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# A Capability Maturity Model for Life Cycle Management at the Industry Sector Level

Helene Seidel-Sterzik \*, Sarah McLaren and Elena Garnevska

Institute of Agriculture and Environment, Massey University, Palmerston North 4442, New Zealand;  
S.McLaren@massey.ac.nz (S.M.); E.V.Garnevska@massey.ac.nz (E.G.)

\* Correspondence: helene.sterzik.1@uni.massey.ac.nz

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**Abstract:** One approach to incorporate environmental sustainability in organisations is the implementation of Life Cycle Management (LCM). LCM is a comprehensive and integrated approach for measuring and managing environmental impacts. Successful sector-wide uptake of LCM has the potential to enable the environmental impacts associated with an industry sector to be efficiently measured and managed in a continual improvement process. There is an opportunity for the New Zealand primary sector to strengthen its competitiveness in the global market place by demonstrating the environmental credentials of its products and supporting the country's "green and clean" image. Previous research has identified the barriers and enablers to successful LCM uptake by New Zealand primary sector Small and Medium sized Enterprises (SMEs) in a sector-based context. This paper builds on that foundation and presents a Life Cycle Management Uptake Evaluation Framework (LUEF) that allows both individual organisations and industry sectors to identify the key factors affecting successful LCM uptake and assess their level of maturity for each factor. The key factors used in this study are structure, culture, resource availability, LCM strategy, knowledge, market requirements and communication. The study employed a qualitative methodology and used face-to-face interviews with different stakeholders in the value chain for the New Zealand kiwifruit sector to inform the development of the framework. In the framework, each factor is represented as a maturity scale to allow organisations as well as industry sectors to assess their position on the scale. This will help them to create a baseline assessment, both for themselves as an organisation, as well as on an industry sector level. The baseline assessment will allow them to identify areas for improvements, which can be tracked over time by checking the progress on the scales in the individual areas. It can also be used as a communication tool for stakeholders in the supply chain (e.g., growers, post-harvest operators and staff from industry boards). These stakeholders can use the tool to measure and compare performance, including evaluating their own performance against the industry average, as well as performance of the industry sector over time. This is useful to engage these stakeholders and demonstrate that changes (such as reducing carbon footprints) have a positive impact and lead to progress (as well as highlighting any actions that need to be reviewed and adjusted).

**Keywords:** Sector-Based Approach (SBA); Capability Maturity Model; Life Cycle Management (LCM) Uptake; Small and Medium Sized Enterprise (SME); primary industry

## 1. Introduction

Environmental problems and wider sustainability questions have become a shared concern for governments, industries and consumers in New Zealand and worldwide. Consequently, many organisations have implemented environmental sustainability initiatives into their business activities [1,2]. Research over the last few decades has suggested that organisations should also consider

the role of their supply chain partners when addressing the environmental impacts of their products and services in order to remain competitive [3–5]. However, not all organisations find it easy to address environmental impacts associated with their supply chains. This is particularly the case for Small and Medium sized Enterprises (SMEs) as highlighted by Mandl and Dorr [6]. SMEs face challenges in implementing environmental initiatives due to their specific characteristics, such as limited support from owner/managers, limited resources and lack of awareness of their own environmental impacts [7]. Therefore, SMEs should not be treated as smaller versions of large organisations. Many New Zealand businesses in the primary sector are in this SME category, and moreover are an integral part of the New Zealand economy as over 70% of New Zealand's exports come from primary industries [8].

One approach to implementing environmental sustainability is the use of Life Cycle Management (LCM). LCM is the application of Life Cycle Thinking (LCT) to business practice, with the aim of managing the total life cycle of an organisation's products and services to move towards more sustainable consumption and production systems. According to the United Nations Environment Programme (UNEP), "LCM has been defined as the application of LCT in modern business practice" [9].

A research study was previously undertaken to identify the specific enablers and barriers faced by SMEs in implementation of LCM [7]. The research drew on the SME, supply chain management and LCM literature to identify relevant enablers and barriers. The factors that could act as enablers or barriers were identified as: owner/manager influence, culture, resources, strategy, knowledge, market requirements, geography and communication. It was concluded that a sector-based approach is preferable for implementing LCM in primary industry sectors that have large numbers of SMEs. The advantages of sector-based approaches include economies of scale for LCM research to support implementation, ease of administration, streamlined collection and management of data, improved reputation of the product, knowledge sharing and creating momentum for LCM [7,10,11].

Building on that study, this research used the concept of capability models to develop an LCM Uptake Evaluation Framework (LUEF) using the identified factors. The factors identified for the LUEF can either act as enablers towards LCM uptake by the organisation or industry sector, or can act as a barrier, if they have not been established and implemented sufficiently. Capability models assess the capability of organisations against sets of complex or multifaceted (complex) criteria [12]. They raise awareness and create a shared reference point, as well as providing guidance for the development of action plans and supporting the ongoing monitoring of progress [13]. Shared reference points are important to ensure that all involved parties use the same way of measuring and comparing performance.

The method used for the research is explained in Section 2, and Section 3 presents the resulting maturity scales for the different factors. Section 4 briefly outlines how the LUEF can be used in the future.

## 2. Methods

The LUEF was developed to comprise a maturity scale for each factor that can be used to assess either an individual organisation or a wider industry sector. This has several purposes. First, it allows an organisation/sector to develop a baseline for measuring progress and identifying future projects to improve the performance. Second, the maturity scales can be used to compare organisations with each other, and identify laggards who can then be targeted for improvements. Third, maturity scales can be used as a tool for communication internally to staff in order to show them how their actions changed the organisation's performance, and externally to stakeholders to report on progress and future plans and goals.

In this research, first a prototype maturity scale was developed for each factor based on a literature review. The literature review was done by using relevant key words to find applicable research articles.

Then a series of interviews were undertaken with stakeholders in the New Zealand kiwifruit supply chain to understand how each factor might act as an enabler or barrier for different stakeholders,

and to inform refining of the maturity scales. The LUEF consists of the following elements: structure, culture, resource availability, LCM strategy, knowledge, market requirements and communication [7].

The stakeholder groups identified for the interviews were Zespri, kiwifruit growers, and post-harvest operators. The Zespri Group Ltd. is the industry organisation for the New Zealand kiwifruit sector; it is recognised as the single desk exporter with exclusive rights to export and market New Zealand kiwifruit overseas (excluding Australia) [14]. Zespri sells directly and indirectly through various collaborative marketing agreements. Growers typically do not contract directly to Zespri but to a post-harvest operator, who packs and delivers the fruit to Zespri markets on the growers' behalf. Each post-harvest operator runs a pool system for grower payments received from Zespri, from which they deduct packing and cool storage fees [15] and then pay the growers. There are approximately 2600 kiwifruit growers and about 13 post-harvest operators in New Zealand [16].

For the study, convenient sampling was used and 23 stakeholders in the kiwifruit supply chain participated. These comprised two staff members employed by the industry body Zespri, twelve growers, and nine post-harvest operators. The interviews were conducted in 2013, in the Bay of Plenty, the main kiwifruit growing region in New Zealand. The growers were the owners of the businesses in all cases, and the representatives of the post-harvest operators were either Production Managers or Environmental Managers. A more detailed analysis of the kiwifruit study can be found in Sterzik et al. (in preparation). In this paper, relevant quotes from the interviews and observations are provided in Boxes to illustrate the points made in the text about the different factors.

Semi-structured interviews were used as a research method to gather qualitative data relating to the implementation of LCM initiatives in the New Zealand kiwifruit sector. Interviews, especially unstructured or semi-structured interviews, offer considerable researcher flexibility. By direct questions to relevant stakeholders of the industry, large amounts of relevant information about the different experiences can be acquired. Qualitative research through in-depth interviews results in more detailed data than what is available through other data collection methods such as online surveys. The use of semi-structured interviews was appropriate to supplement and extend knowledge about the culture, structure and technology transfer processes within the New Zealand kiwifruit sector as well as enablers and barriers to LCM uptake. Moreover, it provides a more relaxed atmosphere in which to collect information and people often feel more comfortable having a conversation as opposed to filling out a survey [17]. The method enables the researcher to ask spontaneous questions and allow the participants to express themselves. This method also allows questions to flow naturally, based on information provided by the participants. The partial pre-planning of the questions still allows for replication of the interview with others. A limitation of this method is that interviewees could be biased which consequently leads to inaccurate results [17]. That can be reduced by avoiding judgement of their answers. In addition, the researcher is from a university and is not a stakeholder in the kiwifruit sector. Moreover, yes/no-questions and leading questions were avoided to allow the respondent to provide the information that reflected and justified his or her opinion. The language and terms used during the interviews were chosen to be easily understood by participants, and complicated or confusing questions were avoided.

There are different means of analysing semi-structured interviews. One way is to record and then transcribe the interviews. However, Denscombe [18] highlights that "the amount of the raw data that needs to be transcribed will depend on the use to which the data is being put. If the contents of an interview are being used for the factual information they provide, for example, as part of a "descriptive account" then the researcher can be quite selective; transcription might only be needed for the purpose of small extracts that can be used as "quotes" to illustrate particular points when writing up the findings". He further explains that "if the researcher is looking for the underlying structure of the talk or the implied meanings of a discussion, the audio recordings will need to be transcribed quite extensively" [18] However, the interviews were conducted to obtain information about what different stakeholders did with regards to LCM uptake, what experiences they had and what projects they might take up in the future. Therefore, as the interviews were about facts and not

about underlying assumptions or perceptions, it was not deemed necessary to transcribe the entire interviews. Rather, it was more important to obtain quotes to highlight the stakeholders' activities in LCM uptake and their opinions about specific issues.

Emails were sent out, addressed to the person responsible for sustainability or, in cases where no role of this nature existed, to the owner or CEO of the organisation. The email explained the purpose of the study and requested to arrange meetings between the researcher and the individual stakeholders. It also indicated the expected duration of the interview. In cases where the kiwifruit stakeholders did not reply, the email was followed up with a phone call.

At the beginning of each interview the researcher provided an introduction to the research and the purpose of the interview was explained. The researcher explained that the information would be treated as confidential and the participants acknowledged that they were comfortable with the interview being electronically recorded. The interview was divided into five parts:

1. Personal information: This includes information about the participant's background and education, particularly for how long they had been involved in the kiwifruit industry, and if they had a degree in horticulture.
2. Company information: This section includes information about the company, such as the age and the size of the orchard, as well as details about other products that they produce.
3. Processes: This section gave insights into how the business is run and how jobs and roles are divided between employees.
4. LCM projects: This section provided insights into environmental practices on the orchards, such as fuel saving, reduction of pesticide use, etc.
5. Supply chain: In this section participants talked about the communication and networking with other growers, their post-harvest operators, Zespri and external research organisations.

### 3. Development of the LCM Uptake Evaluation Framework

This section presents the LUEF which is a maturity model based on the factors influencing the uptake of LCM. A maturity model allows the users to find out how mature an organisation or industry sector is in regard to specific criteria. The purpose of this maturity model is to assess the level of maturity against the seven factors in relation to LCM for the individual organisation, as well as on a sector level.

As introduced in Section 1, Capability Maturity Models (CMMs) are a practical means to represent the capability of organisations against complex or multifaceted criteria [12]. Kolk and Mauser [19] reviewed the literature on organisational sustainability and environmental management maturity models; they found that the models use between three and five maturity phases. Generally, the maturity models of environmental management in organisations refer to organisations transitioning from a 'defensive', 'ad hoc' or 'compliance' phase to an 'integrated', 'optimised' or 'visionary' maturity level (Kolk and Mauser 2002). Cagnin, Loveridge and Butler [20] developed a five-phase organisational sustainability maturity model. The researchers presented the criteria for the various phases of the model based on the key activities and competences of the organisation [20] They argue that if an optimised sustainability maturity is to be achieved, it must be aligned to a common strategy and shared approach amongst stakeholders in a wider 'sustainability net'. The 'sustainability net' includes the organisation, its customers, supply chain, partners and interested stakeholders within society.

The LUEF maturity model in this research has been developed based on findings from the literature on enablers and barriers to the uptake of LCM and other environmental management practices, and informed by interviews with stakeholders in the New Zealand kiwifruit sector. A diagrammatic representation of the model is shown in Figure 1; it consists of the seven enabler/barrier factors identified in previous research, and five maturity levels. A five-point Likert Scale was chosen for the maturity levels which range from "defensive" through to "optimised".

This provides the user with enough distinction between the different maturity levels, and yet not too many levels which would make it hard to distinguish between adjacent maturity levels.



**Figure 1.** Diagrammatic representation of the Life Cycle Management Uptake Evaluation Framework (LUEF).

The following subsections provide an overview of the seven factors used in the LUEF. Each section starts with a short description of the factor, and then describes how the maturity scale was developed based on literature and insights from the kiwifruit study. It should be noted that in these sections, the phrase “Life Cycle Management” is used as an umbrella term to describe all environmental management initiatives, including those that are just concerned with the company’s on-site activities.

### 3.1. Structure

The structural characteristics of an organisation as well as the wider industry sector can act as an enabler or barrier to the uptake of LCM [21]. Structure includes the arrangement of entities within an organisation as well as along the supply chain, and their relationships to one another with respect to flow of information and resources [22,23]. It therefore determines (to a large extent) the allocation of tasks, methods of reporting and information sharing, coordination, control and interaction [24]. Moreover, it affects innovation and the implementation of change (such as LCM uptake) as it has a large influence on the linkages between individuals and their activities, as well as knowledge transfer amongst collaborative entities [25].

Organisations can decide whether to use the existing organisational structure or an extended structure to manage LCM initiatives [26]. When using the existing structure, responsibilities for LCM are allocated to staff in addition to their existing functional responsibilities. In the case of an extended structure, one or more new resources or functional entities are specifically allocated to LCM e.g., an Environmental Manager position may be created. In either case, a critical success factor is the power and influence of the human resource responsible for managing LCM to affect decisions in the organisation [27]. It is important for the Environmental Manager (or equivalent) to have ‘a seat at the table’ or direct access to the owner or CEO for successful integration of LCM into decisions and processes of the organisation [26]. The allocation of responsibility and influence regarding LCM implementation was therefore used to develop the maturity scale in Table 1.

It should also be noted that the optimal structure for an organisation and an industry sector depends on multiple factors such as the external environment, the size of the organisation, and the existence of specific business strategies [28]. External factors are, for example, determined by whether the environment is stable or dynamic, complex or simple, and diverse or integrated. There is therefore a strong connection between organisational structure and other internal influencing factors presented in this paper such as culture, resource availability, strategy and communication [28].

**Table 1.** Proposed maturity scale to assess the effectiveness of organisational and sector level structure for Life Cycle Management (LCM) uptake.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	No roles and responsibilities related to LCM initiatives.	No formal structure or responsibility for LCM exists.
2–Ad hoc	Staff are sporadically encouraged to take part in LCM initiatives.	Industry level policy and commitment to the environment.
3–Proactive	All staff encouraged to participate in LCM initiatives.	Dedicated role at the sector level to coordinate and drive LCM.
4–Managed	Development of dedicated roles and/or responsibilities for LCM or environmental management.	Formal programme exists to coordinate and drive LCM at the sector level.
5–Optimised	Responsibility for LCM or environmental management lies with decision makers such as the owner or roles who report directly to them.	Comprehensive industry wide framework for assessing and verifying sector stakeholders against sector specific standards.

At the individual organisation level, a low level of maturity is represented by situations where no structures or processes are in place to facilitate improvements in LCM performance. An optimised level of maturity involves having dedicated resources allocated to LCM and where processes and structures exist to ensure continual improvement. Similarly, at the industry sector level there may initially be no formal structure in place to improve or promote sector level LCM. As the sector becomes more mature, structures are put in place culminating in formal LCM programmes and sector-specific standards used by industry stakeholders. Table provides a summary of the LUEF scale for structure relating to LCM and Box 1 summarises the findings from the kiwifruit industry.

**Box 1.** Structure examples in the kiwifruit sector.

During the interviews with kiwifruit growers, it became apparent that, due to the small size of most kiwifruit orchards in New Zealand, hierarchies in these organisations are flat and reporting processes are therefore very informal. In most cases, the owner makes all the decisions but is also involved in undertaking day-to-day operations. The post-harvest operators are larger organisations and have more distinct job descriptions for each employee, but the hierarchies are also relatively flat, and the owner/manager is usually still closely involved in the day-to-day operations.

At the sector level, Zespri has considerable influence over both the post-harvest operators and the growers. For example, growers as well as post-harvest operators receive a book of requirements that they need to fulfil in order to supply Zespri with kiwifruit. The growers and post-harvest operators recognise that this system managed by Zespri is helpful in keeping the industry competitive as indicated in this statement by a grower: *“That [system] is very useful and gives a lot of market power as opposed to every individual grower trying to sell their kiwifruit”*.

### 3.2. Culture

Culture is a very important criterion that influences the successful uptake of LCM within an organisation and also within a sector [29]. One frequently cited definition of culture was provided by Schein (1985) who describes culture as a “pattern of shared basic assumptions that the group has learned as it solved its problems of external adaption and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems”. Pizzirani et al. [30] stated “generally, culture is referred to as an emergent grouping of beliefs, knowledge, practices, values, ideas, language and worldviews within a social group; each of these elements affects the social group’s ongoing attitude and behavior”.

Organisational culture is often cited as the primary reason for the failure of implementing organisational change programmes. Researchers have suggested that, while the tools, techniques and change strategies may be present, failure occurs because the fundamental culture of the organization

remains the same [31]. Linnenluecke et al. (2010) suggest that “the successful implementation of culture change for corporate sustainability might be largely dependent on the values and ideological underpinnings of an organisation’s culture and that these in turn affect how corporate sustainability is implemented as well as the results”.

According to the literature, it is important that there is organisation-wide consensus among employees around a set of shared assumptions, values and beliefs [32]. This creates consistency in perceptions, unity of purpose and action [33]. Many researchers also agree with the idea that strong cultures enhance coordination and control, increase motivation and goal alignment, and subsequently lead to better performance [34]. The same can be assumed for industry sectors.

In the context of this research, then, it is important to have an environmental culture. According to Dodge (1997), it is the role of organisational leaders (aka managers) to foster a strong and highly integrative sustainability-oriented organisational culture; this can unite members and foster a sense of identity and commitment to common environmental goals and aspirations [35–38].

Throughout the organisation, culture is created and maintained through the organisational ‘grapevine’ and is supported through frequent opportunities for interaction, so employees and organisational leaders can share stories and re-enact rituals. Organisation magazines and other media can further strengthen culture by communicating values and beliefs [39]. Environmental culture can also be reinforced in meetings by putting environmental issues onto the agenda on a regular basis and discussing ideas, initiatives, etc. Based on these aspects, Table 2 provides a summary of the proposed LUEF scale for culture for both individual organisations and industry sectors. Box 2 summarises the findings from the kiwifruit industry.

**Table 2.** Proposed maturity scale for organisations and industry sectors on environmental culture.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	No shared language, vision or approach to LCM activities.	No shared language, vision or approach to LCM activities.
2–Ad hoc	Some visible elements of an LCM culture are apparent in the organisation.	Some visible elements of an LCM culture are apparent in the industry sector.
3–Proactive	Employees are actively encouraged to improve the organisation’s LCM performance.	The industry sector actively encourages the supply chain partners to contribute ideas for LCM improvements and activities to enhance the sector’s environmental performance.
4–Managed	The organisation has LCM embedded into its culture.	The industry sector has LCM embedded into its culture.
5–Optimised	The organisation promotes an LCM culture outside its own organisational boundaries.	The industry sector promotes an LCM culture outside its own sector boundaries.

**Box 2.** Culture examples in the kiwifruit sector.

In the New Zealand kiwifruit industry, a Zespri staff member commented that the implementation of sustainability initiatives by one post-harvest operator not only resulted in financial savings, “*but they also have been able to enhance their culture in that time when there is great stress on the industry by having a strong sustainability focus*”. In this case, the staff member recognised that there was a relationship between sustainability and culture in that organisation.

Some quotes from postharvest operators illustrate how an environmental culture can be encouraged:

“*After we’ve introduced noticeboards and meetings to provide staff with information on our environmental initiatives, they understand what carbon footprint, biodiversity and so on mean a lot better*”.

“*The noticeboards are used to share ideas around environmental improvements. If we take them up, we mention that in meetings, and if we don’t we also explain why to keep encouraging everyone to share ideas. We don’t just want to ignore them*”.

“*We like to celebrate our successes and share the benefits with our staff. For example, we have built a big new recreational area where they can spend their breaks. This was possible from the savings we made through energy efficiency projects*”.

### 3.3. Resource Availability

The availability of financial, human and technical resources impacts the success of LCM at the organisation and sector level [40]. Lack of any of those resources presents significant barriers for individual organisations to take up LCM initiatives, but also prevents collaboration to facilitate sector-wide LCM uptake. All three types of resources are closely related and dependent on each other [40].

In the context of LCM initiatives, there are organisations that only make resources available for LCM initiatives if legally required to do so, or because they will experience non-tariff barriers in their marketplaces if they are not active in LCM. This can be due to limited resource availability in the organisation as well as limited awareness around LCM initiatives [40]. The same applies to industry sectors. Some industry sectors do not invest resources into the development of LCM programmes unless there is significant external pressure.

On the other hand, organisations that are proactive when it comes to LCM implementation make resources available for LCM projects. This can include human resources to manage environmental projects, such as reduction of packaging material or energy efficiency, but also financial and technical resources to implement change [40]. This also applies to industry sectors that are proactive and support their stakeholders in taking up LCM projects. They make resources available to research, educate and facilitate industry level improvements.

More mature organisations and industry sectors, at the “managed” level, will have ongoing LCM initiatives in place, and environmental management plays a key role in their operations. Ongoing investments can include creating the role of “Environmental Manager” in an organisation. At an industry sector level, Environmental Managers are also beneficial to ensure projects serve different stakeholder groups.

Therefore, at the individual organisation level, the maturity ranges from a situation where no resources are made available for the implementation of LCM through to a mature stage where there are appropriate financial, technical and human resources available to support the integration of LCM into all aspects of the organisation as well as for knowledge sharing within the wider community. Similarly, at the industry sector level, resource availability relating to LCM progresses from being non-existent to providing resources for industry stakeholders to collaborate to improve sector level performance. Based on these aspects, Table 3 provides a summary of the proposed LUEF scale for resource availability for both individual organisations and industry sectors. Box 3 summarises the findings from the kiwifruit industry.

**Table 3.** Proposed maturity scale for organisations and industry sectors on resource availability for LCM initiatives.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	No or limited resources are made available for the implementation of LCM.	No or limited resources made available on an industry sector level to investigate more environmentally friendly options for the stakeholders.
2–Ad hoc	Resources are made available sporadically for LCM initiatives that are required to be implemented to meet market standards or legislation.	Resources are made available for LCM projects that are required in order to operate in a certain market and/or comply with legal requirements.
3–Proactive	Resources are proactively made available for LCM projects.	Resources proactively put in place to work on LCM improvements.
4–Managed	Ongoing resources are available to ensure LCM initiatives can be implemented on a regular basis.	Ongoing resources are available to ensure LCM initiatives can be implemented on a regular basis.
5–Optimised	Appropriate financial, technical and human resources are available to support integration of LCM into all aspects of the organisation as well as for knowledge sharing within the wider supply chain.	Appropriate financial, technical and human resources are available to support integration of LCM into all aspects of the organisation as well as for knowledge sharing within the wider supply chain.



### Box 3. Resource availability examples in the kiwifruit sector.

In the kiwifruit sector, from 2010 until quite recently, the New Zealand kiwifruit industry has struggled with the kiwifruit disease *Pseudomonas syringae* pv. *actinidia* (PSA), a bacterium that can cause the death of the kiwifruit vine. Since it is carried by airborne spores, it can easily be spread by rain, strong winds, animals and humans. Growers as well as other industry stakeholder such as postharvest operators, Zespri and Kiwifruit Vine Health (KVH), together with research organisations like Plant and Food, focused their resources on finding ways to stop the disease as well as helping growers to overcome the burdens they are faced with once their vines are affected. As a Zespri staff member noted, “*We don’t have any budgets. [ . . . ] and right now there is no interest in the industry [ . . . ] because they are all fighting this disease*”. Therefore, during this time the industry body was not able to initiate further LCM projects across the kiwifruit supply chain.

The interviewed organic kiwifruit growers said that the increased cost due to, for example, lower yields, is outweighed by the premium prices they get for their fruit from Zespri. Therefore, financial resources were not considered an overriding barrier for the organic growers that took part in the interviews.

Some post-harvest organisations have implemented sustainability projects. That is driven by employees and managers, and the overall perception that sustainability is important for the business and the environment. One example about how sustainability leads to financial benefits for an organisation is highlighted in the following quote from Zespri about a post-harvest operator:

*“In the [times] of the major disease epidemic [ . . . ], there has been a reduction of staff at Zespri, there has been a reduction of staff at the packhouses and the orchard management companies. In that environment, [one of the packhouse groups] had been able to appoint two new people for sustainability; because they partnered sustainability initiatives with a lean manufacturing approach. And they found they were able to make significant cost savings, which have allowed them to appoint these two new people”.*

This initiative led to a range of benefits for the organisation and thereby created the momentum amongst senior management and employees that led to continuous implementation and focus on LCM projects.

### 3.4. LCM Strategy

Environmental strategies are characterised by a “trajectory in the strategies’ goals, practices, priorities and underlying mindsets” [40]. This definition can be extended to LCM strategy, which means that an LCM strategy sets out the goals and associated actions, priorities and underlying values.

Most researchers conceptualise environmental strategy as a continuum between reactive and proactive strategy [40]. For example, Hart [41] distinguishes the nuances between proactive strategies in terms of incremental pollution prevention and radical, transformative sustainable development. Pollution prevention implies the improvement of existing processes and products whereas strategies of sustainable development entail greater strategic and operational shifts and prompt firms to challenge essential assumptions that underlie their business models [42].

The literature identifies proactive environmental strategies as approaches that involve collaborative and inclusive features, such as partnerships with universities, exchanging, sharing or co-developing environmental knowledge, policies, products, technologies or business models [43]. This applies at the organisational level, where organisations cooperate with other partners to integrate LCM strategies but also on a sector level, where the industry sector cooperates with other organisations to embed and improve the LCM strategy.

Strategic commitment to LCM at an organisational and sector level usually starts with the development of an environmental policy. However, this does not mean that the organisation or the industry sector will necessarily take active steps to reducing environmental impacts. Organisations and industry sectors that are more proactive, undertake research to guide development of an LCM-oriented strategy; this may involve undertaking streamlined LCAs or other research to identify environmental hotspots to guide prioritisation of activities to reduce environmental impacts both internally and in the wider supply chain. Once the LCM strategy has been developed, a focused programme of actions is developed; this should be responsive to changes and trends in markets, political climate, etc. [44]. Table 4 provides a summary of the proposed LUEF scale for LCM strategy for individual organisations and industry sectors based on evidence of increasing commitment to an LCM strategy. Box 4 summarises the findings from the kiwifruit industry.

**Table 4.** Proposed maturity scale for organisations and industry sectors on LCM Strategy.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	The organisation does not have an LCM strategy.	The industry sector does not have a sector-wide LCM strategy.
2–Ad hoc	High level commitment by the organisation to LCM.	High level commitment by the industry sector to LCM.
3–Proactive	Identify relevant criteria for the organisation’s LCM strategy.	Identify relevant criteria for the sector-wide LCM strategy.
4–Managed	Continuously improving and communicating the LCM strategy within the organisation.	Continuously improving and communicating the LCM strategy to relevant stakeholders.
5–Optimised	LCM strategy is integrated into all aspects of the organisation’s decisions.	LCM strategy is integrated into all aspects of the industry sector’s decisions.

**Box 4.** LCM strategy examples in the kiwifruit sector.

Interview responses from the kiwifruit study indicated that “Zespri is mainly doing research into markets and future requirements, including proactively identifying better and more sustainable practices”. Zespri then passes on that information to stakeholders in the industry. On a grower and post-harvest operator level, the focus on future environmental practices is divided. Some growers simply rely on information from Zespri, as shown by this kiwifruit grower: “We get this big catalogue from Zespri with all the information we have to do. They have done their research. It’s this big folder here”.

Other growers proactively work with Zespri or research institutes to identify better practices and solutions; for example, one kiwifruit grower explained, “We work with Zespri and Plant & Food to improve biodiversity on the orchard”.

The interviews with Zespri staff showed that their experience with growers is that they usually have a defensive approach towards sustainability. For example, one Zespri staff member commented, “without the market signals, the growers will say, ‘I don’t really want to know about this and I will wait until it stops me from selling my fruit’”.

**3.5. Knowledge**

The level of knowledge of LCM can have a significant impact on the uptake of LCM at both the individual organisation as well as industry sector levels. Murillo–Luna et al. (2011) conducted a study which concluded that lack of environmental knowledge presents one of the main barriers for SMEs in the uptake of improvement practices [45]. In particular, the limited knowledge amongst owners and senior managers of SMEs is relevant because they make most of the decisions about their organisations [46].

The lack of knowledge about LCM also plays a role at the industry sector level. If no organisation within the sector sees environmental sustainability as a risk or opportunity, then the sector-wide uptake of LCM is unlikely. To overcome this lack of engagement, LCM information should be made relevant to the specific industry as well as being in a form that can be disseminated and absorbed by sector stakeholders who are not yet knowledgeable about LCM.

Cohen et al. (1990) divide knowledge management into three components: acquisition, assimilation and exploitation of knowledge. Zahra et al. (2002) define four components for knowledge management: acquisition, assimilation, transformation, and exploitation of knowledge [47]. Heeley (1997) explicitly highlights that there is an external and internal factor to acquiring knowledge. The researcher uses the phrase absorptive capacity to describe an organisation’s ability to acquire external knowledge and disseminate it within an organisation [48]. Sung et al. (2000) acknowledge the importance of acquiring knowledge but also the dissemination of knowledge on environmental sustainability within an organisation and its role in the supply chain.

Dissemination of knowledge in the organisation is concerned with the flow and absorption of knowledge which occurs when knowledge that exists internally or externally to the organisation, is learned by individuals within the organisation [49].

Nonaka and Takeuchi (1995) and Nonaka (2005) explain that knowledge flows in organisations and is absorbed through the conversion and interaction between its tacit and explicit components. Tacit knowledge is based on experience, thinking and feelings, is contextual and is composed of both cognitive and technical components. The cognitive components refer to mental models, maps, beliefs, paradigms and viewpoints, while the technical components refer to specific contextual know-how and skills. In order to learn tacit knowledge, interaction as well as trust is required. Examples of tacit knowledge include: riding a bike, being able to speak a language, or hitting a nail with a hammer. On the otherhand, explicit knowledge is codified, articulated and communicated using symbols. Explicit knowledge is either object- or rule-based. Explicit knowledge about environmental sustainability is object-based when codified in words, numbers, formulas, or made tangible as equipment, documents and written procedures or models. It is regarded as rule-based when it is encoded as rules, routines or standards [50]. Examples of explicit knowledge include the information found in books as well as images or formulas.

A key organisational characteristic that aids the knowledge conversion process is organisational integration. It has been suggested that integration is a construct with structural and cultural dimensions [51]. The structural dimension (interaction) refers to the formally coordinated activities between functional departments; it includes meetings, memoranda and flow of standard documentation. The cultural dimension (collaboration) represents the more unstructured affective nature of interdepartmental relationships and emphasizes continuity of relationship between departments rather than just transactions.

At the individual organisational level, knowledge maturity progresses from a stage in which few, if any, individuals are able to make the link between the organisation's activities and its environmental impacts, to a stage where the organisational structures and processes are influenced by new knowledge, and mechanisms are in place to disseminate knowledge internally as well as with and between sector stakeholders. Similarly, at the industry sector level, knowledge maturity begins with a situation where no industry-specific LCM knowledge exists and progresses to a stage where case studies and best practice research underpinned by Life Cycle Assessment are shared via sector-based programmes. Table 5 provides a summary of the proposed LUEF scale for knowledge for individual organisations and industry sectors. Box 5 summarises the findings from the kiwifruit industry.

**Box 5.** Knowledge examples in the kiwifruit sector.

In this research, the interviews with Zespri staff highlighted that the organisation is aware of the environmental impacts associated with kiwifruit and the necessity to manage and reduce these to stay competitive. Therefore, a range of projects were conducted in the past to identify the impacts associated with the entire kiwifruit supply chain e.g., a carbon footprint study and a water footprint study for the industry (Hume, 2011; Zespri, 2011).

Zespri also conducted an extensive evaluation of the international marketplace which highlighted the LCM issues relevant to the industry [52]. It was apparent during the interviews with Zespri staff that, as the marketer of kiwifruit, the organisation was aware of the laws and trends in overseas markets and acknowledged the importance for the New Zealand operations to ensure these are met. For example, one staff member commented, *"We have been able to communicate our carbon footprint. But once you go down this route of creating a sustainability update, because you have got customers who are developing their strategies looking for case studies, they are looking for innovators in their supply base and so it's important for us to be seen as an innovator to be innovated by them. and you are helping them understanding how to set their priorities"*.

Based on the interviews with the growers, knowledge about LCM and environmental sustainability issues and trends does not seem to be evenly distributed. The interviewed organic growers in general knew about the environmental and health impacts of certain practices and had adjusted their operations to meet the requirements of BioGro (organic certification). Conventional growers, on the other hand, tended to have the perception that their environmental impacts could be neglected; they thought that the little impact they had was not worth mentioning compared to the harm that other businesses caused to the environment.

**Table 5.** Maturity scale for organisations and industry sectors in relation to environmental knowledge.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	Few, if any, staff understand the importance of LCM for the business. Any knowledge does not result in any action and it does not influence any processes or procedures.	Staff in the industry sector has no specific knowledge about LCM that is relevant to the sector.
2–Ad hoc	Tacit knowledge has been acquired by some staff and/or decision maker(s). Some staff take actions to reduce environmental impacts. However, these people do not actively teach others about the actions and the associated benefits.	Basic environmental knowledge exists within the staff at the sector body of the industry sector.
3–Proactive	Explicit knowledge has been acquired by staff and/or decision maker(s). Set procedures are employed to act on any newly acquired knowledge, and to ensure that existing knowledge is passed on to new employees.	Responsible people in the industry sector proactively seek and acquire knowledge relating to environmental management and LCM through relationships with stakeholders, and policies and procedures that support knowledge management in the area of LCM.
4–Managed	Knowledge of LCM is integrated into the organisation in the form of structures, responsibilities and processes to manage responses to new knowledge.	Staff in the industry sector organisation have in-depth and specific knowledge of LCM associated with the industry as well as relevant market conditions such as customer and legislative requirements.
5–Optimised	Dissemination of LCM knowledge to the wider supply chain. The organisation is not only learning and sharing knowledge internally but also managing knowledge about LCM with other up- and downstream supply chain partners.	Staff in the industry sector actively disseminate LCM knowledge to industry stakeholders, and process exist to continually expand the expertise via close collaboration with research organisations and other relevant parties.

### 3.6. Market Requirements

In order to stay competitive, organisations must identify emerging market requirements and proactively implement initiatives to meet or even exceed those requirements. This may reduce future costs since the organisation will be able to meet requirements once they are legally enforced, and can avoid penalties, as well as increasing its competitiveness [53]. However, this proactive implementation will not take place when organisations are not aware of emerging market requirements, and of the advantages that meeting and exceeding these requirements can bring to their organisation or the industry sector [53].

The spectrum for market requirement ranges from not being prepared to meet new market requirements, through to integrating market requirements into the strategy and researching future trends and communicating these across the industry [54,55]. Manganari et al. [54] and Martínez García de Leaniz et al. [55] believe that implementing sustainability is expensive and complex. These beliefs and motivations result in shallow eco-friendly behaviour, where LCM initiatives are taken to make cost savings [54]. In order to integrate market requirements into the business planning, organisations communicate and share their knowledge and findings about market requirements with other supply chain partners horizontally and vertically [56]. That helps them to develop actions and LCM strategies together to meet and exceed requirements and improves their competitive advantage. Industry sectors set up technology platforms to support sharing and communicating trends about market requirements [56]. Additionally, they interact with players in the market, such as supermarkets, to influence future market requirements and trends.

Therefore, at the individual organisation level, the maturity of meeting market understandings and requirements progresses from a situation where there is a lack of information on market requirements through to a mature stage where there are ongoing initiatives with other supply chain partners to identify emerging LCM trends in the market. Similarly, at the industry sector level, knowledge about market requirements relating to LCM progresses from being non-existent to providing the means and opportunities for industry stakeholders to collaborate to improve sector level

LCM performance. Based on these aspects, Table 6 provides a summary of the proposed LUEF scale for market requirements for both individual organisations and industry sectors. Box 6 summarises the findings from the kiwifruit industry.

**Table 6.** Proposed maturity scale for organisations and industry sectors on market requirements.

Maturity scale	Individual Organisation Level	Industry Sector Level
1–Regressive	The organisation lacks information on market requirements and opportunities for LCM initiatives.	The industry sector lacks information on market requirements and opportunities for LCM initiatives.
2–Ad hoc	The organisation identifies and meets emerging legal market requirements.	The industry sector identifies and meets legal and market requirements and communicates these to stakeholders when appropriate.
3–Proactive	Market requirements are addressed beyond legal pressure, but the organisation only takes initiatives that provide immediate financial returns.	The industry sector proactively researches and identifies future market requirements and trends. These are communicated to the supply chain together with implementation suggestions.
4–Managed	Market requirements are managed by researching potential future trends and actively implementing LCM initiatives to prepare for future changes (even when the short-term financial returns are not apparent).	The industry sector actively researches future market trends to prepare the supply chain for future changes.
5–Optimised	Ongoing initiatives with other supply chain partners to identify and meet emerging environmental trends in the market.	The industry sector establishes a platform which allows communication of existing and future market trends within the supply chain, but also actively works with players in their markets to influence future market requirements.

**Box 6.** Market requirement examples in the kiwifruit sector.

In the kiwifruit industry, one of Zespri’s roles is to identify market trends and requirements. The simple structure of the kiwifruit sector allows all growers and post-harvest operators to benefit from Zespri’s research provided it is communicated effectively. This is an efficient way of gaining information, and at the time of the interviews the participants did not see a need for change.

An example of Zespri successfully meeting an emerging market requirement was the implementation of the KiwiGreen programme; this programme provides growers with information about pests in kiwifruit orchards, and how to monitor and control them [57]. Key elements of the KiwiGreen programme include: monitoring pest populations to decide on timing of spray applications, preferred use of ‘soft’ chemicals wherever possible (to promote biological control), risk assessment, canopy management to minimise disease, and operating a continuous improvement programme [58]. The development of the KiwiGreen programme was driven by the development of stricter environmental standards in Italian markets and enabled New Zealand to continue to supply to that export market.

An example at the postharvest level of market requirements affecting operations is the development of kiwifruit juice production activity at one postharvest facility. As a staff member described, “We researched waste reduction options and are now able to use kiwifruits, which are not meeting the export requirements, to make juice and sell it in local markets”.

### 3.7. Communication

Effective communication is recognised as a key factor affecting the uptake of LCM at both the individual organisation as well as industry sector level. Communication refers to the process by which information is transmitted and understood between two or more people or entities [59].

In the context of environmental management, one of the key themes that emerges in the literature on communication is the progression from one-way to two-way communication [60,61]. One-way communication transfers information from the sender to the receiver only, whereas two-way communication allows the receiver of the information to provide feedback. This factor is relevant within an individual organisation as well as at an industry sector level.

Another communication aspect relevant at the organisation and industry sector level is the importance of both formal and informal communication. Formal communication is planned whereas

informal communication is ad hoc. Formal communication involves deliberate control of information that flows through predefined channels in the organizational hierarchy (for example, through meetings and distribution of printed notices) or industry sector (for example, field days or networking events). Informal communication involves exchange of experiences and ideas between staff members or industry stakeholders [62,63]. At the individual organisation level, informal communication can be facilitated by effective workspace design and workplace routines [59], whereas regular industry networking events can support sector level communication between stakeholders.

Knowledge sharing of LCM is where organisations communicate with other organisations at the same level in the supply chain and/or with supply chain partners up- and downstream in the supply chain [64]. Knowledge sharing between organisations is associated with a higher maturity level since it facilitates other organisations in the supply chain to improve their environmental performance and to exchange ideas and experiences thereby helping make the implementation of sector-wide LCM easier [65,66]. At the industry sector level, technology platforms can support effective knowledge sharing and communication between sector stakeholders.

Therefore, at the individual organisation level, the maturity of communication progresses from a situation where LCM is not addressed by staff at all through to a mature stage where there are mechanisms in place, such as planned meetings, to support the effective exchange of ideas and management of LCM projects. Similarly, at the industry sector level, communication relating to LCM progresses from being non-existent to providing the means and opportunities for industry stakeholders to collaborate to improve sector level performance. Based on these aspects, Table 7 provides a summary of the proposed LUEF scale for Communication for both individual organisations and industry sectors. Box 7 summarises the findings from the kiwifruit industry.

**Table 7.** Proposed maturity scale for organisations and industry sectors on communication relating to LCM.

Maturity Scale	Individual Organisation Level	Industry Sector Level
1–Regressive	No communication about environmental issues in the organisation.	No or limited industry sector communication relating to LCM.
2–Ad hoc	One-way communication about environmental topics to staff.	Basic one-way communication to industry stakeholders around sustainability.
3–Proactive	Informal communication about LCM is encouraged amongst staff members and internal stakeholders.	Opportunities are created for two-way communication for shared learning around LCM.
4–Managed	Regular, planned meetings and communication dedicated to LCM.	Communication of ‘best practice’ and industry specific guidelines relating to LCM.
5–Optimised	Active communication and collaboration on LCM with other industry sector stakeholders.	Collaboration processes in place such as technology platforms to facilitate knowledge management, communication and improvement of industry sector LCM performance.

**Box 7.** Communication examples in the kiwifruit sector.

On informal communication, one kiwifruit grower commented that “we use noticeboards in the common areas to share our successes. For example, we share tips around reducing energy at work and also at home. People really enjoy those tips and make changes in their private lives as well”. The idea of using noticeboards was also mentioned by a postharvest operator who noted that “noticeboards allow our staff to carpool and people can share when they come in to work, and if anyone wants a ride with them to reduce carbon emissions”.

Another post-harvest operator highlighted that “shifts are scheduled in a way that people can have breaks together, in designated areas which we just renovated. We want people to have a place to relax and refresh”.

An additional example of LCM communication of LCM within postharvest operators is “we have monthly environmental management meeting which include the Green Team, as well as upper level management”.

To sum up the results from the kiwifruit interviews, it can be said that the monopoly structure is perceived as beneficial by growers and post-harvest operators as well as Zespri, and it facilitates implementation of processes that lead to efficient distribution of kiwifruit in overseas markets.

Moreover, it facilitates communication back up the supply chain about market trends such as the growing importance of environmental performance. The specific structure of the New Zealand kiwifruit supply chain means that Zespri has influential power over the growers and packhouses and can therefore push LCM implementation in the kiwifruit supply chain in New Zealand.

The culture in the industry is characterised by trust, honesty and effective communication. That is useful in order to implement LCM based on a sector-based approach, since open and honest communication and exchange of experiences and ideas are key for this approach. Communication could still be improved, in particular between research institutes and Zespri, but also between Zespri and growers/post-harvest operators in order to make better use of research results.

However, the kiwifruit sector lacks sufficient resources in order to effectively implement LCM sector-wide although financial resources were available before the outbreak of PSA. Moreover, technical resources are not sufficient in order to communicate research findings from previous studies to growers and post-harvest operators to build a foundation for the development of LCM objectives. At the moment, the limited resources are a barrier for the industry to implement LCM sector-wide and lack of appropriate technical resources has led to insufficient evaluation of previous projects.

The industry recognises the need to move towards more environmentally friendly practices, based on market research undertaken by Zespri. Some growers (in particular the organic growers) and post-harvest operators are convinced that there is a need to be more sustainable and implement LCM projects. Therefore, the industry sector can use the market requirements and their knowledge about the importance of environmental issues in the future as enablers for LCM uptake.

At the moment, the industry is experiencing trade-offs between two different objectives for the industry: managing the PSA crisis and focusing on the sustainability agenda in order to stay competitive. Since PSA is threatening the existence of some orchards, more financial resources are being allocated towards this objective. More research to support LCM implementation is unlikely to be prioritised until PSA is managed successfully.

Also, the separation from consumers means that it is more difficult to convince defensive kiwifruit growers to take up LCM initiatives. Finding mechanisms for these growers to be more aware of market trends regarding sustainability could help to overcome this barrier.

The kiwifruit sector has established networks for communication with external partners that support the identification of environmental improvement areas through scientific research. Networks within the industry have also been established, for example, between growers through field days.

#### 4. Conclusions

A sector-based approach has been suggested to overcome the barriers to LCM uptake identified by Seidel–Sterzik et al. [7]. Sector-based approaches allow organisations to share research results, facilitate administration and streamline data collection and management, contribute to improving the reputation of a product/service, facilitate knowledge sharing, and create momentum amongst involved parties.

The LUEF described in this paper is based on the enablers and barriers faced by organisations during the uptake of LCM as originally identified by Seidel–Sterzik et al. (2018). Both an organisation and an industry sector can be evaluated separately on a scale from one to five for each of the enabler/barrier factors. Once evaluated, an organisation will have a better understanding of its strengths and weaknesses, and areas for improvement. Thus, the LUEF can be used as a benchmarking tool to compare progress over time, but also to compare performance amongst supply chain partners. Additionally, it can be used to communicate progress, as well as future strategies to relevant stakeholders.

The framework has been set up in a visual way and allows interested parties to quickly appraise the organisation and sector. Details and specific actions can then be described further in reports. Furthermore, the visual representation allows stakeholders to easily compare each other's

performances, compare to the industry sector performance, and compare the results with previous years to identify if actions have had positive results, or if they need to be adjusted and changed.

The selected criteria have purposely been developed to be generic so they can be adapted by industry sectors in particular countries to suit their individual context. This is an opportunity for industry sectors to adapt the levels with examples that apply to the sector at the particular time, and thereby support the users in making less subjective evaluations of their performance.

Future research should focus on the use of the LUEF in industry sectors as an evaluation tool to inform development of targeted environmental improvement programmes. Potentially the framework can then be incorporated into cloud-based software to support the effective ongoing management of sector-based Life Cycle Management for different industries.

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## References and Note

1. Dowell, G.W.; Muthulingam, S. Will firms go green if it pays? The impact of disruption, cost, and external factors on the adoption of environmental initiatives. *Strateg. Manag. J.* **2017**, *38*, 1287–1304. [CrossRef]
2. Hsu, C.-C.; Tan, K.-C.; Mohamad Zailani, S.H. Strategic orientations, sustainable supply chain initiatives, and reverse logistics: Empirical: Evidence from an emerging market. *Int. J. Oper. Prod. Manag.* **2016**, *36*, 86–110. [CrossRef]
3. Fernando, Y.; Saththasivam, G. Green supply chain agility in EMS ISO 14001 manufacturing firms: Empirical justification of social and environmental performance as an organisational outcome. *Int. J. Procure. Manag.* **2017**, *10*, 51–69. [CrossRef]
4. Sharma, N. Innovation in Green Practices: A Tool for Environment Sustainability and Competitive Advantage. In *Green Consumerism*; Sage: Newcastle upon Tyne, UK, 2017.
5. Rajeev, A.; Pati, R.K.; Padhi, S.S.; Govindan, K. Evolution of sustainability in supply chain management: A literature review. *J. Clean. Prod.* **2017**, *162*, 299–314. [CrossRef]
6. Mandl, I.; Dorr, A. CSR and Competitiveness—European SMEs' Good Practice. In *Consolidated European Report*; Austrian Institute for SME Research: Vienna, Austria, 2007.
7. Seidel-Sterzik, H.; McLaren, S.; Garnevska, E. Effective Life Cycle Management in SMEs: Use of a Sector-Based Approach to Overcome Barriers. *Sustainability* **2018**, *10*, 359. [CrossRef]
8. Ministry for Primary Industries. Growing Exports. Available online: <https://mpi.govt.nz/exporting/overview/growing-exports/> (accessed on 1 August 2017).
9. UNEP. *Background Report for a UNEP Guide to LIFE CYCLE MANAGEMENT—A Bridge to Sustainable Products*; Division of Technology, Industry and Economics, United Nations Environment Programme: Paris, France, 2006.
10. Schmidt, J.; Helme, N.; Lee, J.; Houdashelt, M. Sector-based approach to the post-2012 climate change policy architecture. *Clim. Policy* **2008**, *8*, 494–515. [CrossRef]
11. Bradley, R.; Baumert, K.A.; Childs, B.; Herzog, T.; Pershing, J. Slicing the pie: Sector-based approaches to international climate agreements: Issues and options. In *Slicing the Pie: Sector-Based Approaches to International Climate Agreements: Issues And Options*; World Resources Institute: Washington, DC, USA, 2007.
12. Dinsmore, P. How grown-up is your organization? *PM Netw.* **1998**, *12*, 24–26.
13. Silvius, A.G.; Schipper, R. A maturity model for integrating sustainability in projects and project management. In Proceedings of the 24th World Congress of the International Project Management Association (IPMA), Istanbul, Turkey, 1–3 November 2010.
14. Kilgour, M.; Saunders, C.; Scrimgeour, F.; Zellman, E. *The Key Elements of Success and Failure in the NZ Kiwifruit Industry*; Lincoln University: Lincoln, New Zealand, 2008.
15. Grant Thornton New Zealand. *The Impact of PSA: Challenges Facing the Kiwifruit Industry and Solutions to Secure its Future*; Grant Thornton New Zealand: Tauranga, New Zealand, 2011.
16. NZKGI. Industry in NZ. Available online: <http://nzkgi.org.nz/industry/> (accessed on 18 April 2018).



17. Woods, M. *Interviewing for Qualitative Research*; Students, M.U., Ed.; Massey University: Palmerston North, New Zealand, 2011.
18. Denscombe, M. *The Good Research Guide: For Small-Scale Social Research Projects (Open UP Study Skills)*; McGraw-Hill: New York, NY, USA, 2010.
19. Kolk, A.; Mauser, A. The evolution of environmental management: From stage models to performance evaluation. *Bus. Strategy Environ.* **2002**, *11*, 14–31. [[CrossRef](#)]
20. Cagnin, C.H.; Loveridge, D.; Butler, J. Business Sustainability Maturity Model. In Proceedings of the Corporate Responsibility Research Conference 2010 “Sustainability Management in a Diverse World”, Marseille, France, 15–17 September 2010.
21. Grekova, K.; Calantone, R.; Bremmers, H.; Trienekens, J.; Omta, S. How environmental collaboration with suppliers and customers influences firm performance: Evidence from Dutch food and beverage processors. *J. Clean. Prod.* **2016**, *112*, 1861–1871. [[CrossRef](#)]
22. Chandra, C.; Kumar, S. Supply chain management in theory and practice: A passing fad or a fundamental change? *Ind. Manag. Data Syst.* **2000**, *100*, 100–114. [[CrossRef](#)]
23. Tatoglu, E.; Bayraktar, E.; Golgeci, I.; Koh, S.L.; Demirbag, M.; Zaim, S. How do supply chain management and information systems practices influence operational performance? Evidence from emerging country SMEs. *Int. J. Logist. Res. Appl.* **2016**, *19*, 181–199. [[CrossRef](#)]
24. Benzer, J.K.; Charns, M.P.; Hamdan, S.; Afable, M. The role of organizational structure in readiness for change: A conceptual integration. *Health Serv. Manag. Res.* **2017**, *30*, 34–46. [[CrossRef](#)] [[PubMed](#)]
25. Klievink, B.; Bharosa, N.; Tan, Y.-H. The collaborative realization of public values and business goals: Governance and infrastructure of public–private information platforms. *Gov. Inf. Q.* **2016**, *33*, 67–79. [[CrossRef](#)]
26. Epstein, M.J.; Buhovac, A.R. *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental, and Economic Impacts*; Berrett-Koehler Publishers: Auckland, New Zealand, 2014.
27. Roome, N. Developing environmental management strategies. *Bus. Strategy Environ.* **1992**, *1*, 11–24. [[CrossRef](#)]
28. McShane, S.; Olekalns, S.; Travaglione, T. *Organisational Behaviour on the Pacific Rim*, 3rd ed.; McGraw-Hill: North Ryde, Australia, 2009.
29. Biondi, V.; Iraldo, F.; Meredith, S. Achieving sustainability through environmental innovation: The role of SMEs. *Int. J. Technol. Manag.* **2002**, *24*, 612–626. [[CrossRef](#)]
30. Pizzirani, S.; McLaren, S.J.; Seadon, J.F. Is there a place for culture in life cycle sustainability assessment? *J. Life Cycle Assess.* **2014**, *19*, 1316–1330. [[CrossRef](#)]
31. Cameron, K.S.; Quinn, R.E. *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework*; John Wiley & Sons: Hoboken, NJ, USA, 2011.
32. Martin, J. *Organizational Culture: Mapping the Terrain*; Sage: Newcastle upon Tyne, UK, 2002.
33. Zammuto, R. *Does Who You Ask Matter? Hierarchical Subcultures and Organizational Culture Assessments*; The Business School, University of Colorado at Denver: Denver, CO, USA, 2005.
34. Deal, T.E.; Kennedy, A.A. *Corporate Cultures: The Rites and Rituals of Corporate Life*; Da Capo Press: Cambridge, MA, USA, 2000.
35. Crane, A. Rhetoric and reality in the greening of organizational culture. In *Greening the Boardroom, Corporate Governance and Business Sustainability*; Routledge: London, UK, 2017; pp. 129–144.
36. Dodge, J. Reassessing culture and strategy: Environmental improvement, structure, leadership and control. In *Corporate Environmental Management 2: Culture and Organizations*; Welford, R., Ed.; Earthscan: London, UK, 1997; pp. 104–126.
37. Hoffman, A.J. The importance of fit between individual values and organisational culture in the greening of industry. *Bus. Strategy Environ.* **1993**, *2*, 10–18. [[CrossRef](#)]
38. Welford, R. *Environmental Strategy and Sustainable Development: The Corporate Challenge for the Twenty-First Century*; Routledge: London, UK, 1995.
39. Ashforth, B.E.; Mael, F. Social identity theory and the organization. *Acad. Manag. Rev.* **1989**, *14*, 20–39. [[CrossRef](#)]
40. Stadler, L.; Lin, H. Moving to the next strategy stage: Examining firms’ awareness, motivation and capability drivers in environmental alliances. *Bus. Strategy Environ.* **2017**, *26*, 709–730. [[CrossRef](#)]
41. Hart, S.L. Beyond greening: Strategies for a sustainable world. *Harv. Bus. Rev.* **1997**, *75*, 66–77.

42. Dyllick, T.; Muff, K. Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability. *Organ. Environ.* **2016**, *29*, 156–174. [CrossRef]
43. Wassmer, U.; Paquin, R.; Sharma, S. The engagement of firms in environmental collaborations: Existing contributions and future directions. *Bus. Soc.* **2014**, *53*, 754–786. [CrossRef]
44. UNEP/SETAC Life Cycle Initiative. Life Cycle Approaches—The Road From Analysis to Practice. Available online: <https://www.lifecycleinitiative.org/wp-content/uploads/2012/12/2005%20-%20LCA.pdf> (accessed on 3 April 2018).
45. Murillo-Luna, J.L.; Garcés-Ayerbe, C.; Rivera-Torres, P. Barriers to the adoption of proactive environmental strategies. *J. Clean. Prod.* **2011**, *19*, 1417–1425. [CrossRef]
46. Seidel, M.; Seidel, R.; Tedford, D.; Cross, R.; Wait, L.; Haemmerle, E. Overcoming Barriers to Implementing Environmentally Benign Manufacturing Practices: Strategic Tools for SMEs. *Environ. Qual. Manag.* **2009**, *18*, 37–55. [CrossRef]
47. Zahra, S.A.; George, G. Absorptive capacity: A review, reconceptualization, and extension. *Acad. Manag. Rev.* **2002**, *27*, 185–203. [CrossRef]
48. Heeley, M. Appropriating rents from external knowledge: The impact of absorptive capacity on firm sales growth and research productivity. *Front. Entrep. Res.* **1997**, *17*, 390–404.
49. Peri, G. Determinants of knowledge flows and their effect on innovation. *Rev. Econ. Stat.* **2005**, *87*, 308–322. [CrossRef]
50. Popadiuk, S.; Choo, C.W. Innovation and knowledge creation: How are these concepts related? *Int. J. Inf. Manag.* **2006**, *26*, 302–312. [CrossRef]
51. Lemon, M.; Sahota, P.S. Organizational culture as a knowledge repository for increased innovative capacity. *Technovation* **2004**, *24*, 483–498. [CrossRef]
52. Mowat, A. Market oriented assessment of the environmental impact of the New Zealand kiwifruit value chain. In Proceedings of the XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014), Brisbane, Australia, 25 November 2016; pp. 439–446.
53. Font, X.; Garay, L.; Jones, S. Sustainability motivations and practices in small tourism enterprises in European protected areas. *J. Clean. Prod.* **2016**, *137*, 1439–1448. [CrossRef]
54. Manganari, E.E.; Dimara, E.; Theotokis, A. Greening the lodging industry: Current status, trends and perspectives for green value. *Curr. Issues Tour.* **2016**, *19*, 223–242. [CrossRef]
55. Martínez García de Leaniz, P.; Herrero Crespo, Á.; Gómez López, R. Customer responses to environmentally certified hotels: The moderating effect of environmental consciousness on the formation of behavioral intentions. *J. Sustain. Tour.* **2017**, *25*, 1–18. [CrossRef]
56. Ross, D.F. *Introduction to E-Supply Chain Management: Engaging Technology to Build Market-Winning Business Partnerships*; CRC Press: Boca Raton, FL, USA, 2016.
57. Zespri Group Limited. Zespri System, Safety and Compliance. Available online: <http://www.zespri.com/storyofzespri/zespri-system-safety-compliance> (accessed on 3 April 2018).
58. Growing Futures. Zespri's KiwiGreen Programme—World Firsts in this Vital Crop Management System. Available online: <http://www.martech.co.nz/images/02kiwi.pdf> (accessed on 3 April 2018).
59. McShane, S.; Travaglione, T. Communicating in teams and organisations. In *Organisational Behaviour*; McGraw-Hill: New York, NY, USA, 2009.
60. McQuail, D.; Windahl, S. *Communication Models for the Study of Mass Communications*; Routledge: London, UK, 2015.
61. Liebowitz, J.; Frank, M. *Knowledge Management and E-Learning*; CRC Press: Boca Raton, FL, USA, 2016.
62. Manuti, A.; Pastore, S.; Scardigno, A.F.; Giancaspro, M.L.; Morciano, D. Formal and informal learning in the workplace: A research review. *Int. J. Train. Dev.* **2015**, *19*, 1–17. [CrossRef]
63. Lai, C.J. The Effect of Individual Market Orientation on Sales Performance: An Integrated Framework for Assessing the Role of Formal and Informal Communications. *J. Mark. Theor. Pract.* **2016**, *24*, 328–343. [CrossRef]
64. Cai, S.; Goh, M.; de Souza, R.; Li, G. Knowledge sharing in collaborative supply chains: Twin effects of trust and power. *Int. J. Prod. Res.* **2013**, *51*, 2060–2076. [CrossRef]

65. Lee, S.-Y.; Klassen, R.D.; Furlan, A.; Vinelli, A. The green bullwhip effect: Transferring environmental requirements along a supply chain. *Int. J. Prod. Econ.* **2014**, *156*, 39–51. [[CrossRef](#)]
66. Dou, Y.; Zhu, Q.; Sarkis, J. Green multi-tier supply chain management: An enabler investigation. *J. Purch. Supply Manag.* **2017**, *24*, 95–107. [[CrossRef](#)]



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