SUSTAINABILITY IN SUPPLY CHAINS

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EXECUTIVE SUMMARY

This report explores a systems-based learning approach taken by a group of corporations in two sectors to improve the sustainability of their products and services, including how to respond to scarce resources and evolving climate change policies.

It presents a learning-based approach as an effective way of engaging members of the supply chain, working with ‘messy problems’ (those that are complex, hard to define and involve many people and issues), and embedding change in policies and practice.

Managing sustainability and supply chains is a report by Link Strategy and the Australian Research Institute in Education for Sustainability. The program was funded by the Australian Government Department of the Environment, Water, Heritage and the Arts, and supported by Macquarie University. Foundation participants were Bovis Lend Lease, Stockland and Landcom (the construction and built environment sector), and Goodman Fielder (food manufacturing and distribution). Over 20 corporations, from SMEs to multinationals, were involved in the project.

The report is for CEOs, managers, educators and staff within industry and government who seek to integrate sustainability into their vision, culture and practices. The report’s methods, discussion, case studies and insights are based on a critical systems approach. The report will be helpful in providing guidance on the drivers (the why), the process of change (the how) and the actions required (the what) to achieve sustainability outcomes.

The critical systems approach to complex problems can be used in any circumstance where no one individual or group can create change without the cooperation of other parties. Sustainability and supply chain problems and solutions frequently fall into the domain of high uncertainty and high risk issues where the outcomes from a course of action cannot be predicted; and indeed, even defining the problems can be difficult.

The construction sector project focused on sustainable concrete as an important, persistent problem that no single company or partnership in a construction supply chain could fix. It involved:

- Multi-stakeholder engagement – identifying the stakeholders (developers, construction firms, suppliers and competitors) and engaging the range of perspectives on an issue
- Institutional change – identifying persistent problems and systemic constraints to implementation of new technology, products or improving practices, and considering ways to overcome them
- Policy and practice change – developing policies and processes for improving information and management.
The food sector project examined a feasibility pilot to reduce greenhouse emissions in fuel use, by reviewing options to improve fuel efficiency in a short-haul bakery distribution network. The focus of this project was on:

- Clarifying values and priorities – managers explored their values and the strategic importance and impact of sustainability on their business and stakeholders, including employees, customers and investors
- Research and development – reviewing current and emerging alternative fuel options in commercial vehicles
- Innovation – the feasibility of implementation and exploring how to operationalise cutting-edge vehicle technology in the bakery division
- Monitoring – diagnosis of current and new processes with the objective of developing monitoring programs and key performance indicators for emerging legislation e.g. greenhouse gas.

KEY FINDINGS

The key finding of this supply chain project are:

1. The critical systems approach to complex sustainability issues can be used in any circumstance where no single individual or group can create change without the cooperation of other parties. Benefits of a systems approach include increased knowledge of corporate and supply chain operations, holistic and systemic thinking about risks and uncertainty, increased capacity for decision-making about sustainability options and more targeted and effective responses to issues.

2. Supply chain sustainability initiatives require multi-disciplinary, intra- and inter-divisional, and inter-organisational cooperation. The case studies revealed the need for stronger collaboration throughout the supply chain, with a greater emphasis on working systemically with suppliers and stakeholders. Collaboration creates new networks, business opportunities and research partnerships.

3. To effectively build the capacity of individuals and organisations towards more sustainable supply chains, it is essential to understand the diversity of stakeholder perspectives and sustainability challenges; the complexity of the system and the options for influencing change.

4. Learning and organisational change takes time and involves new skills. People need time to make sense of new ideas and ways of doing business. Facilitation and support from senior management are essential for maintaining momentum and focus.

5. The drivers of change in the area of sustainability are diverse. They include competition and access to resources, public concern about environmental and social impacts, brand credibility, and a desire to be green and responsible. Some problems were too difficult for the participants to tackle within the scope of this program. Managing logistics in several participants’ supply chains was considered imperative for reducing transport costs and increasing effectiveness, but exploring changes to logistics requires a longer time frame, extensive collaboration, and commitment to share knowledge among a broad range of stakeholders.
The benefits of learning about sustainability in a multi-disciplinary group using a systems approach include:

- more holistic, systemic thinking about risks and uncertainty
- improved capacity to define and prioritise sustainable supply chain problems
- increased knowledge of corporate and supply chain operations which improves decision-making about sustainability options and trade-offs
- increased capacity for decision making about options for verifying sustainable credentials of products and services, reducing waste and improving energy efficiency
- more comprehensive strategy and policy development for influencing systemic change towards a corporate culture that encourages sustainable management practices.

This report discusses sustainability in the context of corporate sustainability and supply chains. We joined corporations on their journey towards developing sustainable products and services, and explored with them the options for responding to scarce resources and evolving climate change policies. There are currently limited resources available for corporations to develop these skills.

RECOMMENDATIONS

To encourage corporations to become more sustainable, this report recommends:

- support be provided by government concerning appropriate leadership and management strategies and policies for complex situations. This will enable corporations to respond more systemically, and therefore more effectively, to climate change issues.
- learning material is developed about how to establish collaborative multi-stakeholder forums and management practices to influence sustainability performance throughout supply chains using systemic learning processes.

This study provides a systems-based learning approach for corporations to address their sustainability management and research needs with supply chain partners. The learnings from the case studies also provide unique insights and ideas for other corporations and government agencies who are considering how to respond to emerging climate change challenges, risks and opportunities.
CPIRS has transformed the world's resources and shaped the physical and social world in which we live (Dunphy et al 2007). Gradually over the last century, awareness about the negative impacts of these activities on the natural environment and the limits of the world's resources has increased. In response, sustainability strategies have been developed and incorporated into many public and private sector visions, policies and management practices (Delaney and Woodhead 2007). The drivers of change in the area of sustainability are diverse. They include competition and access to resources, public concern about environmental and social impacts, brand credibility, and a desire to be green and responsible.

While addressing sustainability issues is often difficult, complex, and beyond daily business practices, the Garnaut (June 2008) and Stern (2006) reviews on the economics of climate change both emphasised the cost of doing nothing. This report, Managing Sustainability and Supply Chains, discusses sustainability in the context of corporate sustainability and supply chains, with a focus on the human and organisational dimensions.

The World Commission on Environment and Development (1987) in their report, Our Common Future, defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. While there seems to be general agreement on sustainability in its theoretical sense, agreement on what is supposed to last, who decides, or how to prioritise and balance trade-offs, is constantly negotiated among corporations and governments (Woodhead et al 2006).

We discuss sustainability in the context of corporate sustainability and supply chains, with a focus on the human and organisational dimensions.

HIGH UNCERTAINTY AND HIGH RISK ISSUES

Sustainability and supply chain problems and solutions frequently fall into the domain of high uncertainty and high risk issues where the outcomes from a course of action cannot be predicted. These problems are complex and messy to work with. Complex because they involve many stakeholders, issues, locations, management practices and technologies. Messy because the problems are ill structured. That is, the problem is often complicated and difficult to define because each individual has a different perception of the problem and the solution, based on their own reality and their position in the supply chain. Cause and effect relationships are therefore only apparent with the benefit of hindsight.

Messy problems are usually systemic, so the flaws and perverse outcomes of policies and practices may have been hidden for years, and as such they require a multi-disciplinary, multi-layered approach. For example, a rating system may incentivise a recycled resource, whilst failing to account for other factors such as local availability and transport impacts. Figure 1 shows a simple model of a supply chain, with systems interactions, influences and policy tools. Each corporation has numerous sub-systems of specialist knowledge and processes, the sum of which makes up the supply chain system, which itself is a part of other systems.
The process of critical systems thinking requires that people, when searching for solutions to problems, consider the interactions between the solution(s) and the external and internal environment.

The concept, critical systems thinking, acknowledges the limitations of traditional scientific inquiry in dealing with the complex reality of social institutions interacting with natural phenomena (Flood and Romm 1996). Traditional inquiry breaks an issue down into manageable units. This approach can yield valuable insights, but does not lend itself to situations that are interconnected, complex and dynamic. It doesn’t reveal the richness of the social interactions among numerous events and actors over time that form the behaviour of a complex system.

The process of critical systems thinking requires that people, when searching for solutions to problems, consider the interactions between the solution(s) and a range of factors in the external and internal environment. Systemic thinking is therefore appropriate for sustainability problems, or messy problems, such as climate change, that involve the perspectives of various actors operating in different systems at different scales (Röling 2000) (e.g. invoicing is a sub-system of the product sales system).

This Link Strategy systems diagram shows a supply chain (represented by the black line) connecting suppliers (the small red circles) which are all part of a larger system (the large red circle). Each system and sub-system has social, environmental and economic elements (indicated by the icons). The red and black arrows show the potential points in a system where one-way and two-way interactions occur between different systems. Each organisation has a range of tools (the spanners) for managing internal and external issues (sales, audits, certification, training and so forth).

Figure 1 Supply chain interactions and boundaries
Every individual and corporation in the supply chain differs in the way they value, perceive and define social, economic and environmental issues.

WHAT IS A SUSTAINABLE SUPPLY CHAIN?

A working definition of a sustainable supply chain (Seuring et al, 2008) is ‘the management of material and information flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social, and stakeholder requirements into account’.

Supply chains are a source of:

- opportunity – effective logistics and quality control can improve resource use efficiency and profitability
- risk – because products and services can expose corporations to sustainability issues that other corporations have limited control over
- uncertainty – global issues such as climate change have multiple unknown consequences.

The Sustainability in Supply Chains program addressed some of these challenges. Participant corporations thought about ways to include sustainability parameters into their operations and supply chain management. The likely impacts of change in both the short and longer term, who would be impacted and the tangible and intangible benefits were also considered.

Every individual and corporation in the supply chain differs in the way they value, perceive and define social, economic and environmental issues. Each link in the supply chain provides different services and processes and employs skilled professionals appropriate to each operation. Therefore the way these issues are defined and acted upon differs, as does how risk and mutual benefit is perceived by people. Mutual benefit was defined as more than financial gains or improved quality control, for it to be considered sustainable. It became apparent that change towards sustainable practices requires establishing and maintaining collaborative partnerships. This requires:

- defining mutual benefits
- understanding how conflict and the exercise of power influences capacity and resistance to change
- aligning the short-term (low hanging fruit) with a long-term view (difficult, messy problems)
- multiple intervention points and a range of policies, regulations, education, incentives, standards, and research and development.

ABOUT THE SUSTAINABILITY IN SUPPLY CHAINS PROGRAM

This program, Sustainability in Supply Chains, was funded by the Australian Government Department of the Environment Water, Heritage and the Arts (DEWHA), and supported by Macquarie University. The intention was organisational change towards sustainability in corporations and their supply chain operations. Understanding the factors that influence learning and change in corporate decision-making towards sustainable outcomes is important to DEWHA and a key focus under the Australian Government’s National Action Plan for Environmental Education and Caring for Our Future: The Australian Government’s Strategy for the UN Decade of Education for Sustainable Development, a more recent document setting out policy directions and priorities.

The objective was to enhance corporations’ sustainability thinking, strategies and management of supply chains via learning-based change and systems thinking.
The recommendation to address sustainability in supply chains came from corporate participants in an earlier Industry Sustainability Project conducted by the Australian Research Institute in Education for Sustainability (ARIES). Education for sustainability and action learning can provide a basis for adaptive change management. One of the principles of education for sustainability is systemic thinking. Given the systemic emphasis of this program, Link Strategy, a consultancy that specialises in systemic thinking, was invited to lead the systemic enquiry.

The objective was to enhance supply chain corporations’ thinking and operations for sustainability via learning-based change. The research approach was monitored and its effectiveness evaluated by the research team (ARIES and Link Strategy).

The expected outcomes of the Sustainability in Supply Chains program were:

- Participant corporations enhance the sustainability performance of their supply chain management by improving policies, procurement standards and practices.

- Supply chain companies introduce or improve sustainability in their activities, such as improved product design, production, packaging, life cycle management, resource use, waste management and transport.

- Demonstrated progress in culture change towards sustainability in supply chain corporations e.g. through increased engagement and changes in relationships, practices and ways of approaching supply chain issues.

- Potential created for indirect and longer term sustainability impacts through: the influence of sectoral clusters on extended supply chain networks, ongoing learning relationships, or program results being scaled up or transferred to other contexts.

- Monitoring of program activities, evaluation of intermediate indicators of progress towards sustainable outcomes, and assessment of program impacts and success factors.

- Learning resources created that document Program/Project outcomes, such as reports, case studies, and an overview of useful tools and models, and promotion of these findings.

Two sectors, construction and food, engaged in supply chain projects.

Participant corporations and projects

Prominent corporations in the Australian industry sector were invited to participate. Participants needed to demonstrate that they were receptive to making sustainability improvements and could exert a significant effect through their supply chain position, influence and reach. Each participant corporation was asked to nominate sustainability changes to specific aspects of their supply chain system (e.g. product line, resource use, transport, waste management, site locations, a particular production focus or a subset of their procurement relationships) and involve approximately 3–5 of their supply chain member corporations.

Two sectors, food and construction, participated in the program. People in the foundation corporations had titles that were environmental or sustainability managers. After initial consultation with the ARIES research team, they facilitated introductions and meetings with key people in their corporation and with potential
partner corporations in their supply chain. The research team also broadened the scope of participant corporations once the project issues began to emerge.

Kellogg, Bakers Delight and Investa engaged in initial meetings and explored options for projects. Foundation corporations that established ongoing projects were Goodman Fielder (food sector), Stockland, Bovis Lend Lease and Landcom (construction sector). The project teams engaged in envisioning and critical systems thinking to explore the range of conditions and plausible outcomes within their corporations, and in their supply chains.

The focus of the construction project was sustainable concrete in the built environment. Beyond the immediate issues, logistics, waste, emissions trading, embodied energy, energy efficiency and resource considerations, there was broader debate. What impacts do concrete production, infrastructure and buildings have on human health and community wellbeing, what are the cities of the future going to look like and what infrastructure will society require? In a similar vein the food sector project incorporated big picture issues into their analysis of alternative fuels. For example, were bio-fuels an acceptable source of fuel for a food manufacturer considering food security and competition for commodities; the drought and their role as a responsible corporate citizen? These projects led to the exploration of a variety of supply chain collaborations. DEWHA contributed expertise, particularly on greenhouse gas impacts, to both project teams. ORiX became a key partner with Goodman Fielder, and ORiX in turn invited several alternative vehicle manufacturing corporations. The construction companies agreed to work together because the complexity of the concrete supply chain necessitates a collaborative effort. Representation was invited from concrete and cement suppliers, the financial and governance sector, associations and the energy sector. Participant organisations included Boral, Hanson, Cemex, Independent Cement, Cement Australia, Macquarie Generation, Delta Electricity, AMP, Green Building Council, Concrete Institute of Australia, Concrete Cement and Aggregates Australia, HBM Group, DEWHA, NSW Department of Environment and Climate Change, and Sydney City Council.

Research team
ARIES established the program and provided research direction, program coordination, and monitoring and evaluation. The approach drew upon an action research methodology and principles of education for sustainability, particularly envisioning an alternative future, collaboration, critical reflection and systemic thinking.

CSR Sydney was involved in the program start-up, with establishing program objectives, identifying sectors of interest, recruiting foundation participants, facilitating initial scoping and envisioning sessions, and establishing project objectives and supply chain considerations.

Link Strategy Pty Ltd facilitated program implementation and led the principal Critical Systems Analysis (CSA). This included facilitating and guiding the methodological approach to systemic enquiry, semi-structured interviews, focus groups, ongoing communication with participants and supply chain partners and reporting.
Expert knowledge

As a catalyst in the Participants’ change process, occasional project input or participation was also sought from external change agents. These agents were subject matter experts, industry or government representatives, or experienced sustainability practitioners.

In addition to the primary data gathered during project activities with participants, the report draws on a range of scientific literature, discussion papers and the popular media to provide insights into the range of perspectives on these issues.

About this document – contents and how to read it

The uncertainty of evolving climate change policies, along with the emergent status of corporate sustainability thinking provided the program team with challenging dilemmas about how to best influence and embed sustainability thinking within the participants’ corporations and in their supply chains. The report is structured to enable the reader to build an understanding of the complexity and scope of the issues within the Sustainability in Supply Chain program and attempts to identify where and how the research team most influenced the participants’ systems.

In this report we outline the sustainability in supply chains program. The report has four major sections which cover: (1) current thinking and literature on supply chains and sustainability, learning and knowledge management; (2) the systems thinking approach; (3) the case studies; and finally (4) our reflections on the process and the outcomes.
Increasing uncertainty in the global environment is changing the very nature of risk, so that management now needs to consider a far wider range of issues to operate in tomorrow’s markets. The decision process, organisational culture, and the social and organisational dimensions of change are all important considerations in this transition process. These are briefly discussed along with the ARIES learning model.

When considering the present and the future, a historical perspective is important to identify longer term influences and emerging patterns. For example, prior to the agricultural and industrial revolutions, most energy for production came from the sun, wind, water mills or biomass fuels. One hundred and fifty years of industrialisation has seen the development of systems and products that rely on non-renewable energy resources (Clift 2006). Widespread assumptions that sufficient resources exist to supply continuous economic growth and that markets give adequate signals for innovation to overcome any resource shortages are now being seriously tested, most notably water, oil and greenhouse gas emissions. Leading corporations are now exploring how to influence and change this cumulative legacy of business practices, assumptions and professional disciplines. They have re-examined their corporate policies and are working on strategies for simultaneously achieving revenue growth, operational efficiency and sustainability.

This report explores issues of developing an organisation’s capacity to respond effectively by adapting to emerging issues. This means extending traditional growth and operational foci to include the social, environmental and governance dimensions in decision making and strategic thinking at all levels of the corporate system. We contest that there are many intangible, long-term benefits to organisations and supply chain partners from becoming more sustainable, and that there is a need for greater awareness of these benefits. According to UNESCO (2005), ‘the larger corporations, especially manufacturers, are reaping huge financial benefits from training measures introduced to address energy, water and waste management issues. Addressing other environmental, social and human resources issues are proving to be rewarding.’

Whilst advocating a three-pillars definition of sustainability (environmental, social and economic), our process focuses on the human and organisational dimension. Understanding the social and governance systems is a vehicle for influencing business strategy and
operational procedures (Dunphy et al. 2007). In this chapter we introduce concepts relevant to exploring sustainability in supply chains and systemic learning for enabling organisational change, collaboration and learning with reference to the construction and food projects undertaken as part of this program.

A complex system is a system composed of many parts that interact in non-linear manner.

**SUSTAINABILITY IS A DYNAMIC CONCEPT**

Governments and corporations are continually exposed to new technologies, regulations, market threats and opportunities, management practices and natural phenomena. Sustainability strategies and policies are attempting to recognise, understand and influence the links among environmental, social and governance factors and financial performance. The dimensions of sustainability, as pointed out by Parker (2005), exceed the traditional legal boundary of a corporation, requiring consideration of external factors, such as input and output dependencies in the supply chain, community and labour relationships, ethics and people’s values. Corporate sustainability is therefore constantly evolving at the confluence of science and society.

CEOs, managers and employees who are involved in sustainability policy now have to deal with – and manage – uncertainty, complexity, indeterminacy, surprise, ambiguity and ignorance. The word complex literally means ‘composed of interlaced parts’. A system is defined as ‘a set of interacting or interdependent entities, real or abstract, forming an integrated whole’. A complex system is a network of systems (such as a supply chain), with each system functioning more or less independently, yet interdependently. A complex social system is a networked system of actors, that is, people who are capable of autonomous choice.

A key challenge for managers is how to examine the range of plausible future pathways of combined social, environmental and business systems under these conditions. Further compounding this complexity is the high degree of variability between individual levels of knowledge about sustainability. In the participant projects, establishing mutual understanding and compatible visions of the future emerged as a key determinant of the success of the supply chain collaboration.

Discussions about the why of sustainability and how it relates to specific situations therefore provide the basis for establishing common knowledge and developing a shared vision of supply chain management. Some issues that can be expected to challenge and shape thinking about sustainability in supply chains (Delaney and Woodhead 2007) are:

- ethics, societal values and intellectual property conflicts around future research – nanotechnology, genetically modified organisms (GMO), bio-technology and nuclear science
- complexity, resilience theory and systems thinking for developing understanding about climatic change and other ‘massive’ issues such as global poverty, multinational corporations and energy
- emissions trading schemes and new valuations of ecological and societal services to establish incentives and market mechanisms
- resource scarcity, drought and environmental impacts, e.g. the Murray Darling Basin
- emerging economies, wealth creation and distribution in these economies, such as China and India.
Supply chains are purposeful networks of operations that enable the production and movement of goods from raw commodity to finished goods, but their effective operation is underpinned by human relationships. At each stage in the network of operations, people make choices about which packaging, equipment, waste disposal, energy source, and so forth, provide the best outcome. For example, a bottle of orange juice can be a blend of oranges from up to seven global origins, to ensure a consistent flavour for the consumer. An OECD report (2002, p 2), defined a supply chain as a ‘network of facilities and distribution channels that encompasses the procurement of materials, production and assembly, and delivery of product or service to the customer’. Supply chain management is the process of planning, implementing and controlling the operations of the supply chain. This includes the movement and storage of raw materials, operations, and all activities that are required to process goods from origin to consumption. The value chain refers to the value adding activities that an organisation provides to support the efficient operation of the supply chain and deliver maximum value for the customer. These activities can include infrastructure management, human resources, research and development, sales and marketing.

Distribution of economic benefits
Identifying the distribution of economic benefits (who gains, and by how much) and where in the supply chain most value is added (as perceived by the customer or by society) can provide insights into the challenges of influencing the system. Clift (2006) discusses how identifying economic traits in a supply chain shows a “highly skewed distribution, with primary resource industries apparently responsible for major environmental impacts but achieving limited added economic value and with the later stages of the supply chain, including retailing, characterised by high added value with much less environmental impact; in other words, global trade can act to export unsustainability from the consuming country to countries whose economies are dominated by primary industries.”

Control over supply chain management has moved downstream (towards the retail end). Historically supply chains were manufacturer-dominated. However, for example in the food sector, what emerged in the 1980s was a highly competitive retailer section, where ‘the retailer is king’ (AEGIS 2001). Broadly speaking, food retailers have three drivers for managing their supply chains:

- the desire to cut costs
- concern about regulation, that is, increasing compliance to reduce risk
- productivity efficiency.

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- productivity efficiency.

There naturally evolved a strong emphasis on technology to help manage transport logistics and track products through supply chains. To date, these models have improved efficiency by removing redundant costs from production systems.

Future supply chains and collaboration
New factors influencing supply chain thinking (Capgemini 2008) are the increasing flow of goods, new technology, resource scarcity, emissions trading, and changing patterns of consumer purchasing. The literature on supply chain management has primarily focused on optimising the value chain. There is limited writing on the inherent social complexity of collaboration among corporations in supply chains, although it is frequently noted as a key enabler of operational effectiveness.
The Capgemini report, *Future Supply Chain 2016*, sees the future supply chain as a collaborative model where information sharing, collaborative warehousing and collaborative logistics define industry or geographical sectors. However, developing effective collaboration and networks of knowledge-sharing among diverse and frequently competitive private and public agencies is a messy problem.

Construction supply chains, for example, involve hundreds of different companies supplying materials, components and a wide range of construction services (Dainty *et al.*, 2001). Within a single construction corporation, the structure of the supply chain and the position of the developer in the supply chain can differ markedly between corporate divisions and even between different projects. Fundamental structural issues have constrained collaboration within the sector, according to Briscoe and Dainty (2005), who make these points:

- Limited integration across different tiers compared to other industrial supply chains, which are more efficient and closely integrated.
- Relationships characterised by adversarial practices and disjointed supply relationships. ‘Commonly, construction clients appear to distrust their main contractors, who in turn maintain an arms length relationship with their subcontractors and suppliers.’
- Construction projects have defined time frames with teams existing for the life of the project. ‘Projects are treated as a series of sequential and predominantly separate operations where the individual players have very little stake in the long-term success of the resulting building or structure and no commitment to it.’
- Vested interest and lack of desire to build trust among supply chain partners have thwarted attempts to extend partnering and collaborative working.
- ‘Reliance on a fragmented and largely subcontracted workforce has increased the complexity of this supply network and delimited opportunities for process integration.’

Benefits of a collaborative supply chain approach are often cited as reduced costs and improved quality control. Other less quantitative benefits are innovation, transparency, knowledge generation, information flow and increased capacity to manage emerging risks rapidly and holistically (Gattorna 2007, Woodhead *et al.* 2006). A recent Global Reporting Initiative study (*Small, Smart and Sustainable*, 2008) focused on defining the added value of sustainability reporting in supply chains. Their initial results indicate that a supply chain focus in a sustainability report, while initially challenging and complex, enhanced the reputation, competitive advantage and improved internal processes and leadership on sustainability issues.

Thorpe *et al.* (2003) argue that long-term strategic partnerships are the key to providing better outcomes, but believe the temporary nature of one-off projects is a major challenge. In these circumstances, the flow of information, management of relationships in all supply chain sectors to build a level of trust, and strategic management are critical for providing a level of continuity and a prerequisite for performance improvement (Graham and Hardaker 1998, cited in Thorpe).

Gattorna (2007, p 233) addresses collaboration with a ‘dynamic alignment’ framework that aligns the culture and leadership styles with the dominant buying behaviour of each buyer market segment. The objective of Gattorna’s dynamic alignment model is to build
Assuming control of purchasing using procurement policies can be a recipe for failure in a complex situation that requires a holistic and comprehensive approach.

Knowledge and coordination to give a supply chain a competitive advantage over competing supply chains. This refocuses the source of competitive strategy, beyond a single corporation or top-down management of a supply chain. Vachon and Klassen (2008) found that environmental management in supply chains had not been strategically linked to organisational performance. Woodhead et al (2006) noted the failure of corporations to move from a competitive to a collaborative model was inhibiting the effective management of sustainability imperatives. These authors found that value in collaboration comes from inter-organisational learning that can develop new skills, improve operations, services and products and increase transparency and verification of sustainable products and services. Competition within a supply chain can inhibit sustainable practices and business profitability.

**Improving trust and transparency**

Improving supply chain collaboration is deeply connected with the push to improve transparency. The Global Reporting Initiative (GRI) sustainability reporting program is a key driver, as is consumer backlash against greenwash and demands for verification of the sustainability of products. Sustainability standards and procurement policies for product and service provision are rapidly developing in most industry sectors, for example, the Green Building Council’s rating system for Green Buildings, Carbon labelling, Fair Trade, FSC, Better Sugar Initiative and so forth.

**Value in collaboration comes from inter-organisational learning that can develop new skills, improve operations, services and products and increase transparency and verification of sustainable products and services.**

Procurement policies are most appropriate for tangible ‘finished’ product categories that have routine supply and manufacturing processes. This allows repeat volume buyers to specify in contracts what they wish to purchase based on sustainability criteria. Examples include packaged coffee and tea, paper products, and building items such as bath tubs and taps. Effective management and certification of procurement policies for sustainability criteria require a commitment to monitoring and verification of supplier systems. However, assuming that a procurement policy will negate all sustainability risks or suit all types of products is naive, and fails to acknowledge the complexity of some products.

Products that have less consistency or that are customised for each job, e.g. concrete, require a more holistic approach to sustainability. These more complicated products have multiple inputs, design and operational considerations that can vary at several points along the supply chain. For example, ‘sustainable concrete’ involves a complex set of operational decisions and input variables that includes logistics, raw materials, durability, longevity and energy efficiency of the building or infrastructure. This is discussed further in the Sustainable Concrete case study.

Fundamental to developing sustainability standards and policies are collaborative relationships with suppliers that involve more parties and considerations than the traditional market-based, buyer-to-seller relationship. Unfortunately, as Burch and Lawrence (2004) noted, most of the participants in a supply chain want it both ways: they want to exercise market and supply chain power to extract value from upstream suppliers, but deny their own downstream buyers from exercising the same market and supply chain power to extract value for themselves.
Hence the importance of understanding where in the supply chain rent is being extracted; building knowledge about the broader, long-term benefits of collaborative efforts; and defining what mutual benefits can be established that achieve sustainable outcomes.

ORGANISATIONAL CHANGE IN COMPLEX SOCIAL SYSTEMS

Organisations are complex social systems with numerous sub-systems. Supply chains are even more complex; they represent interactions within and between corporations and multiple social sub-systems. Figure 2 shows an abstract representation of system interactions, where each oval represents a different system (such as an individual, a business unit, a corporation, an association, or an industry). There are practical limits to anyone’s ability to perceive multiple dimensions of systems. The ‘rule of thumb’ is that three levels of interactions (i.e., your own system, plus one system up and one level down) can be considered at any one time.

Frequently, communication between sub-systems within corporations is weak. People in each sub-system tend to have considerable knowledge about their own activities and vertical lines of control, but horizontal interactions are limited. This is because current systems don’t require interactions; for example, the marketing manager has not traditionally worked with the environmental manager. Horizontal interactions are increasing by necessity. Using the same example, in the mid sections of the supply chain, purchasing and marketing people are finding that they need information from sustainability managers (pers.com, NSW Department of Environment and Climate Change) in order to respond to procurement and contract requirements from downstream in the supply chain. While some of this information can be derived from current certification and assurances processes, there is also a need for holistic thinking across all divisions of the corporation.

The decision process under uncertain conditions

Decisions made in isolation of systemic influences in the operational environment can undermine the sustainability and credibility of initiatives. For example, if a corporation is progressing a sustainability policy to develop a six-star green building while ignoring its purchasing of supplies that may have had child labour input, the greening of the corporate brand will have limited credibility and it may be vulnerable to media reports of ‘green washing’. A strategically aligned whole-of-system approach is therefore crucial for the long-term credibility of the corporate brand.
Sustainability issues frequently fall into the domain of high uncertainty and high risk problems. Sustainability decisions tend to lack clear criteria because behaviour is not usually predictable when different systems interact.

Just providing decision makers with more information about sustainability issues is not enough. Firstly, there is not a simple, causal relationship between “more information” and “better decisions”, nor between purchasing intent and purchasing behaviour. Secondly, decisions in situations of low uncertainty and low risk are the conventional basis for reductionist sciences such as engineering and “Management By Analysis” (Mintzberg, 2004); but, when decisions have high uncertainty and risk, post normal science thinking is pertinent (see Figure 3). This is because these types of decisions stem from messy, ill-structured problems, where the full range of cause and effects is difficult to define. A more holistic, systemic approach provides a better understanding of the complexity of the problem, the scope of information available, and the range of risk, opportunities and solutions.

Risk (Knight (1964 cited in Mayumi and Giampietro 2006) “represents a situation in which the distribution of the outcome in a group of instances is known either a priori or from statistics. While uncertainty represents a situation in which it is impossible to form a reliable group of instances because the situation is to a high degree unique.” In other words, the outcomes can’t be predicted, they emerge after the event. Sustainability issues frequently fall into the domain of high uncertainty and high risk problems. There tends to be a lack of clear criteria to guide decisions about sustainability because when different systems interact, the response of a system to a changed policy can be unpredictable. Knight (1964 cited in Mayumi and Giampietro, 2006) discusses four sources of uncertainty that are inherent in complex issues:

- “perception uncertainty due to two main problems: we cannot perceive the present as it is; and we cannot perceive and represent the present in its totality
- anticipation uncertainty due to the fact that we have to infer the future from the present without being able to obtain a high degree of dependability from our models
- effect uncertainty due to the fact that we cannot know all the consequences of our own actions in the future
- implementation uncertainty due to the fact that any policy formulation cannot be implemented in the precise form in which it was imagined and chosen”.

![Figure 3 Post normal science (Clift 2005)](image-url)
Even if change has become the norm, as Brunnhubera et al (2004) note, many decision makers still dismiss uncertainties and plan as if there is only one possible future. Brunnhubera et al concluded that decision makers who were able to work proactively with uncertainties would be the successful ones. However, we are not good at reasoning with uncertainty. These realisations have led some companies to look more closely at systems thinking and scenarios that include more than one future and focus on experiential learning. Senge et al (2008) stated that the corporation that can capture these sustainability principles will ‘shape the future of their industry’.

Cultural influence on change

A key attribute of successful collaborative relationships is the culture of the organisation and industry. Culture refers to shared assumptions, beliefs, values, norms and actions as well as artifacts and language patterns. Every corporation has its own unique culture even though it may not have consciously tried to create it. Rather it will have developed unconsciously, based on the values of the founders or core people who build and/or direct that corporation. Values and leadership are core tenets of culture. While an observer may perceive some cultural characteristics to be inflexible, culture is not static and a range of drivers can influence the development of culture in people, organisations and even countries.

In the context of a particular industry sector, organisational culture stems from experiences and assumptions about the basis of power and influence, what motivates people, how people think and learn, and how change occurs. Industries are a collection of corporations with common interests that are usually members of professional and product-based associations. The organisational culture of an industry association can have a considerable influence on the members, and vice versa.

Organisations are complex social systems with numerous sub-systems. Achieving organisational change takes time because people are often not aware of the need for a strategic shift in thinking.

Cultural assumptions enable and constrain corporations

Although most corporations realise that they have a culture, few have a comprehensive understanding about the implications of their culture on the ability of their sector to become more sustainable. Cultural assumptions both enable and constrain what corporations are able to do. Understanding the different cultural values by assessing the organisations’ culture (e.g. a power culture involves a powerful central character or group who controls all actions) can enable a corporation to move forward beyond entrenched positions and reconcile divergent perspectives. Schein (1999) discusses the importance of culture stating that:

• decisions made without awareness of the operative cultural forces may have unanticipated or undesirable consequences
• the extent to which culture contributes to an corporation as either an asset or a liability is underestimated
• culture is an explanatory construct underlying numerous organisation phenomena.
Differences of opinion within an industry sector can lead to conflict within and between associations, which in turn may have a negative impact on the capacity of the corporations to change practices by creating hurdles in any of the four areas identified by Kim and Mauborgne (2005) (see Figure 4). These organisational hurdles need to be understood to effectively incite change by both CEO and staff. However, the Kim and Mauborgne review of corporate transformations found that the hardest battle was making people aware of the need for a strategic shift.

We have now established some background to working with messy problems, the complexity of supply chains and sustainability. Climate change and other sustainability issues represent significant cultural and management challenges and responding to them requires new thinking and flexible decision making processes. The next section introduces the principles behind the learning methods used in this program.

Learning for change

As a conceptual framework for working with corporations on developing thinking and learning about sustainability, experiential learning and critical thinking formed the theoretical basis of this program. The research team worked with groups on change projects that tackled current sustainability problems.

Transformational projects must establish an environment where learning can occur in a comfortable, creative atmosphere. This enables ideas for solutions to emerge.
The learning-based change process included facilitated forums and occasional communication (see project case studies for more detail). Through these projects the participants reviewed broader corporate issues and instigated change.

The basic premise of facilitation theory is that learning will occur by establishing an atmosphere in which learners feel comfortable to consider new ideas and are not threatened by external factors (Laird 1985). Whilst its importance is clear, this theory can be challenging to apply when attempting to bring about systemic change in a complex environment where vested interests and power inequalities exist. The action learning approach required the research team to be co-learners in an emergent (unpredictable) process. Simultaneously, they were responsible for leading the program towards its expected outcomes.

The importance of education and learning for achieving change towards sustainable practices has been frequently noted. For example:

‘Professional skills and knowledge of sustainable development should be improved continuously and, consequently, be part of the lifelong learning of individuals including those in sectors such as public administration, the private sector, industry, transport and agriculture. The development of new knowledge and the need to introduce new skills in order to give more specific substance to the concept of sustainable development will remain a constant need, as many areas of expertise are constantly developing.’ (UNECE 2005a, p 10)

Turning information into action requires a person to develop their capacity for independent thinking and decision making. However, while gaining knowledge is a precursor to action, it does not guarantee change. Knowledge is not acquired from one source. Lundvall and Johnson (1994) discuss knowledge in a multi-faceted context:

- **Know what**: refers to knowledge about facts (i.e. ability to assess alternative fuel options for commercial vehicles).
- **Know why**: refers to knowledge about principles and laws in nature, human kind and society (i.e. the source of ground water and its source of recharge).
- **Know how**: refers to skills (i.e. ability to operate a computer).
- **Know who**: involves the social ability to cooperate and communicate (i.e. working in groups and collaborating towards agreed outcomes).

Clearly, achieving social change is a complex process and it takes time. Studies related to the motivational elements of behaviour have stressed that ‘the decision to act in a certain way is affected by a “balancing” or weighing of a number of influences’ (Beedell and Rehan 1999). These include environmental, physical and commercial factors, policy environment, support structures and education in addition to the personality and motivation of the individual.
The ARIES learning model

There is international consensus that sustainability requires an ongoing process of learning (UNECE 2005b), which supports adaptive governance and leadership for sustainability thinking in corporations. Core to ARIES’ model for learning-based change are envisioning alternative futures, participation and partnership, critically reflective thinking, systemic practice and iterative learning through social interactions. Critical thinking and systemic practice helps a group of people to better understand and make sense of a complex issue and the world around it so that they can act more effectively.

Fundamental to the ARIES approach is embedding learning-based change within organisations to work towards a shared vision of the future. An action learning methodology provides a basis for continual learning and adaptive management to respond more effectively to emerging issues of sustainability. Learning processes in an inter-organisational setting enable ‘‘collaborative’’ continuous improvement’ in the supply networks of the Extended Manufacturing Enterprise (Middel et al 2005).

The process:

PROBLEM: Start with reflection on the current situation, and jointly diagnose the issue that the participants have in common.

PLAN: Envision an alternative future. With that shared vision in mind, participants develop a plan of critically informed action to innovate in the area of concern.

ARIES action research cycles

Figure 5 represents the action research phases (plan, act, observe, reflect, then learn and communicate) and iterative cycles in this ARIES program. The diagram also includes the phases of monitoring and evaluation (plan, collect data, monitor outcomes, evaluate and communicate).
ACT: Implement the plans. Engage stakeholders in envisioning an outcome that differs from business as usual, in developing collaborative partnerships, and in critically reflective, systemic practice.

- Collect information (baseline data, information from activities undertaken, and responses and indicators of change).

OBSERVE: actions and associated responses, products and outcomes.

- Monitor the results and continue to collect information on processes, experiences and outcomes (including both successes and failures).

REFLECT: on these observations. Evaluate the actions undertaken and the responses of the system (are there indications that the activities are improving the situation of concern, in line with the vision?). Critically examine your assumptions and expectations.

- Evaluate the evidence. Does it support your conclusions? Compare different sources of data. Are they consistent? This may involve a search for additional information, diverse perspectives or relevant sources of expertise.

LEARN: from experience, and through sharing insights in meetings and discussing assumptions (e.g. about power or control, or about expected results from a particular course of action).

REVISE: plans and practices based on observed responses, insights and shared learnings. The adjusted plans are implemented and the cycle of learning in action is repeated.

In practice the phases are not neatly sequential or as clearly defined as the cycles above portray, but this model provides a useful structure for the process of learning tied with more effective action. An action learning approach to systemic practice on complex sustainability issues can provide a basis for informed, flexible adaptive thinking for managing messy problems.

By holding a vision of a more sustainable outcome and applying critical systemic thinking to the situation, the ARIES approach sought to identify the barriers and levers to change, within and between organisations.

CHAPTER SUMMARY

This chapter established the context and background to the Sustainability in Supply Chains program. In the next chapter we introduce critical systems analysis as a method that provides the analytical construction for understanding the complexity of supply chains using transitional projects.
Thinking systemically provides people with the understanding to respond more effectively to uncertainty and risk because they are more aware of the local and global environments that they operate within (Bawden 2007). It encourages individuals to think about an issue, holistically, while also finding solutions for specific problems. The project therefore becomes a transformational process whereby stakeholders experience, think, act and plan together in an ongoing cycle of learning and reflection.

This chapter discusses the critical systems approach used to work with the participant corporations. It describes how to create conditions for (micro/macro) change by establishing mutual understanding and defining shared benefits to support ongoing collaboration and transformation in supply chains.

### WHAT IS CRITICAL SYSTEMS THINKING?

Critical systems thinking has three commitments (Schecter 1991 and Flood and Jackson 1991a cited in Midgley 2000, p10). They are:

- **Critical awareness** – examining and re-examining taken-for-granted assumptions, along with the conditions that give rise to them.
- **Emancipation** – ensuring that research is focused on “improvement”, defined temporarily and locally, taking issues of power (which may affect the definition) into account.
- **Methodological pluralism** – using a variety of research methods in a theoretically coherent manner, becoming aware of their strengths and weaknesses, to address a corresponding variety of issues.

Critical systems thinking requires people to think critically about their assumptions and interests. It asks individuals to consider the impacts of the solution(s) on the external and internal environment, and vice versa.

The process of critical systems analysis requires that people, when searching for solutions to problems, consider the impacts of the solution on the external and internal environment, and vice versa. Individuals think critically about their own assumptions and interests, and when they reflect on this as a team, they look beyond ‘business as usual’. This is because the range of potential impacts cannot be understood without an appreciation of the individual as part of a system. This involves developing self-awareness and an understanding of the role of the actors; including facilitators, the participants and other stakeholders. By building an understanding of these relationships and dimensions of power, along with the organisational culture, environment and external influences, the project team can then optimise the positive impacts and reduce the negative impacts of any intervention.

**Solutions emerge spontaneously under the right conditions**

Fundamental to critical systems thinking is the concept of emergence. It is a key attribute of complex systems. Mihata cited in Seel (2000) described emergence as ‘the process by which patterns or global-level structures arise from interactive local-level processes’. This evolving structure of patterns, according to Seel, is unpredictable because it comes as a result of interactions between agents in the system.
When enough connectivity happens between systems (if, for example, dialogue occurs between two companies in a supply chain, or two sections in a company interact on a project), emergence can occur spontaneously. Seel’s conclusion was that we ‘should move away from trying to change corporations and instead to look at how we might help them become ready for change – to move to a state of self-organised criticality’. Viewed from an individual perspective and explored as a group, this means achieving a level of self-awareness and trust so that people can confidently collaborate, and think holistically and systemically when solving messy problems and attempting to transform the corporation and the supply chains.

About messy problems

Messy problems are hard-to-define problems that have many systemic causes and effects. No one individual holds the solution, and quick fixes can produce unintended results. Past successes aren’t a reliable guide because the ‘solution’ to a messy problem is only obvious with the benefit of hindsight. Therefore processes to engage multiple actors in jointly diagnosing problems and exploring responses are essential because:

- each individual will have a different perspective on the problem definition and solutions
- the problem definition and solutions constantly evolve and take new forms throughout the project time frame and afterwards.

Key challenges when working with messy problems are:

- differing stakeholder and societal expectations, and unquestioned assumptions
- misaligned policies and incentives can lead to unexpected outcomes
- political influence, vested interest and lobby groups.

How to think systemically and critically

The following provides an outline of the critical analysis process as adapted for the supply chain program. Each sector participated in a transformational project that was defined in the first stage of the analysis. Transformational projects focus on changing a current state to a desired future state. Each sector engaged their supply chain partners in discussion about the projects. The three main phases are:

- Create conditions for collaboration and systemic thinking.
- Critically analyse supply chain and transformational projects.
- Capture emergent strategies and policies.

These learning tools are key to framing conversations and building shared understanding among the participants, and will act as useful tools for the participants to employ in other areas of their corporations beyond the project’s completion.
Sustainability issues frequently fall into the domain of high uncertainty and high risk problems. Sustainability decisions tend to lack clear criteria because behaviour is not usually predictable when different systems interact.

PHASE 1: CREATE CONDITIONS FOR COLLABORATIONS

The first step in a critical systems analysis (CSA) is to build shared knowledge about the organisation as a system and the organisation as part of a larger system. The next step is to gain an understanding of the key people’s knowledge and perspectives and to define the key stakeholders. Once this process has commenced (it is ongoing), a shared vision of an alternate future can be developed or refined. The vision also needs to include specific goals and strategies, such as, to reduce greenhouse gas emissions by incorporating alternate fuels into the delivery systems and increasing awareness of energy efficiency initiatives.

Discuss your organisation’s operations and identify the full range of sustainability issues that are or could have an impact:

1. Share information on the environment in which your system is operating:
   - e.g. local, regional and global pressures from the natural environment; the economy, finance, regulations and markets; technology and media; society, politics and culture.
2. Define core stakeholders in your corporation who influence or are affected by the issue, and identify key actors to be involved in the project. A diversity of professional perspectives is needed.
3. Identify the culture, including sources of power and the influence of key stakeholders.
4. Identify relevant information resources (e.g. internal sustainability and procurement reports and policies).
5. Discuss with the group:
   - perceptions about and knowledge of sustainability
   - people’s influence and levels of support
   - perceptions of risk, sensitivities and politics.
6. Develop a shared vision for an alternative future, at a given future point in time.
7. Imagine placing yourself in the future vision, look backwards and identify the actions that improved the issue.
8. Discuss these potential actions, get commitment and develop objectives and expected outcomes.
The next step is to undertake a critical analysis into the parts (sub-systems) that make up the whole (the system) of the corporation. This enquiry should focus on systems and sub-systems that are directly and indirectly associated with the issue. This analysis includes the participation of the supply chain partners. When engaging other supply chain corporations, it is important to explore the potential mutual benefits – for the corporations. There may not be any, in which case it becomes very difficult to sustain the collaborative effort. In this situation, the issue may need to be redefined to include the interests of the core stakeholders.

CREATE CONDITIONS FOR SYSTEMIC THINKING

1. Define systems and sub-systems within these systems: i.e. the logistics division and distribution centre(s), and how these sections relate to the overall organisation’s structure.
2. Explore the pressures on the systems and sub-systems: i.e. what external and internal forces are influencing the operations, such as scarcity of resources. Identify corporate/societal areas of systemic operational failure and misaligned policies or conflicting incentives.
3. Define the internal environments within which the system operates.
4. Define the boundaries around the sub-systems and systems of interest: i.e. what sections does the logistics network interact with and who is responsible for these interactions?
   - Define people/corporate levels of influence and control over these systems/sub-systems.
   - Discuss the direct or indirect influence that external systems have – e.g. supply chain stakeholders.
5. Draw diagrams of system process, operations and stakeholders, (see examples in case studies).
   - The benefit lies in the shared understanding that arises from the process of doing this as a group.
PHASE 2: CRITICAL ANALYSIS OF SUPPLY CHAIN

In Phase 1, participants developed an understanding about their system and sub-systems. In Phase 2 the objective is to extend the enquiry with supply chain partners using a mutually agreed problem as the basis for dialogue and action.

An adaptation of the OECD’s Pressure State Response (PSR) model (see below) was provided as a framework for the enquiry in the focus groups. Strategy/action was added to the PSR model to emphasise the importance of strategic alignment to change for achieving better practices, the Response. The elements of the model are described thus:

- **Pressure** – the environmental, social or economic impacts (i.e. high CO2 emissions from cement, concrete and construction operations, and fuel used for food distribution).
- **State** – the current practices that are contributing to these pressures (i.e. the production of concrete and the utilisation of concrete in buildings and infrastructure).
- **Response** – the better practices (i.e. that produce lower carbon in product and associated operations).
- **Strategy** (or actions) that enable these better practices to occur, informed by a systemic understanding.

**With supply chain partners:**

1. Explore potential benefits of collaboration. Discuss initial analysis and the scope of the sustainability issue and options for improving sustainability management and outcomes.
2. Expand critical analysis to include supply chain systems and sub-systems. Together, revise stakeholders, environment definition, boundary analysis and vision statement.
3. Define projects and agree the boundaries of the project, the key team and the systems and sub-systems for critical analysis.
**TRANSFORMATIONAL PROJECTS**

Transformational projects focus on changing a current state to a desired future state. Core groups work across corporate sectors and supply chains to share knowledge, analyse problems and find solutions. The two applications of critical systems thinking as applied in the program are noted here.

1. **Project with an R&D focus**
   - Explore technology options with suppliers, scientists and other experts and users as appropriate, using PSR model.
   - Critical analysis: challenge assumptions and technology/process options.
   - Document analysis and key assumptions.
     Refer to food case where the project had strong leadership from one company downstream (near the retail end) and collaborative support from suppliers further upstream in the supply chain.

2. **Project with a multi-stakeholder analysis focus**
   - Re-define the problem with broader audience using Pressure State Response model and other analysis of systems that were developed with the key participants.
   - Engage supply chain stakeholders in dialogue about project issues, challenges and vision for future outcomes.
   - Document outcomes and communicate to stakeholders for feedback.
     Refer to construction case where the project reached the supply chains of several leading companies and involved a range of suppliers and stakeholders.
PHASE 3: EMERGENT STRATEGIES AND POLICIES

By Phase 3, the participants have begun developing their internal and supply chain teams and enhancing their understanding of the operational systems, the supply chain, the key external stakeholders and how the transformational project interfaces with these systems and the broader environment.

Emergent problems and solutions identified during Phases 1 and 2 form the basis of this reflective, strategic phase. Working out what can be influenced and where (see diagram below), and how to empower enablers and manage blockers is crucial for achieving short-term project transformations and effective ongoing collaborative activities. Opportunities may include developing interdisciplinary expert groups, extending collaborations, new technology, information sheets about sustainability issues, procurement and sustainability policies and so forth.

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**Emergent strategies and policies**

1. Review transformation projects with participants and develop strategies/tactics and sustainability policies. Define what you can influence, and how. Define which policies need to be changed or developed.

2. Develop recommended practices/standards/procurement policies to improve the sustainable management of products and supply chain processes including transport, logistics and waste.

3. Review strategies to consult/inform senior management and embed sustainability policies into business strategy.

4. Create strategies to influence key external stakeholders and the supply chain system to improve sustainability outcomes.
**Aligning policies** - Review and develop energy and waste strategy and align with corporate sustainability policies and supply chain procurement

**Thinking systems**

- Diagnosis
  - Where is energy being used?
  - Where is waste going?

- Measure and Monitor
  - Define KPIs and reporting systems

- Technology
  - Define new technology and innovation opportunities

- Facilities
  - Plan and implement infrastructure upgrades

- Communicate
  - CSR, decision support and knowledge management

- Policy
  - Review/develop/align sustainability, CSR, procurement policies

**Embedding learning and communication outcomes**

1. Review the effectiveness of the projects and the collaboration. Consider the vision, reflect on the successes and failures. Discuss the process with the sustainability team and review options for other sustainability issues.

2. Build ongoing collaborative partnerships by interdisciplinary sustainability teams.

3. Develop effective communication, learning and training materials.

**SUMMARY**

Developing representative diagrams is essential when working with complex systems, especially complex social systems where every individual has unique perspectives on the system. Facilitated discussion using diagrams helps people to discuss their role, values, perspectives and the risks and challenges in their section, and see the interconnections and interdependencies. Diagrams were useful as a visual prompt for building understanding of systems boundaries, the levers and barriers and the influence of people. They provided a basis for discussion about how and where to most effectively influence the systems and, in the latter stage of the enquiry, which policy tools (R&D, education, incentives, standards and regulations) could be used to influence the system. How adaptations of this process were applied and adapted is discussed in the next chapter on case studies.
4. CASE STUDIES

This chapter discusses two transitional projects: the application of critical systems analysis; and the outcomes, the implementation of the sustainability policies and the change processes. Both projects featured a ‘walk the supply chain’ approach, with the aim of extending participants’ knowledge and experiences of other parts of the supply chain. In the construction sector this happened through dialogue at multi-stakeholder focus groups, whereas in the food sector we visited a distribution centre and a bakery, inspected trucks and literally walked that section of the supply chain.

The construction sector project focused on sustainable concrete and incorporated:

- multi-stakeholder analysis – identifying the stakeholders and the range of perspectives on an issue
- institutional change – identifying persistent problems and systemic constraints to implementation of new technology, products or improving practices
- incremental change – developing policies and processes for improving management and information.

The food sector project reviewed options to improve fuel efficiency. The focus was on:

- research and development – reviewing current and emerging alternative fuel options in commercial vehicles
- innovation – the feasibility of implementation and exploring how to operationalise cutting edge vehicle technology in the bakery division
- monitoring – diagnosis of current and new processes with the objective of developing monitoring programs and KPIs for emerging legislation, e.g. greenhouse gas (GHG).
With the accelerating pace of globalisation and increasing emphasis on sustainability, it was inevitable that those in the construction sector increased their focus on reducing carbon in buildings. Global trends indicate that Australian government legislation and market pressure will eventually require developers to build zero-carbon buildings. Cement accounts for 5% of the world’s CO₂. Cement, when combined with aggregates, water, chemicals and energy makes concrete. Concrete provides excellent thermal mass, has durability, can last for over 100 years and can be recycled. Therefore effective building design can contribute significantly to a building’s energy efficiency and longevity, which means a building’s lifetime carbon footprint can be reduced.

Given the complexity of this problem, the foundation companies, Bovis Lend Lease, Stockland and Landcom, recognised the need to collaborate. Over 20 companies from the concrete supply chain became involved.

This case study facilitates discussion on using critical systems analysis with multi-stakeholders to understand options for procuring sustainable concrete.

Learning objectives:

1. Understand the diversity of perspectives in the concrete supply chain
2. Work with multiple stakeholders using CSA and developing systemic thinking
3. Build ongoing dialogue and making sense of complex issues
4. Work with the barriers to change in the concrete supply chain
5. Explore critical systems analysis for developing corporate sustainability policy and strategy.

1 Australian Cement Industry Sustainability Report 2007
BACKGROUND
Three companies – Bovis Lend Lease, Stockland and Landcom – were invited to participate in the Sustainability in Supply Chains program. Bovis Lend Lease is an Australian-based global project management and construction company; Stockland is one of Australia’s largest diversified property groups. Both companies provide a range of expertise, including construction management, project and program management, design management, design engineering, procurement and facilities management. Landcom is a state-owned corporation and a development arm of the New South Wales Government. Landcom’s primary focus is planning and developing residential and commercial properties in NSW.

All three companies identified the carbon impact of the use of concrete in construction as an intractable, messy problem that no one organisation by itself could address. It was agreed that collaboration was needed and independent facilitation would be important to bring stakeholders together.

The sustainable concrete supply chain project required time, insight and input from a wide range of industry players, including developers, engineers and architects, builders, cement and concrete manufacturers and associations, power stations, industry standards organisations and the financial sector. The team conducted extensive interviews and systemic analysis of the concrete supply chain – first identifying the key stakeholders, then the changes required and the barriers. We explored why more sustainable practices were not happening and who had the power and influence. A sense of powerlessness and inertia existed, mainly due to the complexity and interconnectedness of the concrete production process. So we invited a group of industry stakeholders to come together in March 2008. The intention was to establish mutual understanding of the barriers and incentives towards a more sustainable construction sector. The participants included some of the nation’s top concrete and cement companies, joined by leaders from several of the industry’s raw material suppliers, associations and government agencies. For a day they worked their way through the issues in the concrete supply chain and, in the end, they agreed on ways each sector could contribute to the sustainability of the supply chain.

PARTICIPATING SUPPLY CHAIN COMPANIES:

Cement and Concrete
- Boral
- Cement Australia
- Cemex
- Hanson
- Independent Cement and Lime

Associations
- Ash Development Association of Australia & Australasian Slag Association
- Cement Concrete and Aggregates Australia
- Concrete Institute of Australia
- Green Building Council

Energy
- Delta Electricity
- Macquarie Generation

Finance
- AMP

Government
- Australian Government
- Department of the Environment, Water, Heritage and the Arts
- NSW Department of Environment and Climate Change
- City of Sydney
CRITICAL SYSTEMS ANALYSIS

Between June 2007 and August 2008 exploratory meetings were held with the construction companies and associated concrete supply chain agencies. The objective was to develop understanding of the diversity of perspectives in the supply chain along with the:

- impact of policies, including unintended consequences
- role that each stakeholder can play in implementing change
- potential levers and barriers for change.

Initial enquiry found that the construction companies wanted facilitated discussion that built on their knowledge of the barriers and opportunities for increasing the use of sustainable concrete in the construction sector. They also wanted to understand how sustainable was sustainable concrete, and under what conditions. For example, what were the options for reducing embodied energy and increasing energy efficiency?

Sustainable concrete is a messy problem because there are many drivers, complex influences and perverse policy outcomes due to:

- a complex range of contractual relationships
- a complicated product with numerous inputs, uses and specifications
- many vested interests, entrenched positions and lobby groups
- a wide range of opportunities and barriers to influence decision making processes
- perceptions of high risk in relation to certain applications of sustainable concrete
- a culture of long hours and tight deadlines.

Supply chain issues are particularly complex due to the many stakeholders involved. To influence the system requires an understanding of the social, institutional and policy processes, as well as the production and operational systems.

An adaptation of the OECD’s Pressure State Response model (see Chapter 3) was provided as a framework for the dialogue and analysis. Putting the ‘system at the table’ (a supply chain or inter-disciplinary group) is a powerful and effective approach to breaking down barriers and building common knowledge.

WHAT IS CONCRETE MADE FROM?

Concrete is a combination of cement and materials that when combined with water can be poured into virtually any form. It hardens into a strong, durable material that is predominant in building and construction.

The materials in concrete can include many combinations of coarse aggregate (crushed rock or gravel), fine aggregate (sand), chemical admixtures (used for mix enhancement), special additives, water and supplementary cementitious materials (SCMs) and cement. The production of Portland cement involves a chemical reaction that produces CO₂. SCMs can be substituted in some cases to reduce the CO₂ impact.
Members of the concrete supply chain gathered for a one-day focus group in Sydney on 19 March 2008. The objective of the session was to build a broader understanding of the range of perspectives and to jointly develop plans and initiatives for a more sustainable concrete supply chain. The participants were seated at tables of 7–8 people each with representatives from sectors of the concrete supply chain. Groups alternated between small and whole-of-forum discussion. ‘Thought starter’ talks identified key issues in the sector and helped to start discussion around the following areas:

- Understanding the production of sustainable concrete.
- Exploring project management, procurement and sustainability drivers.
- Understanding the current standards, incentives and regulations.

Systemic, messy problems often have complex drivers, numerous influences and interdependencies.

Systemic solutions require a collaborative approach with a shared vision and mutual benefits.

No single person or entity can control the issue or determine its outcome.

A diversity of perspectives is needed to make sense of the issue.

**WHY USE SUSTAINABLE CONCRETE?**

Reducing the carbon footprint of a building (the volume of greenhouse gases expressed in equivalent units of CO₂) is becoming an increasingly important driver for builders and developers. One way to achieve this is to improve the efficient use of energy in operation during the life of a building. Another is to reduce the embodied energy in the materials and construction of a building; particularly concrete.

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PRESSURE: WHY SUSTAINABLE CONCRETE IS IMPORTANT

From the developer and construction companies’ perspective, reducing the levels of embodied energy (the energy used in production) in the production of concrete and the use of concrete in buildings, and increasing the information about concrete purchasing options are the key drivers for change. The inability of the companies’ sustainability managers to influence decision making in the concrete supply chain was a key driver for this project.

Issues putting pressure on the sector to increase its focus on sustainable concrete are:

- increasing demands by clients and tenants for ‘green’ buildings
- limited specification of sustainable concrete by architects and engineers (specifiers)
- project Directors lack the incentives or knowledge to critique concrete procurement specifications
- limited information on how to specify sustainable concrete and to support the range of sustainability issues
- lack of sustainable concrete products to provide specifiers with options.

The sum result was low awareness of opportunities, optimum applications and benefits of sustainable concrete. With the prospect of an emissions trading scheme, stakeholders expressed the view that the sector will have to change its production practices and develop knowledge and practices about how to be more sustainable. The foundation participants held a vision of responsible business practice that could cut GHG emissions in excess of that required by the new ETS.

CURRENT STATE OF THE CONCRETE SUPPLY CHAIN

A systemic enquiry of the concrete supply chain systems, links and boundaries is shown in Figure 6. This diagram was developed after initial discussion with the key participants. It was used during meetings to discuss the roles of the supply chain stakeholders, to help them explore from their perspective at their point in the system their risks, uncertainty, influence and control. The diagrams and other learning materials were adapted as new knowledge emerged. There are numerous interactions and a range of relationships among customers, developers, construction companies, specifiers and builders in this supply chain, which the diagram sought to generalise into a working model. Hence it was referred to as a ‘generic sustainable concrete model of stakeholders and processes’. For example, architects and/or engineers and project directors can be in-house or outsourced, and this can vary from project to project, or between different arms of a given corporation.

THE STAKEHOLDERS

The key stakeholders in this supply chain are clients and tenants, developers, construction companies, concrete and cement suppliers and contractors, raw material suppliers, builders, associations and building standards corporations. The context is the use of concrete in the construction of the built environment. Participants described the cultural context as very market-oriented and pressured. The key elements are productivity and competitiveness. Project managers received financial incentives for projects delivered on time and on budget.

The boundaries of the system analysis for this project extended from the developers through to building construction (represented by the grey background in the diagram below). Key sub-systems included: transport and logistics; supplementary cementitious materials (SCMs); concrete and cement production; building policies and standards agencies; specifiers; and environmental and social systems.
The focus group discussion provided insights into the perspectives and issues in the concrete supply chain. While not a key group in the concrete supply chain, the financial sector and building tenants provide leadership within the construction sector. Financial institutions are facing increasing demands to ensure that their funds have sustainable investments and the practices used in construction support their investment principles. These institutions can provide leverage for change in corporations, e.g. through dialogue with CEOs about corporate performance against world’s best ‘sustainable’ practices.

Concrete and cement suppliers are a key group. The exact specification for the use of concrete in buildings is highly contextual, i.e. concrete specifications are dependent on the particular building and site location. Factors that influence the use of concrete include design and engineering specifications: e.g. strength and setting time; location (distance from concrete silos and resources); timing/scheduling and availability of materials and logistics; and structural function of the building element.
MATERIALS AND RESOURCES

There are large quantities of supplementary cementitious materials (SCMs) available that are presently under-utilised in some regions of Australia, such as New South Wales.

SCMs are currently viewed as a commoditised waste product rather than a specialist product. Considerable potential exists to increase the use of SCMs in concrete and in new building products. Other important factors in the availability and sustainable use of SCMs in concrete and building products include:

- availability of water and materials
- uneven distribution of SCMs in Australia, the associated transport distance, economic and carbon costs
- existing contractual arrangements that restrict the capacity of SCM suppliers (e.g. power stations that produce fly ash) to develop the market to its full potential.

The concrete suppliers have infrastructure constraints on their capacity to utilise SCMs in concrete mixes. Their current capacity is highly location dependent – mainly driven by the number of silos on site. Increasing silo infrastructure would enable the concrete sector to provide a greater range of concrete blends. High silo infrastructure costs, space and council planning requirements are major restrictions to this development.

Performance specifications of built structures are also an important factor in the use of concrete. Some participants expressed concern about the emphasis on SCMs as the principal vehicle to create a more sustainable concrete product.

Over-reliance on rating systems to provide incentives to use SCMs, without considering the context for their use, does not necessarily achieve more sustainable outcomes. For example, specified concrete mixes that ‘prescribe’ SCMs as part of a percentage of replacement materials may produce unintended outcomes. Longer curing times of SCMs can affect concrete pour cycles, which in turn may result in subcontractors charging builders extra. To compensate, additional cement may be used to reduce curing times, which is counter-productive.

SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCMS).

Fly ash, ground granulated blast furnace slag, or other pozzolanic materials are collectively referred to as supplementary cementitious materials (SCMs).

SCMs can be

- included in concrete, either as an ingredient added at batching, or as a component of a blended cement, or both.
- added during batching along with Portland cement.
- added to concretes made with blended cements. The advantage of using SCMs and other recycled materials is that it reduces the embodied energy.

Source

City of Sydney

www.cement.org/tech/faq_scms.asp
Other alternatives exist to reduce carbon footprints, such as design optimisation to reduce the amount of concrete required and the use of post-tensioned slabs. Developers and construction companies have specific criteria for the supply of some other building products (such as certified timber products) to ensure their ‘sustainable’ credentials. However, which supplier provides the concrete for a particular project is largely determined by proximity (the weight and curing time of concrete makes logistics and transport important). This means the companies are unable to manage this supply chain in the conventional manner – they can’t work with a preferred supplier to an agreed standard. They have been unable to implement consistent sustainable concrete product standards across the range of suppliers.

Whole-of-supply-chain thinking introduces systems considerations. Design optimisation needs a ‘cradle to grave’ view that includes GHG emitted from mining and production processes through to end-of-life disposal or reuse. Improvements to the operational energy efficiency of a building that draws on non-renewable energy sources by itself won’t reduce the volume of GHG in the atmosphere.

Developing a shared understanding of a supply chain system can support more effective decisions and solutions to messy problems.

CHALLENGES
Specifications for concrete need to support sustainable outcomes through the more effective use of SCMs in a) building design optimisation; b) performance specifications for the % of SCMs in different applications; and c) improved time and logistics management to reduce waste. Key challenges are:

- How to increase the specification of SCMs to reduce the embodied GHGs in the built environment. There is currently limited specification of SCMs by engineers. Pressure from developers and construction companies for the fast laying of concrete does not support the use of SCMs as they take longer to cure.
- How to balance sustainability tradeoffs – reducing GHG from embodied energy vs energy efficiency during the operational life of a building. For example, concrete provides insulation benefits that are closely aligned with concrete mass and effective building design: i.e. concrete can significantly improve energy efficiency by reducing the need for air conditioning and heating. For this reason, attempts to reduce the use of concrete could adversely impact on the energy efficiency, durability and longevity during the operational life of the building.
- How inefficient practices such as a lack of quality control, over-ordering of product, and rigid timing/scheduling of deliveries can lead to considerable concrete and energy waste. For example, currently twice the number of trucks are used to meet morning deadlines than would otherwise be required if deliveries could be spread evenly throughout the day. Note: participants indicated that attempts by the concrete industry to manage logistics and scheduling with clients have achieved limited success so far.
POLICY TOOLS AND MEASUREMENT

Depending on the position of the organisation in the supply chain, there are different drivers, trade-offs, and barriers. People also have a range of incentives and constraints to achieving outcomes. These contextual issues need to be taken into account when considering the policy tools for sustainable concrete.

The Green Star rating system is a building standard for commercial ‘green buildings’. There is limited incentive for their increased use of SCMs due to the small allocation of points. It was argued that a higher point allocation would help to address this issue. However, a key question is whether SCM rating criteria create better sustainability outcomes. The limitations to the current rating system were discussed. For example, the rating system does not accommodate embodied energy or energy efficiency design considerations for concrete.

The Green Building Council is planning to review the rating criteria and will consider how to ensure that point allocations do not create unintended impacts on the sustainable performance of the building. Addressing the issues raised above may take up to three years.

When searching for solutions to problems, consider the impacts of the solution on the external and internal environment. Align policies with sustainability vision, strategies and corporate culture.

The Life Cycle Analysis (LCA) of a product within the supply chain is needed to fully understand the embodied GHG and other resources used to produce the product. Currently, LCA tools are fairly simplistic. LCA tools are not currently recommended state practice, nor are they consistent between states. An LCA can be information intensive and costly to conduct, and is limited to a defined product in a point in time, so allowance needs to be made for parameters that change. There are numerous mixes of cement and concrete and a large variety of input materials available. It’s also uncertain whether the results of an LCA will align with the incentives of a future ETS. In assessing the impact and longevity of a building, an LCA needs to inform not just the decision of what to build, but how to build. This would include a focus on optimal design upfront: a) to extend the life of a building; and b) to provide decision support on whether to refurbish or rebuild an existing structure.

CO₂ from products is undervalued and the ETS will help to solve this issue by placing a price on carbon. Over time, carbon pricing will become an integral part of incentives, regulations and other market and legislative instruments.

The Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) has started dialogue with the Building Products Innovation Council (BPIIC) to develop a nationally consistent approach to carbon accounting in the built form. The scope of the ETS in measuring carbon performance may include design, material, utility and construction/operations considerations. A carbon accounting methodology will need to determine where in the supply chain the transaction costs reside for existing and new products (e.g. the trade of ‘packets of emissions’).

Considerations include: the equitable distribution of benefits from carbon savings; who would bear the costs of an ETS; and at what point would a carbon price translate into change. Participants expressed a need for
communication/education to enable decision-makers in the supply chain to interpret these signals and respond with product and design choices that reduce carbon. Irrespective of a national carbon accounting scheme, participant construction companies expressed the need to proactively reduce CO2 emissions as a moral imperative.

THE WAY FORWARD, THE RESPONSE

Corporations within the construction sector need to demonstrate leadership in order to build momentum for change. The culture of ‘fast turn around’ in this sector limits the ability of staff to engage in sustainable initiatives. Senior management can provide support by allocating time and resources, incentives and performance KPI for their staff to drive sustainability outcomes.

Participants indicated that there is a need for stronger collaboration throughout the concrete supply chain and consistent messages, policies and incentives for stakeholders. To build the capacity of people and organisations to better understand the issues, and effectively work towards a sustainable concrete supply chain, the recommendations were:

- Develop a range of communication and education material on the use of sustainable concrete products and processes for a broad range of stakeholders across the supply chain, such as project managers, specifiers, suppliers, etc.
- Improve decision-making support tools such as LCA, design, product and performance optimisation tools to enable more informed decision-making at all levels of the supply chain.
- Develop incentives, standards and best practice performance specifications that provide assurance of the sustainable credentials of products, a consistent message, and market drivers that do not lead to unintended/unsustainable outcomes.
- Develop contracts and procurement policies that encourage the use of sustainable concrete and support green building criteria.
- Encourage leadership and cultures within corporations that support sustainability practices in the concrete supply chain.

There are extensive knowledge gaps within and across the supply chain about sustainability in the supply of concrete. This lack of knowledge and awareness often drives behaviour and practice that produce unsustainable outcomes. Questions raised included:

- What is the impact of different concrete mixes?
- What are the links to other issues within the supply chain such as water, waste and logistics?
- What does a ‘green building’ actually mean?

More industry-wide and stakeholder-specific information is needed to help support decision-making (e.g. case studies about the trade-offs between embodied energy and energy efficiency). This type of information will enable stakeholders to make more informed decisions about the options for sustainable design and the use of construction materials, and how to most effectively achieve sustainable outcomes.
REFLECTIONS ON THE PROJECT

The ‘walk the supply chain’ approach at the focus group and during meetings, using diagrams and critical system analysis learning tools, broadened participants’ knowledge and understanding of other parts of the supply chain. Below are comments recorded by the participants on review forms after the focus group:

- ‘Positive development of our understanding of other areas of the supply chain – get feedback from downstream members on their view of your sections.’
- ‘Write up results and circulate, hold another meeting, ongoing collaboration.’
- ‘Very informative and insightful. It helped me to understand the key factors and drivers into sustainable concrete.’
- ‘Good to meet the participants and hear their concerns.’
- ‘… challenge to convey complexity of issues across influencers – specifiers.’
- ‘Increased awareness and collaboration between various sectors [are] important.’

Sustainable concrete is a complex issue and a messy problem. When working with so many stakeholders from different disciplines and sections of the supply chain, there are major challenges. A collective response to make sense of complex issues that have persistent, systemic barriers to change can generate simple communication material. Fact sheets, when written in a credible style with relevant, useful information, can help build shared knowledge and can become a tool for leveraging change. One outcome from this project is the development of a Sustainable Concrete Fact Sheet. The Concrete Institute of Australia (CIA) is taking a leading role and is working with its members and participants from the construction project.

Participants indicated that ongoing discussion in the form of a follow-up focus group or small working groups to review the findings and explore next steps would be helpful. An extensive set of recommendations for future research and policy development was formulated during the focus groups and interviews. These recommendations provided incentive for the CIA to develop its own research and development forum and the fact sheet.
In 2007 recognition of the potential consequences of climate change and emissions trading systems (ETS) heightened awareness of the crucial role of effective supply chain delivery systems in Australia.

As a food manufacturer and distributor, Goodman Fielder was aware of growing market competition and rising prices for grain as input for both fuel and food. Advances in alternative fuels, gas, electric and hybrid electric vehicles (HEV) technologies appeared to be showing promise for reducing GHG and fuel consumption.

This study discusses a collaboration among Goodman Fielder, ORIX and truck manufacturers to reduce greenhouse gases from food distribution networks.

This case study facilitates discussion on using critical systems analysis with emerging research and innovation to understand options for distribution networks and alternative fuels and vehicle transport.

Learning objectives:

1. Explore the challenges faced by GF in the baking supply chain.

2. Examine measures taken by GF and ORIX to address these challenges.

3. Describe the systemic enquiry process as applied to this project.

4. Discuss the rationale behind GF sustainability strategies.
BACKGROUND

Goodman Fielder (GF) is an Australian/Asia-Pacific company that has expanded greatly through takeovers of small niche brands. They manufacture and distribute a wide range of food products – fresh bread, frozen pastries and dairy products, requiring a range of storage systems. The range of variables includes delivery schedules and locations, traffic regulations (e.g. routes for large trucks); storage and freighting requirements for different products (e.g. heavy oils versus voluminous bread products, refrigeration needs); and variable shelf life (from one day for fresh bread to months for frozen pastry). Their truck delivery systems reflect this diversity of frozen, refrigerated and fresh products. Manufacturing plants and distribution centres are dispersed throughout Australia and the Asia-Pacific region.

GF has shifted its corporate focus from environmental compliance to improved efficiencies, and is now addressing issues such as climate change (e.g. measuring GHG footprint of supply chain logistics). GF is planning its first sustainability report – internally in 2008, and publicly available in 2009. A primary influence on this shift in focus has been the perspective at the executive board level, with awareness of external drivers such as carbon pricing; consumer, shareholder and investor values; and employee attraction and retention.

The senior management of GF has demonstrated leadership by canvassing potential sustainability projects (including links between food and health) that went beyond its own corporate boundary. Senior management nominated the right people to lead the project and ensured they had adequate support and resources.

THE PARTICIPANTS

The GF supply chain project required time, insight and input from a wide range of GF staff and industry players. GF had representation from staff in the bakery, commercial and corporate divisions, including specialists in supply chains, logistics, marketing, customer relations, environmental and sustainability management. This meant that divisions, which had previously seen each other as separate businesses under the one corporate banner, came together and learnt about each other’s operations.

GF invited ORIX to participate once it became evident that alternative truck bodies, engines and fuels were key initiatives to reduce GHGs. ORIX lease commercial vehicles to the bakery division. ORIX in turn invited specialist alternative fuel and technology suppliers to present their products to the project team. These companies were: Green Fleet Systems International; Clear Sky Solutions; OES CNG; HINO (subsidiary of Toyota); and ISUZU. The Australian Government Department of the Environment, Water, Heritage and the Arts also provided expertise in GHG policy and measurement for alternate fuel vehicles.

CRITICAL SYSTEMS ANALYSIS

Between November 2007 and May 2008 workshops were held with GF and supply chain partners. GF’s vision for the project had this objective: to reduce the GHG footprint of distribution and develop a model of the change process that can help to further improve the sustainability of its supply chain activities. The initial meetings with GF aimed to build mutual understanding about:

- sustainability
- the culture and operational environment
- boundaries of the systems and the sub-systems
- potential stakeholders
- perceptions of risk, barriers, challenges and systemic problems.
Establishing the range of mutual benefits is essential for effective and ongoing collaboration. The benefits need to connect the stakeholders and the sustainability vision. As new parties join the project and understanding evolves, the vision and mutual benefits should be revisited.

After several months of exploring potential projects, and discussing project options with some suppliers and customers, GF corporate, commercial and bakery divisions identified two areas to focus on to improve the GHG footprint of its supply chain performance:

- their short- and long-haul trucking fleet
- transport logistics between distribution centres.

The key objective was to explore opportunities to reduce GHG per unit of product delivered, through such options as fuel efficiencies, substitute fuels or new engines. This case focuses on the baking division’s analysis of alternatives for its light-weight, short-haul vehicles.

PRESSURE: WHY ALTERNATIVE FUELS AND GHG AND THE BAKERY DELIVERY SYSTEM?

In GF, the bakery division has the largest financial investment in distribution. The main drivers influencing GF are:

- Reduce exposure to increasing fuel costs by improving logistics.
- Maintain current product pricing, given the likelihood of substantial increases in both fuel and food commodity resources.
- Anticipate compliance to emerging regulations – emissions trading scheme (ETS), which will provide strong cost incentives to reduce energy use and GHG.
- Do the right thing – GF developed a corporate sustainability strategy that requires futures thinking and actions to be aligned with improving the sustainability of GF.
- Expectations of carbon content labelling, and emerging demands for information about a product’s GHG.

CURRENT STATE: WALKING THE GF BAKERY DELIVERY SYSTEM

The context to serve as a case study in this project was the delivery of bread in the Sydney metropolitan region. The baking delivery system is a ‘spider web’ from the distribution centre to large and small retailers with fixed routes and low variability in load size and orders.

Specify your system boundary and determine what the project group can control or influence, and how. If something affects your project but you can’t influence it, then monitor it.

The boundaries of the system were defined as from GF bakery distribution centre to retail distribution centres. Key sub-systems included: transport and logistics; the bakery; depot; trucks; transit; logistics; and environmental and social systems. The main stakeholders in the alternative fuel project were GF permanent staff and contractors, ORIX, suppliers, customers and the retail sector.
GF’s Ermington Distribution Centre (DC) is the largest stand-alone DC in NSW with half a million deliveries of fresh bakery products per day. Products are delivered from the Moorebank Bakery which services the whole of Sydney. Deliveries from Ermington cover Bondi, the city, the north shore and the northern beaches. Contractors are paid by commission on cents per unit sold. This is a strong incentive to reduce per unit delivery costs through improved efficiencies. A software package called Transit schedules distribution according to the most efficient routes and vehicle type. Inputs include satellite information, roadmaps, peak traffic times, vehicle size, etc. This provides a platform for building an efficiencies analysis. Figure 7 shows the initial discussion points for starting a CSA into the Ermington sub-systems.

Scan for issues that currently impact the supply chain systems. Potential impacts of interventions (micro and macro) include societal and environmental issues.

In a systemic enquiry into whole-of-supply-chain sustainability, participants scan for issues that currently impact the system. Potential impacts of making changes to the system should also be considered. Some issues considered during multi-disciplinary discussions during the project were:

- Regulations are likely to become more stringent, and carbon-intensive fuels will become more expensive. Commonwealth Government mandated GHG reporting is currently under development and it is anticipated that ETS will be introduced in 2010. Information on GHG emissions may need to

GF / Ermington Depot: Current supply chain

**Current Energy:**

<table>
<thead>
<tr>
<th>Diesel?</th>
<th>Electricity – lights and computers</th>
<th>Diesel?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morebank Bakery</td>
<td>Trucked to Ermington</td>
<td>Bread scanned</td>
</tr>
</tbody>
</table>

**Energy saving opportunities:**

- Trucks – Hybrid/Electric/Gas
- Depot – Solar/batteries
- Optimise truck design
- Reduce wasted space
- Optimise delivery routes/loads (requires customer collaboration)

**Monitoring:** Define data for KPIs: Energy, Waste, OH&S...

**Diagnosis:** Define energy use and where waste is going

Figure 7 Ermington DC analysis
be communicated along a supply chain. Transport fuels are also included in a mandatory federal energy efficiency program. Potential future impacts on GF of evolving sustainability and climate policy, government incentives and regulations, local and international market drivers were considered.

- Vehicle design optimisation opportunities included the weight-carrying capacity of vehicles, the options to redesign vehicles, chassis, and the number of wheels. Operations and maintenance of vehicles would be required but at no additional cost to GF. Some changes may require OH&S training for drivers. Operational procedures would be provided by suppliers and managed by ORIX as part of the leasing arrangement. Maintenance costs are included in the lease. It was anticipated that the commercial leasing arrangements with ORIX would incur no immediate additional costs to GF.

- Options to reduce the distances travelled or the frequency of deliveries involved trade-offs. Opportunities to improve the logistics required discussion with retailers whose contracts can constrain efficiency options by specifying such things as delivery times, the choice of engines and truck body sizes. Travel distances may increase if GF depots are consolidated or if fuel locations are changed (compressed natural gas (CNG) depot option). Can the empty space be reduced and load capacity increased within current weight restrictions?

- Societal attitudes towards fuels were also considered important. What are the community/consumer perceptions of petrol? Community considers this fuel to be a major contributor to climate change. Community perceptions are likely to continue to drive consumers away from petroleum fuels towards more alternative fuels. Bio-fuels were not considered a viable alternative fuel. GF is a food manufacturer and there is growing concern about the impact of using food for fuel on global food supplies. Any electric vehicles drawing on coal-generated electricity along Australia’s east coast would emit more GHGs than traditional fuels, according to one participant. Was it possible to put solar panels on factory roofs to charge the solar batteries for the electric vehicles?

Figure 8 shows the alternatives identified for further review. Suppliers were invited to provide detailed information on alternative vehicle and fuel options. This included the advantages and disadvantages of each option in relation to the upcoming ETS and the broader context of climate change.
DEWHA also participated and made these points during a forum with ORIX, GF and the gas suppliers:

- It is a myth or an assumption that alternative fuels must be better. The new generation diesel engines made to European standards (Euro IV) are a lot cleaner and emit less GHG. At the heavy-vehicle end of the market there is no current evidence that there are better alternatives to diesel.

- In some cases, attempts to decrease CO₂ can increase emissions of CH₄ (methane). Currently it is difficult to measure CH₄ and NOₓ as the equipment is not available in Australia. Engine tests conducted overseas may not be a reliable guide to emissions under Australian conditions.

- Hybridisation is a key enabling system for going forward, but battery cost, life, space taken on truck and weight are constraining issues.

A decision support matrix helps to consider the range of perspectives. There were differing views on what the important factors were for making a decision.

The suppliers informed the group about the range of issues to be considered when looking at alternative fuels. General points made by suppliers included the importance of driver skills (a 10% difference in fuel consumption); collaborative opportunities (six-month free trials for new hybrid electric vehicles); and how government assistance is needed to install fuel depot infrastructure for CNG (a low GHG fuel option which has advantages for Australia). Simply upgrading the vehicle fleet with new automatic/manual transmissions (AMT) would result in economic and environmental benefits from lower diesel consumption. AMT helps to take the ‘bad driver’ out of the equation – this in turn reduces maintenance costs and fuel use.

There were differing views on what the important factors were for making a decision. The government focused on GHGs; whereas suppliers were also concerned about particulate matter and air quality. Suppliers emphasised cost savings. Some suppliers lacked knowledge about climate change implications and emissions trading; others had high awareness but their initiatives to develop technologies that emitted less GHG were hampered by the lack of vehicle testing facilities and specific information to guide their activities. Some frustration was expressed that government tests had a limited range of applications.

The decision support matrix below is a useful tool for scoping the options. Data in the matrix and notes captures some of the discussion about options during project meetings. The accuracy of this data hasn’t been verified.
<table>
<thead>
<tr>
<th><strong>PETROLEUM-DIESEL</strong></th>
<th><strong>ELECTRICITY</strong></th>
<th><strong>GAS LPG</strong></th>
<th><strong>GAS-CNG</strong></th>
<th><strong>HYBRID ELECTRIC VEHICLES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>- Negatives</strong></td>
<td>Conventional fuel currently used. Supply infrastructure in place. Can extend with biofuels but lack of consistency in product. New generation of diesel engines are much cleaner.</td>
<td>High emissions especially CO₂. Limited crude oil supply with demand increasing and price forecast to increase. Less resilience if dependent on one fuel supply.</td>
<td>New technology, in development stage. Batteries heavy and bulky. Limited vehicle options. Australian compliance is required. Larger upfront capital costs. Re-charge through domestic main. GHG impact when using coal-fired power stations. May only be feasible with solar panels &amp; inverters/batteries. Battery life &amp; cost of replacement. Potential rapid depreciation of investment (resale value).</td>
<td>Infrastructure cost for refueling. If 100% LPG, short runs or sacrifice load space to carry gas. Larger upfront vehicle costs. Maintenance issues. No warranty insurance from diesel engine manufacturers with retrofitted systems. Low resale value of vehicle. LPG still emits GHGs. If 100% CNG, distance of runs limited to within fuelling station. Substantial upfront capital costs for establishing infrastructure for refuelling ($0.25 million per station). Larger upfront vehicle costs. Maintenance issues. No insurance from engine manufacturers with add-on systems. No secondary market for CNG trucks (related to lack of fuelling infrastructure). Option: use after-market kit and convert back to diesel.</td>
</tr>
</tbody>
</table>
### TABLE 1 ALTERNATIVE FUEL DECISION MATRIX (continued)

<table>
<thead>
<tr>
<th></th>
<th>PETROLEUM-DIESEL</th>
<th>ELECTRICITY</th>
<th>GAS LPG</th>
<th>GAS-CNG</th>
<th>HYBRID ELECTRIC VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RISK</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Short term</td>
<td>LOW-MEDIUM</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>Long term</td>
<td>HIGH</td>
<td>MEDIUM-HIGH</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td><strong>TIME FRAME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>Longer term – dependent on technology and infrastructure costs.</td>
<td></td>
<td>Short term. LPG dual fuel add-on (life expectancy six years) is available now.</td>
<td>Longer term – possible for collaborative fuel depot. Dependent on infrastructure and technology.</td>
<td>Medium term – dependent on infrastructure and technology.</td>
</tr>
</tbody>
</table>

**Technical notes on fuel options**

The LPG and CNG systems were available as dual-fuel add-on for diesel engines, Dual Phase Induction Systems. Suppliers claimed that adding LPG or CNG to diesel engines helps to reduce CO₂ by reducing diesel consumption. In addition to running the engine, diesel also acts as an engine lubricant and a solvent to help keep the engine clean. Therefore, the balance of gas to diesel has tradeoffs with engine efficiency, maintenance and fuel economy. LPG and CNG also have GHG impacts. CNG has the lowest GHG impact but there are few fuel stations.

Hybrid vehicles use either Exhaust Gas Recirculation (EGR) or Select Catalytic Reduction (SCR) technology. The EGR + Diesel Particulate Diffuser (DPD) achieves Euro 4 standard (the highest). DPD is a ceramic filter that collects and incinerates particulates. EGR and DPD vehicles can potentially achieve up to 30% reduction in fuel use and 25% reduction in GHG emissions. Some vehicles use EGR + DPD + Variable Geometry System (VGS) turbo chargers, with potential to reduce particulates by 81.25% and NOₓ by 30%.

NB: Particulates in the exhaust are an air-quality not a GHG issue. Suppliers urged the need to also understand the impact of particulates on air quality. The relationship between particulates and climate change surfaced, but wasn’t addressed.
INITIAL OUTCOMES FROM THE PROJECT

There was uncertainty about how alternative fuel regulations would evolve. Changes in alternative fuel policies in relation to CNG infrastructure, hybrid and electric vehicle tariffs could substantially alter the economics of the vehicle. Financial data from ORiX indicated the cost of leasing hybrid trucks was substantially higher than leasing the new diesel vehicles with AMT. The problem was the uncertainty around the re-sale value of these vehicles in three years and the additional costs such as battery and inverter maintenance. The batteries are expensive and battery life is unknown. There is currently no market for hybrid vehicles, whereas diesel vehicles have an established re-sale market.

Sustainability issues cannot be viewed in isolation of financial considerations, where substantial investment is required. The risk would be perceived as being too high if there isn’t reasonable certainty about the costs. The information does not build a strong enough case to justify a substantial investment in gas, electric or hybrid vehicles.

While this presented a setback for the project team, they remained optimistic about improving the sustainability of the vehicle fleet. Without having consulted a diverse range of stakeholders, GF may have pursued a ‘quick win’ using an alternative fuel under a mistaken impression about its environmental credentials. One of the outcomes from the discussion was the opportunity to work with ORiX and ISUZU on a collaborative six-month trial using a new hybrid diesel-electric truck. GF staff will monitor the performance of the hybrid and build a better understanding of the operational implications of this new technology. The trial progress will be communicated to GF staff and will be used to raise awareness of the sustainability opportunities and challenges in the trucking fleet.

Sustainability issues in isolation of financial considerations will not convince the Board to make substantive investment.

Some additional improvements occurred at GF. The GF team engaged a wide range of employees, including people from marketing, logistics, supply chain management, customer relations and sales in considering a number of potential projects. Some project initiatives were explored but were delayed, for example, by an imminent change in suppliers, or the inability to obtain the information that was needed. Improving logistics management is also a key initiative, but progress on this area was slow due to data limitations and the complexity of the logistics network. There is also a need to collaborate with the retail sectors, but building these collaborative partnerships appeared to be challenging.

GF developed more systemic interactions and alignment between strategy and sustainability options, within its own corporation and with organisations along its supply chain. GF instigated the supply chain collaboration with ORiX, which in turn invited its suppliers to become involved in the project. GF kept senior management informed and consistently demonstrated openness to broader systemic issues and the need for new ways of thinking and collaborating. They also provided valuable feedback on the constraints of their business and industry sector. As discussed in Chapter 2, it is imperative that corporations engage in active discussions about sustainability and their values and roles in society as well as the business world.
5. EXPLORING THE CHALLENGES OF WORKING SYSTEMICALLY

This chapter provides a critical examination of the systemic activities of the participants and the research team. This discussion includes observations from participants outside of the core projects.

Working systemically and collaboratively on sustainability problems can be perceived as a challenge to the culture of ‘business as usual’ by employees. Corporations are starting to associate a business value with sustainability, especially where emerging markets and regulations are now placing financial values on aspects of corporate sustainability (e.g. putting a price on greenhouse gas emissions). Employees and managers generally have definite lines of authority, accountability and roles to perform. Critical reflection and systemic practice requires employees and senior management to examine their assumptions, expand their responsibilities, and form inter-disciplinary networks to share knowledge, and explore uncertainties and systemic drivers. This departs from normal business roles and challenges the expectation that a management decision or a new policy will influence a given issue.

There was considerable enthusiasm for the projects and the majority of participants and experts consistently demonstrated a commitment to prioritise time and resources. The critical systems framework was re-visited throughout the conversations. The supply chain diagrams formed an ongoing basis for analysis and discussion. Given the very short time frame of most meetings (usually one–two hour meetings), it provided a flexible framework and a useful tool for quick introduction to new stakeholders, issues and problems.

While outcomes will continue to evolve and the full influence of the projects is difficult to assess, there were immediate tangible outcomes: a fact sheet is under development; new interactions and supply chain networks; new research collaborations; procurement policies; greater knowledge of systems thinking and sustainability as a business strategy; and understanding of the supply chain. The value of this capacity building was frequently noted, as were the challenges and benefits of working collaboratively across corporate and professional silos. There were many comments about the benefits of interdisciplinary discussion and the importance of a neutral facilitator when engaging the supply chain in discussions.

The challenges of collaboration were discussed at various times during the food and construction sector projects:

- How to build collaboration with the retail sector?
- How to build collaboration with suppliers?
- What is the mutual benefit for these parties?
- How do you maintain a collaborative relationship among suppliers?
It is important to note that the systems enquiry processes used with these participants cannot be exactly replicated, as the facilitator must respond to the unique needs and challenges of each corporation. The model and discussion in this report are intended to offer an insight to the experience, and offer some process guidelines that can be adapted. The critical systems approach as applied in the Sustainability in Supply Chains program aimed to:

- build a shared understanding of the problems, the systems and sub-systems, the boundaries and the environment within which companies operate
- extend the project team learning about the supply chain
- define the risks and opportunities in the supply chain operating environments
- understand the impact of culture and policies, including incentives, standards, and regulations on the operation of companies and the impacts of misaligned policies
- watch for solutions, develop ways forward and influence future decision making processes
- develop capacity to think systemically and collaborate with supply chain partners to implement more effective responses to issues of sustainability.

The critical systems approach used a range of analytical and learning techniques including qualitative interviews, systems enquiry with diagrams and envisioning exercises, expert knowledge and multi-stakeholder focus groups. Experts, policy and communication documentation also formed part of the process of informing the participants about the broader issues. The process was underpinned by a monitoring and evaluation program that required participants to provide feedback throughout the life of their project. Key insights from the process include:

**ENGAGING SUPPLY CHAINS**

Initially, there was limited supply chain engagement. Despite proposing their own project focus that would involve other organisations in a collaborative project to address an issue of sustainability that cut across their supply chain network, many participating organisations (or their supply chain partners) proved hesitant to engage more than one other supply chain participant and to extend the engagement beyond one internal representative. In some corporations, supply chain engagement was very limited and there was resistance to engaging internal people. Reasons were not all clear, but there are some indications that participants:

- need tangible benefits (or confidence in the process and facilitation) before they will engage other supply chain stakeholders
- have concerns about the power and influence of other organisations (influence of large organisations on smaller organisations) and the unknowns of collaboration
• lack experience, knowledge and skill to work on sustainability across the supply chain. Some participants did not have the confidence to engage other corporate divisions, senior management and supply chain companies. An absence of collaboration reinforces perceived limits to responsibility and business-as-usual practices that don’t support cross-divisional initiatives.

• are coping with rapid commercial and market developments. Supplier relationships can change quickly and frequently have both competition and cooperation. Uncertainty leads to risk aversion such as a reluctance to share information, particularly if that information might have a value under new markets, such as an emissions trading scheme.

Conversations about sustainability issues in supply chains would not normally occur as part of everyday business.

The project leaders predominantly came from an Environmental Manager background. Their training focuses on reducing risk by meeting environmental regulations. In general they were unfamiliar with the human and organisational dimensions of sustainability, innovating beyond compliance, or strategic opportunities to incorporate sustainability into the business model or work throughout the supply chain. Logistics, marketing and customer relations people are not focused on sustainability, so there is need for cross-pollination of knowledge and practices.

Few business people come from a discipline or a working background that prepares them for the breadth of topics in a sustainability role. Strategic thinking about sustainability and business alignment across divisions is therefore essential. Developing a shared or compatible vision can provide a basis for working and learning together. It’s important to create a learning environment in which participants interact to co-create a comprehensive understanding of an issue, even if they’re individually expected to be the expert in their day-to-day role.

EMBEDDING NETWORKS

Participants indicated that they do not usually communicate across the corporate silos or with supply chain corporations (except supply chain specialists and buyers). All agreed that ‘sustainability’ conversations about supply chain processes would not normally occur. The role of the neutral facilitation was essential. Facilitation helped to overcome constraints to collaboration such as time pressures, contractual obligations, regulations and risks that collaborative projects could be perceived as anti-competitive. Participants were highly appreciative of the opportunity to build these relationships and to have these conversations, they could see the immediate value and that they were essential for the future to break out of short-term business-as-usual habits.

PERSPECTIVES AND KNOWLEDGE OF SUSTAINABILITY

Knowledge of sustainability was highly variable among participants and new participants joined regularly. Consequently there was a constant need to re-assess the levels of understanding of sustainability and knowledge of the ARIES project during the meetings.
It is essential to obtain senior-level understanding and active support upfront. This helps to ensure commitment, strategic fit and adequate resourcing to avoid burnout in the champions.

**SHARED UNDERSTANDING, ASSUMPTIONS AND INFLUENCE**

Facilitation, voluntary participation and a shared vision are all crucial for participants to practise critical systems thinking to explore the roles of different systems (e.g. individuals, business units or organisations) and make explicit the power relationships, leadership and influence at different levels of the system. The willingness of all core participants to engage in critical reflection of one’s assumptions, own role and impact on the situation (constraining or creating opportunities for change) was important. For example, Bovis Lend Lease provided a high level of leadership and understanding of sustainability. They played a pivotal role in the project by:

- perceiving the need for collaboration in a complex challenge and proposing the project
- providing crucial information that built a rich picture of the concrete supply chain
- acting as advocates for the other participants.

Bovis Lend Lease argued that climate change needs business leadership to exceed the proposed GHG reductions under the proposed ETS.

The opportunity to observe the culture within this corporation also served as a good case study for how participants in this sector engage in conversation about complex issues. Entrenched values and behaviour can reinforce institutional inertia to change irrespective of senior leadership for the change.

Developing the capacity and culture to critically examine one’s own role and assumptions, and discuss expectations, roles and influence in a systemic group can reveal roles, power and politics that co-create barriers or levers to change. The act of sharing this information in a group can threaten an individual’s expert role. If they sense a loss of control and influence, they may become resistant or cause delays. In one case, a senior executive withdrew support from the participation of employees in the project, claiming that they weren’t capable of systemic thinking.

**MUTUAL BENEFIT AND COLLABORATION**

The program highlighted the importance of establishing mutual benefit (‘what’s in it for me?’) among stakeholder corporations that influence the sustainability problem. The mutual benefits (or the mutual problems) should be significant enough to warrant senior management support from each organisation, and should strategically align with corporate priorities. It should offer more than just financial gains, and can include tangible and intangible sustainability gains, such as improved staff morale or corporate reputation.

Mutual benefit also influences the perceived advantages and disadvantages of collaboration among stakeholders within and across supply chains. Successful collaboration that alters current business practices needs participants to have compatible visions that fit their business strategies.

- In construction, the importance of transport and logistics operations restricts any single company from supplying the concrete needs of a developer and construction company. No system of standards or ratings addresses the diversity of sustainability issues involved in the concrete supply chain. Solutions to systemic messy problems require collaboration to build shared understanding of the problems and potential solutions. For example, the construction companies jointly identified that industry inertia resulted from a lack of incentives to obtain information and increase the use of the more sustainable concrete products that were available.
One of the food companies first had to understand its own interest and potential risks before approaching large retailer clients about a collaborative project. The need to establish mutual benefit and revise it during the project became apparent. For example, the mutual benefit amongst the construction participants was less tangible, more distributed and had longer lead times than it did for the food companies. As a result, it wasn’t championed internally by senior management and the enthusiasm for the process was not as strong.

The benefits need to be clear to senior management for participants to have the direction and support to actively engage with sustainability. The participants also need to see the benefits in the critical systems and action learning approach. That is, recognise that a linear decision-making process that assumes control over messy problems is likely to fail and can produce unintended consequences. Understanding this helps to increase the participants’ enthusiasm for collaboration and willingness to attend meetings, be open to new ideas, think critically, implement the change actions identified and become champions within their corporations and with suppliers.

Systemic practice engages a range of stakeholders because multiple perspectives offer richer insights, yet increased diversity brings with it more agendas and different interests. Judgment should be exercised regarding the extent of collaboration, and caution not to assume that the mutual benefit for an individual or one group of stakeholders applies to a larger group. A reason underlying the need for change in one project generated some controversy among supply chain members whose business agenda didn’t align with that reason and who rejected its validity. This highlights the importance, in creating the conditions for collaboration (see Learning to Think Systemically), of identifying sources of influence, power and levels of support. Participants share perceptions of risk, sensitivities and politics before they surface unexpectedly.

The program highlighted the importance for establishing mutual benefit or ‘what’s in it for me?’.

Where mutual benefit was not clearly established the process and the relationships needed to drive the change tended to flounder.

**CHAPTER SUMMARY**

The diversity and complexity of stakeholders and issues provided the research and project teams with challenging dilemmas about how to best influence the systems, and how to capture the outcomes. Supply chains are complex, conflict-prone systems and embedding sustainability principles within these operations is providing new challenges to people, and corporate structures and mindset. In the previous chapter we discussed two supply chain projects, one with a focus on technological research and the other on multi-stakeholder dialogue. Both were attempting to work with messy, ill-structured problems and explore solutions that require systemic changes.
Chapters 1 and 2 introduced the Sustainability in Supply Chains program concepts and the background to this research. The approach was outlined in Chapter 3. Chapter 4 discussed the case studies, providing practical examples of how the systems approach was used and Chapter 5 discussed the factors that emerged from these transformation activities. This chapter discusses some further findings and insights from the Sustainability in Supply Chains program and projects.

TRANSDITIONING TO A SUSTAINABLE FUTURE

The overriding objective for the program was to achieve general sustainability gains in supply chain companies and operations via learning-based change. The philosophy of the process behind the Sustainability in Supply Chains program was that change and learning occur most effectively when participants are actively engaged in the change process of transitioning to a more sustainable future. The complexity of sustainability challenges necessitates a learning-based approach. Further, when participants experience the full range of issues and develop their own strategies for influencing the change process they take greater ownership of the issue. Learning is fundamental to the adaptive management skills to cope with the dynamic nature of sustainability.

Because the problems of sustainability in supply chains are too remote, too big and too complicated and therefore difficult to define, each individual has a different perception of the problem based on their reality. Critical systems analysis was proposed as the methodology to account for this diversity, while also facilitating change with people and with the entire supply chain system. The aim was to develop a sustainability-focused project team that:

- acknowledges uncertainty and the multiple issues encompassed in sustainability thinking
- is flexible enough to respond to the broader demands of the sustainability agenda
- developed their capacity to think and act sustainably and accept the diversity of responses required.

Ultimately some level of agreement was reached about the actions required to influence the supply chain to create a desired future state. The enquiry developed a broad appreciation of the various factors that influence the participants’ ability to effectively
engage in processes of change for sustainability. The critical systems approach enabled a more detailed understanding of individual roles, perceptions of risk and uncertainty, and power and control among the participants and their supply chain members.

THE VALUE OF SYSTEMIC COLLABORATION

Observations suggest that ongoing benefits from a collaborative supply chain approach to solving messy problems are:

- Joint initiatives improve knowledge about problems and overall operations by developing knowledge about processes and imperatives at all points in the supply chain. This will reduce the exposure to increased costs through the reduction in the use of energy and other resources such as packaging, water and waste.
- Building understanding of the sustainability criteria positioned collaborating corporations for ETS and engaged them in a process of thinking about how to reduce their exposure to ETS and manage other emerging issues, e.g. embodied energy, energy efficiency, carbon labelling and food miles.

- Collaborative work has the potential to improve all parties’ sustainability credibility through the development of systems that demonstrate the sustainable credentials of products. New products and processes often emerge from conversations and analysis of broader supply chain issues.

BUILDING A CULTURE OF CHANGE TOWARDS SUSTAINABILITY

To achieve effective learning and cultural change towards sustainability in organisations and their supply chains, it is critical to:

- ascertain the participants’ level of understanding of sustainability issues and challenge assumptions
- align the sustainability initiatives with the business model
- establish an ongoing multi-disciplinary team for driving sustainability initiatives.

Building partnerships and constructive working teams takes time. To avoid loss of momentum due to the challenges of implementing transformational projects it is important to realistically appraise the pressures of the operational environments, and time required to make change happen and for learning to occur.

Where change is occurring in conditions of certainty – that is, history, trends and facts provide more confidence in outcomes – trust in buyer/seller relationships is less important. Where change and decisions are occurring in situations of high risk and uncertainty, trust and establishing mutual benefit between supply chain stakeholders is more important. In these circumstances advice is often sought from trusted advisors. However, these advisors are often not equipped to deal with the complexity of sustainability problems and solutions. Leaders need to draw on inter-disciplinary, multi-stakeholder sources of information and develop skills for strategic decision making within emergent, uncertain environments such as supply chains. For example, some participants had a very low awareness of sustainability – no knowledge of fundamental issues, corporate social responsibility, sustainability reporting frameworks and so forth. Others took sustainability as an extension of environmental regulation and regard it as a GHG measurement process, yet others understand the broader context but seek advice on how to think systemically, to influence the culture and the decision making processes in their organisations.
There were indications that a sense of ‘powerlessness’ exists within some people, that this type of thinking is too complex, exceeds their role, and the system doesn’t facilitate this type of dialogue. The limited project time frame was also a contributing factor. Building shared understanding and knowledge about how to engage sustainably with supply chain participants, who do not normally communicate, takes time and external facilitation. Collaborative, transitional projects need to be sensitive to:

- the complex networks of information sources used by corporations and industry associations
- the diversity of stakeholders in each industry sector, the ‘green’ fringe, the ‘industry leaders’, the ‘laggards’, the lobby groups and the minority gender and ethnic groups
- the diversity of relationships and potential tiers of resistance to change
- the value systems – such as individualism, management control, and IP ownership
- future positioning and opportunities for embedding sustainability in corporate supply chains.

The projects established network interactions and common goals that have the potential to influence long-term learning and outcomes in the participant corporations. The Sustainability in Supply Chains program indicates that when participants have unambiguous information about agreed, practical industry solutions, and they can see the ‘win-win’ from collaborating with a supply chain partner, they are likely to positively embrace changes to work practices, providing that:

- conflict of interests can be negotiated
- sense of control is not threatened (i.e. it does not place their systems at risk)
- it does not involve major expense and time
- people are supported through the process
- the corporation and government provide leadership, support and consistent messages to support the vision.

**SUMMARY**

The Sustainability in Supply Chains program findings have been presented at several forums. For example, the supply chain diagrams were used as a reference point by presenters at a Concrete Research Forum and the focus group summary was provided as background reading and the outcomes were used as guidelines.

The findings of this ARIES program correlate with those of an action research project for collaborative improvement in European supply networks (Middel et al 2005 p. 377). Those researchers found that there was a need for organisations ‘to understand each other’s positions and to create a shared sense of direction’; create a learning environment to communicate information; generate trust and commitment; use tools and frequent workshops; and have a facilitated learning process. These authors drew a similar conclusion: ‘Action learning has provided a useful methodology for the development of a capacity for learning as part of the collaborative improvement process’. (p 378).

The supply chain program has wider implications because it deals with messy problems and solutions that aim to change practices through systemic learning using a collaborative approach. While the study was very short, one year, it enabled the opportunity for several companies to influence their supply chains and to explore the challenges of building collaborative partnerships.
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## Glossary and Acronyms

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<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>ARIES</td>
<td>Australian Research Institute in Education for Sustainability.</td>
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| Action research | Action research aims to involve practitioners as co-researchers of their own practice, to improve a situation of concern and to innovate practice. It views change as the desired outcome, and can empower individuals and build capacity to bring about ongoing systemic change. In this way, action research can generate transformation for sustainability.  
A collaborative approach that bridges action and research, action research is often represented as a four-phase cyclical process: plan formation, action, outcome observation and reflection. Through critical enquiry and the cyclical process of evaluating and validating the research findings, action research builds rigor into the process of developing grounded theories for improving practice. |
| Action learning | Action learning is a process designed to build the capacity of an individual using critical reflection and assessment. The outcome is improved practice by learning from reflection on action and sharing experiences with others.  
Action learning is a collaborative process where participants develop an action plan, implement the plan, and critically reflect on their actions, and learn through sharing experiences. A facilitator or mentor assists the participants through the action learning process. Action learning is often used in bringing a group of people together to critically reflect on and improve professional knowledge and practice. |
| AMT | Automatic manual transmission. |
| CIA | Concrete Institute of Australia. |
| CNG | Compressed natural gas. |
| CSA | Critical systems analysis. |
| Critical reflection | Critical reflection is an ongoing process of questioning assumptions and considering one’s own experience of applying knowledge in practice. It can reveal cultural expectations, social norms and political structures. This deeper understanding can identify opportunities for change and improved practice. |
| Critical systems thinking | Critical systems thinking requires people to think critically about their assumptions and interests. It asks individuals to consider the impacts of the solution(s) on the external and internal environment, and vice versa. |
| DC | Distribution centre. |
| DPD | Diesel particulate diffuser. |
Education for sustainability (EfS) seeks to develop the knowledge, skills, values and attitudes necessary to adapt and make changes that are more sustainable. Education for sustainability examines both the content and context of the learning, and the learning process itself to build individual and organisational capability for sustainability, which is a dynamic concept.

Some core tenets of education for sustainability are:
- imagining a better future: envisioning or futures thinking
- systemic thinking
- critically reflective thinking
- participation in decision-making
- partnerships for change.

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<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>EGR</td>
<td>Exhaust gas recirculation.</td>
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<td>ETS</td>
<td>Emissions trading scheme.</td>
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<td>GF</td>
<td>Goodman Fielder.</td>
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<tr>
<td>GHG</td>
<td>Greenhouse gases.</td>
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<tr>
<td>GMO</td>
<td>Genetically modified organism.</td>
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<td>GRI</td>
<td>Global reporting initiative.</td>
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<td>IP</td>
<td>Intellectual property.</td>
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<tr>
<td>KPI</td>
<td>Key performance indicator.</td>
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<tr>
<td>LCA</td>
<td>Life cycle analysis.</td>
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<tr>
<td>LPG</td>
<td>Liquified petroleum gas.</td>
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<tr>
<td>SCM</td>
<td>Supplementary cementitious material.</td>
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<tr>
<td>SCR</td>
<td>Select catalytic reduction.</td>
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<tr>
<td>Supply chain</td>
<td>A ‘network of facilities and distribution channels that encompasses the procurement of materials, production and assembly, and delivery of product or service to the customer’ (OECD 2001, p 2).</td>
</tr>
<tr>
<td>Supply chain management</td>
<td>The process of planning, implementing and controlling the operations of the supply chain.</td>
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<tr>
<td>SME</td>
<td>Small and medium sized enterprises.</td>
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<tr>
<td>Value chain</td>
<td>The value adding activities that an organisation provides to support the efficient operation of the supply chain and deliver maximum value as perceived by the customer. These can include infrastructure management, human resources, research and development, sales and marketing.</td>
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