to get the rebar out. It will remain so until we get it in the big business way so it's a general part of our business. Other things like plastics and ground tyre rubber are more expensive, glass is more expensive. There's a quantum leap from sort of playing around with it in a small way which is quite expensive. Trialling. And getting the equipment sorted out to take that leap and saying righto we've taken this seriously, we'll invest x</p>

Issues	Description	Example Quotes
		<p>millions of dollars and we'll get into it and we'll take all the concrete that we can get our hands on, process it into crushed aggregate and then use that material.</p> <p>#35At: The volumes are low. That's the problem. Reinforced concrete anyway.</p> <p>#43la: We want to provide our local authority with an alternative resource from an aggregate supply that, I mean, Council has this clean green sort of image, recycling, reuse that they try to drive, there's no financial support there, but in the same token we own a concrete crusher. So, what we do is we receive the product, we separate the rebar from the concrete and then we crush the concrete to make an aggregate. We use, a lot of them we use in our own roading jobs, some of it we use as an alternative to aggregate if our stockpile gets big enough we can generate a cost difference and really what it is, it's a cost to, till that becomes similar to the nearest aggregate resource.</p>

Comparison of the Auckland and Christchurch concrete recycling cases highlights that firms will respond positively with respect to recycling waste streams, even when low cost traditional resource streams are widely available, when they can obtain the waste resources at cost-competitive prices. In those cases, the cost-competitiveness and reliability of the waste streams was only achieved through stockpiling and artificial economies created through a government by-law against the disposal of C&D waste in Christchurch. The low costs of dumping C&D materials has also been identified as a barrier to C&D recycling in existing literature (Leigh and Patterson 2004; Rao et al. 2007; Tam et al. 2009). In the Auckland asphalt recycling case, most of the investment in the new asphalt plant was justified by a combination of regulatory pressure and end-of-life asset replacement which would have happened anyway. Faith-Ell (2005) reported a similar finding in the Swedish road construction industry, where marginal investments to achieve environmental compliance or benefits were only justifiable within the context of the end-of-life asset replacement cycle. In the above case, the marginal investment in the asphalt recycling technology was justified by high bitumen prices and a reliable supply of recycled asphalt in the Auckland Region.

Cost and Subsidies

The costs associated with adopting environmental sustainability initiatives have been identified as an issue for firms in a variety of industry sectors (e.g. Collins et al. 2010; Delmas 2002; Gabzdylova et al. 2009; Park and Brorson 2005; Williamson et al. 2006). It has also been identified in the literature as an issue within the construction sector (Adetunji et al. 2003; Kein et al. 1999; Sakr et al. 2010; Shen and Tam 2002; Shen et al. 2006; Tam 2008; Tam et al. 2009; Tam et al. 2010; Tam 2009; Tse 2001; Zeng et al. 2003; Zutshi and Sohal 2004).

In this study, two road construction managers (#27Dc, #41Fa) identified that there are significant costs associated with implementing EMS e.g. implementation, auditing, employee training, hiring consultants (see Table 15, p.105). The Compliance Manager (#41Fa) also highlights that the process of obtaining environmental resource consents was costly particularly if there are time delays involved. These issues have been identified, and the government has been examining how to reform the resource consent process (MFE 2009).

The issue of costs associated with EMS has been identified as an issue in the construction and management literature (Adetunji et al. 2003; Kein et al. 1999; Ofori et al. 2000; Sakr et al. 2010; Shen and Tam 2002; Tse 2001; Zeng et al. 2003; Zutshi and Sohal 2004). Zeng, Tam et

al. (2003) indicate that the lack of regulatory mandates requiring ISO14001 meant that firms preferred to wait for stakeholder pressure before adopting ISO14001. In New Zealand, the RMA 1991 does not mandate that firms are required to be ISO14001 certified, several road construction firms had clearly pursued certification. In these cases, the firms were able to justify spending on these systems and processes due to the benefits they were receiving in terms of continuing to remain compliant.

In contrast to these cases, one entire firm had decided to end its membership with the SBN. The CEO (#24Hc) indicated that decision to be a member of an association had to be prioritised due to the large number of different associations available to the firm and the significant financial costs involved. While the firm (and the previous CEO) had benefit from its association with the SBN in the past, this CEO perceived greater benefits from membership elsewhere.

Subsidies were mentioned as influencing factors in two cases: the adoption of an energy minimisation initiative, and a C&D recycling initiative to use recycled glass in road pavements (see Table 16, p.106). In the case where the firm engaged in an energy minimisation program, the firm was financially supported by the government through the Energy Efficiency Conservation Authority. In the second case (Gp) the firm incorporated glass into road pavements after receiving financial support from a non-profit organisation (Glass Packaging Forum). Note that the members of the Glass Packaging Forum are major producers of glass in New Zealand, and their objective is to engage in voluntary product stewardship i.e. to identify market opportunities for waste glass, and to avoid regulatory oversight (Glass Packaging Forum 2012).

Table 15. Cost of initiatives

Initiative	Case	Description	Example Quotes
ISO14001	Dc	Costly, but can be justified.	27Dc: I think the audits a yearly audits, three thousand, four thousand dollars, and just the cost of managing the system as well with time for internal audit to do some training, documentation, reviewing the documentation, but I think, yeah it would be a very positive move if local authorities were to adopt that and say “we would like you to have this”. Probably costs us, I don’t know ten thousand dollars a year if not more. There are a lot of hidden costs, the cost of contract managers to perform audits on site, you’ve got the internal audits for the quality management systems, the time to review those findings, to have those meetings, cost of the audits, the external auditors to come in.
Environmental management system	Fa	Costly, but can be justified.	#41Fa: It’s cost us a lot of money. It’s been huge getting consultants in and the training cost and that have been huge. So, it doesn’t come

Initiative	Case	Description	Example Quotes
			<p>free.</p> <p>It's been a huge cost. The training bill and the amount of consultants and things that we've had on board in the last three, three and a half years is huge. And, there will be a culture change, I guess from where everyone is coming from with the opinion that it's a saving.</p> <p>Any training is a huge cost and any consent process is a huge cost and the amount of hours that it takes to get through consents. To get your savings in the end you've got to train the whole industry through the whole linkage it's not just the contractors' side. The consultants and the engineers to the clients and all those people have got to be aware of it as well and the delays in processing paperwork is not going to give you a cost saving on the ground no matter how much you try to sell that to industry. What saves you on the ground is all those processes being caught quick because it doesn't have the time delays.</p>
Sustainable Business Network (SBN)	Hc	Too costly to justify amongst other options	<p>#24Hc: It must be 5 years ago, but we're no longer a member. It's about \$15,000 a year and the previous Chief Executive drove that, so when I came along I cut some of these things out. So we're not a member of the Sustainable Council. But that does not mean that it's not important to us.</p> <p>So what happens is that because we belong to probably 6 or 7 different organisations, all wanting \$15,000-\$20,000 it becomes expensive. So you have to pick the ones that are important.</p> <p>GS: And was the Sustainable Business Council much help?</p> <p>#24Hc: Well I resigned from it when the previous Chief Executive left, so very quickly resigned. Was it a help for him? Absolutely. Yeah, he got a lot out of it because he was an active board member. So he, you know, he put a lot in and got a lot out. but, you know, it's like –</p> <p>GS: I was just curious, I mean, how much help was the organisation?</p> <p>#24Hc: Well I think in the early days it was a great help. And had we stayed in it, it would probably still be a help. But, you know, it's not as high on the list.</p>

Table 16. Subsidies for initiatives

Initiative	Case	Example Quotes
Energy minimisation	Aa	#05Aa: Its 50% funded through the Energy Efficiency Conservation Authority - EECA. For companies using over two hundred a and fifty thousand dollars, I think it is 250,000 dollars' worth of energy a year, they will fifty percent subsidise a level to the energy audit.
C&D recycling (glass)	Gp	#44Gp: I think we got \$40,000 from the Glass Packaging Forum. They wanted us to prove that in the New Zealand context. So, it's been a bit successful because other people have followed and done it.

Conservatism

Road construction managers highlighted the conservatism of clients and engineering consultants as a challenge to adopting alternative materials in road construction (see Table 17, p.108). In New Zealand, materials properties and construction techniques for road pavements were covered by a range of technical specifications (e.g. TNZ M4 for base course aggregates). These specifications were the product of research and development by highway engineers over many years, and represented the state of knowledge about how to build a road, and what to build it out of, so that the pavement would successfully carry load for the full design life.

Alternative materials such as recycled concrete and marginal aggregates presented a risk to the client because of the lack of information about their performance in road pavements. Contractors perceived that their clients were unwilling to accept this risk. This view was supported by the engineering consultants who were interviewed. They highlighted that the road controlling authorities wanted reasonable assurance that the road pavement would perform to standard, and were averse to the risk of premature failure. Quotes from the engineering consultants indicated they were similarly conservative with respect to risk because their reputations with the road controlling authorities depended on it, and because their contractual liability lasted longer than that of the contractors. This unwillingness to share the burden of risk has also been identified by U.K construction managers as a barrier to implementing sustainable construction techniques (Adetunji et al. 2003), as well as in the U.K. road construction industry (Adetunji et al. 2008).

Conservative behaviour by engineering consultants and clients, particularly public agencies, has been documented elsewhere in the literature (Knoeri et al. 2011; Miller et al. 2009; Seaden and Manseau 2001), and appears to be a common barrier to innovative behaviour in the construction industry in general (Lim and Ofori 2007). It is unlikely that the use of alternative materials in road construction can become widespread unless technical specifications are developed for their use (Hyder Consulting et al. 2011; Rao et al. 2007; Tam et al. 2009; Tam 2009). One Asphalt Manager (#09Aa) indicated that his firm had been working towards proving the performance acceptability of recycled asphalt mixes by involving the consultants in the testing regime (see Information and Knowledge and Table 18, p.111).

Table 17. Conservatism of clients & engineering consultants

Manager	Example Quotes
Road construction managers	<p>#09Aa: The process of getting them into contract documents has happened really effortlessly, I would suggest, but the ongoing battle with consultants to get mixes approved and to look at the process of how we make RAP and what we do to it, testing regimes and how it affects our mixes overall that's been quite arduous, that's been the difficult. That's been the difficulty, so we've had some bottlenecks with consultants, particular consultants that give us a lot of trouble. I think they're concerns was that they just wanted to make sure that the materials that we're putting in didn't adversely affect the end produce, i.e. cost of life analysis, so that the resilient modulus you may hear mentioned, it's a test that determines the life of a, of a particular sample, so I mean that was their biggest concern that it wasn't going to last as long as virgin material.</p> <p>#23Ac: We've got these ideas and there's probably, it comes down to the councils, some are very traditional, some are not interested, whereas some will find a way to make it work, rather than find a way to not make it work, so many councils and local authorities are getting so risk averse now because they're so driven, they're driven by the, by the politicians rather than good engineering and good understanding.</p> <p>#35At: They tend to be, they tend to be extremely risk averse, so no, they'll only entertain those things if they can transfer all the risk associated. Off course we are not quite as adverse but if they wanted to be involved in the promotion of and, of sustainability then they are going to have to sort of be prepared to take on a little bit more risk as well to make, to make those opportunities available.</p> <p>#431a: So, we use that a lot, but we do struggle to try and convince our customer that, that product is as good as if not better than the core product which are lime and cement. And, we keep hearing "oh, you can't guarantee the product". I say, well we can to this scope because the tests have proven. We've compensated for the variance, still costs less. It's not comparative because it's a waste product. We're not manufacturing. The alternatives for KOBM are take it to a landfill.</p> <p>#431a: There's nothing more we can do to test it. It's been tested through a variety of pavements and it's been shown structurally sound but because there is a small token of risk attached, here we are, here's something that costs this much, here's something that costs a little bit less with the small amount of risk, "why take that risk?". And this is what we're hearing over and over again. But, what, what on a national level everybody forgets is when you're manufacturing lime and cement tonne by tonne there's carbon going out into the atmosphere, the process of manufacturing steel, hey, there's a lot of carbon going up, but it's gone up to manufacture steel. The KOBM, the waste is already being paid for by someone, it's not manufacturing KOBM, it's manufacturing steel and here's a by-product.</p> <p>#431a: Sometimes Transit will say alternatives are accepted. So, we put in a submission for an alternative and they go "although it's accepted it cost too much for us to analyse the alternative so we'll throw it out." But you can save thousands of dollars using an alternative, using recycled/reused products, using some of the stuff that we do and they come to us says, "look well what can you do", and I say, "well why don't we get someone independently to analyse our design, put their name on it as a peer review and then give it to you and then you don't have to analyse it." Consultant: "Yeah, well we don't know who they are, and how good (are they)?"</p>

Manager	Example Quotes
Engineering Consultants	<p>#12: Every country, every city, every state has its own material, its own environment, its own weather, so, it's, what is relevant to here is not relevant there, and that's why I have to be very specific to decide whether because we are the designers, and we have a professional indemnity... So, we are responsible for, if the failure, if there's any design failure within a period of time, the first person that will be asked will be the consultant, hey you designed it, its failing, it's your problem until we prove the opposite. So, we have to protect our designs, and make sure that what we designed is implemented and not some of it, it comes back to us, and the contractor will just leave in one year, and design affects liability, or maintenance period is only one year, and if there's nothing wrong in one year, you've got no issues, I have no liability anymore, whereas for us, they can call us for six years' time, they can still come back and say we've seen this, and this, and this. The professional indemnity is extended to six years. Council want to use a very professional consultant they, they don't want to get into this kind of saga of problems, and who's that, who did that, and why it's failed, and who's the cause, you know they always they wanted to track down who caused the problem, is it the designer, the contractor, if it is the contractor the contractor has to fix it, if it is the designer the designer has to pay for it, it's very sensitive, we're talking hundreds of thousands of dollars.</p>
Engineering Consultants continued	<p>#06: The clients' driver is well I only want to pay for this once, so, I don't want a marginal aggregate unless you can demonstrate to me that this can do its job. And, maybe I don't want to be the first one to trial, to trial on this, go trial it somewhere else. So, I can see that driver, because they know after a year's maintenance period its, it may not have shown it's worse face yet and they're stuck with it, so you can see that.</p> <p>#06: I mean consultants will stick to a standard specification, because the standard specification gives them security as a designer. If something supplied to the standard specification TNZ M4 and some, there's a problem, then that's an exception to the rule. It's not the consultant's problem, if you're talking about consultant's driver.</p>
Clients	<p>#16: It's not also correct to say that we are not allowing them to use products that we don't like. We have to balance the, we have to balance the risks with the costs. A lot of products does come into the market which the vendors claim that they do this good, this good, and this good. We have no fall back guarantee if the product doesn't meet the requirement and we pay this contractor and it ends up failing, we won't be able to recover the cost from somebody else. If the product has been tested by authorised testing bodies, have been approved for use, and does fail, we can fall back on something, saying that I have used this product because it has been tested by this testing agency and has been approved by this specification body or standards body like Australian standards and New Zealand standards, so, I'm not at fault for having used it. If I try something which is not backed up by anything then it will be my fault that I used the product.</p> <p>#37: I know that Christchurch City just doing a trial now with glass and asphalt, but we haven't gone down that path yet. We'll wait till someone else finds out all the problems with it before we take the... we'll, so watch and see brief for us. But no doubt that'll come along later on. No we don't [undertake trials of materials], we rely on Land Transport research papers for that. The funding and...and they consider if the road sort of falls apart they get all the criticism not us.</p>

Information and Knowledge

Lack of knowledge and information has been identified in the literature as a key barrier to firm greening in New Zealand and internationally (Collins et al. 2010; Sakr et al. 2010). This includes both lack of information on environmental performance as a factor constraining firm decision making (Collins et al. 2010; Henriques and Sadosky 1996), lack of awareness and knowledge as a barrier to the adoption of environmental systems, tools or practices (Adetunji et al. 2003; Kein et al. 1999; Shen and Tam 2002), and lack of experience with recycled materials a barrier to their use (Shen and Tam 2002; Tam et al. 2009; Tam et al. 2010; Tam 2009). In this study, road construction managers identified information and knowledge as key enablers of action with respect to environmental sustainability (see Table 18, p.111).

Two managers (#04Aa, #35At) identified that having reliable data on their firms' environmental performance was necessary in order to identify opportunities for improvement and establish priorities. Those two managers were actively undertaking to collect the necessary information through sustainability reporting and tracking energy consumption within their firms.

Two managers (#41Fa, #29Ec) highlighted that training and education were important for changing culture and attitudes with respect to environmental performance. One firm had contracted a specialist and implemented a training programme to improve knowledge and understanding amongst the firm's project managers. The other manager highlighted that improving his own knowledge helped him to approach environmental issues proactively rather than reactively.

Another manager (#09Aa) highlighted that generating data (i.e. test results) on the performance of alternative pavement materials was critical to enabling the commercial use of those materials (see the section on Conservatism, p.107).

Table 18. Information & knowledge

Issue	Example Quotes
Information	<p>#04Aa: I think for me the starting point has been about identifying what are the key issues around the environmental sustainability area, identify what those are then identify I guess, first of all is to start measuring our performance in that area and to start reporting our progress and from that we'll identify what the priorities are and start knocking some of that off. So, in terms of a continuum we're still operating in my view down at this lower end.</p>
	<p>35At: There was very little data to support any decision-making. So, for example the way we've actually been encapsulating reporting our electricity usage so it was meaningful because we've got a huge number of meters spread across the business. Our fleet and our fuel consumption. Enormous difficulty initially getting accurate records let alone complete records but we're now in a situation where we're reliably getting a 100% returns from all our staff and their meter readings. So we're starting to compile a database which will be quite meaningful and will allow us to analyse and to start looking for opportunities for improvement. Yeah, but access to data has been a real issue.</p> <p>Go and get some proposals for some solar water heatings, come back with a range of prices, well now do the justification as to why we should do this, yeah, sure it's a good idea, but what's the payback on installation of this, this thing and when you try and find the data to justify this expenditure, you find you can't get it, so in this case we're actually putting in slave meters to actually measure what our electricity consumption actually is on our water heaters in the locations where they would make sense to install them to be able to justify the decision. And I want to take us to be seen to be always taking that rationale, commercial approach to all our initiatives. Not just doing things because someone has a rush of blood to the head and thinks it's a good idea and sound great, you know. There's got to be some numbers, yeah.</p>
	<p>#09Aa: It has been a tough job actually getting them out here, I personally have brought them out here now, every consultant has come to this depot, they've looked at our processes, we've shown them our process control, our data collection for all of the work we're doing in a bid to try and make them understand or help them understand how we've actually, you know, how we've come to put these designs together. So, we've done this with all the consultants involved.</p>
Knowledge	<p>#41Fa: So, what we did, we contracted someone in to work with us, and environmental specialist and that person set up some systems for us and also a big component of changing culture and attitudes. So a big component was, was training the guys who were working with the Project Managers out on site, so, we didn't just put in procedures we had training sessions, so, we would have, we would go out and we'd do internal inspections but on whatever site we did it we would get Project Managers from another site to come and have a look, so, each time we went out on one person's site we used it as a training session for other people to come in and have a look at what was happening, so we tried to cover the ground as much as possible. So, it's really just explaining to the guys and working through processes with them.</p>
	<p>#29Ec: Nobody understood what it was all about, there hasn't been enough education to my way of thinking and it was more of the bash your head against the wall, I will, if I've got to do it I will do it, whereas no understanding the consequences. The "why's". The "what it's all about". And fair enough we have to obey these rules and that's what I said to you, I flipped over very quickly to well let's not fight it, let's learn. So, it's just educating yourself as to what products are available for. I didn't know there was a special silt fence material, I do now. What socks are available, you know, downstream catchments slowing water. All those sorts of things</p>

Other Issues Affecting Firm-greening

Incentives

Analysis of the road construction managers' responses finds broad support for the idea that there was a lack of stakeholder support for firms to pursue more environmentally sustainable outcomes. Lack of stakeholder, particularly client, support has been established as an issue in the construction management literature (Kein et al. 1999; Shen and Tam 2002; Tam et al. 2010; Tse 2001). In the U.K. road construction industry Adetunji et al. (2008) identified that tendering processes were dominated by the cost criteria, which did not reward those firms that were adopting innovations and practices for sustainability.

Road construction managers indicated that they were not able to win contracts if their more environmentally sustainable construction materials and methods were more expensive than traditional materials and methods. For example, the organisational capability required to utilise alternative construction products requires substantial capital investments (see Organisational Context p.99), and research and development by the firm (see Conservatism p.107). However, the road construction managers noted that the public-sector was under pressure to keep costs down. As a consequence, clients were unwilling to spend more for environmentally sustainable products and methods when cheaper and reliable products and methods were already available (see Table 19).

Table 19. Clients' focus on least-cost

Example Quotes
#01Bc: At the moment our clients are specifying their work and it's a competitive market you have to win the work, you'll never win it on a more expensive alternative. It just won't happen and that's, I think you said at the start how your study is about what the clients might be able to do and have they seriously embraced sustainability and things like that. At the moment no, the market doesn't differentiate. Differentiate isn't the right word. It isn't prepared to pay a premium. No, the market isn't.
#02Ac: Basically, the methods of procurement in New Zealand, minimum price and all those sorts of things, lump sum or risk transfer is basically forcing decision-making by contractors to say, ok well I'll do the job but I'll want to take my bit out at the end, I'll only do what's necessary for that, but not actually ask the question "what I'm doing is absolutely best for the road."
#23Ac: The public get really up in arms if you don't go to the cheapest price. They don't know any better, they just that contractors the same as that contractor, they're a business, that's what they see, that's what the public see so, it's the public sector have to be very wary of how they do procure
#28Dc: To act in a sustainable way, sometimes the lowest price doesn't allow me to do that, and that one down in Geraldine is a prime example, it cost the client 30% less to use materials, and they did do the right thing, they did go the right way, but it is very difficult when you're using public funds to spend near 50% more just to be sustainable.
#32Ac: You're comparing sort of twenty dollars per tonne for aggregate with sixty-five dollar per tonne for glass and unless the council is going to say, well yes we'll pay forty-five bucks extra to take for our finished mix we're

Example Quotes
not going to charge them any more for manufacturing but we, we do have to, you know, charge them for the extra over and above what our aggregate cost. So, you know, that's where the difficulty is going to arise, unless that's balanced out and people are prepared to pay extra to get recycled.
#29Ho: Sustainability is all about what the client is going to pay. That's really what it's all about. We're only piggy in the middle and we will certainly do it for you but it's all about the dollar. As far as sustainability goes it comes down to the dollar and what the client is prepared to pay for and what views the consultant has to it

Road construction managers indicated that the dominant industry procurement methods did not recognise and reward their investments in environmental performance and capabilities. Depending on the context of the road works, road-controlling authorities used a weighted-attribute tender evaluation method. The weighted-attribute method allowed non-price attributes to be considered in the tender evaluation. In this procurement method the non-price attribute makes up 30% of the tender evaluation, while price makes up the remaining 70%. This was commonly referred to as the 70:30 method. The road construction firms' environmental track record or management skills could be considered under the non-price attributes. Other non-price attributes also considered were relevant experience, technical skills, resources, methodology, and price (Transfund New Zealand 1997, p. 19-20).

Road construction managers repeatedly identified that the 70:30 method did not reward environmental performance or capabilities because the environmental non-price attributes had only a very minor effect on the overall tender evaluation score (see Table 20, p.113). For example, an increase in a few points for environmental management might only affect 5% of the total 30%, whereas in a 10% drop in price of the 70% price attribute is much more significant. This meant that investing in beyond-compliance environmental systems and practices did not deliver the firms a competitive edge in the bidding process.

Table 20. Comments on weighted-attributes procurement approach

Example Quotes
#02Ac: Yep, so, it's a challenge for the way people procure work that they actually can include that second, and that is where procurement comes in. Now, you know, we've gone through New Zealand a decade of, one and-a-half decades basically of competitive-pricing and procurement through CPP. Yeah, they've tried to bring values, quality price trade-off, and value and things in there like but they really haven't they haven't really, it's still 30% attributes and 70% price, so, price dominates and I've had many discussions, cos I used to be a council member and had many discussions where I've said, look we will allow 10% or 20% quality. The most quality driven company tendering for the job, we'll give them 20% on their price and that's the starting point, will measure back from there. But the method of assessing is always every attribute is what percentage out of a hundred. No one actually says, no, no, that's my best contractor, he's a hundred, all the rest are down here. You know, the contractor you pick should say, he's a 100% on all attributes and that's what I'm willing to pay. There's mechanisms like that, there's systems have crept in, which I think counterproductive to the sustainability

Example Quotes

issue. The Alliances, co-operative procurement, those sort of things, early contract intervention are going somewhere there. Cos basically what you're saying is, what's value for money? And I think this is pretty important if you look in at sustainability, it is, what is the optimum affordable solution delivered most efficiently? The optimum affordable solution. So, uh...you know, if you want a washing machine, you know what you can afford, you go looking for an optimum solution, and that's really the crunch of it.

#20Cn: I imagine that you know some of the stuff that Company X (is doing). Just atrocious, and we struggle with that as a contractor going for tenders against guys like that, because we're specifying silt traps, and this TP90 [Auckland Regional Council's erosion and sediment control guidelines] which you might be familiar with. All our designs might be right, and they might not be pricing it, and they just going and doing jobs and leaving silt traps out just reacting and the council jumps on them. So, we tend to find that we price higher than them, and we're trying, in fact we've got a Contractors Federation meeting tonight, we're going to keep pushing this message, with the idea that the Contractors Federation will go to the government and sort of say look to the engineers, or Roading New Zealand, or Transit or whatever and say, look we need to have standard of environmental compliance raised up to drive these other guys to comply.

#24Hc: Yeah, but I think to be very honest, environmental sustainability is very hard to get traction with because there is no benefit from a client's point of view, there is no perceived value for a client. Well they have a requirement to comply with the RMA and everything else is very open ended isn't it? We probably hold in the vicinity of 70 different contracts. So they're all lots of different contracts with different clients and all kinds of different streams. So if we put in a contract against another contractor, the client does not value or does not give us extra points for having environmental management, or an Act of environmental management. They just go on the lowest price. So we win our contracts through a system of, typically, weighted attributes. So, you know, 30% is attributes and 70% is price. So when they work out that 30% there are no extra points given to somebody who takes environmental management seriously.

#24hc: But the problem is that if you take someone like Transit who is under pressure for funding, they just want the lowest price. Now if you get Fulton's, Works, Higgins all putting in a price, how do you pick which is better than the other because all three of them will do a good job. So therefore it becomes a, well whoever's got the lowest price. So really what happens is that because the industry is relatively mature with good contractors, the 30% attributes actually cancels itself out and just goes back to lowest price.

#23Ac: We've never won a tender for good environmental practice. Part of the scorecard at the end of the day it comes down to the lowest dollar a lot of tender work comes down to the lowest dollar and the cheapest.

#23Ac: At the end of the day what does the client want to pay? Do they want to pay a low volume, a low price and what does low price mean. They've got 30/70 split but they've never actually analysed what they're getting for that lower price

#23Ac: So there was a manual set out in the nineties which was a basically the funding manual and in there the 30/70 came out. We want to have some experience, but at the end of the day, price is still the dominant driver and that's what that's telling you. It's telling you that yes there's a bit, and that 30 is broken up into track record, relevant experience, technical skills, management skills, resources and methodology. So, it's a lot to cover in that thirty and it does give differentiation to an extent but then if you go through and see the scoring differential.

#30Ec: A lot of tenders, particularly bigger tenders tend to have a part price and part attributes. Technically speaking I suppose if you do a better job, then the theory is the next time the attributes are higher, so you get a job if you've got similar price to somebody else you'll, you have better attributes and you'll get the job. That's the theory. But, that's very subjective and every client has a different opinion on how important it is and a lot of clients, you'll get a very, like Transit typical, you get a very shallow range between being very good and very average.

#32Ac: And that brings it back to one of X's big gripes, is that we can put this stuff in with spades but the council will only pay us for this much. And so the more of this (environmental systems and processes) we do, the lower our profit.

Attitudes

Road construction managers identified that employee attitudes to the environment were a barrier to change (see Table 21, p.115). The issue of employee attitudes towards the environment has been raised as challenge to firm-greening (Sakr et al. 2010). The road construction managers identified two underlying factors for these cultural attitudes. They noted that attitudes amongst some employees had been slow to change. Road construction managers also noted that the environment was not perceived as important as other priorities, for example, health and safety. They suggested that employees could understand the health and safety impacts better because these result in impacts on the employees. In contrast, environmental impacts are perceived to be separated in time and distance. In order to overcome these barriers, the road construction managers suggested that they needed to find ways to establish connections between environment impacts and the employee's well-being.

Table 21. Attitudes

Managers' Role	Example Quotes
Environmental Compliance Manager	<p>#05Aa: I think they don't really know what else to say about the environment. You know there's a lot to say about Health and Safety, statistics and you know, looking after your workmates. If you make a mistake you chop your finger off, kill yourself. Yeah, I kinda get the feeling that don't really knows what to say when you it comes to environment in terms of, inducting people and training people. So, I guess that's part of my role as well, it's definitely part of my role identifying what are our environmental issues, what is the most important one, what are the messages we want to give to our staff.</p> <p>Okay, setting up systems for them to do it, you go back and check their skip bins and they're still... It's getting better, but there's still material that's getting in there that shouldn't be. So, I guess, the challenge is raising people's awareness about why we're doing it, changing habits, habits of a lifetime. I guess identifying what's in it for them is probably one of the key issues and challenges</p> <p>The challenge is in changing people's behaviour. That's what you find. It's a biggest challenge for someone in the environmental field. Well it's probably Health and Safety as well, but the thing is with Health and Safety, you stuff up you could kill yourself. That's pretty close to home. With the environment, you stuff up, or you don't recycle stuff, it goes and away it goes in the refill, and if you spill something and you don't clean it up it goes down the drain and disappears, you know, you don't really see where it comes out what the effects of that are, so you always find it's a little more challenging or I think as an environmental, someone who is passionate about the environment in particular safe guarding it, making sure my kids and my grandkids can enjoy it as I've done, it's quite a challenge to connect with people, find the trigger that's going to change behaviour. It is identifying what's in it for them and you have to link it to the things going to the beach, breathing clean air and that sort of stuff you know.</p>
Environmental Compliance Manager	<p>#41Fa: I guess the industry's changed. If you go back twenty years ago nobody cared two-hoots about caring about the stuff into a stream or anything like that. And, as you got a whole lot of old guys in the industry it's hard to change them as well.</p>
Chief Executive Officer	<p>24Hc: And this is where I think environmental struggles. You have health and safety, then financial, then financial, then financial, and then down the bottom you have environmental. We have ISO14001 and it would be fair to say that we struggle to get traction</p>

Managers' Role	Example Quotes
	<p>in environmental management because people haven't made a connection with the financials, and there isn't the same, you know, you've got to keep your people safe with environmental management driver. So that's why there is probably less of a driver for our managers to really take up the challenge and run with the environmental thing.</p> <p>And certainly the lower down you go in the organisation, interestingly, I mean I have this belief that whatever you do to a person, it's going to do one of two things. It's going to make their day darker or it's going to make their day lighter. Okay? So when I say, right we're going to do environmental management, everyone can only see the negative side. So it's actually going to make their day darker.</p> <p>By making their day darker, basically it means we're going to make their day more difficult, it's going to take more work to do your job. Now with health and safety it has that impact as well. We're trying to change people around, but there is such strong legislation around it that you can't afford not to do it. So not doing it will make your day even darker when it goes wrong. So environmental management in this organisation, and I would say in the whole industry, is just more compliance. So therefore it's just more work for people, so therefore it's not going to get the traction. Until we make it, or we change it over to making your day lighter. What is the benefit, you know, how is it going to benefit you as an individual in this organisation to be responsible for environmental management?</p>
Chief Executive Officer	<p>#28Dc: They can understand health and safety because they can hurt themselves, but environmental is a huge culture change, you can no longer empty a truck load of, lets say ditch cleanings, anywhere you like. About ten years, you used to be able to, even less than that, you used to be able to, the guys, particularly the older guys, "We've always done that there's no problem. I haven't done anybody any harm", which is probably true. But you're not allowed to do it anymore, it's not in any particular resource consent, it's just one of those generic RMA things.</p>

Findings

The analysis found that road construction firms were motivated to pursue and adopt environmental sustainability initiatives for three reasons: legitimacy, competitiveness, and Corporate Citizenship.

- The motive of Legitimacy was associated with three outcomes: achieving and maintaining compliance, developing credibility with stakeholders, and building relationships with key stakeholders.
- The motive of Competitiveness was associated with achieving cost-reductions through the utilisation of a cheaper resource inputs or operational efficiencies. This motive was also associated with managerial perceptions that competitive advantage could be achieved through improved environmental reputation.
- The motive of Corporate Citizenship was associated with the fulfilment of corporate and managerial environmental values.

The above motives were not exclusive, such that initiatives were frequently pursued for one or more reasons. This is particularly true for the motive of Corporate Citizenship. In some

cases a road construction manager's environmental values played a role in initiating the manager's search for environmental sustainability opportunities. However, only those initiatives that were relatively easy for the firms to achieve were justified on the basis of environmental values alone e.g. Sustainability Reporting and ISO14001 in firm Aa. The remaining initiatives were linked to specific outcomes in relation to specific stakeholders (legitimacy in relation to regulators, and competitiveness in relation to clients).

The analysis identified six factors which influenced the adoption of environmental sustainability initiatives in road construction firms. These are:

- Organisational context
- Lack of incentives from clients
- Conservatism of clients and engineering consultants
- Costs and subsidies
- Employee attitudes
- Information and knowledge

Recycling of waste materials was a key initiative that the case study firms investigated to reduce production costs. The analysis revealed that the viability of waste recycling was critically dependent on cost and reliability of waste streams. The relative availability, low cost, and high quality of virgin aggregates meant that the use of recycled materials was not cost-competitive when compared with traditional products. However, managers anticipated that given time policies and legislations would be enacted which would incentivise recycling initiatives. This anticipation may not have been unrealistic given trends internationally to mandate recycling and curb landfilling practices e.g. Japan (Tam et al. 2010; Tam 2009). Given this perception, several road construction firms pursued a strategy which involved stockpiling C&D wastes in order to generate the economies of scale necessary to develop cost-competitive alternatives. Firms also engaged in trials of alternative products in order to develop the technical data to support the reliability of their product, and to demonstrate their capabilities.

With respect to recycled asphalt, the analysis finds that recycled asphalt was economically attractive due to the high cost of bitumen. However, the technical capability required to recycle asphalt requires significant capital investments into an asphalt plant that is able to recycle asphalt. In cases of significant capital investments, the study suggests that firms may

realise opportunities where these align with the conventional investment cycles i.e. plant reaches end-of-life.

The analysis shows that there was a lack of financial incentives from clients for beyond-compliance environmental performance. Clients were not willing to pay more for environmentally sustainable products or methods when cheaper conventional products and methods were available. Clients were also not willing to recognise and reward firm investments into improved environmental performance and capabilities. In this context, road construction firms primarily sought to achieve competitive advantage through efficiency improvements or seeking to develop cost-competitive alternative materials.

However, there are risks associated with innovative and alternative road construction techniques. Clients are unwilling to accept these risks unless innovations and alternatives can be shown to be equivalent to the use of traditionally-used materials and techniques. Risks around long-term performance of materials are managed through compliance with technical specifications. These specifications represent “obligatory points of passage” with respect to the acceptance of new materials and construction techniques by clients. Consulting engineers who write the technical specifications had been recognised as critical allies in this regard.

Road construction firms also pursued initiatives to improve their environmental track record and management skills with respect to the environment. The primary initiative in this regard was ISO14001. The case study firms expressed a motivation to achieve competitive advantage by demonstrating a higher level of environmental care. However, the analysis showed that this advantage could not be realised because of the road-controlling authorities’ unwillingness to reward environmental performance in the procurement process. The fact that the road construction firms sustained the adoption of these costly EMS was found to be due to the benefits that these systems offered with respect to maintaining regulatory compliance.

Claims by some firms that they adopted certain initiatives (i.e. Enviromark, ISO14001, energy minimisation) in order to develop credibility with stakeholders were found to be relatively weak since those initiatives were also associated with expectations of eco-efficiencies. One might question whether these initiatives would have been pursued and adopted had these eco-efficiency benefits not been expected. The analysis also highlighted that seeking greater credibility with stakeholders can be risky for firms due to the unwanted attention it can create. One firm chose to become a member of the SBN to enhance its environmental reputation and develop greater credibility with stakeholders. In this case, the publicity and enhanced environmental reputation of the firm led to greater scrutiny by the

environmental regulator. This highlights the importance for firms to be genuine in their engagement with environmental sustainability.

Environmental initiatives can require significant investments, and can involve substantial hidden costs. Subsidies from government and interest groups can enable firms to engage in practices which would not normally take place.

Employee attitudes were identified as a challenge to improved environmental performance. Managers noted that employees were slow to change habits, and that they did not perceive environmental issues to be as important as other priorities such as health and safety. Acquiring data about environmental performance, hiring employees with environmental knowledge and expertise, and training and education programs were identified as key enablers in this regard.

The following conclusions are made:

- Managers' environmental values can lead them to seek opportunities to address environmental sustainability.
- When the initiatives involve significant costs and resources, the initiative will be oriented to specific stakeholders. In the context of this industry this refers to the clients and environmental regulators.
- If the initiatives are more expensive than the client is willing to pay, then firms may adopt a strategy of waiting until they can develop a cost-competitive advantage.
- Firms will pursue initiatives that facilitate continued environmental compliance, even where those initiatives are costly and the client is unwilling to reward the firm competitively.
- Initiatives that require a degree of investment and resources to set up, but which are expected to lead to greater efficiency improvements are justified on the basis that they make good business sense.
- Firms may pursue initiatives to improve their credibility with a broad range of stakeholders, however, there are risks associated with pursuing greater environmental reputation.

Theoretical Model of Firm Greening in the Road construction Industry

Figure 7 (p.123) and Table 22 (p.124) present a conceptual model of greening behaviour in road construction firms in New Zealand. The model has been inductively derived from the empirical data and analysis in this chapter and integrates theory and findings from the literature on firm greening (see Chapter 3). The model generates explanations of firm greening through three elements: motivations, internal influencing factors, and external influencing factors. Table 22 defines the model elements in further detail with reference to the literature and to the empirical findings of this study. Table 23 compares the model presented here with previously published models of firm greening. The paragraphs below summarise and discuss the model structure in relation to previous models. Note, that the model of firm-greening presented here has not been externally validated. The model's categories and their relationships were induced from the empirical data set itself. The model of firm-greening is a product of a theory building exercise. Testing of the model could be addressed through further research.

A motivation is defined as a strategic outcome which is sought by the firm. Specifically, the model proposed here takes the view that, in the context of achieving a firm's strategic mission, the firm will seek to adopt environmental initiatives to fulfil one or more of the following strategic outcomes:

- **Competitiveness:** the motivation to sustain profits, fulfilled by achieving competitive advantage and efficiency of production.
- **Legitimacy:** the motivation to do what is right with respect to the normative standards that external stakeholders expect to be upheld, primarily fulfilled through compliance with relevant standards and regulations.
- **Corporate Citizenship:** the motivation of the firm's directors, managers and employees to do what is right with respect to their own values and those of the firm, fulfilled by engaging in activities which fit with the firm's value system and beliefs about how it ought to operate within society.

Others have used the term driver rather than motivation (e.g. Mair and Jago 2010; Marshall et al. 2005; Qi et al. 2010). However, this element has not been consistently defined in previous models, often mixing up internal firm motivations (e.g. competitive advantage), external forces exerted on the firm (e.g. regulation or stakeholder pressure), and internal features of the firm (e.g. presence of CSR policy). For example, drivers identified in other firm-greening

models include compliance with current regulation, and pre-emption of future regulation (Marshall et al. 2005), desire to delay or avoid regulatory action (Lynes and Andrachuk 2008), and environmental regulations (Qi et al. 2010). These codes reflect the higher level motivation of legitimacy used here, while environmental regulation reflects the specific type of force exerted by a stakeholder (i.e. the government). Similarly, Marshall et al. (2005) refer to cost-savings and community groups as drivers of proactive firm-greening. However, cost-savings is an outcome, categorised here under the motivation of competitiveness, while community groups are a type of stakeholder. The use, here, of the term motivation, and its definition in terms of the strategic outcomes sought by the firm resolves such inconsistencies. The three motivations identified here align closely with those identified by Bansal and Roth (2000), and are likely to be common across industries.

An influencing factor is defined here as something which influences the capacity of the firm to successfully adopt an initiative. Internal factors are characteristics, capabilities, and resources over which the firm has control. External factors are forces exerted on the firm by external stakeholders, or other factors arising outside the firm over which the firm has no control. Whereas others have differentiated between constraining and enabling factors (Mair and Jago 2010), the model proposed here allows that a factor may be incentivising, enabling or constraining depending on context. For example, in this study, financial rewards were an enabling incentive in the case of subsidies offered by external stakeholders, while client's unwillingness to financially reward environmental performance was a disincentive. Similarly, information and knowledge can be either enabling or constraining for firm-greening. This study found that some road construction firms lacked data (information) on their environmental performance, such as data on the amount of energy used. This lack of information was a constraint because managers were unable to develop robust business cases to justify investments into the adoption of energy saving initiatives. Conversely, in another case, information on the technical reliability of asphalt products enabled a firm to convince clients and engineering consultants to accept the use of recycled asphalt.

Where there were no incentivising factors present (e.g. financial rewards, regulatory pressures), the justification for adopting initiatives was weak. For instance, although the search for environmental initiatives by road construction firms in this study was frequently initiated by a values motive, Corporate Citizenship was not a strong driver of action because it was not linked to specific tangible incentives. Nearly all of the initiatives that were associated with the Corporate Citizenship motive were also associated with either legitimacy or competitiveness, and the expectation of tangible returns for the firm.

Significant incentivising factors in this regard were regulators' actions around environmental compliance (e.g. issuing infringement notices), and the clients' procurement mechanisms. Several case study firms adopted EMS to mitigate risks around non-compliance in response to regulators' actions. Similarly, there was strong justification for the firms to seek cost savings in materials or process efficiencies because price was key to competitive advantage.

Previously published models of firm greening include another category of factors not identified in this study. For example, Bansal and Roth (2000) identify field cohesion, Lynes and Andrachuk (2008) identify market/political-institutional/scientific/social systems, while Mair and Jago (2010) identify characteristics such as business type and size. These factors represent statistical relationships and patterns which may exist between variables. This study did not seek to collect that kind of information. Rather it sought to identify the proximate (i.e. causal) reasons why road construction firms adopt environmental initiatives, based on qualitative data from a single industry.

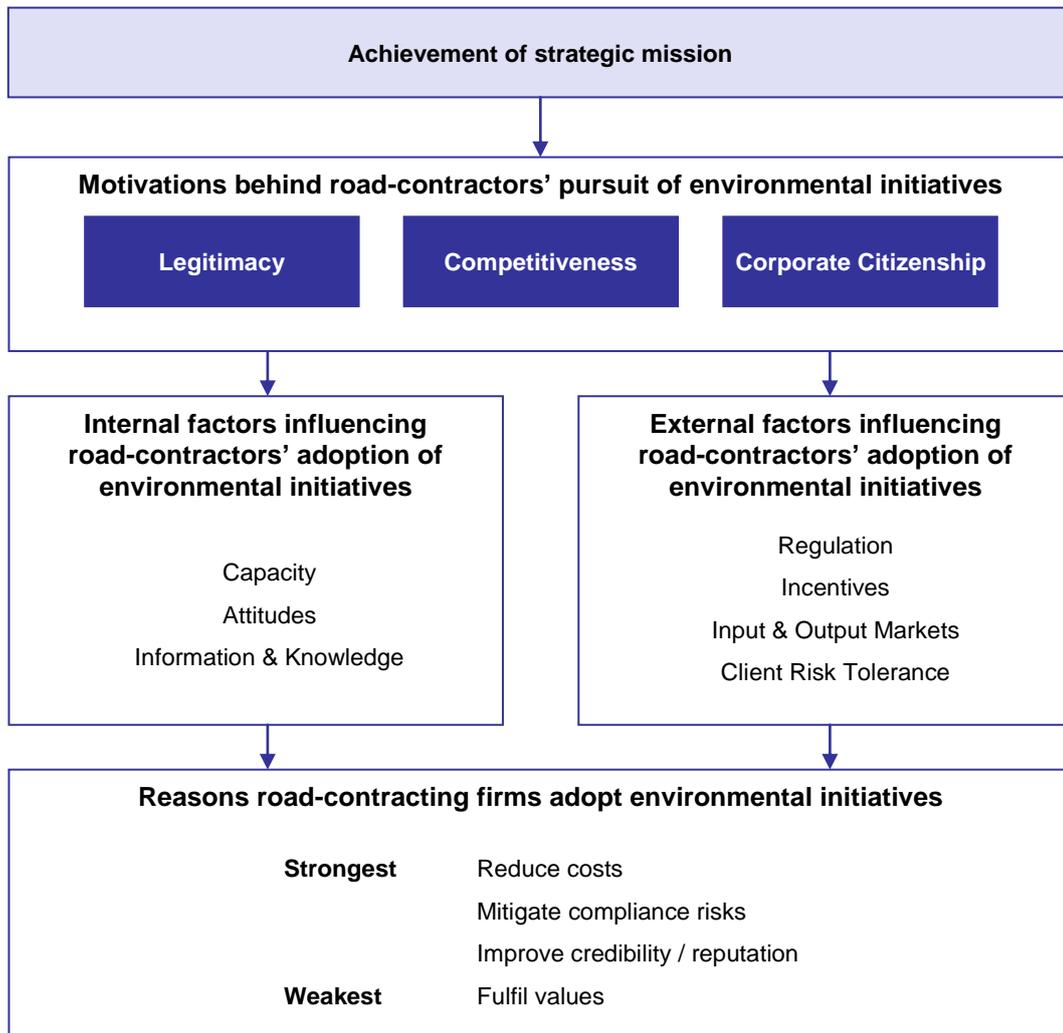


Figure 7. Conceptual Model of Firm-greening Behaviour by Road construction Firms in New Zealand

Table 22. Firm-greening model

Model Element (Type)	Description	Findings from this study
Competitiveness (Motivation)	The competitiveness motivation is about sustaining profits. It is fulfilled by achieving and maintaining competitive advantage, and by improving efficiency of production (Hart 1995; Porter and van der Linde 1995; Shrivastava 1995; Russo and Fouts 1997). This motivation is oriented towards a firm's shareholders (to whom profits accrue), customers (from which revenue is derived), and competitors (who define the state-of-the-art in product or service delivery).	Environmental initiatives associated with achieving cost-reductions through the utilisation of a cheaper resource inputs or operational efficiencies included energy minimisation, asphalt recycling, and construction and demolition waste recycling. The adoption of an environmental management system by one firm was associated with managerial perceptions that competitive advantage could be achieved through improved environmental reputation.
Legitimacy (Motivation)	The legitimacy motivation is about the firm's desire to do what is right with respect to the normative standards that external stakeholders expect to be upheld (Suchman 1995; Bansal and Roth 2000). Legitimacy is achieved through compliance with relevant standards and regulations, or building credibility by adopting acknowledged best practices, gaining membership in industry networks, or supporting worth-while causes (Dowling and Pfeffer 1975; DiMaggio and Powell 1983; Bansal and Roth 2000). The legitimacy driver is oriented primarily towards government and community stakeholders.	Environmental initiatives were associated with achieving and maintaining compliance (ISO14001, internally developed EMS), developing credibility with stakeholders (membership and participation in industry networks or accredited environmental programmes), and building relationships with key stakeholders (relationship-building with regulators).
Corporate Citizenship (Motivation)	This motivation is about the desire of the firm's directors, managers and employees to do what is right with respect to their own values and those of the firm (Carroll 1998; Marsden 2000; Rondinelli and Berry 2000). The firm fulfils this motivation by engaging in activities which fit with the firm's value system and beliefs about how it ought to operate within society (Rondinelli and Berry 2000). The Corporate Citizenship driver is oriented towards the firm's people.	Environmental initiatives associated with the fulfilment of corporate and managerial environmental values included the adoption of ISO14001 environmental management systems, the development and publication of Sustainability Reports, and the adoption of energy minimisation and C&D recycling. Construction firms also engaged in a range of discretionary philanthropic behaviours such as funding wildlife parks and student scholarships, and building infrastructure for local communities.
Capacity Internal Factor)	The capacity of the firm to allocate resources to the development of an initiative. This may include financial resources (Sharma 2000), plant, equipment, and systems (Sharma and Vredenburg 1998; Christmann 2000; Khanna, Deltas et al. 2009), materials and supplies, and people. Capacity is an enabling factor for environmental proactiveness. It is a function of timing of investment cycles, project lifecycles, or relative to external events.	A number of firms stockpiled construction and demolition waste in order to develop a viable resource supply. A proposal to develop asphalt recycling capabilities in one firm was viable because of fortunate timing with respect to a larger asset replacement decision.
Attitudes (Internal Factor)	The attitudes of a firms people toward the environment, including directors, managers, and employees (Andersson and Bateman 2000; Bansal and Roth 2000; Lee and Ball 2003; Fraj-Andres, Martinez-Salinas et al. 2009, Porter 2006). Positive attitudes and commitment to the environment are an enabling factor for environmental proactiveness (Sharma 2000, Collins, Roper et al 2010, Cordano and Frieze 2000).	Managers expressed positive attitudes and commitment toward the environment. In a number of cases, managerial values initiated the search for environmental initiatives. Employee attitudes, particularly perceptions that the environment was not as important as health and safety, were identified as a barrier to change by managers.

Model Element (Type)	Description	Findings from this study
Information and Knowledge (Internal Factor)	The availability of information and knowledge, including information on environmental performance (Henriques and Sadorsky 1996; Collins, Roper et al. 2010), awareness and knowledge of systems, tools and practices (Kein, Ofori et al. 1999; Shen and Tam 2002; Adetunji, Price et al. 2003), and experience with new materials or construction methods (Shen and Tam 2002; Tam, Kotrayothar et al. 2009; Tam 2009; Tam, Tam et al. 2010). Information, knowledge, and experience are enabling factors for environmental proactiveness.	Managers identified information and knowledge as key enablers of action with respect to environmental sustainability, particularly reliable data on environmental performance, training and education, and data on the performance of alternative construction materials.
Regulation (External Factor)	The existence of environmental regulations (Adetunji, Price et al. 2003; Fergusson and Langford 2006, Blum-Kusterer and Hussain 2001; Williamson, Lynch-Wood et al. 2006, Kein, Ofori et al. 1999, Tam 2009) and regulatory pressure, including regulatory inspections (Khanna and Anton 2002), directors/officers liability (Sharma and Henriques 2005), anticipation of future regulation (Khanna, Deltas et al. 2009), or indirect pressures (Reid and Toffel 2009). Regulation is force to which firms respond (Henriques and Sadorsky 1996).	The mitigation of compliance risk was a primary reason for the adoption of environmental initiatives by road construction firms.
Incentives & Support (External Factor)	The existence of incentives from clients or other stakeholders to undertake environmental initiatives, including financial incentives or subsidies, and support or endorsement of environmental programmes (Delmas 2002). The absence of incentives or support is a barrier to environmental innovation (Kein, Ofori et al. 1999; Tse 2001; Shen and Tam 2002; Ofori, Briffett et al. 2000).	The availability of subsidies supported the investigation of environmental initiatives in two cases. In one region, a levy on the disposal of construction and demolition waste provided incentive for firms to develop recycling capabilities. The lack of willingness from public sector clients to procure environmental outcomes or performance in road works was a key challenge for road construction firms.
Input & Output Markets (External Factor)	The availability, reliability, quality, and cost of requisite inputs, and the availability, reliability, quality, and cost of competing products. The availability of requisite inputs at competitive rates is an enabling factor for environmental innovation. The availability and cost of competing products define the requirements for competitiveness in the market (e.g. Hyder Consulting et al. 2011; Kartam et al. 2004).	The availability and cost of waste resource streams, such as construction and demolition waste and waste oil, were enablers of environmental initiatives in some firms. Aggregates made from construction and demolition waste were not competitive with virgin and marginal aggregates which were widely available at low cost. The high cost of bitumen was an incentive for asphalt recycling.
Client Risk Tolerance (External Factor)	Client tolerance for risk associated with innovative construction materials and techniques. Conservative behaviour is a barrier to environmental innovation (Adetunji, Price et al. 2003, Lim and Ofori 2007). Technical specifications are a primary mechanism for controlling risk (Adetunji, Price et al. 2003, Rao, Jha et al. 2007; Tam, Kotrayothar et al. 2009; Tam 2009; Hyder Consulting, Encycle Consulting et al. 2011).	Clients and engineering consultants were averse to accepting risks associated with recycled materials. One road construction firm was working towards proving the acceptability recycled asphalt mixes against the relevant technical specifications.

Table 23. Comparison of conceptual firm-greening models

Model Element (Type)	Bansall & Roth 2000 Multi-sector (UK, Japan)	Marshall et al. 2005 Wine industry (USA)	Lynes and Andrachuck (2008) Airline industry (Sweden)	Mair and Jago 2010 Business events tourism (Australia)	Qi, Shen et al. 2010 Construction (China)	Schafer 2012 Road Construction (NZ)
Drivers (Motivations)	<ul style="list-style-type: none"> Competitiveness Legitimation Environmental responsibility 	<p>Individual drivers:</p> <ul style="list-style-type: none"> Environmental values (primary) Employee welfare (primary) Cost savings (primary) Product quality (primary) <p>Institutional drivers:</p> <ul style="list-style-type: none"> Compliance with regulations (primary) Community groups (secondary) Market differentiation (secondary) Preemption of future regulation (secondary) 	<ul style="list-style-type: none"> Financial benefits Competitive advantage Image enhancement Stakeholder pressures Desire to delay or avoid regulatory action 	<p>Internal</p> <ul style="list-style-type: none"> Presence of an internal CSR policy <p>External</p> <ul style="list-style-type: none"> Competitive advantage Image enhancement Supply chain / customer CSR policy Hygiene factor 	<ul style="list-style-type: none"> Managerial concern Environmental regulations Project stakeholder pressure 	<ul style="list-style-type: none"> Legitimacy Competitiveness Corporate Citizenship
Internal factors	<ul style="list-style-type: none"> Individual concern: (managerial values and discretion) Issue salience: Certainty, transparency, emotivity 		<p>Catalysts:</p> <ul style="list-style-type: none"> Culture Financial position Internal leadership Other 	<p>Contextual factors:</p> <ul style="list-style-type: none"> Business type Business size Organisational values <p>Barriers</p> <ul style="list-style-type: none"> Lack of time Lack of resources Lack of knowledge/ awareness/skills Operational time frame <p>Catalysts</p> <ul style="list-style-type: none"> Culture Eco-champion 		<ul style="list-style-type: none"> Capacity Attitudes Information and knowledge
External Factors	<ul style="list-style-type: none"> Organisational field cohesion: Firm proximity and interconnectedness 		<ul style="list-style-type: none"> Markets Science Social system Political system Other external influences Sector-specific influences 	<p>Contextual factors</p> <ul style="list-style-type: none"> Industry sector Economic situation Consumer trends Available technology Political leadership <p>Catalysts</p> <ul style="list-style-type: none"> Media 		<ul style="list-style-type: none"> Regulation Incentives Input & Output Markets Client Risk Tolerance

Chapter 5

Funding & Procurement of Environmental Outcomes in Road-works

Sustainability is kind of the air that we breathe in local government. It's kinda fundamental to all of the decisions that we make, and those in more recent times. That's been codified in the Local Government Act in the context of the four-well beings. So, those are the parameters that we consider whenever we make decisions. So, that's the social, environmental, financial, cultural aspects. So, those parameters are inherent in all of the decision making that we make.

Quote from General Manager for Infrastructure

Local government road-controlling authorities were required to address sustainable development as set out in the LGA 2002. The LGA 2002 required all local governments (including all councils that are road-controlling authorities) to ensure that local development is undertaken in a sustainable manner. The LGA 2002 increased the responsibilities of local authorities to:

- a) meet community needs and preferences; and
- b) promote social, cultural, environmental and economic well-being and adopt a sustainable development approach.

Source: (LGA 2002, s 3d; LGNZ 2005)

Local governments were demonstrating varying degrees of progress with respect to institutionalising the requirements of the LGA 2002, as evidenced by the above quote and references to sustainability in policies and reports (see Table 24, p.128). However, Chapter 4 showed that road construction managers felt that their public sector clients were not providing the necessary incentives to facilitate the pursuit of environmental sustainability in road construction firms. The road construction managers identified that their clients were

unwilling to pay more for environmentally sustainable outcomes, and that they did not reward firms for environmental performance as part of the non-price attributes during the tendering process.

Following the grounded theory approach, interviews were conducted with local road-controlling authorities to examine the question of why these authorities were not prioritising environmental outcomes in the procurement of road works. Interestingly, the local road-controlling authority managers interviewed for the research did not identify the various procurement methods as being a limiting factor with respect to procuring more environmentally sustainable outcomes. Rather, the research participants emphasised their operating contexts and the federal funding regime as the limiting factor in this regard. This chapter examines the issues that the local road-controlling authorities were facing from their organisational context, and Land Transport New Zealand’s (LTNZ) funding and procurement regime. The discussion is framed by a conceptual model which explains the procurement of environmental outcomes in road works as a strategic response to the road controlling authority’s motivating drivers and pressures exerted by stakeholders. The response is moderated by a range of factors which influence the authority’s ability to prioritise environmental outcomes in procurement. The model is inductively derived from the empirical data presented here and the review of green public procurement literature in Chapter 3. The model is presented in Figure 7 (p.156).

Table 24. “Sustainability” in local road-controlling authorities

RCA	“Sustainability” in Annual Reports/ Asset Management Plans	Environmental Policy?	Sustainability Report?	Sustainable Procurement Policy	Description
Christchurch City Council	✓	✓	✓	✓	Buy local or buy recycled where appropriate and cost-effective.
North Shore City Council	✓	✓	✓	✗	Procurement based on best value based on whole of life cost
Tauranga city Council	✓	✗	✗	✗	Procurement based on best value for money based on whole of life cost
Rodney District City Council	✓	✗	✗	✗	Policy commitment to sustainability.

Constraints on Local Government Prioritisation of Environmental Outcomes in Road Works

The public sector has always faced increasing demands on their limited budgets (Gill and Frame 1990). The local road-controlling authorities operating in 2007 were subject to a number of common competing pressures which influenced their willingness to prioritise the procurement of beyond-compliance environmental outcomes. These were fiscal constraints, competing asset management priorities, and pressures to deliver higher levels of services.

Fiscal Constraints

Local road-controlling authorities faced pressures to keep costs under control from the ratepayers (bottom-up; see Table 25, p.130). Rate increases are generally unpopular with ratepayers, as evidenced by the “rates revolt” in the Auckland region in 2006 (LGNZ 2005; Orsman 2006). Ratepayers can exert pressures on councils through the electoral process, and directly in their interactions with council staff members.

Local road-controlling authorities also faced significant pressures from LTNZ to keep costs down. Significant intergovernmental fiscal transfers were, and are still, occurring between LTNZ and local government. At the time this research was undertaken road works were funded through a mixture of local council rates (57%) and federal subsidy from LTNZ (43%). While local government spent \$757 million into transport and roads in the years 2006/2007 (LGNZ 2007), central government allocated \$2.3 billion for the land transport system (including roads and other transport methods) for the same period (MOT 2006b). This represents a significant degree of expenditure by both local government and LTNZ and highlights requirements for effective oversight to ensure that the funding is spent appropriately (Conway 2012). In this regard, local government was accountable not only to local ratepayers but also LTNZ for transport expenditures. This accountability was effected through the LTNZ funding process, and through an assurance regime which included audits of local authority projects and reviews of local authority asset management practices. This is illustrated by the following quote from an Asset Manager, which highlights the pressures he was under to justify spending increases to LTNZ:

#37: The manuals are about that thick and we get audited every three years on those manuals to comply with them. We get technical audits. Land Transport auditors come up to our office and they audit our procedures, technical reviews and financial procedures reviews. So, you know, we have

to stick to those to get financial assistance .We definitely have to stick to those manuals.

We make an application every year, but we come under quite considerable scrutiny every year from the Land Transport. Staff and even X comes up occasionally and goes through it and we have to justify every dollar just about to X. We have a high growth, we have an ageing network and our aggregates are sort of marginal and, you know, gets a bit frustrating you have to explain to X well why the maintenance budgets going up every year.

Table 25. Fiscal constraint

Fiscal pressures	Description	Example Quotes
From ratepayers	Local councils are under pressure from ratepayers to keep rate increases down. This translates into pressures to keep internal council costs down.	#07: Expectations here are really high. You have a central ratepayers group here. They bang the table, “we pay the rates”. We’ve got quite an aggressive group up which I spend a lot of time because they get out of control terribly. Some of them are good people, but when they get in there and they have the power they want this. My job up here has been to educate the people how the system works, how much work they do each month, the costs, the budgets, that’s the system.
		#16: There is no client, contractor, no consultant, no, no owner who is going to spend more money just for this fun of it. So, it has to be both cost-cutting as well as environmentally friendly. No ratepayer is going to say I’m going to pay more rates because I want to save the world.
		#18: Councils often work under a lot of pressure in terms of our funding, you know, for example, you would have heard calls to reduce rate rises by the communities, a lot of concern about the increases in council’s cost, most of these costs, those increases are associated with infrastructure investment.
From LTNZ	Local councils are under pressure from LTNZ to keep their costs low.	#18: Land Transport New Zealand, that’s right, they’re saying we haven’t got enough money, we can’t fund all of your programme, we’re saying hang on a minute that’s what’s required, we’ve done the analysis.
		#18: The pressures we’re getting at the moment is to reduce the subsidy on those activities, the government’s saying there’s not enough money to go around. It’s, that’s what we’re being told and they are, they want to cut their contributions to those activities, and so the temptations then for councils will be to reduce the levels of renewals, and as you do that then your maintenance spending starts going up as you reduce your planned stuff, your reactive things start going up, and so you get more potholes and things in your roads, as a consequence of that, so that’s one of the pressures there.

Competing Asset Management Priorities

Local councils were responsible for the development and management of a wide range of infrastructure including roads, water and wastewater, stormwater, parks and recreational facilities, and libraries and cultural facilities. There was competition amongst council departments for available funds. The division responsible for the development and management of the road-network was just one of a number of departments competing for a slice of the asset management pie. As one Asset Manager (#37) commented, *“the ability to pay for it, you know, in a local authority with roading budgets, we’re up against the parks and reserves budgets, water, stormwater budget, all fighting for the same dollar.”*

Councils faced a range of challenges with respect to the management of their infrastructure, which were a function of local circumstances and the history of investment (LGNZ 2005). Between 1980 and 2000, New Zealand underwent a period of significant underinvestment in the nation’s infrastructure (MOT 2006b; NBR 2006; NIU 2010). By the 2000s investment in the New Zealand transport infrastructure had increased as there was a recognition that there was a need to do so (NIU 2010). However, local road-controlling authorities were faced with managing an ageing infrastructure that was requiring significant investments to renew. This is illustrated by one Asset Manager’s comment about his perception of a general under-investment in infrastructure across New Zealand:

#13: A lot of assets were left and weren’t kept up to standard. And then there’s a lot of underinvestment in infrastructure across the country. People didn’t have enough funds, so the rate, the council come in they keep the rates down, they wouldn’t spend the money. They don’t have that freedom anymore. So council was making the decision what was best for the roads, ignoring, that’s when they got do your best and you couldn’t get it all done. Now, at least we’ve got enough funding to renew, keep our assets in a reasonable standard, and we have measures, and Land Transport New Zealand do audits to check that all the authorities are looking after their assets in appropriate manner. So, there are some audits that carry on.

Changes in population level also drive public sector spending on renewing, maintaining, expanding the capacity of infrastructure in order to meet population pressures. All the local road-controlling authorities included in this study were anticipating future population growth (see Table 26, p.132). Population growth drives the expansion of urban areas, and leads to

transitions from rural to semi-rural lifestyle developments. These changes present challenges due to changing expectations about levels of service.

Some road-controlling authorities faced an affordability issue, in that their rateable populations were distributed across large geographical areas (low population density) (LGNZ 2005). This meant that the per-person costs of providing services to those distributed population centres were relatively high (LGNZ 2005). For example, Rodney District Council comprised 46% of Auckland total land area, but had 7% of the population (Rodney District Council 2009). The council managed a network that was 1693km in length, which made it the largest road network in the Auckland Region (LTNZ 2006). However, its rateable population density was low making it difficult to finance the large road network. The issue facing these types of councils was illustrated by a General Manager (not from Rodney District Council) as follows:

#18: I mean, the circumstances vary tremendously between councils, I mean when you're looking at smaller rural councils there's a tremendous challenge in terms of trying to maintain your basic infrastructure. You've got a huge network. You've got a very low funding base. You've really got to eek out every penny that you've got.

Table 26. Road-controlling authorities - road network & population statistics

Road-controlling Authority	Length of road-network (km) ¹	Population ²	Population increase ²	Population Difference ²
Christchurch City Council	2269.1	361,800	424,000	62,000
Rodney District Council	1693.3	92,400	139,900	47,500
North Shore City Council	680.3	216,900	291,000	74,100
Tauranga City Council	495.1	106,900	155,300	48,300

Sources: ¹(LTNZ 2006), ²(Statistics New Zealand 2006)

Rodney District Council was also facing significant pressures due to population mobility. A Project Manager in Rodney District complained that their infrastructure had to cope with significant population movements as a result of proximity to Auckland (i.e. Aucklanders travelling up to Rodney for holidays/recreation):

#07: It's a headache because we've got more regional parks in Rodney than any other area in New Zealand. It's not that we don't want to seal those roads. The other thing is when we put our traffic counts in they have to reach 250 or 300 per day on a normal working day to come into an area where we can get funding to do a first coat seal. We're the second highest funded local

body in New Zealand. We're only just behind Auckland City, we used to be the highest funded. Being so close to Auckland, people just come up here. So, we try and qualify for 42% of the total cost of a contract and to do that now, we've got to go through certain criteria and those little boxes have got to have ticks. In general you start off with a traffic count, there's got to be a damn good reason you want to do a kilometre of road.

Rising Level of Service Expectations

Local road-controlling authorities faced rising expectations with respect to compliance and levels of service, whether for quieter pavements, safer roads, or less disruption/congestion:

#13: Coming back to yeah environmental things, we're, we've got to get the work done, and often you've got to do for minimum price and minimum disruption and still adhering to safety things, and all the time there's new standards coming out, higher standards for the environment, higher standards for sustainability, higher standards for this, more prevalence for that. We've got to balance all those things.

For example, pavements in newer Tauranga City subdivisions were frequently hot-mix asphalt, compared to older parts of the city which were chipseal. Tauranga City Council's Ten Year Plan document showed that since 1993 developers were applying a higher standard of surfacing on new subdivisions (Tauranga City Council 2006). Since the council traditionally adopted a "like-for-like" approach to resealing (Tauranga City Council 2006) this meant that the council was committed to providing these higher levels of service on an ongoing basis, which had significant cost implications, as one Asset Manager (#37) commented:

So you know people's expectations are smoother, quieter roads – asphalt. But Land Transports saying "no, no stick to chipseals, or if you want to pay the difference..." That's where the other dollar comes back into it again, you know, chipseal versus asphalts, about four to five times the cost.

Rodney District Council faced similar issues because they operated a very large unsealed road network (715km of unsealed roads) (Rodney District Council 2009). Population growth and changing population patterns were increasing the demand for sealed roads and, therefore,

the council's asset management costs (Rodney District Council 2006). The Project Manager's comments illustrate the problem the district was facing in this regard:

#07: We've just got so many blimming unsealed roads, I think it just tells you really the people up here what they expect now, the bars lifted all the time, and we're grading more roads than we've ever done before. I mean when you had the old farmer up the road, we'd seal that road maybe every six months and he was happy, but now the farmers have sold how, the ten acre block Queen Street people, call them Jafa's or whatever you like, they buy their dream block, build their home, their kids ride the ponies, and she wants the school bus here tomorrow, and he wants that corner cut, it's all about that, very much so in rural areas.

Responses from road-controlling authority managers' responses indicated that environmental outcomes were not viewed as the highest priority, especially relative to safety issues (see Table 27). They found it difficult to justify additional spending on environmental outcomes given the focus on economic efficiency (see section on the funding regime), but did not experience the same challenges in obtaining funding to address health and safety concerns. The relative priority attributed to safety concerns may be seen as the effect of a lengthy period of regulatory and cultural attention to health and safety, stemming from the introduction of the Health and Safety in Employment Act 1992.

Table 27. Environment versus safety

Environment	Safety
<p>#16: There is no client, contractor, no consultant, no, no owner who is going to spend more money just for the fun of it. SO, it has to be both cost-cutting as well as environmentally friendly. No ratepayer is going to say I'm going to pay more rates because I want to save the world.</p>	<p>#26: So, I mean there was a whole modal shift where businesses were coming on board because I never, ever, ever got chastised for budget blowouts when it was to do with safety. If I said I'm actually going to need another, I don't know, 40-tonne crane to do this because of, not a problem. And you'd go to the client, 'sorry we've got this', 'not a problem'.</p> <p>#13: Environmental and sustainability issues these are only just coming up to the fore because previously it was safety, safety of the road-workers and we've got strong code of practice now for traffic safety measures, traffic control that sort of thing, that's really embedded in and quite standard, very expensive, we have to pay a lot of money now for barriers and that sort of thing. So, you know that's rolling and that's just a given cost these days.</p>

The LTNZ Funding Regime

Managers from the road-controlling authorities identified the LTNZ funding regime as another constraint on their ability to consider beyond-compliance environmental outcomes. In order to contextualise their concerns, this section begins by first examining the rules and procedures surrounding the funding of road-works in New Zealand in 2007.

Road-controlling authorities (both local councils and TNZ) are funded by LTNZ. In order to qualify and secure funding from LTNZ, road-controlling authorities have to follow the rules and procedures set forth by LTNZ. Local councils obtain a minimum of 43% of their funding requirements from LTNZ, with the remainder sourced from local rates (Land Transport New Zealand 2006b, p. 2-3). The amount of financial assistance varies from one council to another and is determined according to the size of the councils land transport programme and the financial resources available to the council (Land Transport New Zealand 2006b, p. 3-3). TNZ receives its funding entirely from LTNZ (Land Transport New Zealand 2006b, p. 3-8).

In funding proposed road works, the LTMA 2003 requires LTNZ to take into account how the proposed works:

- Assist economic development
- Assist safety and personal security
- Improve access and mobility
- Protects and promotes public health
- **Ensures environmental sustainability**

Source: (Land Transport New Zealand 2006b, p.5-15)

Each financial year, every road-controlling authority is required to develop a land transport programme (LTP) for the following year (Land Transport New Zealand 2006b, p.5-2). The LTP is expected to include information on road works for which funding is sought. It is also expected to be consistent with, and show how, the proposed road works contribute to the above objectives. LTNZ provided federal funding for two primary categories of road works in NZ:

- Funding for the maintenance, operation, and renewal of road works
- Funding for new roads or growth/enhancement works

Maintenance and operation of roads, and renewal of roads are packaged together to form a programme of works that the road-controlling authority intends to undertake (Land Transport

New Zealand 2006b, p.6-18). Each year, road works that do not qualify under the maintenance and operation category are evaluated to see if they fit into the renewal category. In instances where the work proposed does not fall into the maintenance and operation or renewal category, it is categorised as a capital improvement project. Maintenance and operation of roads is limited to activities pertaining to the routine care of roads and associated assets. For example, patching and repairing potholes, removal of litter/debris/graffiti from the road corridor, or repairing handrails and traffic signals. In contrast, works that fall under the renewal category relate to the planned periodic renewal of assets in the road corridor. For example, the renewal of pavement layers on a road, the repair and replacement of kerb and channel, and the replacement and restoration of strength to pavements. In each case, the renewal involves repairing or replacing an asset to its former agreed upon level of service. In cases where a road (or bridge) needs to be completely replaced and the replacement being of a higher level of service (e.g. reconstructing, widening, and deviation of a road) then that work is considered to be an improvement and falls under the capital works funding criteria. Similarly, the construction of entirely new roads as an addition to the existing road network falls under the improvement category.

Maintenance and operation, and renewal categories are funded under different evaluation criteria from new works or improvement projects. The latter types of works are evaluated as stand-alone projects using the procedures set out LTNZs Economic Evaluation Manual (EEM). Maintenance and operation, and renewal works are combined together to form a package which is set out in the road-controlling authorities' land transport program, and are evaluated using LTNZs Maintenance Guidelines for Local Roads Manual.

Funding and Evaluation of Maintenance and Renewal Works

The LTNZ Maintenance Guidelines for Local Roads Manual provides road-controlling authorities with LTNZ's approach to asset management. Road-controlling authorities can follow these guidelines as they set forth what LTNZ views as the most appropriate approach to managing a road-network. LTNZ evaluates road-controlling authorities' long-term plans on a range of information, such as the road-controlling authorities' asset management plan, asset inventory, condition, and cost reports of the network. LTNZ requires qualifying road-controlling authorities to show how their asset management approach balances the level of service expectations between routine maintenance, renewals and capital improvement works to achieve the lowest lifecycle costs (Land Transport New Zealand 2006b). The LTNZ maintenance and renewals managers analyse road-controlling authorities' asset management

plans, the underlying assumptions such as the expected future demands on the network, the conditions of the different aspects of the road network, and the projected network deterioration levels. They also evaluate the risk of the network deteriorating to below the specified level of service (Land Transport New Zealand 2006b). In addition, the assessment of funding requests includes the opportunity for road-controlling managers to indicate how their works (in terms of effectiveness and confidence) will contribute to minimising or mitigating impacts on sustainability (see Table 28).

Table 28. Sustainability assessment factors in PFM

Effects on Sustainability			
Minimises or mitigates impacts on:	Description	Effectiveness	Confidence
Landscape/townscape		H/M/L	H/M/L
Heritage of historic resources		H/M/L	H/M/L
Biodiversity		H/M/L	H/M/L
Noise and vibration		H/M/L	H/M/L
Air quality		H/M/L	H/M/L
Greenhouse gases		H/M/L	H/M/L
Water environment		H/M/L	H/M/L
Effect on non-renewable resources		H/M/L	H/M/L
Sources of evidence		H/M/L	H/M/L
Summary		H/M/L	H/M/L

Source: (Land Transport New Zealand 2006b, 6-31)

Funding and Evaluation of New Roads and Enhancement Works

Funding for new roads and enhancement works is evaluated using the procedures set out in the EEM. The EEM defined a detailed, multi-step process for calculating the economic efficiency of a project in terms of a monetised Benefit-Cost Ratio (BCR) in net present value (NPV) terms. The BCR is used as an indicator to rank projects where resources are constrained (NZ Transport Agency 2009, p.25). Each year the cut-off point for the BCR varies due to a range of factors, but is generally tied to the degree to which the budget at the funding agency is constrained (NZTA, 2009, p.25). The economic evaluation procedure requires the assessment of the costs and benefits of a range of options, including a “Do Minimum” option, over a 25 year time-frame. Table 29 (p.138) gives examples of the kinds of costs and benefits which might be evaluated for a project. The choice of costs (and benefits) to be included in the analysis is dependent upon the type of project being evaluated

(Land Transport New Zealand 2006a, p.2-10). A discount rate is applied to determine the Present Value (PV) costs and benefits of each option to be compared.

The evaluation seeks to quantify the benefits (and disbenefits) of a project in monetary terms. To facilitate this, the EEM provides procedures, formulae, and unit values for calculating the monetary value of a range impacts (see Table 30, p.139). These are impacts where monetary values have been derived from the marketplace (e.g., vehicle operating costs and the value of work travel time), or where a standard monetary value has been established through research and development (Land Transport New Zealand 2006a, p.14). For example, air pollution might be valued at \$40 per year per person exposed per mg increase in particulate matter (Land Transport New Zealand 2006a, p.5-115). Similarly, accident cost savings which can be understood as the monetary value assigned for preventing a car driver fatality as one benefit for which extensive research and detailed justification currently exists to support the chosen method of calculation. The evaluation also takes into account other external impacts of the project, for which monetary values have not been established, either because it is inappropriate or it has not been possible to establish a standard value (e.g. cultural, visual or ecological impacts) (Land Transport New Zealand 2006a, p.14).

Table 29. LTNZ examples of transport related benefits and costs

Benefits	Costs
travel time cost savings (including those gained from reduced traffic congestion and improved trip reliability) vehicle operating cost (VOC) savings accident cost savings comfort and productivity benefits from sealing an unsealed road driver frustration reduction benefits from passing options benefits from reducing or eliminating the risks of damage carbon dioxide reduction benefits other external benefits national strategic factors	planning, investigation and design fees costs of property required for the project construction costs, including preconstruction and supervision maintenance and renewal costs, including repair and reinstatement operating costs risk management costs external impact mitigation costs provisional costs contingencies

Source: LTNZ, 2006, p.3-8, 3-12

The manual states that environmental impacts are an important aspect of external impacts that may occur from road works. When developing projects, the emphasis is to

‘avoid to the extent reasonable in the circumstances, adverse effects on the environment by:

- reducing the negative impacts of the transport system on land, air, water, communities and ecosystems
- ensuring the transport system will make more efficient use of its resources, reduce its use of non-renewable resources, and shift over time from non-renewable to renewable resources .

Source: (Land Transport New Zealand 2006a, p.19)

Where the cost of a design feature to mitigate environmental effects is significant, then the EEM requires asset managers to distinguish whether the feature has been included due to a requirement under the RMA or whether the feature represents a beyond-compliance environmental outcome (Land Transport New Zealand 2006a, p.19). In the case where it is required to comply with legislation it becomes an integral part of the project costs, that is, it is a basic requirement of any option and the monetary cost becomes included in the cost-benefit analysis. Otherwise the additional works must be evaluated and justified in benefit-cost terms (Land Transport New Zealand 2006a, p.19).

Table 30. Guidance for calculating monetary value provided for in EEM

Information provided	Description	Examples
Monetary values provided	The EEM provides asset managers with procedures, formulae, or unit values for calculating monetary values	Travel time cost savings, Vehicle operating cost savings, Accident cost-savings, Comfort and productivity benefits from sealing an unsealed road, Driver frustration reduction benefits from passing options, Benefits from reducing risks of damage, Road noise, Vehicle emissions, National strategic factor
No monetary values are provided	The EEM does not provide asset managers with procedures, formulae, or unit values for calculating monetary values of impacts. Guidelines recommend that project reports indicate degree of impact as can be best established, either in general terms or quantitative where possible. It is also required that any incremental costs and benefits from mitigation measures to reduce impacts (or restoration measures) be included for comparison of costs and benefits.	Vibration, Water quality, Special areas, Ecological impact, Community severance, Overshadowing, Isolation

Constraints with Respect to Internalising Environmental Benefits in Road Works Evaluations

Following the passing of the LTMA into legislation in 2004, LTNZ revised its funding procedures and manuals to give effect to the requirements of the new Act. The revised procedures were made publicly available to the road construction industry in November 2006. (It should be noted that the interviews on which this research is based took place starting the third quarter of 2007.) Interviews with local council asset managers and managers from LTNZ identified that internalising environmental benefits in road works evaluations was constrained by the relatively low level to which the new procedures had been institutionalised within the industry. Technical issues around the calculation of environmental costs and benefits are also identified as constraints in this regard.

Degree of Institutionalisation of the New Evaluation Procedures

In principle, the revised project evaluation procedures enabled the internalisation of environmental (and social) costs and benefits into project evaluations (see the quotes from LTNZ managers in Table 31). However, the responses from local council asset managers revealed a continued powerful focus on achieving a high BCR in order to qualify for the LTNZ funding subsidy (see Table 32). Considerations of broader environmental and social outcomes were seen as risky due to the need for the LTNZ funding subsidy. Similar fears with respect to cost increases were shown by public and private-sector clients in the Swedish construction industry (Varnas et al. 2009). In their research, Varnas et al. (2009) found that the clients were limiting their request for environmental preferences for fear that it would increase project costs.

Table 31. Assertion that LTNZ manuals considered sustainability outcomes

Enabled in...	Example Quotes
Funding Manuals	#34: See the assessment process for road maintenance, renewals focuses on the following there's a number of things there, and one of those is innovation and sustainable practices, when selecting materials, maintenance method etc. So, even though, it's not right in your face that, you know, sustainability is a top priority, we, it's kind of filtering through there in a whole lot of things that we say.
	#49: Economic efficiency which is the, the factor that really comes into that, we have monetized impacts which are looking at those specific Land Transport benefits. They can bring in non-monetized impacts as well into that, there is nothing stopping any approved organisation bringing in [non-monetized impacts]. Because if there's a saving to be had that can be shown that it's a benefit to the nation or community, totally entitled to do that. There is absolutely nothing stopping

	<p>them from actually putting that in as part of the benefits. They need to do it from a, how to put it, a perspective of what is good for the nation and it obviously has to be netted off.</p> <p>#50: I would say that you look at the principles that the beginning that the economic evaluation manual, they talk about national economic costs and benefits, yeah, and national resource costs approach. So, that certainly doesn't say cars and trucks that use the facility only that says, how you build the facility too. Yeah, it says it takes that approach, therefore I believe it ought to be that holistic, okay. It ought to be that holistic. You could kinda argue that if anybody does an economic evaluation that doesn't kind of try to account for that is arguably not doing a complete evaluation.</p>
Procurement Manuals	<p>50: Supplier selection method. It talks about how you ought to be able, in the end, to give value to it, in other words, be prepared to pay a dollar premium for a superior supplier. For instance a supplier that has a record of not getting bluesies out of the regional council for a lack of environmental consent compliance, all right, in other words, you ought to be prepared to pay a premium to get such a superior supplier and it also goes on to say, and furthermore you ought to be prepared to pay a premium, well, for the example, effectively says, the example that we gave, ought to be prepared to pay a premium for a supplier that is going to deliver, going to produce less CO2. And you ought to also, ideally be prepared to consider alternative offers from suppliers. Alternatives that say, if we amend the design of this somehow it will have a better environmental outcome or social or whatever outcome. So, theoretically it's all there. Practically, I sometimes think we're a mile away.</p>

Table 32. Focus on Benefit-cost Ratio by RCA Managers

Managers	Example Quotes
Road-controlling Authority Managers	<p>#16: One of the main driver of the project is, I'll get funding, I can't do the project unless I get funding for the project from central government. My project costed \$160,000, my fund from central government will be 58% of that money. If I increase the cost, my benefit-cost ratio goes down, you know what it mean, benefit-cost ratio. So, if the benefit-cost ratio goes down, falls below the threshold I don't get any money for my project.</p> <p>They are saying that your project has a benefit-cost ratio of point eight. "I have one hundred applications sitting on my table with a benefit-cost ratio of more than two. So, why I should I fund your, give you priority, the pot of money is only so much, I can only fund projects which has a BC ratio of 1.5, below that it all gets cut off." So, to have a project viable I have to try and minimise the cost.</p>
	<p>#37: We get financial assistance from Land Transport New Zealand and the old, what they call the benefit-cost ratio kicks in and anything under say three to four we wouldn't get funding for, and I think, the, the idea is to replace the pavement every twenty-five years. It's cheaper that, either do a structural pavement, concrete would last a hundred years but the capital cost is about four, five times higher than, than the whole of life of the roundabout.</p>
LTNZ Manager	<p>49: It's a balancing act I suppose. The economic efficiency is still important and we would be concerned if projects came through which had BCR's of less than one for instance, and have to really look at those closely. But for ones that can show economic benefits greater than the cost, then the effectiveness part of it takes even more weight and, and sort of the tick marks that you give to things like recycling and so on.</p>

Historically, funding decisions in the road construction industry had been based on the BCR, where new road projects *needed to have a benefit four times the cost to achieve funding* (NIU 2010, p.55). One LTNZ manager suggested that the continued pre-occupation with the BCR

stemmed from the fact that it was until recently the dominant criteria by which road-controlling authorities' funding applications were evaluated:

#49: There's an awful lot of focus on this [BCR] part of it, and part of it is history. Cos prior to the Land Transport Management Act the criterion really for deciding whether or not a project would be undertaken was this, only economic efficiency! The BCR, and basically you had to get a BCR of greater than four.

Some of it I think is history, because it's only three years ago, let's face it, three, four years ago that there was this incredible focus on BCR. So, some of it's a legacy from that, but some of it will be that perhaps there's that perception, as you say, here's my square that I can stand in and I'm not allowed to actually put a foot outside of that. Well, they can. It's just a matter of making sure that there's a robust case.

Project evaluations were still predominantly based around the traditional main evaluation criteria: i.e. the physical construction costs, travel time cost savings, vehicle operating cost savings, and accident cost savings. While local road-controlling authority managers recognised that the assessment of road-works could be broader (i.e. a more complete whole-of-life cycle analysis) than what they had traditionally focussed on, such an approach was still considered unusual in practice. This is demonstrated in the following quote from an Asset Manager:

#33: I suppose if you started getting really technical, you know, a lot of the material that we cart now from X to Y, the landfill, gets carted on the roading network. So, you know, I suppose if you really wanted to get out in left-field you could say, well there is benefit to Land Transport in us using more recycled stuff like concrete. In that to save on their network, and they can save thousands of tonnes of materials being carted from here to X, then surely that must save the wear and tear on their network to some degree. So, think carbon, you know, carbon footprint and all the rest of it.

This highlights that, at the time the research interviews were undertaken, the practice of road works evaluations had not advanced significantly with respect to internalising environmental costs and benefits. While the LTMA had introduced a broader criteria set of for decision making, decisions on funding for transport still heavily on the BCR (MOT 2006a). The

interview responses are also suggestive of a knowledge gap between LTNZ (which developed and published the evaluation procedures) and the local road controlling authorities (who had to use them in practice). One LTNZ manager expressed frustration in this regard:

#50: I have had questions, only recently in a road controlling authority forum, out of a local authority person around whole of life and this person says, “*you know, ...somehow or rather we all have to accept that whole-of-life economics you know, is important and best value for money.*” And I’m thinking for god’s sake is the state of knowledge so poor that that’s considered to be a radical concept. It is considered by so many people to be radical and that says to us, oh my god, we really have to do some serious work here in the education area and so that’s one of the things that we’ve got to sort out.

The quotes illustrate that even though the transport sector had recognised that value for money would be achieved by consideration of the whole-of-life costs and benefits, the degree of awareness and practice varied throughout the sector. An investigation into the U.K. public sector in 2006, found that procurement practices also failed to adequately undertake whole of life cycle analysis (DEFRA 2006). Responses from LTNZ managers indicated an awareness of the need for a more engaging approach in order to facilitate the institutionalisation of the new procedures within the industry (see Table 33).

Table 33. Patterns of communication

Patterns of Communication - Example Quotes
<p>#34: We would prefer people coming to us with lots of new ideas (rather) than saying that’s never going to get funding we won’t bother. And, yeah, and if contractors see that they’re getting nowhere when they’re talking to road controlling authorities, we’re happy to have that discussion also with the contractors directly and maybe looking at ways of promoting an idea in an area.</p> <p>#34: And, maybe that’s because like I say, we’re new to this too, and we’re trying to work out what the best approach is to be taken, but at the moment, I guess, in a lot of things we do we rely on people coming to us rather than us going to them. Yeah, and so, and so until we have people coming to us saying can we do this, can you fund this, we don’t know.</p>
<p>#49: Look if there’s a robust case of it, and it doesn’t, doesn’t have to be monetized only it, it can actually come into other aspects of it that is seen as, as a positive thing. We certainly want that to happen. So, there should be any fear that because they’re taking a step that is not precisely in tune with, with the Land Transport procedures that they’re going to get turned down. The important thing is that it is drawn to our attention that they’re wanting to do this ...and yet they acknowledge that it’s a step and almost, what do you think of it, are you happy with that approach? Cos we’re not going to whack them over the head or anything like that because of it. We will if, if we believe that they haven’t followed the procedures properly on normal stuff, yes, then they get a whack on the head.</p> <p>#49: Maybe that’s the message, that perhaps hasn’t gotten through...there is nothing in any of our manual, any of guidance that says you must restrict yourself to Land Transport components only.</p>

Issues with Calculating Environmental Costs and Benefits

The previous section demonstrated that local road-controlling managers were averse to including broader environmental outcomes in project evaluations if these were associated with cost increases but not with commensurate increases in financial benefits. Cost increases reduced their chances of achieving a qualifying BCR. In addition to these concerns, other managers highlighted two additional problems around internalising environmental benefits into the BCR calculation (see Table 34). The problems are those of accounting for distant benefits (discounting), of numerating environmental benefits, and of financing investments which deliver distributed benefits.

With respect to the road construction industry, LTNZ required the application of a discount rate of 10% (determined by the New Zealand Treasury) over 25 years for each design option. Discounting involves applying a discount rate to discount future costs (and benefits) of decisions. The rationale for applying a discount rate is to compare cash flows over time on a consistent basis. Where benefits are expected to accrue in the some point in time in the future it is necessary to establish what those benefits are worth today in order to compare them against the costs which will be incurred today. Applying a high discount rate of 10% has the effect of making capital intensive investments appear unfavourable.

Table 34. The problems of discounting and environmental numeration

Problem of...	Example Quotes
Numerating environmental benefits	#42 Transit NZ Manager: I'm suggesting if you really want to make a step change in the implementation of sustainability, the use of sustainability within the contracting industry broadly, then amend environment, then amend the economics, include environmental economics and there's a lot of work being done on that. I'm talking about what is the actual real cost of something like bitumen, for example. What is the environmental cost associated with that? What is the environmental cost if you're using petrol or diesel in an engine, for example? What are the total health costs and everything else associated with it? What is the actual environmental and social cost of it, and factor that into the overall cost of the project.
Distributed benefits	#34 LTNZ Manager: When you get into sustainability there is also a cross over in benefits outside of Transportation. So, what I think the discussion that we've probably had is more that the benefits, and therefore the cost should really be spread wider than just from a Land Transport Funding source.

Applying a discount rate to an investment that has significant upfront costs associated with it but a payback over a long period of time will result in a distorted benefit-cost calculation. This is because the present value of distant benefits is negligible compared with the relatively undiscounted near term costs. This is an issue for inclusion of environmental costs and

benefits in economic evaluations because the costs of securing environmental benefits are usually incurred in the near term while the benefits continue to accrue to future generations (e.g. initiatives to address CO₂ emissions and climate change). This presents a challenge in terms of accounting for the environmental costs and benefits of road works because of the negative impact on the BCR.

The internalisation of environmental costs and benefits in economic evaluations requires that those costs and benefits can be numerated and translated into monetary terms. The EEM provides monetary values (or the methodologies for calculating monetary values) for some environmental costs and benefits. However, the EEM is weak with respect to providing monetary values (or methodologies) for environmental costs and benefits when compared with other more traditional impact categories (e.g. accident cost savings). The numeration of environmental costs and benefits is a significant challenge which has been identified as an issue in the scholarly literature, particularly by Ecological Economists (e.g. Ackerman and Heinzerling 2002; Costanza and Daly 1987; Gregory and Slovic 1997). The first challenge lies in the ability to quantify the natural environment. Stocks and flows of natural resources need to be accounted for but these may not be easily measured e.g. stocks of mineral resources or forests (Costanza and Daly 1987; Statistics New Zealand 2002). The second challenge relates to our ability to assign monetary values to these natural resources (Ackerman and Heinzerling 2002; Costanza and Daly 1987; Statistics New Zealand 2002). These challenges have significant implications with respect to the knowledge, skills, and calculative tools required to perform comprehensive, reliable and robust economic evaluations. These capabilities are necessary to clearly articulate and quantify the broader costs and benefits of road-works, to enable the alignment of land transport programmes with the strategic objectives of the LTMA (MOT 2006a). LTNZ's economic evaluation manuals provided relatively little guidance in this regard.

In addition, the environmental benefits do not necessarily accrue to the agents that made the initial capital investment. This raises the problem that internalising environmental benefits in the cost-benefit evaluation could lead to a situation where the investing agent has justified a capital expense for which real capital costs may be incurred (i.e. interest payments), but where real cash flow returns are not forthcoming because they accrue to other stakeholders. This is already a feature of the economic evaluation of road works e.g. travel time cost savings, vehicle operating cost savings, accident cost savings. However, since these benefits primarily accrue to the road-users the financial loop can be closed through taxation (e.g. petrol tax) of that stakeholder group. Broader environmental (and social) benefits present a

more significant challenge with respect to closing the financial loop, since the benefits will accrue to stakeholders beyond immediate road users. The issue of broader benefits and current budgeting and funding practices was also identified as an issue by the Task Force investigation into procurement practices in the U.K. public sector (DEFRA 2006).

Prioritisation of the Environment under Different Procurement Methods

The majority of road works carried out by local road controlling authorities are procured through contracts using conventional measure and value contracts. Tender bids for these contracts are evaluated using the lowest-price conforming or weighted-attribute methods as prescribed in the CPP (Transfund New Zealand 1997). Under the weighted-attribute method, attributes are typically weighted in the ratio of 70% for price to 30% for non-price attributes. The non-price attributes which are considered are relevant experience, track record, technical skills, resources, management skills, methodology (Transfund New Zealand 1997). Under the lowest-price conforming method, the lowest bid price wins the contract, provided the bid conforms with the requirements set out in the tender documents. Larger and more complex or risky projects are procured under more complex contract structures and evaluation methods such as design-build, alliancing, or even public-private partnerships (PPP). These types of contract structures were used more frequently by TNZ than the local road controlling authorities.

The different procurement methods and contract structures offer more or less opportunity to consider and, therefore, procure environmental outcomes. The degree of opportunity depends on whether environmental performance is merely a consideration during the tender evaluation, or a core requirement of the project design and specification (e.g. deliverable requirements, or for materials or construction methods).

Where environmental performance is not a project requirement, the tender evaluation process offers only limited opportunities for road-controlling authorities to drive better performance. Even where the weighted-attribute evaluation method was used price still dominated, and this method offered very little scope to distinguish those contractors who perhaps merely complied with minimum regulatory requirements from those whose environmental practices and performance may have been far superior (i.e. beyond-compliance). Even if road construction firms were to highlight their environmental accreditations in their tender submissions this attribute would not significantly affect the outcome of the tender evaluation

given the low weighting assigned to non-price attributes. This characteristic of the tender evaluation methods used by road controlling authorities was raised by the road contractors as frustrating their efforts to competitively differentiate themselves on the basis of environmental performance (see Chapter 4).

The TNZ managers who were interviewed frequently referred to the Northern Gateway Alliance (NGA) Project as an example where significant environmental outcomes were prioritised as core project requirements (see quotes in Table 35, p.148). At the time, the NGA was the largest capital construction project ever undertaken by Transit New Zealand with a budget of \$365 million (Boffa Miskell 2012). ALPURT was a 7.5km extension of Auckland's northern motorway from Orewa to Puhoi. The project route traversed an area of major ecological significance, and involved the construction of three viaducts and twin 240 m long tunnels through Johnson's Hill. The environmental achievements of the Northern Gateway Alliance project were recognised in multiple awards for the project (Boffa Miskell 2012).

The Northern Gateway project was enabled by the tolling provisions of the LTMA. Preparations for the project included a major consultation phase to establish community and stakeholder support for the project. This consultation was required by the LTMA as a condition for seeking permission to construct a toll road (Transit New Zealand 2004).

As a result of the ecological significance of the area, stringent environmental compliance conditions were imposed on the project through the resource consent process. The Nukumea viaduct was added to the project as an enhancement to avoid environmental impacts (van Barneveld 2004). Tunnelling through Johnsons Hill also avoided significant environmental impacts associated with the major earthworks that would otherwise have been required (van Barneveld 2004).

The project was delivered through a multi-agency alliance consisting of TNZ, consultants, and contractors. The Alliance organisation was driven by a key focus on environmental compliance (NGA 2005; Snijders 2009). This was achieved through a combination of explicit, high-profile compliance actions (including capturing and relocating native lizard and fish populations, and minimising the motorway footprint), and a cultural focus on environmental performance and innovation driven through management attention and public reporting against environmental key performance indicators (NGA 2005; Snijders 2009). The LTNZ managers attributed the Alliance organisation as a key factor which enabled this focus on the environment, because of the close working relationship between all parties, and the use of non-financial KPIs to drive performance.

Table 35. Quotes about the Northern Gateway ALPURT Alliance Project

Contextual Factors	Example Quotes
<p>Environmental significance: The site of the project is on an environmentally significant area creating complex issues that need to be addressed.</p>	<p>CB: Because of the complexity of the project. High risk, high cost, high value. There's been a lot of stakeholder input. Not so much stakeholder's but there's been a lot of battles. It's been to the Environment Court, there's been a long standing battle with landowners and people. There was a number of other things, one of them was for example this road was not on Transit's 10 year plan, I don't believe to build but they needed to progress with it, and when 2003 I might be not one hundred per cent correct here, but in 2003 the Land Transport Management Act was passed as a result of that Transit found that they could fund this project by debt funding through tolling. But in order to toll it they had to have an order in council passed which is effectively like an act of parliament to enable them to toll it. So, they were able to start this job which they couldn't have entered into a conventional contract with, I don't believe, it certainly would have been much more problematic. They entered into a contract with the Alliance to start working without the funding in place without the order in council, if they hadn't, if we couldn't have gotten the order in council we couldn't have continued work. Much more risky in terms of being liable for claims and variations if they'd gone into it, a project like this without order in council in place, they had no surety of funding. All those sorts of things, yeah, So high risk and significant environmental issues.</p> <p>#53: In ALPURT there's quite a significant difference which is that in the commercial model we are able to stretch the suppliers by using what we call non-cost performance measures, and Transit went into the ALPURT procurement approach wanting, heading with some specific objectives in mind, and they related to the fact that we were building this project in a very sensitive environmental area and that the history of us fighting a number of people through the appeals and environment court to get it to that point was, you know, was generated our view that we wanted to do a really crash hot job. So, putting into practice some, you know, some environmental issues with money tied around them would make the Alliance think about those issues and in particular for ALPURT it was the net environmental benefits score, and also just the compliance with the, you know, the ARC consent conditions and so they're the sort of measures they had to do. But what those measures do is that they're not actually valuable in terms of the reward that people get from paying out on meeting a certain standard. The whole point of those measures is to engender a culture within that entity up there that wants to aspire to do greater things, and so that, what you find is off that platform the energy of the organisation itself can then drive all sorts of wonderful things on the back of that.</p>
<p>Environmental significance: The project lies in Recommended Area of Protection 21, making it a site of environmental significance.</p>	<p>#11: Quite a bit of project was through the RAP 21, Recommended Area of Protection, so it's a native bushland. Under Auckland Regional Council's land, so, up here it's sort of regenerating bush (inaudible) land. So it's all got Manukau bush, some Kauri trees as well, so we tried to minimise the amount of clearance we did particularly through that Otanerua Valley and Nukumea Valley, the bridges, clearing and large fills. The Otanerua bridge was always within the project,</p>

Contextual Factors	Example Quotes
	<p>agreed as part of the designation, but the Nukumea bridge was added, additional really. The reason is to provide ecological corridors across the land cos we got the rare fern bird, semi flightless, so it couldn't cross the motorrow, keep their breeding colonies connected. Yeah, so there's quite a lot in protecting the native streams and diversity of native fish in terms, so we have to avoid polluting the streams as well, providing fish passage as well, so, quite a lot of efforts gone into providing fish passage through culverts, controlling the run-off from cleared areas to preserve those.</p> <p>#53: ALPURT's on the far end of the spectrum of environmental responsibility. It's in a receiving environment that's almost of New Zealand context where we're in a, what they call a RAP 21 zone. It's a piece of bush that's you know, close to, you know, well next step down from National Park status and so you know, treating that with the respect it deserves. You know, you've got to get that right. But if you go down and have a look at one of our projects in urban Hamilton, you'll find our environmental responsibility really ends up as being treating stormwater before, off the construction site before it discharges into the sumps, that's about it.</p>
<p>Project significance: First of its type under the LTMA.</p>	<p>#10: This is the first project under the LTMA and that was a big driver in terms of what you're actually delivering and that's where the whole sustainability issue became quite high profile. And particularly, in this project going through the area we are going through it's obviously a lot of bush, a lot of streams, and how we deal with all that, and there's a lot of thinking about what could this team bring and how the, how they see this project and what would be the key issues for them so.</p>
<p>Project criteria - Early contractor involvement:</p>	<p>#15: It's been a really positive experience, and I guess one of the things that has been good about it is that you know, we start considering the issues right from the time of design. So, in terms of you know, what can we factor into the design that is going to either provide a better whole of life cost, reduce construction costs, reduce perhaps materials use, energy, waste those sort of things, really good to be involved in it from the beginning rather than, you know, typical construction sort of traditional hard dollar contract, I mean you're bidding on a job where the design is complete so the options are limited at that point in time, so, you tend to build what is, you know, what's designed and you're really sort of, yeah, you don't have that option to, that flexibility to look at alternatives.</p>
<p>Project criteria: The project criteria were based on value-for-money, where addressing environmental sustainability is an important outcome.</p>	<p>#15: Just in terms of, you know, particularly non-cost areas, you know in terms of how we might deal with communities, environment, social issues and those sort of things. I think we've been able to do a lot more here than what we'd be able to do if this was the hard dollar environment. So, there's a series of intangible benefits that an Alliance can deliver on, and I think any form of relationship contracting can deliver better in those areas because there's a closer relationship between the contracting parties and the clients. So we understand the client's drivers, and clearly in this situation the client's drivers are quite strongly linked to the LTMA. The LTMA has a number of requirements there that road controlling authorities must meet. So, I just think they're better able to deal with intangible side of, you know in context of you know</p>

Contextual Factors	Example Quotes
	<p>creating value in its rawest form is sort of benefit over cost. I just think we're able to generate more benefits so you know in a hard dollar environment, I mean we wouldn't be reinvesting project savings that we made in other aspects of the project into enhancing the pavements to get a better longer term view of, you know, we're looking at the cost minimisation rather than whole of life cost and I think that's quite a different ethos that comes through there.</p>
	<p>#53: At ALPURT people would argue about, for example, all the rehabilitation of the vegetation we've done, you know. Why have we bothered with that, just let it be barren and it will all grow back itself. But our perception is that our environmental responsibility was to return, you know, the forest and all the plants around it to their, to at least an equivalent position to when we started, and that's the minimum standard. That's it. We have to pay for that, so, that's a value for money issue.</p> <p>#53: In ALPURT there's quite a significant difference which is that in the commercial model we are able to stretch the suppliers by using what we call non-cost performance measures and Transit went into the ALPURT procurement approach wanting, heading with some specific objectives in mind, and they related to the fact that we were building this project in a very sensitive environmental area and that the history of us fighting a number of people through the appeals and environment court to get it to that point was ...you know, was generated our view that we wanted to do a really crash hot job. So, putting into practice some, you know, some environmental issues with money tied around them would make the Alliance think about those issues and in particular for ALPURT it was the net environmental benefits score and also just the compliance with the you know, the ARC consent conditions and so they, they're the sort of measures they had to do. But what those measures do is that they're not actually valuable in terms of the reward that people get from paying out on meeting a certain standard. The whole point of those measures is to engender a culture within that entity up there that wants to aspire to do greater things, and so that, what you find is off that platform the energy of the organisation itself can then drive all sorts of wonderful things on the back of that.</p>
	<p>#14: Originally, we tried to minimise the amount of bush clearance on Johnson's Hill to put the tunnel through on the south side to Johnson's Hill it's covered with native forest and it actually is a very significant ecological corridor that extends from the East Coast that extends to the West Coast in Kaipara Harbour. We tried to minimise the amount of vegetation clearance, so we designed such that it had a very steep cut which was going to be mainly in rock which is like so (illustrates). Two to one slope there, and one to one steeper down here rock face with a near vertical retaining wall at the bottom. And that was all going to be rock and we thought that would be okay. When it weathers it would look like the Wairoa cliffs, sort of thing, and in the scheme of things that's quite small. But what happened is that when we started excavating we found that the rock was unstable. We had to put rock bolts, sketch is trying to indicate that, so, those are rock bolts all over it. Then we found that we would have to put mesh, and shotcrete before you knew it, it was beginning</p>

Contextual Factors	Example Quotes
	<p>to become an eye sore, so I said we need to look at ways to improve that and the only way is to extend the tunnel and get a slope that we can re-vegetate the whole thing and hide that wall. Well that was going to cost 2 ½ million dollars and no one was very interested and after much debate what we did is some of the engineers said “well why don’t we just cut a whole lot more bush that will flatten the slope and you can re-vegetate it”, and I said “that’s not really very acceptable. This is a very important ecological corridor. The whole reason for the tunnel.” What we ended up with was a compromise. We did a survey of a bush and decided that the best quality bush was here, this stuff over here is not so good and so we cut more out this way. By flattening the slope here we could actually do away with the rock bolts, the slope becomes stable enough, by doing away with the rock bolts we saved enough money so we could extend the tunnel some of the distance, not the 30m that was required, but 20m, so, therefore we ended up with a slope that we can re-vegetate entirely with the tunnel tube just sticking out.</p>

Findings

Sustainable Development was mandated as an explicit policy objective of local councils by the LGA 2002. The LGA 2002 also prescribed that councils were required to develop their long-term plans in consultation with the community. However, road construction managers identified that their clients were unwilling to pay more for environmentally sustainable outcomes, and did not reward road construction firms for environmental performance as part of the non-price attributes during the tendering process (see Chapter 4). Local council asset managers were interviewed to ascertain the reasons why they were not giving effect to environmental priorities in road works.

The interviews revealed that road-controlling authorities were not procuring environmental outcomes in road works unless required to do so for compliance reasons or there was a clear financial benefit (i.e. cost saving). Discussions with local council asset managers revealed that they were constrained in their ability to prioritise beyond-compliance environmental outcomes by the context in which they were working. That context was defined by a number of conflicting pressures.

1. Councils faced pressures from both rate payers and central government to keep costs down. Fiscal constraints were imposed on council asset managers through demands for accountability in funding requests and budget expenditures.
2. Councils were faced with competing priorities for asset management funds. Roads were just one category of infrastructure competing for funds.
3. A lengthy period of under-investment in infrastructure renewal through the 1980s and 1990s had led to increased demands for investment across all infrastructure categories.
4. Population growth and changing population patterns and mobility were generating demands for increased levels of service, and therefore additional investment.
5. The council asset managers expressed the view that environmental issues were not as important as these other priorities unless they were a compliance requirement.

Preuss (2007) found that local councils in the U.K. also faced pressures from central government to reduce spending. The financial constraints on local councils and the focus on value for money have resulted in cost being the most important decision-making criteria. The additional cost associated with pursuing higher environmental outcomes can therefore end up

clashing with other budgetary priorities (Preuss 2007). Fiscal pressures on local government has been well-established as a challenge to the adoption of more environmental (and social) sustainable outcomes in procurement (Brammer and Walker 2011; Carlsson and Waara 2001; Geng and Doberstein 2008; Michelsen and de Boer 2009; Nykvist and Nilsson 2009; Preuss 2007; 2009; Sourani and Sohail 2011; Thomson and Jackson 2007; Walker and Brammer 2009; Walker et al. 2008; Warner and Ryall 2001)

Central government (i.e. LTNZ) funding for roads was a critical source of revenue for local road-controlling authorities, generally covering 43% of a council's expenditure on roads. Road-controlling authorities obtained LTNZ funding each year by submitting a Land Transport Programme to LTNZ in accordance with the rules and procedures defined in LTNZ's funding manuals. Although the evaluation procedures in those manuals had been revised to give effect to the broader sustainability objectives of the LTMA 2003, the funding regime was fundamentally still dominated by a focus on economic efficiency. This was at least partially due to practitioners' state of awareness and understanding of what was possible (or what would be permitted) under the new evaluation rules and procedures, and the persistence of historical perceptions of the criticality of the BCR. However, the inclusion of beyond-compliance environmental benefits in the evaluation of road works projects was also fundamentally constrained by practitioner capabilities for quantifying and valuing environmental benefits, and the temporal bias against frequently distant environmental benefits generated by net present value discounting.

In this context, the analysis finds that:

- Beyond-compliance environmental outcomes were not as important as other investment priorities.
- Local road-controlling authorities were unwilling to fund beyond-compliance environmental outcomes in road works from their local rates base unless driven by a clear mandate from the local community.
- Local road-controlling authorities were unwilling to include beyond-compliance environmental outcomes in federal funding applications for fear of jeopardising project business cases by lowering their benefit-cost ratios.

Thus, despite the legislative mandate for local government to address sustainability, in the mid-2000s the environment was not an investment priority in the context of road works, except for compliance reasons or where coupled with a clear financial incentive. These findings highlight that the principal constraint on the procurement of beyond-compliance environmental outcomes by local council road controlling authorities was not the specific

procurement methods identified by the road construction managers, but rather the councils' broader operating contexts and investment priorities.

In contrast, TNZ's ALPURT project provides an example of where significant environmental outcomes were prioritised, albeit under unique enabling conditions. In that project environmental outcomes were prioritised through stringent regulatory conditions due to the ecological significance of the area, the flexibility afforded by funding the motorway through tolls, and the performance benefits achieved through the Alliance structure.

Theoretical Model of Public Sector Procurement of Environmental Outcomes in Road Works (Green Public Procurement)

A model of Sustainable Public Procurement (SPP) has been presented in the literature, which examines the procurement of both environmental and social outcomes (Brammer and Walker 2011; Walker and Brammer 2009). The SPP model proposes that the procurement of environmental and social outcomes occurs due to pressures from the national policy (Brammer and Walker 2011). It also proposes that the procurement of environmental and social outcomes is influenced by four factors, which are perceived costs/benefits from policy, familiarity with policies, supplier availability/resistance, and organisational incentives and pressures (Brammer and Walker 2011; Walker and Brammer 2009).

Figure 8 (p.156) and Table 37 (p.158) present a conceptual model of the green public procurement in the context of the procurement of road works in New Zealand. The model has been inductively derived from the analysis in Chapter 5 and integrates theory and findings from the literature on GPP (see Chapter 3). Note that as with the model of firm-greening, the model of GPP has not been externally validated. The categories and their relationships were induced from the empirical data set. The model of GPP is a product of a theory building exercise. Testing of the model could be addressed through further research.

The model of GPP proposed here follows the same general structure as the proposed model of firm greening described in Chapter 4. The reason for this is that the structure provides a useful differentiation between motivations and factors that influence the decision making process. The model is sufficiently abstract that it can be used to establish explanations of agency behaviour in any context as it can accommodate the context-specific variations in motivations and influencing factors. It, therefore, provides a higher degree of resolution, flexibility, and explanatory power than the previous model (Brammer and Walker 2011; Walker and Brammer 2009). Table 36 (p.157) compares the two models.

The model generates explanations of green public procurement with respect to road works through three elements: motivations, internal influencing factors, and external influencing factors. A public sector motivation is defined as a strategic outcome which is sought by the public sector agency. Specifically, the model proposed here takes the view that, in context of the transport outcomes sought by the public sector agency, the agency will seek to procure environmental outcomes to fulfil one or more of the following strategic outcomes:

- **Value for money:** the optimal achievement of objectives in a cost-effective manner
- **Legitimacy:** the desire to do what is right with respect to the normative standards that external stakeholders expect to be upheld, primarily achieved through compliance with relevant standards and regulations.
- **Other Policy Objectives:** Achievement of the broader objectives and mandate of the public sector agency.

Table 37 (p.158) defines these motivations in further detail with reference to the literature and to the empirical findings of this study. As with the model of firm greening, influencing factors are those elements which influence the capacity of the public sector agency to successfully procure environmental outcomes in road works. Internal factors are characteristics, capabilities, and resources over which the agency has control. External factors are forces exerted on the agency by external stakeholders, or other factors arising outside the agency over which the agency has no control. Influencing factors may be incentivising, enabling or constraining depending on context. Table 37 defines the factors which influenced green public procurement of road works in New Zealand with reference to the literature and to the empirical findings of this study.

As with the firm greening model, it was found that where there were no incentivising factors present (specifically, regulatory pressure or funding), the justification for procuring environmental outcomes was weak. Indeed, local road-controlling managers expressed complete unwillingness to pursue environmental outcomes unless they were required for compliance reasons, or there was a win-win cost saving to be achieved.

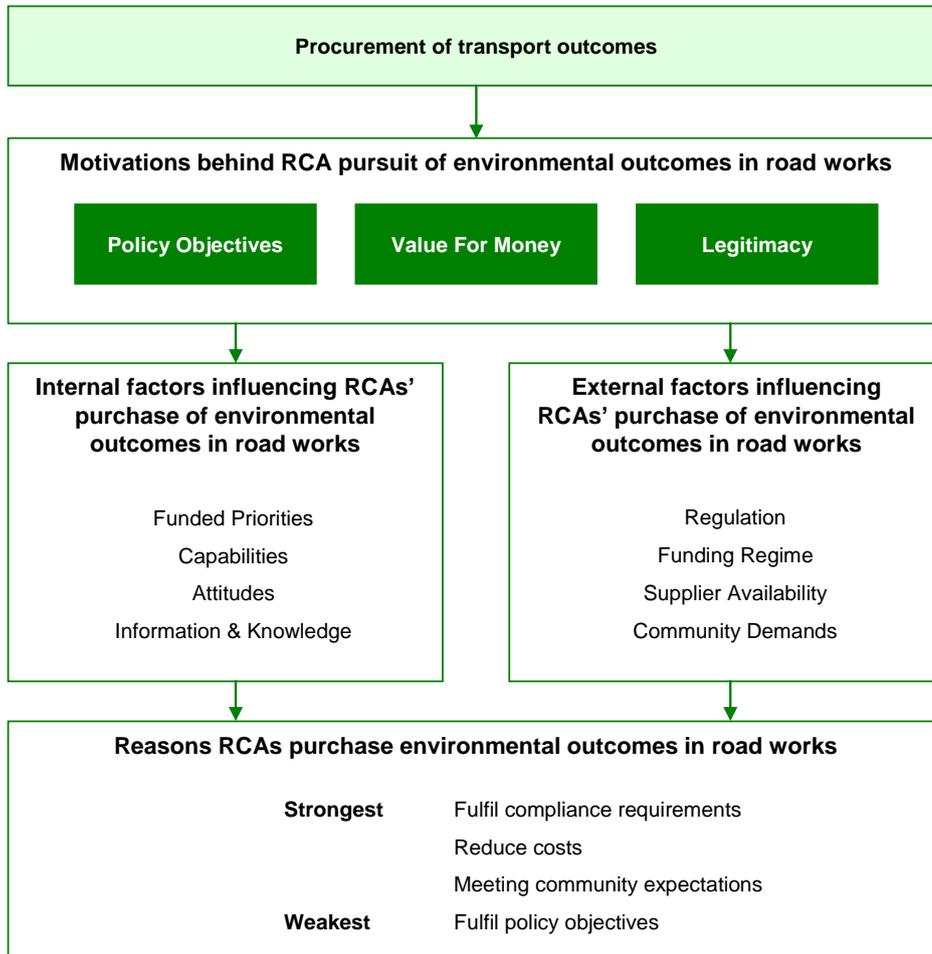


Figure 8. Conceptual Model of GPP in the context of the New Zealand road construction industry

Table 36. Comparison of theoretical GPP models

Model Element (Type)	Brammer and Walker (2011) International, public procurement officers	Schafer 2012 Local Government, Road Construction (NZ)
Drivers (Motivations)	<ul style="list-style-type: none"> ▪ National Policy Context 	<ul style="list-style-type: none"> ▪ Policy objectives ▪ Value for money ▪ Legitimacy
Internal factors	<ul style="list-style-type: none"> ▪ Perceived costs/benefits of policy ▪ Familiarity with policies ▪ Organisational incentives/pressures 	<ul style="list-style-type: none"> ▪ Funded ▪ Capabilities ▪ Attitudes ▪ Information and knowledge
External factors	<ul style="list-style-type: none"> ▪ Supplier availability/resistance 	<ul style="list-style-type: none"> ▪ Regulation ▪ Funding regime ▪ Supplier availability ▪ Community demands

Table 37. Green public procurement model

Model Element (Type)	Description	Findings from this study (from Chapter 5 unless otherwise stated)
Policy Objectives (Motivation)	The public sector will seek to address overarching policy objectives. These may be set out in legislations that govern the public sector. They reflect the desires of the agency, its stakeholders and community, and the values about how it out to deliver its services.	Land Transport New Zealand and local government authorities pursued a range of broad policy objectives. For LTNZ these included achieving an affordable, integrated, safe, responsive, and sustainable land transport system (LTMA 2003). For local government these included taking a sustainable development approach, and promoting the social, economic, environmental, and cultural well-being of their communities (LGA 2002)
Value for Money (Motivation)	The optimal achievement of objectives in a cost-effective manner (MOT 2006). The public sector is held accountable for the prudent management of public finances. Value for money is a guiding principle for public sector procurement in many countries. The public sector is expected to ensure that procurement reflects the sectors' requirements and whole of life cycle cost.	Value for money was stipulated in Land Transport Management Act 2003 as an operational and procurement principle for Land Transport New Zealand. The Local Government Act 2002 required local authorities to manage their finances in a prudent manner, while the LTNZ funding guidelines required local authorities to demonstrate economic efficiency. Some local road-controlling authorities had also developed council specific procurement principles which referred to the need to achieve value for money.
Legitimacy (Motivation)	The legitimacy motive refers to the desire to do what is right with respect to the normative standards that external stakeholders expect to be upheld (Suchman 1995). It is primarily achieved through compliance with relevant standards and regulations	Road controlling authorities procured environmental outcomes when required to comply with resource consent conditions prescribed under the Resource Management Act 1991 (e.g. the Northern Gateway project).
Funded Priorities (Internal Factor)	Whether funding is available, and for which priorities.	Local road-controlling authorities faced competing priorities for asset management funds. This was due to the historical investment decisions on the network, ageing network, population patterns and mobility, increasing level of service demands, and competition on available funds from other council departments.
Capabilities (Internal Factor)	Access to skills, competencies, and tools to undertake GPP and SPP in practice (Brammer and Walker 2011; Walker and Brammer 2009). There are significant challenges to internalising the environment into the economic evaluations due to the problems around numerating environmental values (Ackerman and Heinzerling 2002; Costanza and Daly 1987; Gregory and Slovic 1997).	While the EEM provided some guidance on environmental values, more comprehensive monetary values or methodologies to generate such values was lacking.
Attitudes (Internal Factor)	Degree of support for GPP from managers (Brammer and Walker 2011). Managerial commitment to address GPP, and managerial action is necessary to enable change. The transformation of institutional structures also involves cognitive restructuring (Zucker 1983). Also, the degree to which procurement decision makers are willing to tolerate risk related to environmental innovation.	Perception by local authority asset managers that the LTNZ funding regime was still primarily about economic efficiency. LTNZ managers expressed openness to proposals for beyond compliance environmental outcomes, and a willingness to work with local authority asset managers to get them funded. Road controlling authorities and engineering consultants were averse to accepting risks associated with recycled materials.

Model Element (Type)	Description	Findings from this study (from Chapter 5 unless otherwise stated)
Information & Knowledge (Internal Factor)	The availability of information and knowledge, including information on environmental performance, and awareness and knowledge of policies, systems, tools and practices (Walker and Brammer 2009).	There was a knowledge gap between LTNZ and local road-controlling authorities' e.g. local government was not as familiar with the opportunities inherent in the funding manuals, undertaking comprehensive life cycle assessments were considered to be unusual in practice.
Regulation (External Factor)	The existence of regulations which require the public sector to purchase environmental outcomes.	Local road-controlling authorities were subject to various legislations which required decisions to consider how they contributed to addressing sustainable development (LGA 2002), the development of a sustainable transport network (LTMA 2003), and sustainable resource use (RMA 1991). The LTMA 2003 was a strong driver for environmental (and social) sustainability, and which led to the comprehensive consideration of environmental costs and benefits over the life cycle of the Northern Gateway Project.
Funding Regime (External Factor)	Availability of funds from rates, central government, and other revenue streams, and the rules and requirements for securing that funding.	Local road-controlling authorities were under significant pressures to keep costs down from ratepayers and LTNZ. Road-controlling authorities received federal funding subsidies for their respective road-networks. The LTNZ funding regime (rules and procedures) exerted a strong influence on the decisions made by local road-controlling authorities. Local road-controlling authorities were unwilling to include beyond-compliance environmental outcomes in federal funding applications for fear of jeopardising project business cases by lowering their benefit-cost ratios.
Supplier Availability (External Factor)	The availability of more environmentally sustainable products and services in the market influence the ability to procure such services (Brammer and Walker 2011; Walker and Brammer 2009).	Finding from Chapter 4 indicate that road construction firms were pursuing a range of different initiatives to delivery more environmentally sustainable products and methods, and to improve their environmental performance. Their challenge with respect to their abilities to deliver such products and services at cost-competitive prices.
Community Demands (External Factor)	Demands from ratepayers, road users, and other stakeholders for environmental outcomes.	Local road-controlling authorities were unwilling to fund beyond-compliance environmental outcomes in road works from their local rates base unless driven by a clear mandate from the local community.

Chapter 6

Findings & Implications for Practice

The purpose of this thesis is to identify opportunities to address environmental sustainability in the road construction industry in New Zealand. Chapter 2 described the methodological approach. Chapters 4 and 5 have presented the results of the enquiry. This chapter builds on Chapters 4 and 5 to suggest where opportunities exist within the New Zealand road construction industry to leverage change towards environmental sustainability.

The chapter first summarises the key findings from Chapters 4 and 5. The subsequent section reflects on the degree to which environmental sustainability was institutionalised in the road construction industry in 2007. The last section draws out the implications and opportunities to leverage change for environmental sustainability in the New Zealand road construction industry.

Key Findings of the Research

Chapter 4 presented the results of the research with respect to what road construction firms were doing to address environmental sustainability, why they were doing it, and what challenges they were encountering. It was found that road construction firms were pursuing the adoption of a range of environmental sustainability initiatives during the mid-2000s. These were:

- **Pollution-control:** environmental management systems
- **Quality control & external accreditation:** ISO14001, Enviromark
- **Public relations:** Sustainable Business Network, Sustainability Reporting
- **Eco-efficiency:** Recycled asphalt pavement, marginal aggregates, construction & demolition recycling, recycling waste oil, energy minimisation initiatives, and waste management initiatives.

Road construction firms were motivated to pursue the adoption of environmental sustainability initiatives for three primary reasons: legitimacy, competitiveness, and Corporate Citizenship. These motivations are consistent with findings in the literature. A number of internal and external factors were identified which influenced road construction firms' ability to successfully adopt environmental sustainability initiatives. Internal factors included the capacity of the firm to allocate resources to the development of an initiative, the attitudes of the firms' employees toward the environment, the availability of information, and knowledge and expertise about the environment. External factors included the existence of environmental regulations and regulatory pressures (enforcement), the existence of incentives from clients or other stakeholders to undertake environmental initiatives, the tolerance of clients and their representatives with respect to the risks associated with innovative construction materials and techniques, and the availability and cost of resource inputs and competing products in the market place.

The road construction managers interviewed for the research strongly emphasised a lack of financial incentives from their clients for beyond-compliance environmental performance. Specifically they identified that:

1. Clients were not willing to pay more for environmentally sustainable products or methods when cheaper conventional products and methods were available; and
2. Clients were not willing to recognise and reward firm investments into improved environmental performance and capabilities.

Chapter 5 investigated the willingness and ability of road-controlling authorities to procure beyond-compliance environmental outcomes in road-works. The research found that local road-controlling authorities were only just beginning to consider beyond-compliance environmental outcomes in road-works. They were motivated to achieve three outcomes, namely value for money, legitimacy, and other policy objectives. However, their ability to successfully procure environmental outcomes was influenced by a number of factors. Internal factors included whether environmental sustainability was a funded priority for the agency, whether the agency had access to the skills, competencies and tools necessary to procure environmental outcomes in practice, the degree of support for green procurement from managers, the degree to which decision makers were willing to tolerate risk related to environmental innovation, and the availability of information and knowledge and expertise about the environment. External factors included the existence of regulations requiring public sector agencies to purchase environmental outcomes, and the enforcement of this activity, the

availability of funding and the rules and requirements for securing it, the willingness and ability of road construction firms to supply environmental outcomes, and demands from ratepayers, road-users and other stakeholders for environmental outcomes.

The study found that road-controlling authorities were constrained in their ability to procure beyond-compliance environmental outcomes due to their operating contexts, and the funding regime. Road-controlling authorities were not willing to procure environmental outcomes in road works unless they were required to do so for compliance reasons or were driven to do so by a clear mandate from the local community. They were also unwilling to include beyond-compliance environmental outcomes in funding applications for fear of decreasing the benefit-cost ratio of their applications and jeopardising their ability to obtain funding subsidies from LTNZ.

Chapter 5 also revealed that the LTNZ funding regime had been revised by late-2006 to allow broader considerations (i.e. beyond-compliance environmental outcomes) in the economic evaluation procedures. However, the inclusion of broader environmental benefits was ultimately constrained by practitioner capabilities for quantifying and valuing environmental benefits, and the temporal bias against distant environmental benefits generated by net present value discounting.

Chapter 5 also found that different procurement methods and contract structures offered different degrees of opportunity to address environmental outcomes. LTNZ procurement guidelines dictated that larger, more complex or risky projects were procured using complex contract structures and evaluation methods such as design-build, alliancing, or even public-private partnerships. These contract structures offered a greater ability to procure broader environmental outcomes, and were more commonly used by TNZ. The ALPURT project was repeatedly identified by participants as an example where significant environmental outcomes were enabled through the use of the Alliance contract structure. However, it was also noted that the purchase of environmental outcomes on that project was driven by stringent environmental compliance conditions as a result of the sensitive nature of the environment through which the road was constructed. In contrast, local road-controlling authorities tended to procure using lowest-price conforming or weighted-attribute methods, which offered limited scope to pursue beyond-compliance environmental outcomes.

Institutionalisation of Environmental Sustainability

The thesis findings provide an opportunity to reflect on the degree to which environmental sustainability was institutionalised in the New Zealand road construction sector in 2007 (see Table 38, p.168). Institutional theory is applied here as a lens to examine the degree to which environmental sustainability was institutionalised as a basis for locating opportunities to leverage change. It is argued that the ability of industry to address environmental sustainability is dependent on the degree to which it is institutionalised within the industry.

Scott (1995) identified three aspects of institutions, which he labelled as *pillars*. The three pillars of institutions are regulative, normative, and cognitive. These three pillars are the governing rules, values, and cultural traditions which act to support institutions (Scott 1995). Regulative institutions refer to *rule-setting, monitoring, and sanctioning activities* which determine the incentives or penalties for behaviours (Scott 1995, p. 52). Normative institutions refer to socially shared expectations of appropriate behaviour, for example, values and norms (Scott 1995). Values are those behaviours that are preferred and desirable, while norms specify the legitimate means of achieving outcomes (Scott 1995). Cultural-cognitive institutions refer to socially shared conceptions, that is, they are the cultural frames and customs of group (Scott 1995). This institutional pillar is considered to reflect the highest degree of institutionalisation, because actions no longer require justification. In this case, *routines are followed because they are taken for granted as “the way we do these things”* (Scott 1995, p. 57). The three pillars provide a description of the reality in which organisations operate, such as the *“the way things are”, “what is important”* and *“the way things are done”* (Scott 1987, p. 496).

Institutions are dynamic and evolve over time (see for example Hoffman’s 1999 study of the chemical industry). This is reflected in the changes that were occurring in New Zealand’s public policy during the early 2000s. The LGA 2002, the NZTS 2002, and the LTMA 2003 oriented public policy in local government and the transport sector towards sustainable development. They established a regulative pillar for environmental sustainability within the institutional field. LTNZ and road-controlling authorities were required to ensure that the development of the road-network would contribute to environmental sustainability. However, the requirements of the LGA 2002 and the LTMA 2003 were not prescriptive. It was left up to the agencies to determine what specific outcomes would be pursued with respect to environmental sustainability, and the actions required achieving those outcomes.

Tolber and Zucker (1996) note that the process of institutionalisation begins when new institutions are formalized in policies and procedures of a given organisation. Suchman

(1995) and Tolbert and Zucker (1996) also note that a high degree of institutionalisation in organisations is necessary to provide legitimacy and justification for action. In this way institutionalisation and legitimacy in actions are strongly related (Suchman 1995). At the time this study was undertaken, the degree to which environmental sustainability had been institutionalised varied significantly across the industry actors. By 2007, local road-controlling authorities and LTNZ had integrated environmental sustainability within their normative institutions. This was evidenced by environmental sustainability objectives in internal policies and public reports. LTNZ had also revised its funding rules and procedures in late-2006 to align with the objectives of the LTMA 2003. The revised funding procedures allowed road-controlling authorities to include beyond-compliance environmental outcomes as part of funding applications. The agency also held training workshops with road-controlling authorities in an effort to diffuse this knowledge.

However, successful institutionalisation requires the development of measurable objectives, the development of indicators against which performance can be measured, and the integration of these into budgets and funding programmes (Goodman and Dean 1984). In this respect, neither LTNZ nor the local-road-controlling authorities had made any significant progress to internalise environmental sustainability. While LTNZ had opened up the evaluation procedures to allow for the consideration of broader outcomes these had not yet been defined in measurable terms nor linked into the funding regimes either in LTNZ or the local road-controlling authorities. This meant that environmental sustainability was not a tangible priority for local road-controlling authorities. At the time, the calculative capabilities to numerate the environment were also not well developed. In the absence of standard unit rates for valuing environmental benefits, local road-controlling asset managers were not inclined to seek funding for beyond-compliance environmental outcomes because of the negative effect on project BCR. There was a strong taken-for-granted belief that in order to qualify for funding subsidies from LTNZ, the authorities had to adhere strictly to the guidelines of the manuals. Thus, there remained strong cognitive beliefs that addressing environmental sustainability was not possible due to the perceived costs increases associated with beyond-compliance environmental outcomes, the lack of calculative capabilities to numerate environmental benefits, and thus the inability to justify funding for it. It was for these reasons that local road-controlling authorities did not procure beyond-compliance environmental outcomes in road-works.

As private-sector organisations, road construction firms were not directly affected by either the LGA 2002 or the LTMA 2003. However, within the road construction firms, the

normative pillar of environmental sustainability was beginning to take shape. For example, firms had, or were, developing policy commitments to address their environmental sustainability performance. Road construction managers expressed opinions that firms should be good Corporate Citizens, and that they were personally motivated to identify business opportunities that aligned with their environmental values. The degree to which road construction firms had achieved maturity with respect to the cultural cognitive pillar was limited. This is evidenced by managers' assertions that they struggled to get traction with internal change for environmental sustainability because of their employees' attitudes towards the environment. Off-the record, managers from a number of firms indicated that achieving compliance with existing regulatory requirements was a challenge and they viewed EMS as a way to mitigate this risk. This was further evidence that the environment was not yet culturally embedded within the firms' day-to-day practices.

The study findings show that road construction firms were responsive to the regulative pillar. They adopted environmental sustainability initiatives to address demands for compliance with environmental regulation (e.g. penalties arising from non-compliance). The firms were also strongly motivated to pursue and adopt environmental sustainability initiatives where these were expected to yield cost-savings. The focus on achieving cost-savings was driven by the procurement environment, which emphasised least-cost. Although some firms expressed a belief that they could achieve competitive advantage in the tender process by improving their non-price attribute rankings with respect to environmental track record, it was shown that clients were not willing to reward firms in this way.

Overall, the findings of this research indicate that the road construction industry experienced institutional changes in all three pillars identified by Scott (1995). The government explored how to align public policy with the concept of sustainable development. This was followed by the development of the regulative pillar in terms of establishing the LGA 2002, NZTS 2002, and LTMA 2003. However, the regulative pillar was relatively weak due to the non-specific nature of the objectives, the absence of prescriptive performance targets, and a weak enforcement regime as compared with the RMA 1991. At the time this research was undertaken the policy reforms were still relatively recent such that the road construction industry was only just beginning to understand how to operationalize the requirements for environmental sustainability within their own systems and processes.

Within the various organisations (road construction, road-controlling authorities, and LTNZ), the normative institutional pillar of environmental sustainability was being established. Managers across the road construction industry expressed an affinity for environmental

values, and these were institutionalised as objectives in high-level policies and annual reports. Overall, the cognitive pillar was the least well developed with respect to environmental sustainability. The existing ways of *doing things* and existing institutional structures (e.g. focus on economic efficiency) still dominated how road-works were funded, procured, and constructed. Based on the findings of this research, it is possible to identify a number of opportunities to promote the institutionalisation of environmental sustainability within the road construction industry. This is the focus of the next section.

Table 38. Degree of institutionalisation of environmental sustainability in the road construction industry in 2007

Organisations	Regulative Institutions Incentives, penalties, governance	Normative Institutions Value alignment	Cultural-cognitive Institutions Cultural alignment
Land Transport New Zealand	<ul style="list-style-type: none"> Managing environmental impacts due to RMA 1991 requirements are automatically incorporated as part of project costs. LTMA 2003 establishes environmental sustainability as agency objective, but is not prescriptive in its requirements. Beyond-compliance environmental outcomes may be considered, but need to be economical to justify funding & consideration in procurement. 	<ul style="list-style-type: none"> The agency's objectives require it to consider environmental sustainability as an outcome to be addressed Manager suggest that not undertaking comprehensive whole life cycle assessments would mean assessment did not fully address environmental sustainability LTNZ holds workshops with RCAs to discuss revisions to LTNZ manuals 	<ul style="list-style-type: none"> Managers' perception that environmental sustainability can be addressed due to the changes in the manuals. Managers suggest that there is little comprehensive whole of life assessment being undertaken in the industry
Local Road-controlling Authorities	<ul style="list-style-type: none"> RMA 1991 establishes sustainable resource management as a regulatory compliance requirement in all activities & failure to comply leads to penalties. LGA 2002 establishes environmental sustainability as local government objective, but is not prescriptive in its requirements. No penalties for not addressing beyond-compliance environmental outcomes i.e. discretion of local authority. Continued penalties from LTNZ for low BCR i.e. no funding. 	<ul style="list-style-type: none"> The local road-controlling authorities' policies and objectives refer to environmental sustainability values. 	<ul style="list-style-type: none"> Managerial interest in addressing environmental outcomes Managers struggle to consider more costly beyond-compliance outcomes It is taken for granted that managers must adhere to the LTNZ funding manuals, and that the manuals do not allow for broader considerations due to the BCR
Road construction firms	<ul style="list-style-type: none"> RMA 1991 establishes sustainable resource management as a regulatory compliance requirement in all activities & failure to comply leads to penalties. There are no financial incentives from clients for firms to deliver beyond-compliance environmental outcomes where these are more expensive than the status quo. There are no financial incentives from clients for firms to deliver beyond-compliance outcomes due to the low weighting of non-price attributes in the weighted attribute procurement method. 	<ul style="list-style-type: none"> Some road construction firms affirm their concern to address environmental sustainability as part of their activities Some road construction firms are developing formalised Corporate Citizenship Managers are thinking about how they can translate their green values into business opportunities. 	<ul style="list-style-type: none"> Managers perceive that their employees do not value the environment as strongly as health and safety. Managers struggle to get traction to improve their environmental performance due to employee attitudes.

Implications for Practice

The findings of the research have allowed the identification of opportunities for the road construction industry to address environmental sustainability in practice. The opportunities are multiple, diverse, and are located within organisations as well as in the relationships between organisations. Six key opportunities have been identified where change for environmental sustainability could be leveraged within the road construction industry in New Zealand. The first five opportunities primarily target improving the capabilities of road construction firms. The sixth opportunity seeks to enable the prioritisation of environmental outcomes in road works by road controlling authorities. The areas for opportunities are:

1. Cultivate environmental values in road construction firms
2. Recognise opportunities which arise with the timing of investment decisions
3. Manage client and consultant risk tolerance to achieve beneficial outcomes
4. Generate information and knowledge
5. Enable the pursuit of cost-competitive alternative materials and the utilisation of waste resource streams
6. Enable road-controlling authorities to purchase environmental outcomes in road works.

The following sections frame up where the opportunities lie for road construction firms, road controlling authorities, and other industry stakeholders, based on the findings of this study.

1. Cultivate Environmental Values

The study found that road construction managers' environmental values led them to seek opportunities to address environmental sustainability. Negative or apathetic employee attitudes toward the environment were also identified as a challenge with respect to improving firm environmental performance. Internationally, managerial attitudes and commitment to environmental causes have been identified as important factors affecting firms' development of environmental strategies (Andersson and Bateman 2000; Bansal and Roth 2000; Cordano and Frieze 2000; Fraj-Andres et al. 2009; González-Benito and González-Benito 2006; Lee and Ball 2003; Marshall et al. 2005; Sangle 2010).

Opportunities for road construction firms

Firms may be more successful with respect to identifying and realising environmental sustainability opportunities if they cultivate a culture of environmental values, awareness, and opportunity seeking behaviour among the firms' managers and employees. Internal organisational processes such as recruitment strategies may be a means of ensuring that the firm recruit individuals who embody the values that the firm wishes to pursue. Other internal organisational factors that could elevate environmental values among existing employees include the internalisation of environmental sustainability principles in organisational policy, as well as in human resource programs of employee training and development. Educating employees about the values that are important to the firm will focus the employees' attention and orient them to identify opportunities that align with these values. In addition, to the explicit organisational elements such as policies, systems, and processes, employees are also influenced by implicit organisational elements such as the attitudes and behaviours of colleagues and senior management (Jose and Thibodeaux 1999).

Opportunities for road-controlling authorities

The opportunity for clients is to engage in formal and informal relationships with firms who demonstrate alignment with client values in order to reinforce and legitimise those values. This builds on the strong commercial relationship between road construction firms and their clients in this industry. Clients who are themselves pursuing an environmental sustainability agenda, and who are struggling to implement this due to their fiscally constrained contexts, may benefit from closer relationships with firms that demonstrate commensurate values because those firms are more likely to pay closer attention to their clients' environmental needs (Buysse and Verbeke 2003; Fineman and Clarke 1996; Freeman et al. 2000). This could be achieved through basic relationship management to keep key contacts apprised of the clients' interests and objectives. Firm managers who are enrolled in this kind of process effectively become boundary spanners (Hosking and Morley 1991), as they detect and bring information into the firm, and generate internal awareness the clients' needs and expectations. Formally, the client might also invite those firms that have demonstrated compatible environmental values to bid on tenders. While it would not be fair to give these firms preferential treatment in the competitive process, such invitations would incentivise competitive behaviour since it signals the client's interest in environmental outcomes.

Opportunities for other stakeholders

Other stakeholders such as the industry association, government, or interest groups also have a role to play in terms of promoting environmental sustainability values in order to legitimise those values within the institutional field. This could be achieved through promotion, awareness campaigns or educational programmes.

2. Recognise Opportunities Due to Timing of Investment Decisions

The study highlighted that opportunities to upgrade to more sustainable technologies may exist when firms make key investment decisions such as renewing or replacing plant and equipment. At these times, the marginal investment required to upgrade to more sustainable technologies may be justified by the anticipated efficiency savings.

Opportunities for road construction firms

Firms that are approaching these milestones should take a strategic view of their operating contexts, resources and capabilities, and existing systems and processes.

Opportunities for other stakeholders

The process of developing new products and services can take a long time. In addition, assets and technologies once purchased can have very long lifespans (e.g. 30 years for an asphalt plant). This means that investment decisions are critical decision points. Where central governments are pursuing an environmental sustainability agenda it may be cost-effective for the public sector to financially incentivise firms to adopt better performing technologies/capabilities during these investment decision. In this way, investment decisions made at the firm level would contribute to achieving the broader policy outcomes desired by central government. For example, governments could provide businesses with loans to help finance the purchase of new technologies with substantial environmental performance improvements. The government could also provide tax relief for firms that are considering technologies which utilise products for which there are national objectives to reduce or to increase their efficiency (e.g. waste oils, construction and demolition wastes). Similar financing opportunities have been developed by the EU as part of their Environmental Technologies Action Plan (ETAP, European Commission 2006).

3. Manage Client and Consultant Risk Tolerance to Achieve Beneficial Outcomes

The study found that conservatism of clients and engineering consultants was a challenge to adopting alternative materials in road construction. In particular, the lack of information about the long-term performance of alternative materials such as recycled concrete and marginal aggregates presented a risk for road-controlling authorities and engineering consultants. Clients were unwilling to accept these alternative materials unless they were shown to be equivalent to the performance of traditionally-used materials and techniques. Conservative behaviour by engineering consultants and clients, particularly public agencies, has been documented elsewhere in the literature (Knoeri et al. 2011; Miller et al. 2009; Seaden and Manseau 2001), and appears to be a common barrier to innovative behaviour in the construction industry in general (Lim and Ofori 2007).

Opportunities for road construction firms

Risks around long-term performance of materials are managed through compliance with technical specifications. It is unlikely that the use of alternative materials in road construction can become widespread unless technical specifications are developed for their use (Hyder Consulting et al. 2011; Rao et al. 2007; Tam et al. 2009; Tam 2009). These specifications, therefore, represent “obligatory points of passage” with respect to the acceptance of new materials and construction techniques by clients. Consulting engineers who write the technical specifications are critical allies in this regard. Road construction firms who pursue the development of alternative materials and construction techniques must enrol consultants in the innovation process, and develop the necessary database of test results to allow informed decisions about risk.

The clients’ engagement in the innovation process is likely to be dependent on their perception of the benefits to themselves (Ivory 2005; Von-Hippel 1988). Firms will be more able to engage a client, especially early on, if they are able to communicate the benefits of alternative products and services effectively and with respect to their clients’ objectives. In the same vein, clients who recognise the importance of their participation in fostering the development of environmentally sustainable products and services are more likely to enable such products and services to be delivered.

Opportunities for road-controlling authorities

Clients who identify specific environmental sustainability objectives that they wish to achieve may be approached by firms that have ideas with respect to potential solutions but which require further investigation. Given the clients' financial constraints, it may not be reasonable to expect them to sponsor research and development (Ivory 2005). However, a client could be both open to new innovations, and could facilitate firm engagement in research and development by establishing networks with academic institutions in order to develop the information and understanding about the risks and benefits of alternatives which provide better environmental sustainability outcomes.

Construction innovations can be costly and risky for firms as they take time to develop and trial innovations may be expensive (Gerwick 1989). Collaborative relationships between firms and clients, engineering consultancies, and academic institutions could also help to reduce uncertainty about the performance of an alternative innovation (Weaver et al. 2000).

Opportunities for other stakeholders

Governments seeking to incentivise innovation for sustainability may need to provide protected spaces in which firms and their research partners can develop such innovations (Weaver et al. 2000). More radical innovations can be enabled through sector-wide programs such as the Sustainable Technology Development (STD) program of the Netherlands (Weaver et al. 2000), or through Strategic Niche Management (SNM) in which promising technologies are provided a protective environment in which to develop (Kemp et al. 2001). These approaches are designed to lead to the creation of innovations that are path-breaking in that they reflect fundamental renewals of technologies and organisational arrangements and thereby deliver significant eco-efficiency improvements when compared to end-of-pipe or environmental technologies (Weaver et al. 2000).

4. Generate Information and Knowledge

The availability of information, knowledge, and experience are key enablers of both firm and local government capabilities with respect to environmental performance. This includes the availability of information and knowledge, including information on environmental performance (Collins et al. 2010; Henriques and Sadorsky 1996), awareness and knowledge of systems, tools and practices (Adetunji et al. 2003; Kein et al. 1999; Shen and Tam 2002),

and experience with new materials or construction methods (Shen and Tam 2002; Tam et al. 2009; Tam et al. 2010; Tam 2009).

Opportunities for road construction firms and road-controlling authorities

Firms and local government may enable innovation and change for environmental sustainability by seeking information, knowledge, and expertise. This could be achieved through a number of interventions, including: data collection and analysis, recruiting managers and employees with appropriate backgrounds and experience, in-house training relating to specific environmental sustainability practices, sending employees on training courses/workshops and conferences, and encouraging networking as a means to facilitate knowledge development.

Opportunities for other stakeholders

Other stakeholders such as the industry associations, government, or interest groups could develop and promote educational activities that provide firms with the relevant knowledge and tools to assist professionals to address environmental sustainability within their respective firms. They could also sponsor educational and networking opportunities to facilitate knowledge development e.g. workshops, conferences. Industry trade associations can disseminate information packages with respect to environmental sustainability practices as they relate specifically to their industry sector. Environmental regulatory authorities could develop educational packages that identify clear and practical guidelines for how firms could address environmental issues. Academics and practitioners may facilitate industry to address environmental sustainability in practice if they are able to translate generic tools and methods for addressing environmental sustainability into industry specific applications (e.g. Kein et al. 1999; Shen et al. 2006).

5. Pursuit of Cost-competitive Alternatives & Utilisation of Wastes

Nearly all of the road construction firms which participated in this study had or were investigating the utilisation of wastes (C&D, glass, recycled oil) as inputs into the production process. Some firms were stockpiling C&D waste. The study found that:

- The mere availability of waste streams was sufficient to interest road construction firms in their use as alternative resource inputs.

- Where there was a financial or regulatory incentive the recycling of C&D wastes was economically viable (e.g. Christchurch bylaw).
- Some road construction firms demonstrated willingness to stockpile wastes in anticipation that C&D wastes would be the subject of future regulation.
- The risk associated with the long-term performance of unproven alternative and recycled materials in road pavements was a significant barrier to their acceptance by clients and consultants (see Opportunity 3, above).

Opportunities for other stakeholders

Road construction firms demonstrated willingness to investigate the utilisation of waste streams (especially C&D waste) presents opportunities for regional and central government with respect to diverting resources from landfill and reducing the long-distance cartage of bulk materials (virgin aggregates). Central governments could pursue a specific waste strategy similar to ones developed overseas. For example, facing a landfill capacity shortage and a dependency on importing natural resources, the Japanese government pursued an aggressive approach to transforming the nation into a recycling-based society (OECD 2010). The government enacted the Construction Material Recycling Law 2002, which mandates that construction materials must be sorted, demolished and recycled (Japanese Government - Ministry of Land Infrastructure and Transport 2006a). The law stipulates the responsibilities of the clients, contractors, and sub-contractors with respect to construction material recycling. Contractors are required to submit a detailed construction material recycling plan for works which has to be signed off by the relevant government agency (Japanese Government - Ministry of Land Infrastructure and Transport 2006b). Japan is now considered to be at the forefront of recycling practices (OECD 2010).

Another option would be for central government to mandate the utilisation of a certain percentage of C&D wastes in all appropriate road-works. For example, in the United States, the Resource Conservation and Recovery Act (RCRA) specifies that federal government and its contractors must purchase the highest recovered material content level practicable (EPA 2004; US Government 2007).

Realising these opportunities will require an integrated approach to ensure the economic viability of the waste stream utilisation, that the use of recycled materials is enabled by the development of the necessary technical specifications (see Opportunity 3, discussed above),

and that road-controlling authorities can still achieve value for money in their purchasing (see Opportunity 6, discussed below).

6. Enable Road-controlling Authorities to Purchase Environmental Outcomes

The study made the following key findings about the willingness and ability of road-controlling authorities to purchase environmental outcomes in road works:

1. Local road-controlling authorities were willing to purchase environmental outcomes where they were a compliance requirement.
2. Otherwise, environmental outcomes were not as important as other investment priorities (e.g. health and safety).
3. Unless required to for compliance reasons, local road-controlling authorities were not willing to purchase environmental outcomes where these led to an increase in the cost of the proposed works. This was because the resulting decrease of the project's BCR was seen as a threat to the project's viability.

These findings lead to the identification of three avenues for enabling the purchase of beyond-compliance environmental outcomes by road-controlling authorities:

1. Strengthening the enforcement of environmental regulations
2. Institutionalising environmental sustainability policy objectives into funded priorities.
3. Enabling the monetization of environmental benefits in the benefit-cost calculation

These three opportunities are briefly elaborated in the following sections. The final section discusses the resulting funding implication which is common to all three.

a) Strengthening the enforcement of environmental regulation

This study made two related findings about compliance with environmental regulation as a driver of environmental performance. First, the analyses in Chapter 5 revealed that road controlling authorities were willing to purchase environment outcomes when required to for compliance reasons. While not a typical road works project in the New Zealand context in terms of scale or location, the Northern Gateway ALPURT Project does illustrate that strong

environmental regulation can drive high quality environmental outcomes in road works projects. Second, the analysis in Chapter 4 revealed that road construction firms were motivated to improve their environmental management capabilities in response to regulatory pressure. Managers from both road construction firms and road-controlling authorities indicated that there was scope to improve contractor compliance with existing regulations.

On the basis of these findings, strengthening environmental regulation and its enforcement is one avenue through which environmental sustainability improvements could be leveraged in the road construction industry. First, more rigorously enforcing contractor compliance with existing resource consent conditions could be utilised as an incentive to drive improvements in contractors' environmental management capabilities (Shimshack 2007). This could be an effective low-hanging fruit, particularly when coupled with a collaborative approach to assist contractors to make the necessary capability improvements. Second, introducing more stringent resource consent conditions on Greenfield projects may drive higher quality environmental outcomes. This second strategy is likely to be politically more difficult as it would increase the cost of Greenfield projects, and could result in some projects not being built which would otherwise have desirable economic and social benefits. However, it might also provide an economic incentive for innovative engineering solutions in road construction. Strong regulation for Greenfield projects might also be suitable as part of a longer-term strategy to direct greater attention to integrated transport solutions and changes in land-use planning.

b) Institutionalising environmental sustainability policy objectives into funded priorities

Sustainable development had been introduced as a broad policy objective for the land transport sector, through the Land Transport Management Act 2003, and for local government more generally, through the Local Government Act 2002. However, this study found that that local road controlling authorities were not willing to purchase beyond-compliance environmental outcomes in road works. There were several reasons for this. Councils faced significant fiscal pressures which were driving a continued focus on cost (economic efficiency) as the primary basis for procurement decision making. The sustainable development mandate was a relatively recent introduction through legislation such that there had not been significant institutionalisation of these objectives within local authority decision making and budgeting processes. And councils were facing a number pressures on their limited asset management funds across all infrastructure services. In this context, beyond-

compliance environmental outcomes were not considered to be significant priorities for investment, and therefore did not attract funding.

There is therefore an opportunity to leverage environmental sustainability outcomes by facilitating the institutionalisation of environmental sustainability policy objectives into funded priorities. Institutionalisation creates legitimacy and therefore power to justify action (Suchman 1995; Tolbert and Zucker 1996). Key enablers of such institutionalisation include:

- Translating broad sustainability objectives into meaningful performance parameters, and developing key indicators to measure performance
- Enabling asset management and procurement processes to give effect to environmental performance objectives by allocating funds to those objectives
- Enabling decision makers to make trade-offs between competing environmental, social, and economic objectives

These enablers are critical at a time when the inclusion of broad sustainability objectives for local government coincides with increasing pressure from stakeholders to demonstrate value for money. The former reflects societal interest in creating vibrant and liveable communities while the latter reflects stakeholder demands for public sector accountability. The above enablers are critical to achieving both. Indeed, a 2006 Ministry of Transport review of the National Land Transport Programme concluded that it was difficult to assess whether the NLTP was achieving value for money because of the “*gap between the vision and broad objectives in the New Zealand Transport Strategy and Land Transport Management Act 2003, and their implementation through the NLTP*” (MOT 2006a, p. 1-2). The report stated that the objectives of the NZTS, which included environmental sustainability, lacked specificity and did not contain measurable targets (MOT 2006a). That review recommended the development of a set of Value for Money indicators (MOT 2006a).

They also reflect Agenda 21 recommendations of the actions that are required to integrate the environment into the decision-making processes (UNDPI 1993). Chapter 8 of Agenda 21 requires the development of methodologies to value environmental costs and benefits (UNDPI 1993, Chapter 8 s8.37c). This in turn relies on the capacity to generate the information necessary about the environment on which to base decisions (UNDPI 1993, see Chapter 40).

c) Enable the monetization of environmental benefits in the benefit-cost evaluation.

Land Transport New Zealand's funding and economic evaluation manuals defined the processes and criteria to which road-controlling authorities had to adhere to when they applied for funding subsidies for road works. Traditionally, the economic evaluation of road works had been based on economic efficiency. The benefits of road works were evaluated in terms of benefits to road users (vehicle operating costs, travel time savings, accident savings), and considerable research had been conducted to provide standardised methodologies of quantifying these benefits and unit rates for monetising them. In this way the benefits and costs of a project could be compared on a common dollar basis.

The ability to include environmental benefits in the evaluation of road works projects had been enabled within the LTNZ economic evaluation procedures by 2006. It was possible for broader – i.e. beyond-compliance – environmental (and social) benefits to be considered within the decision making process. However, standard unit rates for valuing environmental benefits were not readily available, and local authorities did not necessarily have the capabilities to identify and quantify beyond-compliance outcomes. This meant that the justification of funding for such outcomes was constrained in two important ways. First, even if the road-controlling authority was inclined to seek funding for beyond-compliance outcomes, those outcomes were not likely to be quantified; and, second, even if they were quantified, they could not be monetised in the absence of standardised unit rates. Consequently, there was no incentive for local authorities to seek funding for beyond-compliance environmental outcomes because the only effect would be to increase the project costs and decrease the project benefit-cost ratio. Local authority asset managers were unwilling to reduce their project BCRs as this would threaten their ability to secure federal funds for their projects.

Thus, while the LTNZ funding regime had shifted to a more comprehensive whole-of-life assessment, the performance of that assessment in practice was hampered by the lack of capabilities to internalise beyond-compliance environmental benefits into the assessment. Enabling the numeration and monetisation of environmental benefits is therefore a key opportunity to leverage environmental sustainability outcomes within the current system.

d) Enable funding to be raised to pay for environmental outcomes

Ultimately the effect of all of the above proposals will be to increase costs. Enforcing compliance or raising the compliance bar results in increased costs to the road controlling

authority for delivering and maintaining transport infrastructure. Institutionalising environmental outcomes as funded priorities requires either that funding be reallocated away from other priorities, or that increased funding be obtained to pay for the new outcomes. Internalising environmental benefits in project evaluations will increase capital expenditure on road works, which will have to be funded. This highlights the central challenge of the transition to sustainability: if change cannot be funded through direct cost savings, then how is it to be funded?

The difficulty is that the benefits of environmental improvements accrue in a distributed fashion to those located in distant times and places from the initial investment. Those benefits are both economic (e.g. a healthy environment is both more productive and poses fewer health risks to the population) and non-economic (e.g. amenity benefits). In the context of road works, this means that the benefits of investments to reduce the environmental effects of road construction are reaped by society at large. However, the real financial costs are currently funded primarily from road users (through petrol taxes). The ethical question is whether it is appropriate to raise taxes on one part of society to pay for benefits to the rest of society (Rabl 1996). The practical question is how to numerate and account for environmental capital within the system of national accounts (Bartelmus 1999) so that the true costs and benefits of investments can be evaluated and, where they have real economic impacts, appropriately taxed. Monetising broader environmental benefits would allow the government to evaluate whether funding decisions were meeting the environmental sustainability objective. The findings of this research point to the internalisation of the environment in national accounts as an enabler with respect to raising the funds, or at the very least properly accounting, for change for sustainability. Some opportunities for action in this regard are listed below:

1. Providing funding to local road-controlling authorities to prioritise environmental sustainability outcomes. For example, central government could subsidise local government to ensure that environmental sustainability outcomes that central government wishes to achieve are prioritised in practice.
2. Examining the benefit-costs associated with more stringent regulations around environmental sustainability. Modelling or theorizing about the shifts in technologies, planning that may occur from different policies and instruments (e.g. regulation on recycling mandates). For example, the Ministry for the Environment commissioned a report on the cost-benefit of recycling (see Denne et al. 2007).

3. Developing New Zealand's environmental system of national accounts, by identifying the environmental stocks and flows, and translating these into monetary values. Statistics New Zealand has been developing natural resource accounts for New Zealand, but they do not appear to be regular (e.g. Statistics New Zealand 2002; 2012)

e) Seeking win-win solutions through sustainable technologies

The thesis has highlighted that the predominant concern for managers across the road construction industry has been with the perceived cost of addressing environmental sustainability. However, addressing sustainable development has been identified as achieving substantial reductions in the consumption of energy and resources, and the production of wastes (Schmidt-Bleek 2000; Schmidt-Bleek 1999; von Weizsacker et al. 1997; Weaver et al. 2000). In this respect, technologies which can achieve such substantial eco-efficiency improvements should also result in associated cost-savings when compared with present technologies. The opportunity in this regard is to research and develop sustainable technologies that achieve these win-win outcomes.

Conducting industry-wide programs to establish the long-term vision for sustainability, the objectives that need to be achieved to fulfil that vision, and the actions that need to be facilitated for road construction firms, local government, and other stakeholders. The Sustainable Technology Development (STD) program developed by the Dutch government provides an exemplar model (Weaver et al. 2000). Conducting such a program in the New Zealand land transport industry could help to identify the substantial environmental improvements that the industry wishes to achieve. For example, factor 10 improvements in resource efficiency, and reduction in environmental degradation. In this way, specific indicators and performance measures can be developed to drive socio-technical changes to achieve these outcomes.

Relevance of the Findings & Opportunities in the Current Context

Chapter 1 highlighted that the scale of the challenge to addressing sustainability was substantial, requiring significant multi-scale organisational, institutional, and social, and technological changes. Even though it has been 5 years since the research was initiated the findings and conclusions are still relevant in the present context of the New Zealand road

construction industry. There remain significant challenges to addressing environmental sustainability.

Introduction of the Waste Minimisation Act 2008

Chapter 4 identified that a number of the road construction firms were investigating C&D recycling initiatives, particularly in the Christchurch region. The existence, at the time, of a city bylaw (since repealed) was a key enabler of this activity. However, in 2007, road construction firms were struggling to justify the investments into the equipment necessary to develop cost-competitive alternatives to virgin aggregate. The thesis has identified that the utilisation of waste products in road construction activities could be incentivised through the imposition of levies on the landfilling of wastes.

In 2008 the government enacted the Waste Minimisation Act. The Act introduced a levy on wastes going into landfills starting in July 2009 (MFE 2011; WMA 2008). The funds collected through the levy are then used to fund waste minimisation initiatives (WMA 2008). One such initiative was the granting of NZ\$2.5million to Transpacific Waste Management to fund machinery to sort rubble from the Christchurch earthquake for recycling (NZ Government 2011; Perella 2011). The earthquake of February 2011 resulted in significant damage to Christchurch City, and the production of some 4.5 million tonnes of C&D waste (NZ Government 2011; Perella 2011). The introduction of the WMA 2008 and the activities in Christchurch in this regard represent a step towards incentivising the use of C&D wastes by road construction firms.

Change to the Governance Structure of Land Transport

The New Zealand land transport sector underwent yet another shift in its governance structure in late-2008. Land Transport New Zealand and Transit New Zealand were amalgamated to form the New Zealand Transport Agency (NZTA). The NZTA produced a revised Economic Evaluation Funding Manual (NZTA 2010a). An examination of the manual suggests that with respect to beyond-compliance environmental outcomes, the issues identified in Chapter 5 are still relevant. The funding guidelines indicate that broader environmental outcomes may be included by asset managers as part of their funding applications. Ultimately however, the funding evaluation continues to be assessed on the basis of economic efficiency. Thus, the need to for calculative capabilities to numerate and monetize environmental values in order to

internalise these into the decision analysis remains an issue. In addition, there are no requirements by NZTA to utilise waste products in road pavements.

Reform of the Local Government Act 2002

The current National Government has proposed an amendment to the LGA 2002 (NZ Government 2012). The Government's position is that achieving the four well-beings (social, economic, cultural, and environmental) is beyond the rightful purview of local government (NZ Government 2012). While the Government acknowledges that broader outcomes are important to the community, it believes that in the current economic climate it is prudent for local government to focus on providing “*good quality local infrastructure, public services and regulatory functions at the least possible cost to households and business.*” (NZ Government 2012). Pressures behind the amendment include that rates revenues have increased at double the rate of inflation since 2003, and that labour costs, capital spending and debt have grown too much (NZ Government 2012). The government attributes escalations in local government spending during 2003-2010 to the introduction of the LGA in 2002 (LGEC 2012).

Chapter 5 of the thesis identified that local road-controlling authorities were constrained by their operating contexts and fiscal pressures. The analysis also revealed that environmental sustainability had not been significantly institutionalised within local road-controlling authorities. Consequently, managers within those authorities were unwilling to procure beyond-compliance environmental outcomes where these could not be justified economically.

This chapter recommended that the prioritisation of environmental outcomes in road-works could be enabled through strengthening environmental regulations and its enforcement, and strengthening the institutionalisation of environmental as a funded priority for local government. The chapter also identified that the ultimate challenge in both respects is how to come up with the money to fund improvements and environmental well-being. In this regard, the chapter highlighted two key opportunities. First, that accounting for environmental benefits in national accounts would enable funds to be raised from the resulting economic growth. Second, that enabling and protecting research and development into sustainable technologies would result in win-win outcomes.

There has been considerable opposition to removing the reference to the four well-beings from the LGA 2002. Opposition parties argue that the increases in local government spending have not been irresponsible and that the governments' analysis is based on less than

comprehensive information (LGEC 2012). The Government desire to remove the four well-beings from the Local Government Act reflects a narrow perspective on the role of local government. Indeed, Chapter 28 of Agenda 21 states that local authorities have a major role to play in addressing sustainable development:

Because so many of the problems and solutions being addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development.

On 1st November 2012, the Local Government and Environment Committee released their preliminary review of the LGA 2002 Amendment Bill (LGEC 2012). The Select Committee was unable to reach an opinion as to whether the four well-beings should be removed from the LGA 2002. Despite the uncertainty which exists to this amendment at the time of writing, the on-going concern for fiscal responsibility in local government in New Zealand highlights the relevance of this thesis in the present context.

Chapter 7

Conclusions, Contributions & Future Research

In the early 2000s, the New Zealand government passed a series of legislative acts which instituted sustainable development as a key public policy objective. This included the Local Government Act 2002, which imposed the requirement for local government to consider how economic, social, cultural, and environmental well-being could be achieved and sustained long-term. It also included the Land Transport Management Act 2003, with its objective of an *integrated, safe, responsive, and sustainable land transport system* (LTMA 2003, s3).

Within road construction firms there was some anticipation that these reforms would lead local government to demand better environmental outcomes in road-works. Some road construction firms were proactively pursuing the development of environmental sustainability initiatives to improve their environmental performance and develop more sustainable construction materials and methods. However, at the time that this research was initiated there had not been any significant shift in local government priorities with respect to road-works and the environment.

This thesis has contributed to resolving this practical problem by identifying opportunities to leverage change for environmental sustainability in the New Zealand road construction industry. This was achieved through a grounded study which explored the greening of road construction firms and of the public procurement of road-works by local road-controlling authorities in New Zealand. The questions which oriented this enquiry were:

- Why are road construction firms pursuing and adopting environmental sustainability initiatives?
- What challenges are road construction firms experiencing in their attempts to adopt and develop environmental sustainability initiatives?
- Are road-controlling authorities prioritising environmental outcomes in procurement of services from the road construction sector?
- What challenges are road-controlling authorities facing in their attempts to prioritise the environment in public procurement of road construction services?

The study presented here is significant for a number of reasons. First, there had been little academic research into greening in road construction firms and public procurement in New Zealand or internationally. With respect to firm-greening research, the organisational studies literature and construction management literatures have examined firm-greening internationally. Both literatures focussed on drivers of firm-greening, but only the construction management literature also examining the challenges to firm-greening. In terms of context, there has been little research into firm-greening in road construction industries internationally, and none in the New Zealand context. With respect to GPP, no studies have been conducted within the New Zealand context, and none in the context of procuring road-works locally or internationally. In addition, conceptual models of firm-greening had not been developed from research into road construction industries. And, while a sustainable public procurement model had been developed, no green public procurement model had been developed in the literature.

Second, the New Zealand road construction industry was relatively unique compared with industries in which the greening behaviour of firms had previously been studied. Road construction services in New Zealand are funded and procured by public sector agencies from privately-owned road construction firms. This institutional arrangement is markedly different when compared to other types of industries in which firm-greening has been examined. For example, other industries studied for firm-greening are characterised by multiple providers who supply to a market of multiple clients. While the construction management literature has examined firm-greening in the construction sector, it has not specifically examined the road construction industry, and much of the literature remains at the substantive level.

Third, the study employed a grounded theory methodology, and explored issues, forces, and relationships across both organisational and disciplinary boundaries. The use of inductive research methodologies, such as the grounded theory method is not common in the literatures on firm-greening and GPP. The use of the grounded theory methodology was necessitated by (1) institutional uncertainty that characterised the New Zealand road construction industry as it was undergoing the early stages of a strategic reorientation towards sustainable development, and (2) a research context which was relatively novel such that there was no dominant theory considered applicable to the domain in question. In addition, due to the strong public procurement aspect in this industry, understanding the greening behaviour of the road construction sector could not have been fully understood without also understanding GPP. The methodological approach was novel in that it brought together two traditionally separate fields of enquiry, firm-greening and GPP, within a single study. This meant that the

study explored issues that that crossed both organisational and disciplinary boundaries. This chapter draws together the conclusions from this novel enquiry and reflects on directions for future research.

Conclusions

Road construction firms adopted environmental sustainability initiatives when these were expected to result in tangible outcomes for the firm.

Road construction firms were motivated to adopt environmental sustainability initiatives for three primary reasons, which are legitimacy, competitiveness, and Corporate Citizenship. These motives of firm-greening have been identified in Organisational Studies and Construction Management literatures, and shown to be strong drivers of firm greening (e.g. Bansal and Roth, 2000; Cordano et al. 2010; Gabzdylova et al. 2009; Gonzalez-Benito and Gonzalez-Benito 2005a; Lynes and Andrachuk, 2008; Mair and Jago, 2010; Marshall et al., 2005, Sakr et al. 2010; Shen and Tam, 2002; Tam et al. 2010).

In this industry, regulators' actions around environmental compliance and clients' procurement practices were strong incentivising forces on road construction firms. Road construction firms adopted initiatives to mitigate the risks of non-compliance with environmental regulations, and also adopted initiatives to generate cost-savings because price was a key source of competitive advantage with clients. However, while Corporate Citizenship motivated the search for opportunities, most of the initiatives associated with Corporate Citizenship were also associated with either legitimacy or competitiveness motivations, indicating only a weak association with actual investment initiatives. Ultimately, road construction firms were only willing to invest in green initiatives where they expected tangible outcomes in terms of competitive advantage, or the reduction or avoidance of regulatory risk.

Where the benefit to the firm from an environmental initiative is unclear or incurs substantial costs, then the literature has shown that firms will not pursue its adoption (e.g. Sangle 2010; Tse 2001). In this study firms did not pursue environmental initiatives when the costs relative to the benefits were too high (e.g. recycling C&D), they exited initiatives when tangible benefits were not forthcoming relative to investments (e.g. SBN), or they undertook initiatives that would otherwise have been too expensive without a subsidising factor (e.g. glass recycling subsidy, timing of technology upgrade/renewal). Thus, as with other

investment decisions investments in environmentally sustainable initiatives require a viable business case (e.g. Reinhardt 1999a; Reinhardt 1999b; Salzmann et al. 2005).

The thesis builds on the findings to contribute a more nuanced theoretical model of firm greening than has previously been developed in the literature. Previous literature makes inconsistent use of the term “driver”, referring variously to motivations, external forces, and internal features of the firm. The model constructed in this thesis explicitly differentiates between motivations and influencing factors, both internal and external to the firm, to provide explanation of firms’ actions. In this model, the desire to achieve certain strategic outcomes motivates the search for possibilities to deliver those outcomes. Whether a firm makes subsequent investments, and the size of those investments, necessarily depends on the firm’s expectations with respect to the benefit versus cost of achieving its strategic objectives. Those expectations, and the ultimate success of an initiative, depend on the combination of enabling and constraining factors which are present in the firm’s context. If the costs or benefits of implementation are too high relative to the perceived strategic benefit then implementation is unlikely (or unlikely to be successful). Methodologically, this highlights that association is not the same as explanation. To understand why firms do things, and why they are or are not successful, requires an understanding of all the factors that are taken into account when making investment decisions.

The commercial relationship between road construction firms and their clients was the key determinant with respect to the adoption of environmental sustainability initiatives by road construction firms.

Road construction managers demonstrated a high degree of attentiveness to their clients, and their clients’ procurement practices. Road construction managers perceived their clients as unwilling to pay more for environmentally sustainable products or methods when cheaper conventional ones were available. They also felt that their clients’ low weighting for non-price attributes reflected an unwillingness to reward firms competitively for adopting practices to improve their environmental track record and management skills with respect to the environment. In this regard, road construction firms focussed their attention on those environmental sustainability initiatives which could address their clients’ predominant interests for cost-savings. However, clients and their representatives (i.e. engineering consultants) also demonstrated a degree of risk averseness. They were unwilling to accept risks associated with innovative and alternative road construction products and methods unless these were shown to be at least technically equivalent to the use of conventional

products and methods. In this respect, road construction firms worked hard to develop the necessary information required to satisfy their clients and their respective representatives.

The importance of clients in influencing the adoption of environmental sustainability initiatives by construction firms has been extensively discussed in the Construction Management literature. Clients are considered to be the key stakeholder with respect to the adoption of sustainability practices in the construction sector because of their role in setting the objectives and expectations of the work to be undertaken by the contractor (e.g. Adetunji et al. 2003; Seaden and Manseau 2001; Tam et al. 2009; Varnas et al. 2009). The scholarship has also repeatedly highlighted that the costs associated with firm-greening practices have been a barrier to their uptake in the construction sector due to clients' expectations and demands in this regard (e.g. Kein et al. 1999; Lim and Ofori 2007; Shen et al. 2006; Zeng et al. 2003). Conservative behaviour on the part of clients and engineering consultants is also understood to be a characteristic problem which construction firms need to overcome in order to address environmental sustainability (Adetunji et al. 2003; Adetunji et al. 2008; Knoeri et al. 2011; Tam et al. 2009).

The ability of road construction firm to successfully adopt environmentally sustainable initiatives was influenced by a number of factors both within and external to the firm.

Internal factors are characteristics, capabilities, and resources over which the firm has control, while external factors are forces exerted on the firm by external stakeholders, or other factors arising outside the firm over which the firm has little or no control.

Internal factors which influenced the ability of road construction firms to successfully adopt environmental sustainability initiatives included capacity, attitudes, and information and knowledge. Capacity refers to the firms' abilities to allocate resources to the development of an initiative. For example, road construction firms engaged in stockpiling C&D wastes in order to develop viable resource supplies. Attitudes refer to the attitudes of managers and employees towards the environment. Positive managerial attitudes were identified as a factor motivating the search for environmental opportunities. Negative or apathetic employee attitudes were identified by managers as a barrier to the uptake of new environmental practices. Information and knowledge were identified as key enablers of action for environmental sustainability in road construction firms, particularly employee knowledge and expertise, and the availability of reliable data on environmental performance. The availability of data on the long-term performance of recycled materials was essential to their justification as viable alternatives for road construction.

External factors which influenced the ability of road construction firms to successfully adopt environmental sustainability initiatives included regulations, incentives and support, input and output markets, and client risk tolerance. Road construction firms adopted initiatives to mitigate risks of non-compliance with environmental regulations, while subsidies and levies provided the necessary financial incentives for the development of recycling capabilities. Conversely, the lack of financial reward from clients for improved environmental performance was a major frustration for the road construction firms. Input and output markets refer to the availability, reliability, quality, and costs of alternative construction materials versus that of conventional inputs. In this study, alternative materials made from C&D waste recycling were not viable given the availability of cheap virgin and marginal aggregates. Lastly, client and consultant averseness to accepting risks associated with recycled materials was a challenge to their development by road construction firms.

A wide range of internal and external factors have been documented in the Organisational Studies and Construction Management literatures as either constraining or enabling the adoption of environmental sustainability initiatives by firms. The factors identified in this study have all been documented in the existing scholarship. The above finding, that firms' ability to adopt environmental sustainability initiatives is also a function of internal and external factors, is consistent with the literature more generally.

Environmental sustainability was not institutionalised with respect to the funding and procurement of road-works by local government. As a result road-controlling authorities did not procure environmental outcomes in road-works unless required to do so for compliance or where there was a clear financial benefit.

The legislative changes of the early 2000s had oriented public policy in New Zealand toward sustainable development. Local government was required to give consideration to environmental well-being in its activities including the development and maintenance of the land transport system. However, local road-controlling authorities were not willing to purchase beyond-compliance environmental outcomes in road works. There were several reasons for this. Road-controlling authorities faced significant fiscal pressures which were driving a continued focus on cost as the primary basis for procurement decision making (i.e. economic efficiency). The sustainable development mandate was a relatively recent introduction through legislation such that there had not been significant institutionalisation of these objectives within local authority decision making and budgeting processes. In addition, councils were facing a number of pressures on their limited asset management funds across

all infrastructure services. In this context, beyond-compliance environmental outcomes were not considered to be significant priorities for investment and, therefore, did not attract funding.

While the LTNZ requirements and procedures for the funding of road works had been changed by 2006 to enable the inclusion of environmental benefits in the evaluation of road works projects, the performance of that assessment in practice was hampered by the lack of capabilities to internalise beyond-compliance environmental benefits into the assessment. Standard unit rates for valuing environmental benefits were not readily available, and local authorities did not necessarily have the capabilities to identify and quantify beyond-compliance outcomes. This meant that the justification of funding for such outcomes was constrained in two important ways. First, even if the road-controlling authority was inclined to seek funding for beyond-compliance outcomes, those outcomes were not likely to be quantified and, second, even if they were quantified, they could not be monetised in the absence of standardised unit rates. Consequently, there was no incentive for local authorities to seek funding for beyond-compliance environmental outcomes because the only effect would be to increase the project costs and decrease the project BCR. In this regard, the traditional focus on economic efficiency in the evaluation of road-works continued to dominate the industry.

These findings are consistent with the international literature on SPP and GPP which found that fiscal pressures on local government were a significant challenge to the procurement of more environmental sustainable products and services. The literature indicates that procurement managers are unwilling to pay a premium for environmentally (and socially) better performing products and services over convention or traditional ones (Carlsson and Waara 2001; Preuss 2007; 2009). In addition to fiscal constraint, the rules that govern public spending have also been shown to restrict local government spending (see Sourani and Sohail 2011). The issues around broader benefits and current budgeting and funding practices were also identified by the task force investigating procurement practices in the U.K. public sector (DEFRA 2006).

This research highlighted the importance of environmental valuation and monetization in advancing the institutionalisation of environmental sustainability in the New Zealand road construction sector. The challenges around environmental valuation and monetization are well established in disciplines such as Ecological Economics. In contrast, the SPP and GPP have focussed on the on-ground challenges facing procurement managers in local government, and have identified, more generally, that lack of information, skills,

competencies, and tools to undertake GPP (and SPP) in practice is important to overcome (Brammer and Walker 2011; Walker and Brammer 2009).

About the Institutionalisation of Environmental Sustainability in the Road construction Industry in 2007

Scott's (1995) three institutional pillars (regulative, normative, and cognitive) were used to conceptualise the degree to which environmental sustainability had been institutionalised in the New Zealand road construction industry in 2007. The thesis is able to show that environmental sustainability was in the process of becoming institutionalised across the industry. The government's pursuit of sustainable development as an overarching public policy objective led to the development of the regulative pillar for environmental sustainability. This occurred with the development of the NZTS 2002, the LGA 2002, and the LTMA 2003. However, this regulative pillar was weak due to the non-specific nature of the objectives, the absence of prescriptive performance targets for environmental sustainability, and the lack of an enforcement regime comparable to that which was constituted under the RMA 1991. The regulative changes were also relatively recent at the time this research was conducted, such that the industry was only just beginning to understand how to operationalize these requirements within their own systems and processes.

There had been some evolution in the normative pillar within the various industry organisations i.e. road construction firms, road-controlling authorities, and LTNZ. Managers across the industry also expressed an affinity for environmental values, and environmental sustainability objectives had been included in high-level policies and annual reports within these organisations. Overall, the cognitive pillar was the least well-developed. Existing ways of doing things, existing institutional structures, and traditional priorities (e.g. economic efficiency) still dominated how road-works were funded, procured, and constructed.

Opportunities to leverage change for environmental sustainability require action by stakeholders at all levels within the industry.

Opportunities were identified to leverage change for environmental sustainability within the road construction industry. Opportunities were identified with respect to improving road construction firms' environmental capabilities and performance. These include cultivating environmental values/knowledge/expertise, making the most of the opportunities afforded by capital investment decisions, enabling the recycling of waste resource streams for road

construction, and working with clients and consultants to develop and approve the use of alternative construction materials and methods. These opportunities cannot be realised by road construction firms alone, and require engagement and collaboration amongst all industry stakeholders.

Opportunities were also identified with respect to the funding and prioritisation of environmental outcomes in procurement of road-works by road-controlling authorities. These include strengthening the enforcement of environmental regulation, enabling the institutionalisation of environmental sustainability outcomes as funded priorities, and enabling the monetization of environmental benefits in the evaluation of road-works projects. The thesis points to the development of capabilities to account for environmental outcomes at a national level as a critical enabler with respect to funding environmental sustainability and making informed trade-offs between competing priorities in investment decisions. Again, these opportunities cannot be realised by local road-controlling authorities alone and require action and collaboration amongst government stakeholders and stakeholders outside the sector, for example, academia.

Contributions

The thesis has made a number of contributions:

1. The thesis has documented the motivations of greening in road construction firms and the factors which influenced their ability to successfully adopt environmental sustainability initiatives. Firm-greening behaviour in the New Zealand road construction industry has not previously been studied. Internationally, greening in road construction firms has not been studied to any significant extent.
2. The thesis has documented the motivations and factors which influenced road-controlling authorities' willingness and ability to procure environmental outcomes in road-works. The greening of public procurement has not been studied to any significant extent in New Zealand, and is an emerging field of study internationally.
3. The thesis offers empirically grounded and theoretically justified conceptual models of firm-greening and green public procurement in the New Zealand road construction industry. The models employ a common structure which explains organisational action in

terms of the strategic outcomes to be achieved, the factors which incentives action, and the factors which enable or constrain action.

4. The substantive findings and conceptual models provided a robust and credible basis for identifying opportunities to leverage change for environmental sustainability in the New Zealand road construction industry. While a novel contribution in respect of the context of this research, the identified opportunities are consistent with the strategic requirements for institutionalising sustainability which have been identified elsewhere, including Agenda 21.

Limitations of the Research

There are a number of limitations inherent with the research procedure used in this study. The most important being that while the researcher worked hard to ensure honesty and discover bias from the participants' answers, issues of honesty and bias are not wholly under the researcher's control.

The thesis findings are also limited in terms of their context. This thesis is a study of firm-greening and GPP in the context of the New Zealand road construction industry. The substantive findings and conceptual models of this thesis relate to a unique industry structure, consisting of a strong private and public sector relationship. Generalizing the thesis findings to other road construction industries may be possible. However, researchers will need to take considerable care, and consider the influence of industry context on firm-greening or GPP, when attempting to use the findings from this research to inform their understanding in different industry contexts.

The thesis is also likely to suffer from a selection bias in the sample with respect to road construction firms and local road-controlling authorities. While all Roading New Zealand and local road-controlling authorities were sent a letter inviting them to participate in the research, the voluntary nature of their participation meant that only a sample of firms and authorities agreed to participate in the research.

The thesis offered empirically grounded and theoretically justified conceptual models of firm greening and green public procurement in the New Zealand road construction sector. However, these models have not been tested because the categories and their relationships were induced from the empirical data set. This is a nature of the exploratory, grounded theory research method, in that the thesis focussed on theory building rather than on hypothesis

testing, hence external validation has not taken place, and could be addressed through further research.

Future Research

By reflecting on the findings of this thesis, it is possible to identify interesting avenues for future research. These are:

1. As the state highways manager, TNZ was a significant procurer of road-works in New Zealand. However, managers from TNZ were only interviewed with regard to the Northern Gateway ALPURT project. This study did not investigate the motivations and factors influencing the procurement of environmental outcomes in road-works by TNZ more generally. Since this study commenced TNZ has been amalgamated with LTNZ to form the New Zealand Transport Agency (NZTA). This study could be usefully extended through an examination of NZTA's procurement processes and practices with respect to environmental outcomes.
2. The sample of local road-controlling authorities was relatively limited. In total, 14 city councils and 44 district councils were asked to participate in the research. However, only four authorities responded to this request, and interviews were conducted with seven managers across these authorities. This study could be beneficially extended through further research of the motivations and factors influencing the procurement of environmental outcomes by local road-controlling authorities across New Zealand.
3. This thesis is the product of a strategic enquiry into the greening of the road construction industry in New Zealand. It has identified opportunities within the industry to leverage change for environmental sustainability based on the strategic identification of the drivers and challenges of greening in road construction firms and the public procurement of road-works. The enquiry did not seek finer details about how the drivers and challenges were constituted within the particular practices of the industry. The main avenues for future academic endeavour in this regard lie with conducting the research to address how the opportunities identified in this research can be realised in practice.
4. The findings of the enquiry into the greening of road construction firms in New Zealand suggests that motivations and considerations of firm behaviour with respect to the environment are no different than for any other aspect of firm behaviour. In essence, why

should the business case for the environment be any different to the business case for anything else? Firms may be motivated to “do good” for the environment as they are motivated to “do good” for the community, but fundamentally the principal drivers of action are legitimacy and competitiveness.

Similarly, why should the justification for the procurement of environmental outcomes by the public-sector be any different to the justification for the procurement of any other type of outcome? The findings from the enquiry into the procurement of environmental outcomes in road-works by road-controlling authorities in New Zealand suggest that there is no difference. Environmental well-being is one of a number of outcomes that local government in New Zealand seeks to achieve. The purchase of environmental outcomes toward the achievement of that well-being depends on the prioritisation of those outcomes and the allocation of funds to them. This is no different to the prerequisites for procuring outcomes toward the achievement of economic, social, or cultural well-beings.

In these respects, the question of why firms and local government seek to give priority to environmental outcomes can be conceptualised as a matter of institutionalisation. The answer depends on the degree to which the environment is institutionalised within the regulative, normative, and cultural-cognitive dimensions of organisational decision-making. It may therefore be suggested that future research into these phenomena would significantly benefit from greater engagement with the theoretical insights provided by studies of organisational behaviour more generally.

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