CARBON EMISSIONS MANAGEMENT CONTROL SYSTEMS:

FIELD STUDY EVIDENCE

Binh Bui
Victoria University, Wellington, NEW ZEALAND
binh.bui@vuw.ac.nz

Charl de Villiers (corresponding author)
The University of Auckland, NEW ZEALAND; and University of Pretoria
charl.devilliers@auckland.ac.nz
+64 9 923 7292
Graduate School of Management
12 Grafton Road
Auckland 1142
NEW ZEALAND

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Abstract

The paper examines the types and role of carbon management control systems by analysing in-depth interviews undertaken with 38 individuals from 30 organizations that use carbon management control systems. The paper identifies the different types of carbon controls, and the internal and external uses and objectives of controls. Carbon controls can be used to achieve compliance or improve performance, and organizations can focus on different objectives at different times. The findings suggest that emissions reductions do not occur without absolute (as opposed to intensity) reduction targets, management support, and resource allocation for carbon management. The findings further suggest that firms that want to improve performance or manage compliance costs effectively will require the integration of carbon controls into operational and strategic processes. A framework is developed that managers and researchers can use as an implementation guide or a research framework. The framework highlights three elements that were found to be critical to ensure control effectiveness, namely managerial communication, quality of information, and employee perceptions. The evidence suggests that communication of carbon information through appropriate channels and language, as well as high quality of carbon information are essential to ensure positive employee perceptions and buy-in, which will contribute to effective carbon reduction.

KEY WORDS Management control systems; Carbon emissions; Carbon controls; Carbon management control systems

1 INTRODUCTION

Excessive carbon emissions have been identified as a major threat to sustainability (Brundtland, 1987). This has led governments in many parts of the world to commit to reducing the amount of carbon emitted by either taxing carbon emissions or establishing carbon cap-and-trade schemes. These initiatives cause substantial financial impacts (Rankin et al., 2011), compelling organizations to account for and control their carbon emissions by implementing management control systems (MCS). Stakeholder groups, such as customers and suppliers, increasingly demand more proactive corporate action to mitigate carbon emissions (Schaltegger and Csutora, 2012; Massa et al., 2015), and investors demand environmental disclosure (De Villiers and Van Staden, 2010; Atkins and Maroun, 2015; Atkins et al., 2015; Stent and Dowler, 2015). Therefore, carbon MCS are not only required to comply with legislation but may be critical to maintaining organizational reputation and legitimacy.

Prior studies have examined separate controls and MCS such as environmental reporting (Larrinaga-González et al., 2001; Rao and Tilt, 2016), sustainability management accounting and techniques (Henri and Journeault, 2010), sustainability indicators (Adams and Frost, 2008), and the balanced scorecard (Burritt and Schaltegger, 2010, De Villiers et al., 2016). Research into carbon-specific controls have tended to emphasize diagnostic controls such as carbon performance measures (Hoffmann & Busch, 2008; Weidema et al., 2008), carbon monitoring and reporting system (Martinov-Bennie, 2012; Tang and Luo, 2014), carbon incentive system (Eccles et al., 2014, Ioannou et al., 2016). Some also examined interactive controls and how they are used by management to drive sustainability and enable organisational change (Rodrigue et al., 2013, Gond et al., 2012). However, few studies have examined sustainability MCS using a comprehensive MCS framework (Gond et al., 2012, Crutzen and Herzig, 2013). Most researchers have investigated one or two sustainability controls or tools in isolation and only focused their inquiry on the types and uses of sustainability controls. This limits the understanding of the variety of carbon controls as a package (Malmi and Brown, 2008, Ferreira and Otley, 2009). In particular, it remains unclear from the literature what types of carbon controls, or characteristics of controls, lead to effective carbon management. Overall, despite a growing body of literature, the understanding of how companies design and use MCS to drive sustainability strategy remains limited (Crutzen and Herzig, 2013).

Motivated by the need to understand better how organizations use the MCS package to measure, monitor, report, and manage carbon emissions, this study aims to address the following research questions:

1. Which types of carbon controls are used?
2. What is the role of carbon MCS in carbon management?

Although the answers to these questions are of interest to managers and accountants involved in carbon management, carbon reduction, or the implementation/improvement of carbon MCS, the prior research does not fully address these questions. In particular, few studies move beyond theory and provide case/field study evidence. Arjaliès and Mundy (2013) come close by using Simons' (1995) levers of control to analyse sustainability MCS, but they use survey data, instead of case/field study data, restricting their ability to fully explore the types and role of MCS.

In-depth interviews are ideally suited to the examination of the research questions, because of their open-ended and exploratory nature. Therefore, this paper examines carbon MCS through the analysis of 38 interviews with individuals involved in carbon MCS in 30 organizations in New Zealand. New Zealand is the first country to implement an economy wide carbon emissions trading scheme which has restrictive criteria for free credit allowances (MfE, 2007). The European Union ETS, for example, covers only the utility and industrial sectors and commercial airlines and gives generous allocation of credits/allowances (EU, 2016). Thus, the New Zealand setting enables the selection of a wider range of organizations which are likely to be impacted more onerously and are therefore more likely to make extensive use of carbon MCS.

The insights gained in New Zealand can be relevant to other settings where carbon mitigation policies are pursued, because these policies generally require carbon emitters to implement and maintain carbon MCS. The data analysis starts with one of the latest and most comprehensive MCS frameworks (Tessier and Otley, 2012). On the basis of this initial analysis, the Tessier and Otley (2012) framework is modified and the findings are presented using this modified framework.

The analysis shows that researchers can benefit from emphasizing characteristic of controls including intensity, use, objectives, quality of information and managerial communication, rather than focusing solely on the design of controls. This paper contributes to the carbon

controls literature by being the first to list and classify the carbon MCS used by organizations in terms of their type, design, and objectives. The paper shows that carbon controls can be used to achieve compliance or improve performance and that organizations can change these objectives over time. The findings suggest that emissions reductions do not occur without absolute (as opposed to intensity) reduction targets and extensive management and resource deployment into carbon management. The paper also provides evidence to suggest that firms that want to improve their performance or manage compliance costs effectively will require the integration of carbon controls into operational and strategic processes. A new carbon MCS framework is developed that managers and researchers can use as an implementation guide or a research framework. Three elements in the framework, which ensure control effectiveness, are particularly important, namely objectives of control, managerial communication, and quality of information.

Simons (1995) defines MCS as "the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities". Henri and Journeault (2010) applies this definition to environmental controls, stating that eco-controls are "the formalized procedures and systems that use financial and ecological information to maintain or alter patterns in environmental activity". This paper defines carbon controls more broadly as the formal and informal routines and procedures that use financial and non-financial carbon information to maintain or alter patterns in organisational activities. Carbon MCS is the package of the formal and informal carbon controls intentionally used by management to achieve an organisation's carbon management objectives.

2 CARBON EMISSIONS MANAGEMENT AND MANAGEMENT CONTROL SYSTEMS

This section provides a review of prior studies that investigate carbon management strategies and the role played by MCS in organisations' carbon management.

Firms can adopt different carbon management strategies and approaches. Some studies examine the drivers of specific strategies. Schultz and Williamson (2005) suggest three strategies firm can adopt to gain a competitive advantage: minimising the additional costs effectively, differentiating products by adding carbon credits into product offerings and turning the capacity to supply carbon credits into a profit centre. Pinkse (2007) argue that firms adopt carbon norms such as carbon neutrality and carbon labels to respond to stakeholder pressures and make a favourable impression. Weinhofer and Busch (2012) reveal

that electric utilities implement climate change risk management processes similar to existing risk management processes. Pinkse and Busch (2013) find that firms participate in emissions trading activities due to industry pressures and product/process innovation. However, Slawinski et al. (2017) criticise the lack of reduction in absolute carbon emissions, which is often due to short-termism and the need to avoid uncertainty. Some studies propose typologies for climate change strategies. Weinhofer and Hoffman (2010) classify climate change strategies as focusing on either CO2 compensation, CO2 reduction, or carbon independence. Cadez and Czerny (2016) identify three strategic priorities ranging from internal carbon reduction (i.e. product or process–related emissions reduction) to external carbon reduction (mainly through the supply chain), and carbon compensation (Alkaraan, 2016; Borghei et al., 2016; Del Sordo et al., 2016; Green et al., 2017). Bui and Villiers (2017) find that firms can adjust their climate change strategy from stable to reactive, anticipatory, proactive or creative, depending on the degree of uncertainty of regulatory requirements.

However, despite the variety of possible strategies, the implications of carbon controls or MCS in implementing carbon management strategies are unclear. Some studies examine individual controls used in the sustainability or carbon context, such as performance indicators, targets, and incentives. Bonacchi and Rinaldi (2007) find that the integration of sustainability strategies into the traditional performance measurement systems enables the progressive internalisation of sustainability principles into organisational activities and culture (Khlif, 2016; Baldarelli et al., 2016). Perego and Hartmann (2009) indicate that when environmental PMS is focused on financial information, this information is increasingly used to support a proactive environmental strategy. In the carbon context, Schaltegger and Csutora (2012) suggest two types of measures, namely corporate accounts for sustainability improvement (such as a budget for carbon mitigation or carbon emissions avoided), and accounts for unsustainability (such as total emissions levels or carbon liability or costs). Hoffmann and Busch (2008) identify four types of carbon indicators that are essential to decision making by policy makers and investors, including: carbon intensity, carbon dependence, carbon risk, and carbon exposure. These indicators can be physical or financial in nature. Weidema et al. (2008) and Wiedmann et al. (2009) explore how carbon footprint measures, in both absolute and intensity terms, can promote a more consistent environmental assessment for products/services and the evaluation of firms' sustainability performance within its industry. However, Kumarasiri and Jubb (2016) find that in the Australian context the use of management accounting techniques to set targets, measure performance and

incentivise emission mitigation is limited. Lee (2012) finds that firms have not considered the benefits of setting targets, even though targets are essential to carbon mitigation (Tang and Luo, 2014; Lee, 2012). Different performance measures can be used to monitor different environmental aspets (Comoglio and Botta, 2012). Ioannou et al. (2016) find that firms adopting more challenging targets achieve a higher percentage of those targets. Financial incentives have also been studied, with conflicting results, having no impact on carbon performance (Tang and Luo, 2014) or a negative impact on motivating environmental performance (Eccles et al., 2012).

The prior literature has also investigated the different uses of sustainability and carbon-related MCS. For example, Tang and Luo (2014) argue that higher quality carbon MCS leads to higher carbon mitigation. Burritt et al. (2011) outline different accounting tools for different circumstances, e.g. depending on whether the decision relates to the short/long term, physical/monetary data, past/future activities. Sustainability MCS are commonly used to monitor legal compliance, improve efficiency, enable innovation, save costs, support decision-making, and enhance legitimacy through external reporting (Henri and Journeault, 2010; Schaltegger and Csutora, 2012; Passetti et al., 2014).

Some studies have examined sustainability controls from a MCS perspective. Martinov-Bennie (2012) highlights that a carbon MCS needs to include the design of the measurement and the capturing process, calculation, compilation and reporting, each underpinned by specific key controls. Gond et al. (2012), based on Simons's (1995) levers of control, suggest that the various combinations of diagnostic and interactive uses of controls enable the integration of sustainability control systems into the organization's traditional MCS, and in turn this integration allows the implementation of sustainability policies. Bui (2011) groups sustainability-oriented MCS into: internally oriented strategy MCS, externally oriented strategy MCS and pressure related MCS. Arjaliès and Mundy (2013) demonstrate how companies manage their sustainability strategies through a variety of MCS, particularly emphasising the role played by internal and external communication processes. Tang and Luo (2014) develop a carbon management control framework that captures carbon governance, emission tracking and reporting, and engagement and disclosure. However, due to the differences in the types and components of controls, the insights from these studies are not comparable.

The review of the prior literature highlights four gaps. First, little is known about the specific MCS used for climate change policies and strategies, as most prior studies investigate general sustainability or environmental MCS. The global importance of climate change issues and the need for effective carbon mitigation requires a more in-depth understanding about the role played by MCS in enabling climate change policies. Second, most studies have focused on a small subset of MCS (Lisi, 2015; Burritt et al., 2011), ignoring other supporting controls (Bui, 2011; Collins et al., 2011). Thus, prior studies have not examined carbon controls within a comprehensive MCS framework. Third, the prior literature does not differentiate between strategic versus operational level controls. The MCS literature suggests that top management uses MCS differently from middle and operational managers (Mundy, 2010). In terms of decisions made using carbon information, again the prior literature does not provide evidence of which decision is more prevalent, and under which circumstances. Fourth, little is known about the variations of carbon MCS between organizations. Given that the prior literature shows that MCS is contingent upon strategy and organizational and environmental characteristics, the configurations of carbon MCS within different settings could provide important new insights.

Overall, while carbon MCS potentially acts as an important bridge between climate change strategy and organizations' carbon mitigation and performance outcomes, little is known about the operationalization of carbon MCS (Lisi, 2015). The next section discusses the background and research methods, and outline the research framework for this study.

3 BACKGROUND AND RESEARCH METHOD

3.1 Background

New Zealand implemented an ETS (NZ ETS) in January 2009, which immediately covered all sectors, including government, and all gases/emissions, except for the agricultural industry, which was to be covered from 2012. Organizations participate in the ETS through three mechanisms. First, some have the obligations to surrender carbon credits when carrying out certain activities. Second, organizations able to generate carbon credits, such as through forestry, can opt into the ETS. Thirdly, some are allocated carbon credits as compensation for increased costs under the ETS. ETS participants have to measure and report their emissions for carbon credit inventory to the Environmental Protection Agency.

New Zealand provides an ideal setting for the research, because the effect of the NZ ETS on organizations is potentially more onerous than under other ETSs, because (i) the NZ ETS covers virtually the whole economy, while other schemes (such as the EU ETS) cover a limited number of industry sectors, and (ii) because of the generous allocation of carbon credits/allowances elsewhere. For example, in 2009 the allocation of carbon allowances in EU countries varied between 92% and 152% of median emissions during the baseline period of 2005–2008. In the EU many sectors get carbon allowances, whereas in New Zealand, very few businesses qualify for carbon credits and these credits are limited to 60% to 90% of 2005 emissions (GPCNZ, 2010). These factors combine to result in higher carbon costs and thus a stronger incentive for organizations to control emissions. Therefore, the New Zealand setting allows for the selection of a wider range of organizations that make extensive use of carbon MCS to control emissions.

3.2 Site selection and data collection

A range of organizations are included in the study to ensure that the various ways carbon controls are used can be observed (Burritt et al., 2011). A field study approach is followed to gain an overview of MCS used in different settings, rather than a case study approach, which would only uncover a single solution (Kraus and Lind, 2010). Suitable organizations had to meet at least one of the following criteria: having an obligation under the emissions trading scheme (ETS); being an energy-intensive organization likely to incur carbon costs due to the ETS; having a strong commitment to sustainability and carbon management as evidenced in publicly available information (Burritt et al., 2011). These criteria increased heterogeneity in the data (Burritt et al., 2011; Engels, 2009), by including diversity based on energy-intensiveness and public/private sector organizations.

Yin's (2003) interview protocols were followed. First, we introduce the project to the most relevant person in the organization. Organizations were contacted and engaged through several phone calls. The most appropriate person to interview was determined through the examination of the organization's website or annual reports, or a phone call to the organization. The first phone call to the potential interviewee involved a general introduction to the project, with a follow up email that provided more information. Second, upon agreement to participate, the time and date of the interview was set, and the semi-structured interview questions were sent to them (Yin, 2003). The interview questions were designed to capture the objective and process of carbon management, the controls used to monitor, measure, and collect carbon data, the ways of communicating and disseminating carbon

information, the uses and purposes of carbon information and indicators, the emphasis on them at different management levels and employee perceptions of carbon information and controls. Third, during the interviews, the interviewee(s) were assured of the confidentiality of their personal and organisational identities as part of the project's ethical approval requirements. Fourth, we asked for the interview to be tape-recorded to enable more accurate representation of the interview notes. Fifth, a summary of each interview was sent to interviewees to check (Yin, 2003).

Three quarters of the interviews were conducted face-to-face with the remainder by phone or Skype. The interviews lasted between 40 minutes and one and a half hours. The manager with the greatest involvement in carbon management was targeted. However, in six organizations, two or three managers with carbon-relevant responsibilities were willing to be interviewed. Hence, 38 interviews were conducted involving 39 interviewees (one interview involved two interviewees) from 30 organizations. The interviewees are line managers, environmental/ carbon managers, and accountants in a range of industries/sectors. As such, our study differs from studies with a top management focus on MCS (Bisbe and Otley, 2004; Henri, 2006; Simons, 1995; Widener, 2007) by including different levels of management. Where our interviewees are not senior managers, they regularly interact with top management about carbon management plans. Therefore, these interviewees have first-hand knowledge of the design, use, and objectives of carbon MCS, including insight into top management intentions.

Of the 30 field organizations, 43% have ETS obligations (called participant entities) and 57% do not (non-participant entities). Appendix A provides interview/interviewee details, including dates, lengths of interviews, and job titles.

3.3 Framework and data analysis method

Existing literature has examined carbon controls in a rather fragmented manner. To fully understand carbon MCS design and use, rather than focusing on one type of carbon control, controls need to be examined as a package (Otley, 1999).

There have been various sustainability MCS frameworks proposed in the literature. Gond et al. (2012) use Simons' levers of control, but only emphasise the diagnostic and interactive uses, and identify different organizational configurations that reflect the modes of integration between sustainability control systems and traditional MCS. Various authors (Figge et al., 2002; Hansen and Schaltegger, 2016) adopt the concept of the balanced scorecard to propose

a sustainability balanced scorecard (SBSC) that enables the incorporation of sustainability principles into the strategic and performance perspectives of an organisation's performance measurement system. However, by focusing on performance measures, SBSC approaches do not consider belief, boundary, and interactive control systems. Crutzen et al. (2017) utilises Malmi and Brown (2008)'s MCS framework, which captures five types of formal and informal controls including planning, cybernetic, reward and compensation, administrative, and cultural controls. However, by focusing on types of controls, this framework ignore other important aspects of controls such as managerial intention, presentation of control and employees' perception of control, which have important implications for control effectiveness.

Given these limitations of other MCS frameworks, we chose Tessier and Otley's (2012) MCS framework as our starting point. This framework incorporates Simons' (1995) levers of control, examining not only (comprehensive) types of controls, but also their uses and the managerial intentions in using them. Four types of control systems are identified. Strategic performance controls (SPC) ensure that the strategy in place is appropriate while strategic boundaries (SBC) impose limits on strategic opportunity search. Operational performance controls (OPC) include critical performance indicators and operational boundaries (OBC) prescribe acceptable behaviour, procedures and rules in daily activities. These controls can serve different objectives: compliance or managing performance. The framework also captures managerial intentions in using individual controls (to reward or punish), and the intensity of use, i.e. whether managers use a control interactively or diagnostically. In addition, the framework deals with two characteristics of controls, namely how controls are presented and how employees perceive controls. The strengths of Tessier and Otley's (2012) framework are widely recognized in the literature, including: clearer definitions of constructs, a comprehensive consideration of different types of controls, differentiation between design of control and the intensity of use, emphasis on managerial intentions and employee perceptions and highlighting the dual facilitating and constraining elements of controls in achieving balance in the MCS (Kruis et al., 2016; Hanzlick, 2015; van der Kolk et al., 2015; Chenhall and Moers, 2015; Seal and Mattimoe, 2014).

We modify Tessier and Otley's (2012) framework as appropriate for our setting. We identify use of controls as a separate attribute. While Tessier and Otley (2012) only refer to two uses of MCS: reward or punishment, the literature suggests further uses, such as facilitating decision making, stakeholder engagement or external reporting (Tang and Luo, 2014;

Schaltegger and Csutora, 2012; Burritt et al., 2011; Henri and Journeault, 2010; Etzion, 2007). We also add quality of control as prior carbon-related studies identify information quality as a key driver of carbon management effectiveness (Bowen and Wittneben, 2011; Martinov-Bennie, 2012). While Tessier and Otley (2012) only identify the communication channels of controls, our data also sugggest that language of control (how carbon issues are framed) is an important attribute of communication. The modified framework is presented in Figure 1.

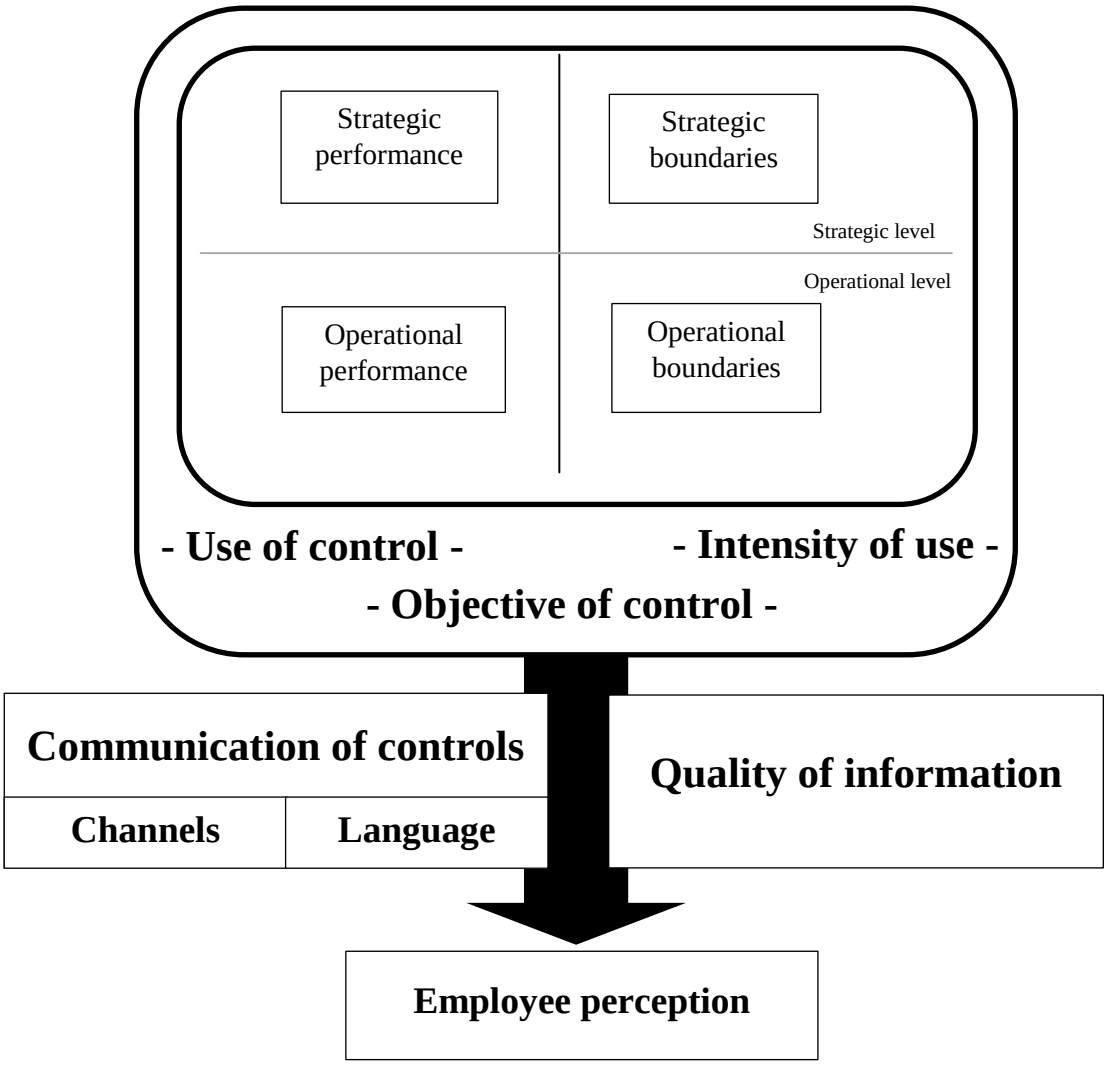

Figure 1: MCS Framework developed in this paper

The interviews were recorded and subsequently transcribed. A summary of each transcript was sent to the interviewee for review. Where possible, the information from each transcript was triangulated with publicly available documents and reports (Arjaliès and Mundy, 2013). The coding process followed the following steps.

First, all transcripts were imported into Nvivo, which enabled the traceability of the chain of evidence (Yin, 2003). Second, data were categorised to identify related themes. A coding tree was developed, based on the modified framework, that includes nodes for (i) types of controls (OBC, OPC, SBC, SPC), (ii) characteristics of controls (Use of control; Intensity of use; Objective of control; Communication of control; Quality of control; Employee perception). We did pattern matching to check that the transcript data correspond to the predicted MCS patterns according to the modified framework (Yin, 2003). To enable cross-case comparison and synthesis (Yin, 2003), we also set up nodes for type of organizations (participant/non-participant), size (big/medium/small), and industry. Each sentence/section/paragraph was then manually coded into these nodes, based on keywords and content analyses. We also displayed the data through tabulating our main findings with the columns representing the patterns/themes, and the rows representing the organizations (Miles and Huberman, 1994; Yin, 2003). This enabled comparing and contrasting of patterns across organisations, to identify the drivers of variations in carbon MCS packages across firms.

Coding and analysis were performed by one of the co-authors, followed by a thorough re-evaluation and check by the other co-author. Where differences or uncertainties arose, these were discussed and clarified. This procedure was designed to ameliorate any tendencies towards confirmation bias, where according to Yin (2003), a researcher emphasizes findings that confirm their prior expectations. However, it should also be noted that the two co-authors have different levels of expertise regarding MCS and that the interviewer was not an expert on controls at the time of the interviews. As such, the interviewer did not have preconceived ideas of what to expect and the two co-authors, who might be expected to have different expectations, acted as a check on each other. The triangulations of interview with non-interview data, provided some comfort regarding the threat of observer bias, where the interviewer influences the responses of the interviewee (Yin, 2003). However, note again that the interviewer did not have pre-conceived ideas around MCS.

4 FINDINGS: CARBON CONTROLS IN NEW ZEALAND ORGANIZATIONS

Our analysis below is divided into two sub-sections, in accordance with our modified carbon MCS framework. The first section identifies and discusses the types of carbon controls found, following the Tessier and Otley (2012) framework. In the second section, we highlight and discuss the different characteristics of carbon controls, including intensity of use, use of control, objective of control, quality of carbon information, communication of carbon controls, and perception of controls.

4.1 Types of carbon controls

From our analysis, we identify different types of controls and classify each control into the most suitable category of the framework. Table 1 provides the list of carbon controls found in the 30 interviewed organizations. The next sub-sections will discuss the key findings related to each type of control.

Table 1: List of carbon controls found, classified into four types

Strategic boundary control	**Operational boundary control**
Carbon focused vision statement Carbon focused belief systems Carbon reduction defined as strategic opportunity in strategy documentation Carbon-related criteria used in investment evaluation Communication of carbon risks Ban on carbon trading	Segregation of duties related to carbon measurement and monitoring Suppliers' carbon-related audits and guidelines Investment guidelines integrating carbon evaluation Supplier monitoring program Physical behaviour controls aiming towards carbon reduction Authorization and limits of carbon credit purchasing Government regulation around carbon inventory and credit surrendering
Strategic performance control	**Operational performance control**
Carbon risk monitoring system and assessment Top management engagement in carbon-related issues Carbon strategy document Strategy review and planning that include carbon-related issues Carbon budget control Funding to encourage carbon-related innovation Executive sponsor that drives sustainability Education to change senior management perception on carbon-related issues International/competitor carbon benchmarking	Carbon performance measures Carbon measurement and monitoring system Target setting Performance evaluation and reward structure Environmental policy / plan Budget control/ On-demand funding Carbon audit Carbon calculation and measure Carbon performance review process Internal carbon communication and discussion Internal benchmarking Carbon neutrality/reduction certification Carbon credit policy Industry certification system that has carbon relevance Parent-subsidiary carbon holding account

4.1.1 Carbon strategic boundary control

Strategic boundary controls (SBCs) define the areas to be explored for strategic opportunities, and can specify inappropriate domains, or suggest preferred areas. The 30 organizations adopted a range of SBCs, the most popular being vision statements and belief systems.

4.1.1.1 Vision statement

Many organizations include carbon management in their vision statements, such as the goal to become a "carbon neutral company" or "a carbon industry leader". A vision statement sends a strong signal to unlock employee potential and encourage positive behaviour. Our data suggest that vision statements are enabling when managers can relate to and commit to them and internalize sustainability into their personal identity and values. A vision statement can only be enabling when it aligns with existing "organizational identity". For instance, in C14, organizational members are receptive of a carbon-focused vision because carbon "*fits more into the whole renewable, or we're mainly a renewable energy company anyway*". However, in an organization where business operations are perceived traditionally as environmentally-damaging, a clean or carbon neutral image does not sell because "*a coal mining company being carbon neutral, it's […] like putting lipstick on a pig*" (C15).

4.1.1.2 Belief system

Only a few organizations consider carbon/environmental sustainability as an inherent part of the belief system, even though it is often a part of the vision statement. In these few organizations, an environmentally-focused belief system enables top management to communicate their environmental vision to the rest of the organisation, promoting goal congruence. However, we find that the impact of carbon integration in the belief system can have different consequences for performance. For example, in C17, environmental excellence is part of the culture and inspires managers and employees to exceed targets and continuously improve environmental performance. In contrast, while they consider themselves as "responsible community members", C24's environmental efforts are really focused on complying with existing regulations and rules. Hence, belief systems can entail limitations to, or improvements of, environmental performance.

4.1.2 Carbon strategic performance control

A number of controls and systems are used by the organizations in reviewing and renewing strategy (strategic performance control (SPC)). These controls engage top management levels rather than operational level managers, and involve challenging and rethinking of existing business direction and strategy. The most popular SPCs are risk and opportunity monitoring, engagement at top management level, and carbon strategy documents.

4.1.2.1 Risk monitoring system and assessment. Our field organizations had all undertaken a risk assessment, normally around the introduction of the NZ ETS in 2008, to identify the risks and opportunities the ETS entails, the implications for organizational profitability, and

the possible strategic responses. An interactive use of risk monitoring systems and information enables the assessment of intended strategies but also allows emergent strategies to arise (Gond et al., 2012). Indeed, some firms changed their environmental strategy after 2008 to focus on pollution control in order to reduce potential ETS carbon and compliance costs. With significant fluctuations in carbon prices and modifications in the ETS between 2008 and 2012, regular monitoring of carbon markets and policy changes allowed for the evaluation of the effectiveness of their environmental strategy.

4.1.2.2 Top management engagement. Many organizations discussed carbon intensively in their senior management meetings as carbon is perceived as a key strategic uncertainty, especially around the time of ETS introduction (Simons, 1995). Carbon continues to be a significant item in some organizations' monthly meeting agendas because they consider carbon to be a key driver of competitiveness. Interactive top management discussion allows the implications of carbon issues to be explored, carbon reduction projects to be evaluated, and carbon strategy formulated or revised. Besides formal meetings, top managers use various channels (forums, newsletters, face to face discussion) to communicate carbon management expectations and intervene in the carbon-related decisions of lower managers. In some organizations, environmental managers mobilize support from operational managers to trigger top management engagement with carbon issues.

4.1.2.3 Carbon strategy documents. Carbon strategy documents are used in about half of the organizations in an effort to understand the effects that different carbon strategies would have, and to facilitate discussion around the key causal relationships in the strategy. For example, in C19 the choice of a low-carbon strategy led to extensive debate about the external conditions that might enable or thwart its success, and implications of various strategies for competitiveness. Essentially, an interactive use of the carbon strategy document allows for a sense-making process around strategy. A number of organizations include stretched quantitative targets in the strategy document to motivate management to question and discuss the appropriateness and achievability of these targets. Hence, the strategy document is used as an input (rather than an output) of the sense-making process (Gioia and Thomas, 1996).

4.1.3 Carbon operational boundary control

Operational boundary controls highlight the behavioural expectations and boundaries in carrying out carbon strategy or carbon-related business strategy (Simons, 1995; Tuomela, 2005; Tessier and Otley, 2012). Segregation of duties is the most common OBC.

4.1.3.1 Segregation of duties. Five functional areas are commonly involved in carbon reporting and management: business units, environmental department or team, accounting/finance, risk/audit function, and trading team. Each of these has segregated responsibilities. We find that accountants play an extensive role, beyond the "gate-keepers" between sustainability managers and higher management identified by Schaltegger and Zvezdov (2013). Specifically, accounting and finance are also often responsible for retrieving energy consumption and staff travel data from supplier invoices. Accountants also receive carbon footprint data from operations, calculate ETS liability and carbon costs, and prepare reports for top management. The risk and audit team checks carbon reports to ensure compliance with the organization's risk limit. Overall, most organizations have absorbed carbon-related responsibilities into existing roles.

4.1.4 Carbon operational performance control

Operational performance controls (OPC) are used by managers to ensure the achievement of specific carbon objectives. Although we found an extensive range of OPCs, we only discuss those interviewees considered most important, namely environmental policy/plan, carbon measures, carbon measurement and monitoring system, target setting, and incentive system.

4.1.4.1 Carbon performance measures. Physical or monetary approaches can be used to evaluate carbon performance/impacts (Ratnatunga and Balachandran, 2009; Stechemesser and Guenther, 2012). The majority of companies focus on physical indicators over the financial implications of carbon. Physical carbon measures are set on an absolute (carbon emissions) or intensity basis (carbon emissions per unit produced). Some organizations explicitly focus on intensity measures as they fear that absolute reduction targets will inhibit growth. Compliant entities focus more on liability and thus financial indicators. Where they are able to pass carbon costs onto customers, they use carbon costs to justify these charges. Those that are not able to pass on the cost also find physical measures of carbon important as they need to reduce carbon emission levels to remain competitive.

4.1.4.2 Carbon measurement and monitoring system. The field organizations have different ways to calculate their carbon output, either through an internal function, by relying on suppliers, or both. Carbon output is often calculated by multiplying consumption of energy by a government specified factor. Organizations can also use supplier invoices in carbon calculations. Organizations with a carbon strategy monitor carbon more actively, for example, regularly checking carbon performance against targets.

4.1.4.3 Target setting. We find that most of the interviewed organizations either set carbon-related targets or have explicit carbon reduction targets. Some prefer energy targets, being more meaningful to operational managers. Sometimes targets are imposed top-down, but in other cases result from interactive discussion. Most organizations break overall targets down into business unit and operational site targets, with targets customized to fit each business unit and site. The organizations that have no carbon targets, reason that carbon costs are low compared to other costs, do not see carbon reduction as achievable as the company is in a growth phase, or because carbon reduction technology is not available, or carbon is seen as the inevitable result of operations.

4.1.4.4 Incentive system. About half of the organizations that set carbon targets have formal carbon-linked incentive systems. Performance evaluation can be used restrictively, for example, in C22 it was made clear that "*if you don't perform* [on carbon] *then there may be personal ramifications*". Performance evaluation can also be open, for example, in C19 site managers can explain why they do not meet certain targets and it is uncommon for targets to be part of line managers' KPIs. Integrating carbon considerations in the bonus structure is another way to incentivize. In two organizations, managers' performance is not specifically measured based on carbon, but achieving carbon targets will result in bonus payments and this has motivated staff to be creative in carbon management. In C29, no penalty is applied for not achieving the targets, but staff are motivated by strong internal competition between the New Zealand and Australian branches.

4.1.5 Effectiveness of controls to reduce emissions.

In our field data, we find that ETS participants rely more on measures of total carbon emissions and carbon liability, while non-participants focus more on physical and intensity-based measures (e.g., total emissions and tons of CO_2 per unit of production). ETS participants that reduce carbon emissions significantly deploy significant management attention and resources through strategic investments or organization-wide behavioural change. Furthermore, the greatest carbon reduction occurs among firms that set yearly targets for both absolute and intensity carbon levels. The ETS participants who are able to pass additional carbon costs on to customers do not set reduction targets and achieve little or no carbon reduction. Organizations that set only emissions intensity measures generally achieve a reduction in intensity level, but no absolute reduction. Overall, our data suggests that setting a carbon reduction target appears to be necessary but not sufficient to achieve emission reductions. The extent of carbon mitigation depends on whether carbon controls are used

intensively, for compliance or performance objectives, and communicated appropriately, as discussed in the next section.

4.2 Characteristics of carbon MCS

In the previous section we have identified the different types of carbon controls and discuss design and use of the most popular controls of each type. This section will provide evidence for the following carbon MCS dimensions: intensity of use, use of control, and objective of control, quality of information, communication of control and employee perceptions.

4.2.1 Intensity of use: interactive versus diagnostic

Managers can use carbon controls and information interactively or diagnostically. In almost half of our field organizations, top managers discuss and use carbon information interactively. Senior managers are regularly updated on the progress towards strategy implementation. Compliance-oriented use does not occupy much top management time. Interactive meetings around carbon market trends, ETS changes, and their implications are more time-consuming. The CEO or CFO often chairs the environmental committee, signalling executive interest. Particular attention to carbon-related issues is demonstrated in various ways: whole organisation being involved in carbon-related discussions (C17), the board regularly scrutinizing and questioning management on carbon (C22), or having a dedicated environmental month each year (C21). Our interviewees confirm that these interactive discussions reduce uncertainty and enable organizational learning on carbon-related issues, and encourage innovation. In the other half of the organizations, carbon information is only used on an *ad hoc* basis as managers only pay attention to it when there are significant variations. Even when carbon information is reported to senior management, the information receives minimal attention ("*probably taking up about 3% of the meeting time*", C10). Interviewees explained this as due to a lack of top management commitment, low carbon exposure due to low carbon prices, and carbon not being seen as a core objective.

4.2.2 Use of control

The various uses will each be discussed under its own sub-heading.

4.2.2.1 Investment planning. Interviewees recognize the importance of considering carbon in their investment decisions, but the extent of integration varies. Some apply different carbon prices in their investment modelling, i.e. sensitivity analyses (C13, C14, C16, C22). In C22, avoiding future carbon costs was one of the key reasons for building lower-carbon buildings. C10 has a criterion that new investments need to have higher carbon efficiency than existing ones. C15 developed some projects to create tradable carbon credits. However,

the low carbon prices explain why some firms are reluctant to integrate a carbon price in their investment modelling.

4.2.2.2 Strategic sense making, review and planning. The key test for the significance of carbon information is whether it is integrated in strategic sense making, review and planning processes. All the interviewed organizations have gone through an "initial teething period" of strategic sense making when the ETS was first introduced, where they identified carbon and ETS risks and their organizational implications. This process can also be on-going as organizations continually monitor and assess carbon-related regulatory and market developments. This allows top management to review the efficacy of existing business strategies, and modify or develop new strategies. Consistent with prior studies (Ratnatunga and Balachandran, 2009; Schaltegger and Csutora, 2012), carbon information can make a difference to an organization's product and marketing strategy. C29 discontinued one traditional product because of its high carbon content. In C23, using low-carbon materials in production provided a point of competitive difference in the tendering process. Similarly, C24 adjusts its marketing strategy to demonstrate how its carbon efforts can benefit its customers' business.

4.2.2.3 Decision making/resource allocation. Most organizations use carbon information to identify areas to gain operational efficiencies. Carbon measures allow organizations to make changes to their operations, such as building highly energy efficient buildings, or setting up video conferencing facilities to reduce staff travel, or improving recycling practices. However, sometimes managers do not have to use carbon information to drive change, as change is already happening - motivated by operational efficiency or environmental accountability - regardless of the ETS. Thus, we find that carbon measures only provide a marginal incentive for managers to lower carbon emissions. Consistent with Schaltegger and Csutora (2012) and Tang and Luo (2014), carbon information is found to play a role in supply chain relationships and pricing decisions. A number of companies monitor their suppliers' carbon management practices for compliance with the companies' guidelines, and many organizations use carbon data to pass carbon costs to customers.

4.2.2.4 Training and education. Several communication channels are used to train and educate staff on carbon, including interactive meetings and seminars with top management involvement, the intranet, emails and face to face discussion. Dedicated reports and webpages are also used to disseminate carbon information widely. Environmental/carbon managers explain carbon management process and carbon performance in formal and informal settings.

Some organizations choose to take this training beyond the organizational boundary to their supply chain and the wider public.

4.2.2.5 Reward/punishment. Only a few organizations use carbon information for reward or punishment. Some organizations integrate carbon targets into managerial performance evaluation for environmental or carbon trading managers, for whom achieving these targets are part of their core responsibilities.

4.2.2.6 External reporting/award. Carbon information is often used for external reporting (Bebbington and Larrinaga-Gonzalez, 2008; Henri and Journeault, 2010; Rankin et al., 2011). In many cases, external reporting corresponds to what an organization does internally. Hence disclosure focuses on highlighting achievement to external stakeholders. However, internal reporting focuses more on carbon cost and provides the incentive for carbon mitigation. This does not suggest "green-washing", but rather reflects the varying purposes for which internal and external stakeholders use carbon information. However in some organizations, carbon disclosure is "*just another number to report*" and there the information is not used internally to motivate behavioural and operational change. Hence, though hard indicators (emissions levels) might be disclosed rather than soft indicators (e.g., generic environmental policy or statement) (Clarkson et al., 2008), they do not necessarily reflect a high level of carbon responsibility.

4.2.3 Objective of carbon control: performance or compliance?

Consistent with the prior literature (Berry et al., 2009; Gond et al., 2012; Tessier and Otley, 2012), the interview data suggest that carbon controls can be used for compliance, performance, or both. Many participant organizations employ carbon controls primarily to satisfy their ETS obligations. The manager from C14 bluntly commented "*if [the ETS] wasn't there we wouldn't do [carbon management]*". Some engage in carbon management to become "*compliant at least cost*" (C12). Non-participant organizations often subsume carbon in the wider environmental management systems that comply with other applicable environmental regulations and rules. However, as the emphasis is on the regulatory side, "*it doesn't get improved a hell of a lot, it just gets done*" (C20). Additionally, some organizations comply with the standards imposed by supply chain partners. For example, C18 reports carbon information to comply with the standards of an external body, but does not use such information in internal decision making. Carbon management in public sector organizations also shifts with changes in government's directives. Before 2009, these organizations had to comply with a government directive to promote a wide environmental

sustainability agenda. Recently, government policy has shifted to prioritize the financial implications of energy consumption (and de-emphasize other environmental aspects), causing public sector organizations to refocus in order to comply (C28).

While many ETS participants stop at compliance, some choose to engage in beyond-compliance carbon controls for strategic purposes, to maintain and improve financial performance, and (re)gain market competitive advantage (Burritt and Schaltegger, 2010). Managers maintain organizational performance by forecasting and charging carbon costs correctly to customers, and managing carbon credit purchase carefully (C16, C24). Some specifically change their marketing strategies to emphasize carbon reduction initiatives, gaining a carbon-focused competitive advantage. Some organizations are interested in carbon trading as a revenue generating business (C14), and a way to identify areas for improvement (C19, C21), as suggested by Henri and Journeault (2010).

Notably many interviewees agree that the focus on either performance or compliance is not absolute, but transitional. Our data reveal that some organizations moved from compliance to performance over time. In contrast, some organizations made the opposite transition from performance to compliance. When the ETS was initially introduced, organizations set up various controls to learn about and capture any potential opportunities. However, as understanding increased, carbon became just another number to report. The moderated ETS and the weak carbon prices meant many of the proposed carbon mitigation projects were premature, causing the move from performance back to compliance. This supports Wouters' (2009) suggestion that some controls are initially seen as exciting, but then turn into a template few people find relevant or useful. Managers did not encounter much difficulty in balancing the different objectives of carbon controls (Ahrens and Chapman, 2007) as either performance or compliance tends to dominate managerial attention during a given time period (Mundy, 2010).

4.2.4 Quality of carbon information

Accurate and complete information is considered a prerequisite for use by many interviewees. Data accuracy is particularly challenging in big and decentralized organizations where there are not sufficient controls in place to ensure consistent and accurate carbon reporting across autonomous business units and branches. This is both a problem of data entry ("*they might put a figure in wrong, and suddenly things go to millions instead of thousands*", C25) and data manipulation ("*there's no accountability, there's no auditing of the data, there's no shut off to stop branches from tinkering with it*", C20). Our evidence

suggests that information quality is both the driver and consequence of control: informational quality determines whether and to what extent carbon controls are used, whilst proper controls (monitoring, measurement, and verification systems) need to be established to improve information quality. Additionally, low quality information can cause significant resistance among managers and employees (C16).

4.2.5 Communication of control (channels and language) and employee perceptions

Communication channels vary depending on control type. Within SPCs risk monitoring systems and carbon strategy documents are communicated mostly through formal channels, such as meetings and reports. However, top management uses both formal and informal channels to facilitate interactive engagement and influence decision making. OBCs, the most common of which is segregation of duties, are documented formally in job descriptions and operationalized informally through emails and reports between departments/functions. Vision statements and belief systems (part of SBCs) are employed extensively across many channels in order to reinforce a carbon-focused discourse. Within OPCs, carbon information is monitored, disseminated, and used through various formal and informal channels to ensure the achievement of carbon management plans and strategy. According to our data, the formality of the communication channel does not significantly influence employee perceptions. Controls communicated most often and through several channels garner most attention and are more effective, because employees tend to initiate regular incremental improvements.

We find that in addition to channels, the language of carbon controls also influences the effectiveness of communication and employee perception. In some organizations carbon is intertwined with organizational identity or ingrained in vision (C8, C13, C14, C10, C11). In these cases, staff perceptions of carbon controls tend to be positive (Gioia and Thomas, 1996). However, many organizations, managers often struggle with the legitimization of carbon-related issues as important business priorities. As carbon on its own can be seen as "*just a random number*" (C27), managers in such companies have to modify their language to place carbon on the agenda, for example, by emphasizing carbon management's ability to promote efficiency and market differentiation (C20, C23), or being part of the continuous improvement process (C27). Aligning carbon with organizational traditions and routines helps "*click with the people it needs clicking with*" (C23). When the language used is appropriate, the perception tends to be positive as carbon management is believed to bring about performance enhancement.

However, carbon legitimization may not work where there is a constant tension between carbon management and other managerial priorities. In C21 the carbon agenda is evaluated and adjusted against strategic and operational priorities, because "*there's no point in having a totally environmentally neutral business if you go out of business*". So when carbon management is seen as a constraint to primary objectives or hinder growth/profitability, operational managers tend to ignore and perceive carbon controls negatively. Therefore, appropriate language to communicate is essential to ensure managerial buy-in and carbon MCS effectiveness.

5 VARIATIONS OF CARBON MCS BETWEEN ORGANIZATIONS

We re-analyse our data to identify variations in the level of integration of the carbon MCS package organizations employ. We find that the sample organizations vary in their carbon MC along two key dimensions: strategic integration and operational integration. Strategic integration relates to SPC and SBC, indicating the level of senior management engagement with carbon controls. Operational integration includes OPC and OBC and indicates the level of integration of carbon controls at the operational and lower management levels. Additionally, the carbon MCS can also be distinguished based on the primary objective of control: compliance or performance. Along these dimensions, five clusters of organizations can be identified. A summary of the organizational and MCS characteristics of these five groups is provided in Table 2.

Table 2: Classification of management control system packages found among field organizations

	Strategic integration	**Operational integration**	**Objective of carbon MCS**	**Organizational characteristics**
Group A Low integration	Low	Low	No clear objective	Low/medium carbon intensity, no compliance
Group B	Low	Medium	Performance (energy efficiency)	Medium carbon intensity, private sector, no compliance
Group C	High	Medium	Performance (cost reduction/ competitiveness) or legitimacy	No compliance
Group D	Medium	High	Compliance or performance (efficiency)	Big size and high carbon intensity
Group E Full integration	High	High	Performance (cost reduction/ competitiveness) or both performance and compliance	Big size and high carbon intensity

Group A (G2, C28, C29, G30) used to pay attention to carbon issues, but data are no longer collected and there are no carbon targets, budget, or dedicated personnel assigned to carbon

management and communication. These organizations have low to medium carbon intensity and no ETS obligations. They show low levels of both strategic and operational integration.

Group B (C8, C9, C13, C19) shows a medium level of operational integration with monthly measurement and monitoring of carbon (OPC). However, there is limited visibility of carbon information at operational decision making and the strategic levels (low strategic integration). These organizations do not have a carbon strategy/vision statement. They are in the early stages of carbon data collection and tend to be private organizations with no ETS obligation. Their objective with carbon management is to improve energy efficiency and achieve business growth.

Group C (G1, C3, C7, C20, C24, C25) have high strategic integration but medium operational integration. There is strong senior management engagement supported by a vision statement and a carbon management strategy (SPC and SBC). The belief system is changing to support the carbon program, the frequency of monitoring has increased, and reduction targets and carbon budgets have been set. However, at operational levels the information collected is not used in decision making. With no ETS obligation, the main objective of carbon management is to gain legitimacy.

Group D (C4, C5, C6, C12, C20, C23, C27) contains ETS participants and carbon intensive organizations with intermediate strategic integration, but high operational integration. Top management discusses and reviews carbon-related issues, even though carbon is not seen as a strategic issue and there are no carbon vision/belief systems. Carbon monitoring/reporting is undertaken to comply with the ETS, to facilitate trading, and/or to reduce intensity. There are carbon reduction targets and responsibility is assumed by the engineering/operations, environmental, and accounting functions. The objectives are ETS compliance and energy efficiency.

Finally, **Group E** (C10, C11, C14, C15, C16, C17, C18, C21, C22, C26) consists of organizations with full strategic and operational integration. All four types of carbon controls are employed, with a clear carbon vision/strategy in place and extensive management engagement (SBC and SPC). Carbon-related information is used extensively in decision making. Carbon monitoring, targets, and budgets (OPC), are used extensively, and responsibility is assumed at the operational level (OBC). These organizations are large and high in carbon intensity. The objectives of carbon MCS are performance and competitive improvements, as well as ETS compliance.

In summary, organizations with low/medium carbon intensity and often with no obligation to comply (Groups A and B) have limited carbon MCS integration at both strategic and operational levels (see Fig. 2). ETS participant organizations (Groups C, D, and E) employ a medium to high level of operational integration (carbon targets, monitoring, and decision making) as this ensures ETS compliance. Strategic integration varies depending on top management commitment. For non-participant organizations, big and carbon intensive businesses (Group D) display medium to high operational integration to embed carbon management in business as usual and take advantage of opportunities to gain energy efficiency. Big but less carbon intensive organizations (Group C) tend to engage with carbon controls through top management, with limited operational engagement.

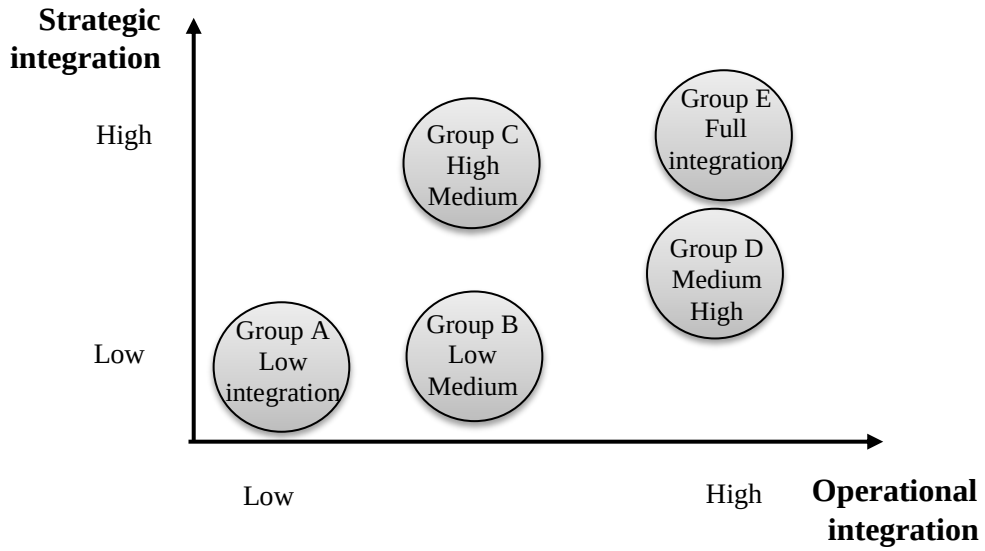

Figure 2: A graphic representation of organizations' integration of carbon information into their management control systems (refer to Table 2 for further information)

6 DISCUSSION AND CONCLUSION

The findings suggest that carbon management presents significant benefits as well as challenges for the 30 organisations studied. Implementing and using carbon controls have enabled these organisations to understand and monitor their carbon footprint, identify areas for product/process improvements, and in some cases, gain a competitive advantage through pursuing lower-carbon technologies or products. At the very least, carbon controls allow the organisations to comply with the ETS regulations. However, this compliance/financial focus has caused a number of challenges. While most organisations have little difficulty in

implementing a wide range of carbon controls, especially measures, monitoring system, incentives, risk assessment, segregation of duties, the problem lies in the quality and communication of carbon information. Low quality information is not useful at either the operational or the strategic level. Another challenge is how to engage management at different organisational levels, as carbon management does not always align with, or contribute to, operational or strategic objectives (e.g. increased revenue or decreased expenses). The lack of a carbon-focused belief system confirms that for the majority of organisations, carbon management is seen as ancillary rather than part of core business activities. Without a strong carbon price signal, it is likely that carbon information will be used in a limited way to achieve incremental carbon reduction rather than being incorporated in investment planning to drive significant mitigation and a strong alignment between carbon management and organisational objectives.

This study contributes to enhancing the understanding of carbon MCS in a number of ways. In terms of contributions to the research literature and managerial implications, first, the paper identifies the range of carbon controls used and the purposes with which they are employed (performance-oriented or compliance-focused). The comprehensive list of carbon controls, provided in Table 1, extends the prior literature that tends to focus only on emissions measurement, monitoring and reporting (Tang and Luo, 2014; Martinov-Bennie, 2012; Schaltegger and Csutora, 2012).

The paper's second contribution relates to the insights into the complexity and variety underlying carbon controls. The paper finds that effective carbon reduction occurs when organizations set both absolute and intensity reduction targets and deploy significant management attention and resources through strategic investments or organization-wide behavioural change. Carbon controls need to be employed in several areas, including training and education, decision making, strategic review and planning, as well as be integrated with performance evaluations/incentives. The paper finds organizations employ carbon controls to achieve compliance or manage/improve performance and can change the objectives of carbon MCS over time. Additionally, effective communication of controls and superior quality of information are required for carbon MCS to transform organizations. Hence, the paper extends prior carbon studies (Burritt et al., 2011; Passetti et al., 2014; Tang and Luo, 2014), which tend to highlight the common types or uses of carbon controls, by providing the configurations of a carbon MCS that enables effective carbon mitigation, including the types of controls, the required uses and objectives, communication and quality of controls.

The paper's third contribution is to provide practical managerial insights around how to design and implement an organization's carbon MCS. The newly developed MCS framework can be used to plan, implement, and monitor MCS. Specifically, managers need to initially consider whether their primary objective is compliance or performance improvement. Compliance can be achieved through operational integration of carbon MCS, whereas both strategic and operational integration is required for performance improvement. Next, managers need to formulate strategic boundaries and promote new beliefs. During the implementation phase, strategic performance controls, operational performance controls, and operational boundary controls come into play. Managers need to ensure the quality and the appropriate communication of carbon-related information. Appropriate carbon measures have to be chosen and reduction targets set. Carbon measures can be used diagnostically or in a more intensive, interactive way.

This study is not without limitations. In common with all case-based research, any attempt at generalisation needs to be treated with caution. Further, the types and uses of controls observed may not be applicable to organisations operating in jurisdictions with no or different carbon regulations. The ratification of the Paris agreement by New Zealand government (on 4 October 2016) with the ETS being the principal mechanism to achieve emissions reduction may act as a signal that elevate carbon management and alleviate some of the challenges mentioned in this paper. Examining organisational responses and their carbon MCS after the Paris agreement in different countries and jurisdictions could be the basis of future research projects. In doing so, researchers should consider using the MCS framework developed in this paper.

Appendix A: Interview list, date, and duration and interviewee position

Key	Industry group	Date	Length	Interviewee title
G1	Local council*	6-Dec-12	50 min	Financial accounting manager
		12-Dec-12	40 min	Climate change manager
		6-Jan-13	60 min	Business unit manager
G2	Government agency*	25-Feb-13	40 min	Shared service manager
C3	Transportation	10-Mar-13	55 min	Planning and environmental manager
C4	Manufacturing	6/12/2012	53 min	Energy manager
C5	Transportation	23-Feb-13	35 min	Environmental manager
C6	Manufacturing	5-Dec-12	80 min	Environmental manager
C7	Agriculture	16-Dec-12	41 min	Forestry/carbon trading manager
		25-Jan-13	70 min	Finance manager
C8	Service	3-Jan-13	40 min	Project manager
C9	Transportation	15-Dec-12	38 min	Financial controller
C10	Transportation	9-Jan-13	40 min	Sustainability manager
C11	Wholesale or retail	18-Jan-13	45 min	General manager for community and environment
C12	Energy	3-Jan-13	75 min	Carbon manager
		20-Jan-13	45 min	Financial accounting manager
C13	Energy	5-Dec-12	43 min	Carbon trading manager
C14	Energy	19-Jan-13	43 min	Derivatives trader
C15	Mining	10-Jan-13	42 min	Environmental manager
		10-Jan-13	35 min	Accountant
		30-Jan-13	52 min	Investment analyst/carbon analyst
C16	Energy	12-Jan-13	60 min	Sustainability manager
		5-Jan-13	60 min	Treasurer
C17	Energy	18-Jan-13	40 min	Sustainability coordinator
C18	Manufacturing	11-Jan-13	73 min	Group sustainability manager
C19	Agriculture	22-Feb-13	51 min	Carbon trader
		19-Jan-13	43 min	Sustainability group manager
C20	Agriculture	14-Dec-12	57 min	Carbon trading/ETS compliance manager
C21	Wholesale or retail	16-Dec-12	62 min	National environmental officer
C22	Manufacturing	13-Jan-13	80 min	Group manager - Sustainability
C23	Manufacturing	20-Jan-13	50 min	Sustainability manager
C24	Waste	4-Jan-13	42 min	Business improvement manager
C25	Agriculture	14-Feb-13	72 min	Sustainability manager
C26	Telecommunication	14-Feb-13	60 min	Manager for environment and community
C27	Manufacturing	15-Feb-13	43 min	Environmental manager AND energy procurement manager
C28	Manufacturing	17-Jan-13	38 min	Product development manager
C29	Manufacturing	23-Jan-13	52 min	Product stewardship manager
G30	Government agency	18-Jan-13	55 min	Capacity analyst

Key: G1: public sector organization no. 1; C4: private sector company no. 4

*Many local councils and government agencies oversee ETS regulated activities, such as forestry, waste management, heating, and transport.

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