The Life Cycle Management (LCM) pilot project evaluation
LCM pilot project evaluation report

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1 Executive summary

The Life Cycle Management (LCM) programme was a collaborative programme between Landcare Research, the Ministry of Economic Development, the Ministry for the Environment, Business New Zealand, and New Zealand Trade and Enterprise (NZTE). The programme was designed to build capability among New Zealand manufacturing companies for product-oriented environmental management through LCM.

This report evaluates the effectiveness of the design and delivery of a LCM pilot project led by Landcare Research from 2008 to 2010. It reviews the experiences of five firms participating in the LCM pilot project in regard to different aspects of the project. The report also identifies areas for improvements in delivery of services for building LCM capacity in the sector. Alternative delivery methods were also considered with the aim of accelerating LCM adoption across the manufacturing sector.

The six companies that participated in the LCM pilot project included Fletcher Building Roof Tile Group (known as AHI Roofing or simply AHI), Comvita, David Trubridge Design (David Trubridge), Mastip Technology (Mastip), Nufarm, and Verda New Zealand (Verda). The firms were chosen by the project partners to represent typical examples of businesses within the manufacturing sector that wished to address product-related environmental issues.

The main audience for whom this document is written is the LCM Programme Project Management Group and Project Governance Group formed from representatives of the partner organisations. The evaluation has taken into account findings within the international literature review completed as part of the programme (Mortimer 2011) and should be read in conjunction with the findings on the enablers and barriers experienced by the firms in the LCM pilot project (Hume & Mortimer 2011).

1.1 Life cycle management

LCM aims to minimise the environmental impacts associated with products throughout their entire life cycle and across the supply chain. LCM enables firms to deal with different environmental issues, e.g., carbon emissions, energy, and waste that might be relevant to their products in coordinated process. The approach involves the strategic and operational consideration of the options to reduce product environmental impacts through every day business practice, related company policy decision-making, and within relationships both up and down the supply chain.

1 Mastip withdrew from active participation in the LCM pilot project and did not contribute to the evaluation process.
1.2 LCM pilot project activities

The main activities of the LCM pilot project included:

- Appointment of a LCM Champion in each company to act as a focal point for activity
- 10 single-day training workshops, attended by the LCM Champion, covering different aspects of LCM, including developing a LCM strategy, Life Cycle Assessment (LCA), green marketing, supply chain management and carbon footprinting, etc.
- A Life Cycle Study (LCS) for each company to quantify the environmental impacts of a firm product, completed by Landcare Research in collaboration with the companies
- Free entrance of the firms into the Enviro-Mark programme for a year
- Supporting postgraduate training of up to six students in LCA techniques
- A research project to identify barriers and enablers to LCM adoption in New Zealand and provide a better design for the LCM use in the future.

1.3 Evaluation method

The pilot project components were evaluated in two phases. Each phase consisted of a facilitated workshop: the first phase workshop was held with the LCM champions (the staff member who led adoption of LCM activity in each participating firms), drawing on their feedback. The second phase consisted of a workshop held with the team of LCM researchers.

1.4 General quality of pilot project design and delivery

The evaluation established that nearly all components of the LCM pilot project were valuable to the firms, with a number of firms highlighting the value of the Life Cycle Study (LCS), the ongoing support provided by Landcare Research staff, and the collegial contact gained from the workshops. The extent to which the LCM Champions perceived that the separate components of the programme needed improvement varied between firms and even between individuals within the same firm. This appears to reflect the differing experience levels between participants, with some champions needing either more basic or more advanced training in certain areas than other champions. This suggests that an LCM capacity-building activity needs to be designed to cater for different levels of expertise.

1.5 Recommendations

- Improve the recruitment process for candidate firms: The recruitment process must identify those firms most likely to adopt LCM and those that are more able to adopt LCM related improvement in performance. Examples of firms/sectors most likely to adopt life cycle thinking due to external pressures might be sectors/firms that have current and potential environmentally sensitive markets, e.g., Europe. Alternatively, firms that produce goods for the final market and therefore receive early pressure from customers and stakeholders will be more open to LCM adoption. Examples of firms more able to adopt LCM include those with simple products with relatively few
components (e.g., paper in contrast to electronic products) or firms that are developing new types of products with greater scope for innovation.

- **Develop a flexible delivery framework for firms:** The findings of this study suggest that large companies and SMEs face different challenges in LCM adoption and these differences need to be addressed in programme development and LCM information provision. However, tailoring the design of training and the support mechanisms for firms obviously has to be tempered by resourcing and cost constraints. Company LCM projects tailored to the individual context of each firm should increase effectiveness of adoption. Therefore, LCM training should be designed as a flexible framework that can be tailored to the individual firm.

- **Design-in a comprehensive set-up strategic process:** Internal LCM company projects need to have a robust set-up strategic process that involves the direct participation of senior management to identify a clear business case for LCM adoption, build commitment, prioritise LCM activities, and allocate appropriate resources. To improve the current project the set-up activities should include the following steps: recruitment, pre-assessment, identification of necessary resources, a strategic workshop with senior management, and an implementation meeting with senior management. These steps would be designed to ensure the business case is at the heart of LCM adoption to increase the likelihood of success.

- **Incorporate change management:** LCM adoption is influenced by a firm’s ability to undertake organisational change management effectively. Often staff members leading LCM or environmental initiatives were not equipped with change management skills. This issue was addressed in the current design, but subsequent LCM projects should emphasise the importance of the change management process to senior management early on, encourage firms to put staff with change management skills in their company LCM project team, and integrate change management training throughout the adoption activities.

- **Subcontract LCS:** Some participating firms did not have the staff capacity to collect data for their LCS, which slowed their progress and required Landcare Research to provide additional support over and above the requirements of the project. To address this, firms could be provided with options to subcontract the LCS process out to a consultant.

- **Improve workshop quality:** Feedback from the firms highlighted areas that were success factors for the LCM workshops. These factors included opportunities for group learning and networking, tangible steps champions can take to implement workshop learning, and relevant case studies. Attendance of additional staff from the firms at workshops relevant to their area of responsibility is also suggested to build broader knowledge base for LCM adoption within each firm. For example, marketing staff should be encouraged to attend the LCM green marketing training workshop.

- **Improve workshop quality:** If firms are joining an LCM process at irregular intervals, alternative delivery approaches for workshops may be required, e.g., webinars. However, workshops were a time when LCM Champions could discuss issues with their peers from other firms and gain one-to-one support from LCM experts. If workshops were delivered through webinars, firms would need alternative means of support from LCM experts, and professional networking forums might need to be put in place.
2 Introduction

The Life Cycle Management (LCM) programme was a collaborative programme between Landcare Research, the Ministry of Economic Development, the Ministry for the Environment, Business New Zealand, and New Zealand Trade and Enterprise. Initially envisaged as a five-year programme (2008–2013), it sought to build capability among New Zealand manufacturing companies for product-oriented environmental management.

This report is centred on the findings from a LCM pilot project conducted as part of the LCM programme. The pilot project ran for two years between late 2008 and the end of 2010 and involved case studies from Fletcher Building Roof Tile Group (known as AHI Roofing (AHI) when participating in the LCM pilot project), Comvita NZ Ltd, David Trubridge Design (David Trubridge), Mastip Technology (Mastip)\(^2\), Nufarm, and Verda New Zealand (Verda).

Results from this evaluation of the pilot project are intended to spread key learnings about the design and delivery of LCM to other firms within New Zealand. The content of the report draws on international literature review findings (Mortimer 2011) on designing effective environmental programmes and should be read in conjunction with the findings of the LCM enabler and barriers report (Hume & Mortimer 2011).

3 Glossary of project terms

In this report several different terms are used that relate to different elements of the work completed. The list below is provided to avoid confusion when discussing these different work streams.

- **LCM programme**, i.e. the collaborative programme between Landcare Research, the Ministry of Economic Development, the Ministry for the Environment, Business New Zealand, and New Zealand Trade and Enterprise.
- **LCM Pilot project**, i.e. the 10 training workshops, company membership of Enviro-Mark scheme, student projects and research project delivered by Landcare Research and overseen by the project partners listed above. The pilot project was completed between late 2008 and the end of 2010.
- **Company LCM project**, i.e. the internal company project developed by the LCM Champions in conjunction with senior managers to facilitate LCM adoption in the six firms that joined the LCM pilot project.
- **LCM adoption**, i.e. the process of applying LCM in a firm, from setting up a LCM company project, establishing the business case for LCM adoption, integrating into day-to-day decision-making, implementing related activities, to developing approaches to facilitate continuous improvement.

\(^2\) Mastip withdrew from active participation in the LCM pilot project in March 2010 but did participate in the enablers and barriers research in the latter part of 2010.
LCM Amplification, i.e. the process of increasing capability for LCM support and adoption in the manufacturing sector. Amplification also includes the promotion of the business case to the wider New Zealand manufacturing sector.

4 Evaluation objective

The goal of the LCM programme was to understand how manufacturing firms could address product environmental issues using LCM. The primary objective of the evaluation is to identify how effective the LCM pilot project is in terms of its design and delivery and how it might be improved to enhance LCM adoption. For the purposes of this research LCM adoption is defined as the process of integrating LCM into decision-making and implementing initiatives.

A further objective is to gather feedback from the participating companies on whether it is possible to design projects in a way that would amplify LCM across the manufacturing sector. The evaluation supplements the research on enablers and barriers to firm adoption of LCM in Hume and Mortimer (2011).

5 Evaluation method

The pilot project was evaluated in two phases. In phase one the LCM Champions evaluated the design and delivery of the pilot project in an initial workshop; the key findings are outlined in section 4. In the second phase the research team (including sub-contractors) considered the champions’ feedback and then identified methods for improving the effectiveness and cost efficiency of any subsequent LCM projects in a second workshop. The findings from the second workshop were assessed alongside the literature review findings; research on the broader enablers and barriers to firm adoption and recommendations for improvements are outlined in section 5.

The first workshop was attended by the LCM Champions from Nufarm, Comvita, David Trubridge, and AHI, while the Verda champion was interviewed separately over the phone. Participants from the firms were each given a set of cards representing different components of the LCM programme (see Table 1 for list). To indicate how important and how well designed and delivered they found each component they were asked to score the components individually against a matrix (see Figure 1). All participants chose not to evaluate any components they had not personally experienced. Participants were given blank cards to add any additional comments. Findings are mapped in Table 1.
Having first been individually evaluated by each LCM Champion, the group collectively discussed each programme component with an emphasis on how components might be improved or, in a few cases, how they might be designed differently. Special attention was paid to components that had been rated as having high importance but delivery needed improvement. At the workshop the champions also discussed how LCM could be amplified across the manufacturing sector and what initiatives might support LCM uptake.

6 Evaluation findings

This section provides an overview of the LCM programme and the original rationale for the programme design. It then explores the five firms’ perception of the quality and importance of different programme components. The recommended improvements are summarized in section 5.

6.1 The LCM pilot project design

The United Nations Environment Programme / Society of Environmental Toxicology and Chemistry (UNEP/SETAC) Life Cycle Initiative define LCM as the systematic application of life cycle thinking in business practice with the aim of providing more sustainable goods and services. It involves the development and implementation of a product-oriented management system; this seeks to improve the sustainability of an organisation’s product portfolio(s) across the entire life cycle and supply chain (UNEP and SETAC 2007). The process of expanding consideration of product impacts from cradle (conception) to grave (disposal and beyond) within LCM is commonly termed life-cycle thinking. LCM is not a single tool or method but rather a product management system that includes a basket of tools such as a life cycle assessment or supply chain management that can be applied to reduce the environmental impacts of a product (McLaren & McLaren 2009).
The LCM pilot project was designed to develop capability by facilitating the adoption LCM through training and providing data on product environmental issues. Each firm was expected to manage their own activity within their project rather than relying directly on the research team as a consultancy service. The pilot project developed an LCM strategy for each of the case study firms and facilitated the development of a plan of action for each of the firms. The LCM strategy aimed to ensure that internal capacity to undertake ongoing LCM adoption was created in firms at the earliest possible opportunity.

The LCM pilot project started with the identification of those firms who might be most interested in participating in the first two years of the programme. Identification was undertaken by Landcare Research, NZTE, and Business NZ. The criteria for the assessment of potential recruits to the LCM pilot project were developed by the Project Management Group. The assessment criteria are provided in Appendix 1.

Several meetings were held with the senior management (often including the CEO) of firms who had committed to the LCM pilot project focusing on the strategic alignment of the firms to LCM, resources available for LCM development, previous experience in tackling environmental issues, and the need of the company to address LCM. These meetings were the main mechanism for assessment of the suitability of the case study firms fit to the LCM pilot project. In these recruitment meetings, firms were assessed using the criteria outlined in Appendix 1. Each firm was asked to nominate an LCM Champion who would lead the LCM training and project management in their firm. The champions received a training folder introducing LCM and outlining each stage of the pilot project, including the timing of the training workshops. The training folder was also designed for champions to use to store additional notes and information related to the training workshops.

Each firm was additionally supplied by Landcare Research with an LCM dossier, a single document recording the rationale for involvement in the LCM pilot project, the expectations of the firms for the pilot project, the company’s LCM strategy, some of the results of the research completed with each firm, and plans for further action. When used correctly the dossier would provide a single source for describing the outcomes of LCM adoption and in many cases provided useful resource for updating senior managers on the progress.

The champions were required to develop their firms’ LCM strategy, which included the long-term objectives of LCM adoption, and the implementation plan for their selected LCM project. They developed this strategy as a stepped process through attending the workshops series. The firms’ LCM strategies are provided in Appendix 2. Champions were given pre- and post-workshop homework to do for each workshop. As LCM is intended to cover all functions of a firm form strategy, design, supply chain management, and marketing, the workshops covered all these elements.

Two workshops were designed to up-skill the champions, either directly or indirectly, on undertaking an LCS of one of their products. The first workshop on life cycle assessment built the champions’ knowledge for interpreting the results of a life cycle study. The second workshop on environmental management systems discussed methods in which any data collected in development of an environmental management system could be utilised by firms for their individual LCS. This was important, given that having systems in place to collect and assess data is a critical foundation to undertaking LCS.
Landcare Research staff then worked with the champions to support their data collection and, having obtained it, Landcare staff undertook the LCS of the selected product for the firms. The results of the studies were both presented orally and provided as a report to all firms.

Landcare Research staff met with the senior management team of each firm twice in order to discuss the firm’s LCM strategy and progress. Throughout the pilot project Landcare Research staff were also available to the champions for advice on an ongoing basis.

6.2 Relative importance of different programme components

Analysis of the firms’ evaluations indicated that nearly all components of the LCM pilot project were considered of high importance. The LCS was identified by several firms as being the most critical aspect in the pilot project for implementing LCM. It should be noted that firms were not required to pay for the full cost of the LCM pilot project and therefore were largely evaluating benefits achieved by their investment in staff time.

At least two firms considered the Enviro-Mark programme and Workshop 9: Maintaining the Momentum to be of low importance. Given that Enviro-Mark was important to some firms and not relevant to others, its strategic relevance to a firm should be determined at the start of an LCM programme and not incorporated as an element of an LCM programme unless it is needed. Workshop 9 explored organisational change and how to keep the momentum of LCM adoption going after the programme ends. The LCM Champions felt the workshop could have been combined with the final evaluation workshop, as they did not believe it warranted a whole day (the value of change management training is further discussed 4.5).

6.3 Relative quality of design & delivery of different components

Opinions on the quality of the design and delivery of each LCM pilot project component varied across firms and even within the same firm. For example, one firm had two representatives participating in the evaluation, and these two participants rated seven components differently and only two the same. This suggests that in some cases the design of a component may work better for some firms/people than for others; the challenge is often not to improve the design per se, but rather to ensure adaptability to different levels of expertise or need. For example, in discussion on the End-of-Life and Waste Management workshop, one champion who had waste management experience found the workshop pitched at too basic a level, while others rated the design and delivery of the workshop highly. Another champion supported this insight by commenting that different firms might obtain different levels of value from the different components of the programme, depending on how experienced the organization was in LCM-inspired manufacturing.

Those components identified by at least two firms as needing improvement in design/delivery were:

- Creation of firm’s Lifecycle strategy
- Workshop 1: Life Cycle Management
- Workshop 3: Life Cycle Assessment
- Workshop 4: Design for Environment
• Workshop 6: Supply Chain Management
• Workshop 7: End-of-Life and Waste Management
• Workshop 8: Carbon Footprint
• Workshop 9: Maintaining the Momentum

Only one component, Workshop 9: Maintaining the Momentum, was scored by more than two firms as needing improvement. Workshop 10: Final Evaluation was excluded from the evaluation process.

**Table 1** Rankings for each LCM component

<table>
<thead>
<tr>
<th>Component</th>
<th>Low importance Delivery needs improvement</th>
<th>Low importance Good delivery</th>
<th>High importance Delivery needs improvement</th>
<th>High importance Good delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCM Training folder</td>
<td>C1</td>
<td>A</td>
<td>D, N, V</td>
<td></td>
</tr>
<tr>
<td>Creation of firm’s Lifecycle strategy</td>
<td>A, C1</td>
<td>D, C2, N, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 1: Life Cycle Management</td>
<td>A, D</td>
<td>N, C1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 2: Environmental Mgmt Systems</td>
<td></td>
<td>N, D, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 3: Life Cycle Assessment</td>
<td>C1, D</td>
<td>N, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 4: Design for Environment</td>
<td>D, C2</td>
<td>N, C1, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 5: Marketing</td>
<td>N</td>
<td>D</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Workshop 6: Supply Chain Management</td>
<td>D, N</td>
<td>C1, C2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 7: End-of-Life and Waste Mgmt</td>
<td>C2, D</td>
<td>N, C1, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 8: Carbon Footprint</td>
<td>N, A</td>
<td>D, C2, C1, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop 9: Maintaining the Momentum</td>
<td>N, A</td>
<td>C2</td>
<td>C1, D, V</td>
<td></td>
</tr>
<tr>
<td>Life cycle study: Landcare support in collecting data</td>
<td></td>
<td>C1</td>
<td>A, D, V</td>
<td></td>
</tr>
<tr>
<td>Life cycle study: Oral presentation of results</td>
<td></td>
<td>C2</td>
<td>A, D</td>
<td></td>
</tr>
<tr>
<td>Life cycle study: Technical report</td>
<td></td>
<td>C2</td>
<td>A, D</td>
<td></td>
</tr>
<tr>
<td>Enviro-mark: Free membership and advice</td>
<td>A</td>
<td>C2</td>
<td>D, C1, V</td>
<td></td>
</tr>
<tr>
<td>LCM firm dossier</td>
<td>A</td>
<td>C1</td>
<td>D, C2, V</td>
<td></td>
</tr>
<tr>
<td>2 Senior Management meetings</td>
<td>C1</td>
<td>N, D, A, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ongoing access to Landcare staff</td>
<td>C1</td>
<td>N, A, D, V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared learning process</td>
<td>C1</td>
<td>N, C2, D, A, V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4 The initial company LCM project set-up process

Firms with a clear idea of the reasons for their participation in the LCM pilot project and good levels of senior management involvement (often including a level of CEO involvement) and/or support, found it easier to focus their company LCM project. These factors also maintained momentum during adoption. This reflects the literature review’s key findings (Mortimer 2011) that it is important to ‘tailor a programme to a firm’s needs, context and goals and start to create senior management commitment at the beginning of an environmental change management programme’. While the LCM pilot project was designed to facilitate this, greater focus on the strategic front end of the recruitment process would help provide a critical foundation for the firms.

Recommendations for improving the set-up process to address issues about strategic alignment and management commitment are outlined in section 4 below. However, the set-up process should be flexible enough to meet the needs and constraints of the individual firm. For example, where a firm has an existing high level of interest in environmental performance, it may be feasible to undertake a comprehensive strategic management workshop; however, where there is low senior management interest in improving environmental performance, this may be more difficult, and initially a small LCM pilot project may need to be undertaken to demonstrate benefits to the firm’s management team. As an example, Stone (2006) provides a two-system approach of initiating an environmental programme within an organisation based on the level of current senior management commitment in Figure 2.

![Figure 2 Options for a process for an Environmental programme based on levels of senior management commitment (source: Stone 2006).](image)

Identifying and committing to realistic resourcing requirements before initiating the programme are also critical if the champions or project team are able to deliver the
programme. Most LCM Champions felt they did not have enough dedicated time to undertake the champion role. Some champions felt that while the time Landcare Research estimated to cover the formal aspects of the programme (e.g., attending workshops, etc.) was accurate, they and their firms underestimated the work involved in implementing LCM across their organizations. Two key additional resource requirements were highlighted:

- LCM requires a great deal of data infrastructure and if the firm lacked this infrastructure and lacked data collection processes, setting this up took considerable additional resources. This was particularly so for the firms who adopted the Enviro-Mark programme.

- The time needed for the implementation of change management processes in an organisation was underestimated by most champions, particularly as LCM is a holistic framework touching on all areas of an organisation. For example, Verda’s LCM Champion felt that the time estimates provided by LCR to undertake the formal parts of the LCM pilot project were realistic, but he had underestimated the additional time required to communicate and work with staff to start embedding LCM into firm processes.

The contract agreed between Landcare Research and the individual firms when they joined the LCM pilot project committed the champions to 45 days working on the company LCM project per annum. The contract also committed senior managers within the firm to two meetings over the course of the LCM pilot project. Landcare Research had also stressed at the outset that additional resource would be required by the firms to implement LCM beyond the resource needed to undertake formal components of the LCM pilot project, such as strategy development and workshop attendance. However, it was difficult for firms to judge what resourcing LCM adoption would entail as the requirements varied between firms. In future it would be useful for the five firms to calculate the staff resource they required and present these as case study examples to New Zealand firms entering the LCM pilot project.

6.5 Integrating change management support into programme

Change management is often an important element of LCM adoption (Mortimer 2011). However, the LCM Champions had mixed views about this topic. Workshop 9, which focused largely on change management and maintaining momentum, was seen as being ‘less important’ by three participants, while it was seen as being ‘important but needing improvement’ by three other participants. The literature review indicates that the ability to implement change management processes is critical for achieving significant environmental improvements, and two barriers to environmental programme adoption are ‘underestimating the scale and complexity of organisational change required to implement LCM’ and the ‘narrow skills set of the project team’, who often have technical skills but no organisational change management skills. This suggests training in change management is a critical component of LCM adoption, even if some participants did not recognise it as such.

To improve understanding of change management required to successful adopt LCM, one champion felt change senior management e.g. the board or CEO of a firm should tackle this aspect early in the training workshop series. Emphasis should also be given to change in the set-up of the firm’s company LCM project before formal workshops are completed. In this way issues related to organisational change could be planned into the firm’s plans for LCM
adoption at the start. Another champion did not support a separate organisational change workshop, as the workshops should be focused primarily on LCM. However, there was general agreement in the workshop that organisational change should be built more explicitly into different workshops, particularly through real case study examples. One champion recommended discussion on change management should take place in the two senior management meetings.

6.6 Senior management meetings

To facilitate LCM adoption meetings between a firm’s senior managers and the research team were essential for all firms. The first meeting was described as an important selling exercise to get management buy-in, and it was therefore critical that the champion was able to ensure the right people attended. For example, the country manager (Nufarm’s New Zealand Chief Executive equivalent) attended Nufarm’s senior management meetings and the LCM champion felt this signalled the importance of the programme to other managers, making it easier for him to enlist their support.

As outlined earlier, most champions felt it was important to have a strategic process upfront that determined the focus of the LCM programme and that involved senior management. This set-up process of strategic engagement could incorporate elements from the first senior management meeting.

Many champions found it difficult to ensure senior managers attended the second meeting, which, for most companies, took place approximately 9 months into the project. Ensuring senior management are actively kept involved is important for LCM adoption and suggested solutions made by the champions to increase their attendance were to keep that second meeting short (1 hour) with specific decisions to be made by the managers at it. However, an alternative approach to the LCM pilot project design would be to use the second meeting as a longer workshop to develop an implementation/action plan with management.

6.7 Creation of the firm’s LCM strategy

Each firm was required to develop a LCM strategy, with the development of that strategy discussed at the first senior management meeting. The first workshop of the LCM pilot project then focussed on strategy development and was attended by LCM Champions, but not by senior management from the different firms.

Champions found that the strategy was important to prioritise the firms’ limited resources and keep their LCM projects on track. Verda commented that the course provided ‘a well structured approach to developing and evolving Verda’s lifecycle strategy over the 18 month period’. Participants also commented that the ongoing support of the Landcare Research staff was critical in helping them develop their strategies and continue to prioritize effort, though it was evident through the firm’s feedback and the project team’s experience that some firms/champions require more one-to-one support than other firms/champions. Feedback also suggests that firms that were able to continue to involve senior management directly in the strategy development were better able to encourage LCM adoption.
To strengthen the engagement of senior management across each organisation, an alternative approach would be to run an in-firm strategy workshop with the senior management of each firm. The objective would be to identify the focus of the company LCM project and the responsibilities of each department of the firm in implementing the strategy.

6.8 Use of Life Cycle Studies (LCS)

A LCS was completed on a product from each of the participating firms and used to quantify product-related environmental impact and areas of the supply chain where reductions could be made. The LCS was a highlight for many firms, and champions valued Landcare Research’s staff support in scoping which study to do. Two firms, however, expressed concern over how they would translate the data into product design, indicating that some firms/individuals require more programme support than do others.

In the second phase of the evaluation at the research team workshop, the project team discussed the need to provide firms with two options to undertake an LCS. The LCM pilot project took a ‘firm up-skilling approach’, intended to develop the skills of the firm in undertaking its own data collection. Some firms, however, did not have the resources to do this or failed to commit the necessary cross-firm resources needed to support the LCM Champion to complete this task. This put pressure on the constrained resources of some of the LCM Champions, which meant other aspects of the company LCM project could not be completed. It also required Landcare Research to provide support to those firms over and above the requirements of the programme, which put pressure on project resources. While up-skilling has obvious benefits for building capability and ought to remain an option, some firms may find it is more cost effective and/or makes better use of their staff resources to choose an alternative second option to contract the LCS data collection, analysis, and interpretation out to an expert.

6.9 Enviro-Mark

The Enviro-Mark certification programme helps organisations develop and implement an environmental management system (EMS) in 5 manageable steps. The programme enables businesses to gain certification for each step after an independent audit. Membership of the Enviro-Mark was offered free of charge to participating firms for one year.

Enviro-Mark was included in the LCM pilot project to ensure each firm could address the environmental issues across the whole supply chain including important issues on their own sites. Enviro-Mark provides the training and process for tackling the firm’s on-site environmental impacts, e.g., waste and energy saving. Depending on the company, an EMS can also facilitate data collection, and use and store their environmental data (e.g., waste and energy data), which is important for LCM adoption.

In most cases, the firms did not have an EMS in place when they entered the LCM pilot project. Enviro-Mark was of particular value to David Trubridge, who achieved Bronze level and renewed their membership of Enviro-Mark beyond the free period. However, a number of companies did not necessarily find a strong business case for actively participating in
Enviro-Mark. AHI had been working towards an ISO14001 certified EMS scheme. AHI initially thought that achieving Enviro-Mark platinum would be a good preparation to test their readiness for the ISO14001 certification audit but eventually decided to go for a pre-qualification audit for ISO14001 rather than Enviro-Mark because of the standard’s greater recognition for their key stakeholders. In the case of Nufarm the company was looking for a system for on-site emissions that would resonate better with the chemical industry than Enviro-Mark.

6.10 The training folder and dossier

Each LCM Champion was provided with a training folder compiled by Landcare Research. The folder contained an overview of the programme, learning objectives, a schedule for potential implementation, and space to store notes or presentation materials from workshops; pre- and post-homework for the workshops was also collated in the training folder.

Alongside the training folder each LCM Champion was provided with a dossier for their company. Rather than being specific to the training activities the dossier contained details of the company’s motivation for joining the LCM pilot project and was used to collate the company’s LCM strategy development, research findings, and proposed actions generated throughout the company LCM project. Together with the LCS technical report, the training folder and the dossier are intended to provide a complete record of the company LCM project for each of the participating firms. Both the training folder and the dossier were considered useful reference tools, and the dossiers were useful communication tools for champions at the early stage of the programme.

However, for most companies the dossier was not always maintained despite the emphasis placed on this document at the training workshops. The majority of the LCM Champions did not often update actions and record their progress within the dossier; Verda, however, used it extensively and kept it updated as an internal communication tool. Comvita abandoned the dossier format and presented information about the LCM pilot project in the style of their own company documents because this was more effective for briefing senior managers. At the evaluation workshop there were no suggested improvements to either the training folder or the dossier from the LCM Champions. However, it is important to question whether the dossier was fit for purpose in all cases. Alternative methods to formal written reporting that demonstrate progress to senior managers and others within an organisation should be developed for future company LCM project support.

6.11 The ten training workshops

In most cases, champions from each firm collectively attended a workshop, delivered in one location, though the David Trubridge champion attended a number by video conference. However, Nufarm joined 6 months into the programme and in order to catch up, 5 workshops were delivered individually to Nufarm by video conference. This provided an alternative delivery model for comparison with the collective workshop approach.

Ten workshops were run in the following sequence:

1. Life Cycle Management
2. Environmental Management Systems

3. Life Cycle Assessment

4. Design for Environment

5. Marketing

6. Supply Chain Management

7. End-of-Life and Waste Management

8. Carbon Footprint

9. Maintaining the Momentum

10. LCM pilot project evaluation

While nearly all the workshops were rated as important by the champions, less value was placed on ‘Maintaining the Momentum’, which, as mentioned in 5.2, may in part reflect participants’ lack of recognition of the importance of change management in LCM adoption. The LCM Champions identified those aspects of the workshops they considered provided greatest value. These aspects were not consistently present in every workshop, so effort should be made to ensure they are incorporated in subsequent workshops. Important design aspects of the workshops to maintain or include are:

- The opportunity for group learning and networking
- Preparatory work participants are required to do to enable them to get more benefit from the workshops
- A few clear concepts the champions can sell back to the wider company
- Tangible steps champions can take to implement workshop learning back into their organizations
- Case studies relevant to participating firms that demonstrate how other firms have managed to implement LCM (including their failures). These would preferably be from within New Zealand; however, international case studies relevant to the type of firms in the workshop would also be of value.
- LCM Champions often found it hard to sell’ or explain ideas and techniques or concepts they had learned during in the workshops to other key staff in their organisations. This issue often prevented greater integration of LCM principles in everyday working practice and also limited progress because the champions struggled to involve others in the project. Attendance of additional staff from participating firms at workshops relevant to their area of responsibility could create more support within the firm for the LCM programme and help build a broader skills base for LCM adoption. For example, marketing staff should be encouraged to attend the LCM marketing workshops
- The costs and logistics of running a specific series of workshops linked to one programme, especially if firms are joining an LCM process at irregular intervals, may require alternative delivery approaches, e.g., webinars. However, it is important to
recognise that workshops were designed as a stepped process in order to help the champions develop their strategies, with LCR staff providing advice on each firm’s strategy development informally during the workshop series. Workshops were also a time when LCM Champions met with LCM experts and discussed issues with other LCM Champions. If there are fewer workshops or if they were delivered through, for example, webinars, some thinking needs to be done about how this technical and social network support will be delivered.

One of the challenges previously mentioned is to pitch the workshop at the right expertise level when participants have varying degrees of experience. An alternative workshop design would be to provide a general introduction to a concept in the morning and then run a more advanced workshop in the afternoon for more experienced participants.

Champions enjoyed working with people from diverse firms as they felt such contact/interaction could open up thinking and reduce issues of competition and confidentiality that are possible between firms in the same business. However, having a diverse range of firms increases the challenge of ensuring that case studies in workshops are relevant to all participants. Maintaining the LCM programme scope to manufacturing firms appeared to be a good balance, with enough diversity to prevent issues of competition and confidentiality, but enough commonality to help make the case studies and workshops relevant to most participants.

The second phase of the evaluation with the research team (Workshop 2) included looking at ways to reduce the resource requirements made on the LCM pilot project and participants through alternative delivery approaches. Most firms attended the workshops in person with other champions from other firms; however, Nufarm, and David Trubridge undertook at least one workshop individually via video conferencing, which allowed other managers to participate. Other methods that might help reduce the costs of delivering and attending workshops include delivering them through webinars, and running a regular series of regional seminars. It was also felt that the number of workshops could be reduced, with the first workshop replaced by the set-up strategic process within the firm, and some workshops, such as that on carbon footprinting, being optional. However, it is important to recognise that workshops were not just about content but were about providing support to companies in the implementation of their LCM strategies and company LCM projects. Workshops were a time when LCM Champions met with LCM experts and discussed issues with other LCM Champions. If there are fewer workshops or if, for example, they were to be delivered through webinars, some thought must be given to the delivery of technical and social support.

7 Recommendations for improving the effectiveness of the LCM project design and delivery

7.1 Targeted recruitment

To be able to focus on those firms most likely to achieve success in LCM adoption, identifying the right firms at the recruitment stage is important. Mortimer (2011) identified that firms most likely to need to adopt LCM or most able to adopt LCM would provide two criteria for recruiting firms to a LCM project. Literature indicates that firms/sectors most likely to need to adopt life cycle thinking due to external pressures might be:
• Sectors/firms that have current and potential environmentally sensitive markets, especially ones that may soon require certification that includes a requirement to undertake LCS

• Firms in highly polluting industries that are likely to face increasing pressure from public stakeholders and subsequently their customers

• Firms that produce goods for the final market and therefore receive early pressure from customers and stakeholders

• Firms that are part of the supply chain of large companies that are beginning to move towards Supply Chain Environmental Management. Many of these may be large international companies.

Literature indicates that firms/sectors that are more able to adopt LCM might be:

• Firms with a high level of vertical integration and few suppliers

• Firms with simple products with relatively few components (e.g., paper in contrast to electronic products)

• Firms that are young, or that are developing new types of products, as the scope for product innovation may be greater

• At the sector level, sectors that have strong industry associations that are used to working collectively to improve industry practice and have the soft and hard infrastructure to support this

• Firms that already had an environment management system in place would generally be better positioned to have better data management and processes as a foundation for LCM adoption.

In terms of a recruitment process, the LCM pilot project evaluation found that several conversations with the senior management of the firm were required to identify if the firm had both the need and ability to undertake a company LCM project.

7.2 Designing an LCM project as a flexible framework

As company LCM projects tailored to the individual context of each firm appear to increase effectiveness of adoption, LCM programmes should be designed as a flexible framework. While there may be benefits in designing LCM approaches for different business sectors, to increase rates of success tailoring an LCM project to each firm in that sector will still be required. The results of the research completed as part of the LCM pilot project suggest that large companies and SMEs face different challenges in LCM adoption, and these differences need to be carefully addressed in project development and in LCM information provision; for example, some smaller firms faced difficulties of adequately resourcing the company LCM project in terms of staff time, while some larger firms require formalised communication and integration processes in place to ensure the company LCM project can be embedded across their organisation.
7.3 Creating a strategic set-up process

At an early stage during the LCM pilot project strategic meetings were held with the firm’s senior managers to develop an LCM strategy for the firm. As strategic alignment in the set-up of a company LCM project is a key success factor in effective LCM adoption, it is essential that the project should concentrate efforts on ensuring the set-up stage is effectively delivered.

The LCM project set-up process should identify:

1. Why the firm might strategically benefit from an LCM project:
   - The specific drivers for adopting LCM (e.g., growing green market or threat of new regulation) and, directly related to these,
   - The specific outcomes the firm is seeking from a company LCM project, e.g., resource efficiencies, certification of product, or integrity of green brand.

2. The level of resourcing the firm will need to put in place to implement a company LCM programme, which involves assessing:
   - what data infrastructure it has and what relevant data it currently collects and stores
   - what resource requirements for the formal aspects of an LCM programme will be required (based on their identified outcomes)
   - staff capacity and capability: can the firm commit a full-time LCM champion or LCM project team; do they have staff with the right technical and change management skills.

3. How the company LCM project will be implemented across the firm:
   - How it will be communicated to the staff
   - What responsibilities different managers and their teams will need to take
   - How progress will be monitored and success measured.

While these questions are best addressed in the initial stage of a company LCM pilot, answering them is likely to be an iterative process. However, it is important that any process be designed to engage the whole of the senior management team early on in developing the LCM strategy, in order to build management commitment and define a focus for the company LCM project.

The research evaluation highlighted the following steps as initial stages for a company LCM project approach that can be adapted to each firm as required:

1. Recruitment stage. The programme proactively identifies and then assesses firms most likely to have the drivers and ability to undertake LCM. The programme works with NZTE and industry sector associations to do this.
2. **Pre-assessment stage.** Firms are contacted and an initial discussion is held with the CEO about the firm’s key drivers and the potential benefits of LCM. CEOs of firms who wish to explore LCM attend a one-day LCM introductory workshop. This requirement would be similar to that required in the NZTE Lean recruitment process. The workshop provides an introduction to LCM and supports each CEO in identifying alignment between their firm’s strategic direction and LCM benefits, and a potential LCM project for their firm.

3. **A resource requirement checklist** of what the firm needs to have in place (e.g., data infrastructure, staff time to implement the programme) is provided to the firm to carry out an initial assessment of resource requirements.

4. **Strategic workshop with firm’s senior management.** A half-day workshop is held for senior management including the CEO for a period of time (and nominated staff that will lead the company LCM project. The workshop objectives are to build the understanding and commitment of senior management to LCM adoption by defining the appropriate business case, refine the focus of their company LCM project, tailor the LCM training accordingly, and map key implementation steps.

5. **LCM adoption meeting with senior management.** The LCM Champion presents a company LCM adoption plan, and senior management agree on their respective responsibilities in implementing this plan across the organization. Opportunities for alignment between other formal change programmes being undertaken by the firm are identified (e.g., the NZTE supported the Lean programme to improve efficiency and reduce waste (Lean Enterprise Institute, 2011)).

6. **The firm then moves into the LCM adoption stage.** However, a set-up process needs to be flexible (as outlined in 1.2.2) and designed to fit the context of the individual firm. For example, where a firm already has a high level of interest in improving its environmental performance, it may be feasible to undertake a comprehensive strategic management workshop in the set-up of the process; however, where there is low awareness/support for environmental performance from the firm’s senior management, engaging them strategically early on may be difficult. In these situations, a small LCM pilot project could be undertaken first, in order to demonstrate an LCM business case which could then lead to a strategic firm wide adoption LCM programme (see Stone, 2006, Figure 2, p. 12).

**7.4 Incorporate change management training throughout the LCM training**

Mortimer (2011) and Hume and Mortimer (2011) identified that LCM adoption was influenced by a firm’s ability to undertake organisational change management effectively, and that staff leading an LCM or environmental programme were often not equipped with change management skills. Change management training was built into the end of the LCM pilot project but its importance was not recognised by all LCM Champions. Any subsequent support for company LCM projects should emphasise the importance of change management process to senior management early on, encourage firms to put staff with change management skills in their company LCM project team, and integrate change management training throughout the company LCM project activities.
7.4.1 Provide options for data collection in Life Cycle Studies

Some participating firms did not have staff capacity to collect data for their LCS, which slowed their progress. To address this, firms could be provided with two options to undertake a LCS: a ‘firm up-skilling approach’ whereby firms are trained to collect the data; and an option to contract the whole process out to an LCS consultant.

7.4.2 Increase the consistency of workshop quality

The following factors were identified as success factors for LCM workshops and should be consistently built into any subsequent workshop training:

- The opportunity for group learning and networking
- Preparatory and post-workshop homework that participants are required to do to enable them to get more benefit from the workshops
- Identification of a few clear concepts that the champions can sell back to the wider company
- Tangible steps champions can take to implement workshop learning back into their organizations
- Case studies (New Zealand and international) relevant to participating firms, which demonstrate how firms have managed to implement LCM (including their failures)
- Attendance of additional staff from participating firms at workshops relevant to their area of responsibility in order to build a broader firm knowledge base for LCM adoption. For example, marketing staff should be encouraged to attend the LCM marketing workshops.

If firms are joining an LCM process at irregular intervals, alternative delivery approaches for workshops may be required, e.g., webinars. However, workshops were a time when LCM Champions could discuss issues with their peers from other firms and gain one-to-one support from LCM experts. If workshops were delivered through webinars, firms would need alternative means of support from LCM experts and professional networking forums might need to be put in place.

8 Conclusions

The evaluation of the LCM pilot project has shown that the pilot project was successful in providing the five firms with comprehensive training and support for developing and implementing their company LCM projects. The two-year LCM pilot project provided essential information for further development of the LCM programme by the project partners. A number of areas for improvement have been identified during the evaluation. A priority area for improvement is laying greater emphasis on the strategic set-up of the company LCM project to identify firm alignment to LCM business case, building senior management’s active commitment, and tailoring the training to the firm’s context.

There are a number of barriers to firm adoption of LCM and many of these are outside the direct control of any organised LCM project design; for instance the firm’s ability to resource...
LCM adoption adequately or to influence their supply chain. It is therefore important that a thorough pre-selection assessment be undertaken to select those firms that have the strongest drivers and ability to implement LCM.

Undertaking a company LCM project takes considerable time, and many of the firms were only just beginning to utilise the results of their LCS after being on the programme for two years. A dedicated LCM Champion would help speed up the LCM adoption process but any company LCM project should be prepared to run over at least a two-year company LCM project. Most firms had not yet looked seriously at their supply chain management, and more evaluation of how best to support firms in addressing this area may need to be undertaken in any subsequent programme.

Finally, this report evaluated the effectiveness of the LCM pilot project, which was provided free of direct cost to the participating firms and financially subsidized by Landcare Research, MED and MfE. No future funding is currently envisaged so further assessment will need to be made of the ability and preparedness of New Zealand firms to pay for the full cost of undertaking a company LCM project. Alternative designs for the LCM pilot project may need to be developed in which, to reduce costs, a firm can choose to undertake only those components most critical for their context and goals.

9 References


10 Acknowledgements

Landcare Research is grateful to the project partners and the six case study companies for the opportunity to have been part of the LCM programme. It has been very rewarding to witness the level of engagement by both the partners and the case study companies, and the energy exhibited by the LCM Champions. The LCM Champions for each company are listed below:
Ray Shanley and Geoff Allan (AHI Roofing)

Karoline Jonneson and Elisabeth Andrews (Comvita)

Peter Tang (David Trubridge Design)

Brendan Redmond (Nufarm)

John Gifford (Verda)

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Thanks are also extended to all the others who worked in developing the research programme during that time (in no particular order): Timothy Allan (Locus Research), and Christine Harper (Landcare Research).

The gratitude of the authors must also be extended to members of the Project Management Group not already mentioned above: Martin Knoche (New Zealand Trade and Enterprise), Jacinta Syme (Business New Zealand), and Jane Tier (Ministry for the Environment).
Appendix 1 – Eligibility Criteria LCM Project Participant

Businesses that implement LCM often share common characteristics. An essential prerequisite is a positive attitude and desire to reduce environmental impacts and engage in new methods for increasing productivity and taking advantage of new market opportunities. We are looking for manufacturing companies that display the following attributes.

- A member of Business New Zealand and an NZTE sector client.
- Unlikely to go out of business in the next five years.
- A degree of complexity in its production processes.
- Facing regulatory and/or market access pressure in relation to environmental performance of their products or services (or incorporated materials). Facing challenges around sustainability.
- Has an onshore supply chain.
- Active in international markets with an export-driven growth strategy; the company exports to markets where environmental impacts are likely to be a competitive issue over the next few years.
- Controls its own operations.
- Corporate culture that is open to change that delivers environmental (as well as economic) benefits at design, operational, administrative, marketing, and strategic levels.
- Company has core attributes similar to many other companies, enabling findings from the project to be widely applied across the NZ economy.
- Each company will be asked to make the following commitments:
  - Appoint a staff member to be the LCM Champion within the company. The LCM Champion will commit at least 45 days per year to training and implementing LCM.
  - Cover costs of LCM Champion to attend network meetings
  - Commitment at Board level to supporting change that delivers environmental benefits.

The nominated LCM Champion will need to have the following attributes:

- Positive attitude and willingness to listen to others and learn from their experiences.
- Open to new ideas and ways of thinking about company operations and environmental issues.
- Preferably educated to at least degree level in a science or engineering discipline. An advanced understanding of environmental issues is not required.
## Appendix 2 – LCM Company Strategies

AHI Roofing’s LCM strategy

<table>
<thead>
<tr>
<th></th>
<th>Objectives</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Market Opportunities</strong></td>
<td>Research emerging environmental trends in export markets and opportunities for new products</td>
<td>Ongoing research of future opportunities through LCM programme, including identification of new markets</td>
</tr>
<tr>
<td><strong>Customer Awareness</strong></td>
<td>Staff environmental awareness</td>
<td>Promotion of environmental credentials associated with brand products</td>
</tr>
<tr>
<td><strong>Company Policy</strong></td>
<td>Staff awareness of environmental policies and LCM initiatives</td>
<td>Staff ownership of company-wide environmental values</td>
</tr>
<tr>
<td><strong>Legal Aspects</strong></td>
<td>Identify upcoming regulations in major export markets</td>
<td>Meet all legal requirements in export markets</td>
</tr>
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</table>
## Comvita’s LCM strategy

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Issues</strong></td>
</tr>
<tr>
<td><strong>1. SUPPLY CHAIN:</strong> Environmental impact of supply chain and distribution network, appropriateness of manufacturing locations in relation to markets.</td>
</tr>
<tr>
<td><strong>2. PRODUCTS:</strong> Environmental impact of products and packaging.</td>
</tr>
<tr>
<td><strong>3. RAW MATERIALS:</strong> Security of supply as well as traceability of raw materials.</td>
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<td></td>
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<td></td>
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<tr>
<td><strong>4. CLIMATE CHANGE:</strong> Environmental impact of organisation. Implications of carbon legislation.</td>
</tr>
</tbody>
</table>
5. COMMUNICATION: Integration and uptake of Comvita’s Natural Performance Model internally. External communication about the model.

Effective integration with all Natural Performance initiatives.

Templates and targets for reporting on Comvita’s sustainability work.

Annual sustainability reporting on key LCM and organisational issues.

Comvita is widely perceived as a leader in sustainable business.

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### David Trubridge’s LCM strategy

<table>
<thead>
<tr>
<th>Issue</th>
<th>Objectives</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design process</td>
<td>Investigate options for decision-support with respect to: Manufacturing</td>
<td>Decision-making around products and company processes is supported</td>
</tr>
<tr>
<td></td>
<td>process</td>
<td>by verifiable data.</td>
</tr>
<tr>
<td></td>
<td>Transport</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Material selection</td>
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<tr>
<td></td>
<td>Development of datasets, indicators and/or processes to support decision-</td>
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</tr>
<tr>
<td></td>
<td>making.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ongoing updating of datasets, indicators and/or processes to reflect the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>market conditions, material availability, manufacturing process, and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>changes in social awareness.</td>
<td></td>
</tr>
<tr>
<td>Certification(s)</td>
<td>Evaluate alternative certification systems</td>
<td>Products are certified as environmentally responsible by third-party</td>
</tr>
<tr>
<td></td>
<td>Acquire internationally recognised certification(s)</td>
<td>bodies</td>
</tr>
<tr>
<td>New products</td>
<td>Visioning of alternative dematerialised products</td>
<td>A range of products that do not require form, only ideas (dematerial-</td>
</tr>
<tr>
<td></td>
<td>Create new conceptual designs to fit environmental performance results, re</td>
<td>isation)</td>
</tr>
<tr>
<td></td>
<td>material, transport, market certification, recycling, etc. Adjust</td>
<td></td>
</tr>
<tr>
<td></td>
<td>existing designs to fit as much as possible.</td>
<td></td>
</tr>
</tbody>
</table>
## Mastip’s LCM strategy

<table>
<thead>
<tr>
<th>Issue</th>
<th>Objectives</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification</td>
<td>Agree on most relevant environmental certification scheme(s).</td>
<td>Maintain / audit and manage certifications and the associated collection of life cycle data. Ensure continuing access to markets through certification and management of life cycle environmental issues.</td>
</tr>
<tr>
<td>Product environmental impact</td>
<td>Understand the environmental impacts of Mastip’s products “from cradle to grave”. Improve product environmental performance on basis of life cycle data (e.g., by reducing energy use). Continuous improvement of environmental performance based on life cycle data. Mastip is viewed as an environmental leader in hot runner solution delivery.</td>
<td></td>
</tr>
<tr>
<td>Material sourcing: manufacture and supply</td>
<td>Instigate supplier agreements to guarantee security of supply.</td>
<td>Strong relationships with other companies to leverage purchasing power. Supply chain is managed through strong relationships and shared vision of LCM issues.</td>
</tr>
<tr>
<td>Future of plastics</td>
<td>Complete literature review of biodegradable plastics. Working with AU Plastics Centre of Excellence. Identify opportunities for Mastip within the biodegradable plastics market. Form strategic links with potential partners on biodegradable plastics. Pilot new techniques for hot runner use in the moulding of biodegradable plastics. Opportunities for developing new customers and services related to biodegradable plastics are realised.</td>
<td></td>
</tr>
</tbody>
</table>
Closer to market production | Form strategic manufacturing alliances in market. | Investigate life cycle benefits of closer to market production. | Establish production facilities closer to market. | Maximised manufacturing days and minimised transport costs, and minimised foreign exchange risks.

Nufarm’s LCM strategy

<table>
<thead>
<tr>
<th>ISSUES</th>
<th>NUFARM NZ OBJECTIVES</th>
<th>GOAL STATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain efficiency: A greater focus on minimising resource use in the supply chain</td>
<td>Analysis of product inputs vs outputs. Statistical analysis of actual finished product fill weights. Enhance the system of washing reuse that eliminates/reduces liquid waste. Monthly reporting of washing reuse data. Research systems most effective for giving accurate bulk yield data on storage tanks. Understand and reduce downstream and upstream environmental impacts of products.</td>
<td>Replace or modify &lt;20 l filling machines to provide a more precise fill. Develop new supply chain operation to minimise environmental impacts in the supply chain.</td>
</tr>
</tbody>
</table>
## Beyond resource consent and maintenance

| Beyond resource consent and maintenance | Short-term we must continue to adhere to all resource consents. Set targets to reduce site-based emissions as part of Environmental Management System (EMS) assessment prioritise the most important issues. For example reduce the total weight of site emissions per ltr/kg of product manufactured. Continue to reduce the volume of water required to manufacture each ltr/kg of product manufactured on site. | Research, design and install a dosing system that more effectively matches waste streams to the immediate capacity of the treatment plant. Measure and monitor response to targets and report on progress internally. Record and reporting of data on a monthly basis to form backbone of EMS. Produce monthly reports on performance. | Use of the New Product Introduction system should start to result in selection of raw materials that assist in the maintenance of consents. Substitute out inputs with alternative materials that are reduce environmental impacts of waste treatment. Substitute with alternative raw materials that are assessed to have negative environmental impacts. | Meet and beat consent requirements to show continuous environmental improvements not just today but into the future. |

## LCA: Improve our understanding of the environmental attributes of our products across the supply chain

| LCA: Improve our understanding of the environmental attributes of our products across the supply chain | Conduct LCA of Glyphosate. Prepare for the day when customers will request for footprint data. Establish environmental hotspots for the upstream and downstream supply chain. Roundup Transorb to be the first product for which we will conduct an LCA. | Measure footprints and performance that are of most interest to customers and other important stakeholders; for example, the carbon footprint for the next tier of products at Nufarm. | In conjunction with the global Nufarm group identify opportunities that will enable continuous improvement across supply networks, manufacturing plants and logistic functions. | Obtain /maintain a competitive advantage by taking a market leading approach to making environmental footprint data available to its customers. |
Verda’s LCM strategy

<table>
<thead>
<tr>
<th>Issue</th>
<th>Objectives</th>
<th>Medium term</th>
<th>Long term</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shavings disposal</td>
<td>Identify options for reusing, recycling and disposing of treated shavings</td>
<td>Reduce cost of shavings disposal</td>
<td>Manage treated shavings to reduce handling costs and environmental impact arising from the use of timber treatment chemicals</td>
<td>Scale up production of treated product and reduce environmental footprint</td>
</tr>
<tr>
<td>Packaging</td>
<td>Identify packaging solutions that minimise waste and that allow recycling</td>
<td>Trial minimal packaging options based on knowledge of the supply chain and customer requirements</td>
<td>Packaging minimised End of life issues resolved</td>
<td>Zero packing waste in local and export markets</td>
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<tr>
<td>Energy and carbon footprint of product</td>
<td>Define the cost and fuel savings from a fully optimised supply chain</td>
<td>Reduce energy use by 20% for the domestic market and 10% for export markets and associated carbon footprint.</td>
<td>Supply chain carbon footprint is carbon neutral</td>
<td>Supply products from sustainably grown radiata pine that are considered carbon positive in export markets</td>
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</tbody>
</table>