Towards a Lean NZ pipfruit industry; improving practices within and between supply chain elements

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Abstract
With a world population estimated to rise 9 billion people in 2050, the New Zealand government has set ambitious primary industry production goals. One key action is to deploy Lean thinking to improve performance. This paper presents findings of an original study into assessing Lean within the NZ pipfruit industry. A survey established the status quo. Case study and action research are used to better understand the value of Lean deployment within the industry. Early findings show encouraging results for progressive organisations.

Keywords: Lean, supply chain, pipfruit

Topics: Lean and Agile, Supply Chains

Methodology: Case study, Action Research

Introduction
As a country of 4.5 million people, New Zealand (NZ) currently grows food to sustain 40 million people (Guy, 2013). With the United Nations estimating the world population to rise from 7 billion today to 9 billion people in 2050, the New Zealand government has recently set ambitious goals such as doubling its primary industry exports by 2025 (Barnao, 2013). The horticultural sector already set a goal to achieve revenue of NZ$10 billion by 2020 (Horticulture Growth Strategy June 2009: Growing a New Future), and the pipfruit sector in 2013 set a goal of achieving one billion dollars in exports -more than double of 2013’s revenue- by 2022 (Pollard, 2013).

These are formidable targets when the World Apple Review (2013) sees New Zealand as the third most competitive apple producing country in the world. Can the industry continue to improve and meet the ambitious targets set by its government and governance bodies?

The New Zealand government’s business development agency (New Zealand Trade and Enterprise –NZTE) is tasked with assisting businesses to succeed internationally and has initiated a number of support programmes. One of the support programmes is the ‘Better by Lean’ programme which includes many sectors (Goodyer et al, 2011). As primary industries are crucial in the government’s growth plans, the NZ pipfruit industry is also looking at Lean as a way to improve its performance. However Lean was not developed for horticultural industries and there is little research about implementing Lean in horticultural settings. In seeking to understand the implementation of Lean in a horticultural setting, this study sought to investigate:
• To what degree are Lean elements applicable to, and currently used as an approach by growers, packhouse/coolstore organisations and exporters within the NZ pipfruit industry supply chain?
• How can Lean be implemented and ‘made to fit’ these three core activities within the NZ pipfruit industry supply chain?

Literature review

Lean and the New Zealand pipfruit industry

The available pipfruit industry literature shows a traditional focus on technical innovations and a distinct lack of process issues. Frater (1999) e.g. observes that only 9.9% of articles in the national horticultural magazine relate to management subjects, of which 4.3% relates to Research and Development and a further 1.8% relates to innovations, patents and IP protection (Frater, 1999). In 2009, the on-line Pipfruit NZ library contained over 600 publications addressing mostly technical fruit-growing issues, with not a single paper addressing quality of management or business management issues (Doevendans, 2010). This gap in industry literature may well be indicative of the industry focus.

‘Lean Production’ (Lean) has been identified as the driving factor behind the growth of the Toyota Motor company (Womack et al, 2007) to become the world’s largest car manufacturing company in 2008. In their seminal book identifying Lean production, ‘The machine that changed the world’, the authors’ state:

“In this process we’ve become convinced that the principles of lean production can be applied equally in every industry across the globe and that the conversion to lean production will have a profound effect on human society – it will truly change the world” (Womack et al, 2007, p6).

This indicates that common theoretical themes for the Lean philosophy, methods and tools are deemed not industry or contextually bound and may be transferable to other industries, such as the pipfruit industry. While Lean was mostly restricted to the operational manufacturing area in the late 1900s, Lean has since extended to other disciplines such as economics (e.g. Stone, 2012), human resources (e.g. Holton, 2003), product development (e.g. Womack et al, 1990; Holweg, 2007), marketing and sales (e.g. Piercy and Morgan, 1997), service (e.g. Arbos, 2002; Seddon and Caulkin, 2007), construction (e.g. Jørgensen and Emmitt, 2008), health (e.g. Joosten et al, 2009; Aronsson et al, 2011), IT (e.g. Staats et al, 2012), government (e.g. Seddon and Brand, 2008; Krings et al, 2006), supply chain (e.g. Holweg and Pil, 2001; Aronsson et al, 2011), aerospace (e.g. Financial Post, 1999) and accounting (e.g. Hines et al, 2004, Maskell & Kennedy, 2007). Lean as a concept has evolved significantly since its origins in the older concepts around shop-floor improvement in the car industry (Hines et al, 2004). However research of Lean in other disciplines showed very little literature could be found on implementation of Lean in a horticultural setting.

Lean involves the diligent implementation of best practices in a fluid paradigm, moving with times and environments (Holweg, 2007), while grounded in stabilising fundamentals such as customer value stream management, waste reduction, flow, continuous improvement, respect for people and Just-In-Time principles. This affirms that Lean may well be applicable and appropriate for use in horticultural settings.

Value stream, value chain and supply chain

Hines and Rich (1997) find that Lean is primarily concerned with the value stream concept within organisations. It is important to differentiate this theoretical concept
from those of the supply chain and value chain. ‘Supply chain’ is defined by Stock and Boyer (2009) and summarised as “The network of relationships between interdependent organizations consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction”.

‘Value chain’ was first described by Porter who used the term to point out how important the interconnected responsibilities within organisations are for competitive success (Porter, 1990). The value chain is defined as a system of interrelated activities where each organisation will link its value chain to the value chain of suppliers upstream and customers downstream. A supply chain thus consists of a series of linked value chains (Fawcett et al, 2007). Gaining competitive advantage requires that a firm’s or an industry’s value chain is managed as a system, not as a collection of independent parts (Porter, 1990).

Womack and Jones (2003) describe the value stream as a set of actions required to bring a specific product through the three management tasks of problem solving (from design to product launch), information management (from order taking to delivery) and physical transformation (from raw material to finished product). Tapping et al (2002) perhaps more simply define value stream as a collection of all steps (identifying both value-added and non-value-added steps) involved in bringing a product or group of products from raw material to finished products accepted by a customer.

The concepts of supply chain, value chain and value stream should not be viewed as wholly separate and independent concepts; they are conceptually overlapping. In our view, there is a value chain and a value stream within each supply chain, where value streams focus on reducing waste in material and information flow processes (Rother and Shook, 2003) and where the emphasis of supply and value chain could be argued to be on functional structures, synergetic relationships and logistics between organisations.

A Lean pipfruit supply chain?
The direct supply chain within the industry consists of a set of product and service deliveries up- and down-stream that is straight forward from the point of exporting onwards, but appears convoluted where it concerns the on-shore supply chain. Growers ‘manufacture’ the initial product but often have no idea who the customer is. Product may be grown for certain markets, following phytosanitary rules to get access to specific countries, but have no guarantee that the product actually goes there. Packers deliver a packing and coolstore service to growers but follow exporter instructions; the grower has no say in the packing choices but is liable to pay for the packing service and the packaging.

The exporter never touches nor pays for the product – product is shipped by the packhouse/coolstore on exporter instructions- but sells the product and receives the money. The exporter then withholds his commission and pays the balance to the grower unless arrangements have been made to pay the packhouse/coolstore first. Value is added by the coolstore that maintains fruit quality over time, by the packer who grades and sizes the fruit before packing, and by the exporter who selects the grades and packaging.

This somewhat chaotic supply model adds value but through its architecture also adds information flow and unnecessary waste challenges. Added to that is the competition between on-shore exporters for overseas sales, a destructive remnant of de-regulation in 2001 (Doevendans, 2010).
The industry has not yet learned that gaining competitive advantage requires that a firm’s or an industry’s value chain is managed as a system, not as a collection of independent or even competing parts (Porter, 1990). A lack of value stream understanding will continue to allow waste in the supply chain. It is therefore essential that value streams are managed both within and between supply chain companies. The current study attempts to understand the value stream within and between organisations as a precursor for systemic improvements.

**Methodology**
A study into various elements of the pipfruit industry’s supply chain may require multiple approaches to develop a deeper understanding of the principal business
processes within it. It was decided that a mixed-method approach involving both quantitative and qualitative methods (Creswell, 2003) would be adopted. The research approach is summarised to provide an overview (table 1), followed by an expansion on each individual part of the research methodology.

The initial literature review highlighted those fundamental elements of Lean theory that could be transferable to the pipfruit industry. The literature review uncovered a lack of published research in this area applied to such an industry.

Table 1: Research organisation grouping by research strategy and organisation type

<table>
<thead>
<tr>
<th>Research Strategy</th>
<th>Orchards</th>
<th>P/H 1</th>
<th>P/H 2</th>
<th>P/H 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative research</td>
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<tr>
<td>Survey 2012</td>
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<tr>
<td>Survey 2013</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Qualitative research</td>
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<tr>
<td>Action Research</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Case Study</td>
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</table>

Survey
As there was limited published research, it was decided to carry out a primary data collection phase to provide a general view of how widely Lean is both understood and applied within the pipfruit supply chain. A stakeholder survey was conducted using a questionnaire to assess current levels of Lean within the pipfruit industry (Survey 2012 in table 1). The national pipfruit body was approached to assist by providing a list of all stakeholders –the population- which included growers, packers, cool-stores and exporters. Considering that response rates to surveys have been low for this industry (Doevendans, 2011), and that surveys with more questions return lower response rates (Sheehan, 2006), an original and unique survey approach was adopted by the researcher in a ‘perceived diminished participant effort’ approach (PDPE). This consisted of the researcher emailing a single question or statement each working day to a sample of 150 randomly selected stakeholders out of a population of approximately 800. The survey was grouped into two sections, focussing on:

1. Kobayashi keys: Twenty statements, each relating to one of twenty keys (Kobayashi, 1995) indicating level of implementation of each key using a five point Likert scale. The Kobayashi criteria were selected as they had been part of earlier research into Lean in NZ (Goodyer et al, 2011) (for Kobayashi criteria, refer to figure 3).

2. Lean principles, methods and tools: Twenty broadly accepted Lean principles methods and tools, indicating the level of knowledge and use of these tools using a five point Likert scale (A list of the selected principles, methods & tools is provided in figure 4).

The stakeholder survey was also applied as a post-implementation assessment to both the action research and case study companies (survey 2013 in table 1).

Action Research
Since there is little literature about Lean in a horticultural environment such as the NZ pipfruit industry, a ‘green-fields’ approach is axiomatic when considering the qualitative component of the research methodology. This study proposes to research a relatively contemporary paradigm (‘Lean’) in its actual environment (various organisations within the NZ pipfruit industry). This actual environment provides a real-
life context for the research questions where actions and reactions can be observed
directly and indirectly, allowing relatively little control over events.

From the initial stakeholder survey it became apparent that Lean is not known or
practiced by the grower and exporter elements of the supply chain and that only a few
packers have started to implement Lean. As such, it was essential to involve a minimum
of one grower, one packer and one exporter in a qualitative study and it was decided to
adopt an action research approach for interested non-Lean companies to assess how
Lean could be implemented.

Action research has a reputation for low rigour and being ‘messy’ (Cardno, 2003)
and presenting the double burden of affecting change and research. This potentially
causes a conflict between rigour of the research and relevance of the research (Argyris
& Schon, 1991). Action research is appropriate as Coughlan and Coghlan (2002) point
out, whenever the research question relates to describing an unfolding series of actions
over time in an organisation as is expected to be the case in this inquiry. Validity and
reliability can be addressed using critical scrutiny when assessing outcomes (Checkland
& Holwell, 1998). The action research approach was therefore proposed involving a
grower, in this case an orchard organisation with several orchards, a pack-house and an
exporter to:

• Involve all elements within the industry;
• Better understand issues around Lean implementation;
• Improve organisational practices during the course of the study.

Unfortunately, no exporter could be found to volunteer for the action research element
and the exporting element was therefore eliminated from the action research approach.

Case Study
The case study approach has consistently been one of the most powerful research
methods (Voss et al, 2002). Voss et al believe that case studies can be used for different
types of research including exploration, theory-building, theory-testing and theory
extension/refinement (2002). Eisenhardt (1989) considers case studies a source for
grounding and building of theories and the possible need for building a model at a later
time further reinforced case study as an appropriate method of investigation. As such,
the case study approach is an appropriate and alternative method to analyse the
applicability of the Lean philosophy, methods and tools for the few packhouse/coolstore
organisations within the NZ pipfruit industry that have engaged in Lean.

Synthesising the approaches
The survey was aiming to find out how Lean the pipfruit industry was in 2012 and
provided additional value by being used to measure the research companies after a
period of approximately 1 ½ years of lean. The Lean state of the research companies
was then compared with the wider industry to assess progress over time.

The action research component was introduced because there was no orchard or
exporter that had started implementing Lean. The case study approach offered the
opportunity to research two additional pack-house organisations, offering triangulation
opportunities.

Reliability and validity for the survey approach were achieved using a questionnaire
with a 5 point Likert scale, sample selection through industry body collaboration, and
questionnaire design allowing convergence and discrimination, cross-referencing of
questions, validating consistency and differentiation between sub-samples of industry
activities.
Reliability for the action research and case study approach was addressed by using a semi-structured protocol, using a single researcher for consistency, identification of themes and participant verification. Validity was addressed by using multiple sources of evidence, achieving ‘recoverability’ (Checkland and Holwell, 1998), cross-case analysis, focus group review and comparison with known theory and empirical evidence.

Findings
Stakeholder survey:
The initial response rate to the survey averaged 23.88%. This response rate is considered satisfactory given the length of the questionnaire, the relevance of the subject and the declining response rates to surveys over the years (Sheehan, 2001). On completion of the survey, feedback was given to participants to increase response rates (Heberlein & Baumgartner, 1978); the follow up included the missed questions. Several participants then returned answers to the missed questions, lifting the response rate to 25.39%.

The survey was spread over a period of approximately sixty working days. A single question was used as pre- and post-survey question to assess each respondent’s perception of their own Lean knowledge. Comparison of the responses to the pre- and post-survey question indicated that respondents estimated their knowledge of Lean much higher at the start of the survey than at the end of the survey. Organisations appeared to have realised during the course of the survey that their level of Lean knowledge was lower than originally thought.

![Figure 2: Pre- and Post-survey self-assessments of Lean knowledge](image)

2012 Industry Stakeholder survey: Kobayashi keys: Respondents applied little or none of the elements captured by the 20 Kobayashi keys; 29.9% of all responses indicated a nil level of implementation, while 45.1% indicated a low level of implementation. 2.0% of responses indicated a level of implementation that was between level three and five on the 5-level Kobayashi keys. Generally, the industry responses implied an industry with a low level of Lean operations (figure 3).
The research companies' (i.e. the action research and case study) Lean position at the end of 2013 was assessed using the same questionnaire as was used for the industry stakeholders in 2012. The research companies showed an improved position in comparison with the wider industry which included their own position in 2012 (figure 3).

2012 Stakeholder survey: Lean principles, methods and tools: There was little knowledge of Lean principles, methods and tools in general; 62.2% of responses indicated that respondents did not know the principles, methods and tools presented. A low percentage (6.7%) of all responses indicated use of specific tools or use with some form of regularity, while 1.9% of responses indicated continuous use of specific tools (figure 4).

The same questionnaire was answered by the research companies after approximately one year of Lean field work at the end of 2013. Responses showed that the level of knowledge and use of Lean principles, methods and tools differed markedly from the wider industry. Figure 4 shows a significantly better knowledge positioning of the research companies in relation to the general industry.
**Action research: Grower orchard group**

The orchard group was involved in action research. The researcher visited the managers group regularly and got involved in the development of Lean ideas. One aspect of action research is that the researcher can act as coach, while allowing the team to develop their own ideas and systems. During 2013, the researcher visited the action research orchard group (AROs) 24 times. Visits included visits to the technical manager (the Lean champion), orchard managers’ meetings and orchards themselves. At the request of the organisation, distinctive points of identification are omitted in the following description.

A decision was made to look at the main groups of activities during the year. These included pruning, thinning, spraying and harvesting. Discussions included explanations concerning certain Lean philosophies methods and tools and how these could be used or might be made to ‘fit’ the orchard environment. The orchard managers exchanged information and agreed on best practices which were then standardised by the technical manager.

Simultaneously with the introduction to Lean, the company had exposed its orchard managers to an on-site Dale Carnegie course (Effective Communications and Human Relations) and to assist improving people skills. In addition, the technical manager introduced electronic pads for the managers and started working on a software database that could be used to record and exchange information. All of these developments provided a temperate enthusiasm amongst the managers and a feeling of going somewhere; it was apparent that the company wanted to make progress.

A breakthrough occurred when discussing pruning requirements. Pruning affects the volume of fruit, the average fruit size and colour. Usually, orchard managers receive the exporter requirements (fruit size, colour) in December or January (if they receive requirements at all) which is too late because pruning would start in the previous June and hence had to be adapted to the fruit specifications required. As a result of the action research intervention, a meeting was organised with the exporter and as a result the exporter provided specifications in July, thus allowing unpruned blocks to be pruned.
according to fruit requirements. Further improvements included that at the start of 2014, the orchard managers met weekly with representatives of the packhouse, coolstore and exporter to integrate their actions, providing examples of improving flow through coolstore and packhouse.

Themes were identified (table 2) and although the research was not completed at the time of writing this paper, preliminary findings indicate that orchard managers were learning and started to implement Lean thinking, leading to operational improvements. Orchard managers acknowledge that they observe the beginning of a culture change.

Table 2: Emerging themes in the action research orchard

<table>
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<tr>
<th>No.</th>
<th>Theme</th>
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<tbody>
<tr>
<td>1.</td>
<td>Orchard managers had time for Lean during the off-season (e.g. standardisation); their attention being absorbed during the intensive harvest process slowed down Lean thinking</td>
</tr>
<tr>
<td>2.</td>
<td>Orchard managers had a distinct focus on financial indicators rather than Lean indicators</td>
</tr>
<tr>
<td>3.</td>
<td>There was a distinct disconnect between grower and exporter, leading to ill-timed communication (too late) of essential information</td>
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<tr>
<td>4.</td>
<td>Transfer of Lean ideas to seasonal staff required leadership and discipline</td>
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Orchard managers did identify some organic Lean elements: Planting of different varieties to satisfy the mostly unknown customer is not necessarily Lean but does spread the pruning, thinning and harvesting period and so achieves some load levelling. Using certain chemicals, the grower can bring the harvest forward or delay the maturing process, thus delaying harvest, and further levelling the load.

Action research: Packhouse/coolstore

During more than 20 visits to the action research packhouse/coolstore (ARP) company, a gradual understanding started to develop concerning the Lean fundamentals. The ARP was relatively small, with shifts consisting of approximately 50 people of which most were seasonally employed. The season generally started in February and finished in June or July of each year. The permanent employee number was therefore low. This means that the few permanent staff members have all the knowledge and experience and are called upon to resolve multiple issues that arise. They are generally absorbed by running the packhouse/coolstore and find little time to consider philosophical changes.

Consequently, the researcher attended several planning meetings with the manager and his team and partly educated the team on Lean elements. The team would then agree to e.g. look for any form of waste and the findings would be discussed the next week. On several occasions, people had been too busy and nothing had changed from the week before. This was one of the limiting factors. On one occasion, the researcher arranged a visit for the company’s supervisors to a company that had substantially implemented Lean, to observe the concept of stand-up meetings. Within an hour, the attendants had observed three stand-up meetings and reflected on returning that stand-up meetings would be useful and subsequently implemented them. The team did achieve a number of results, mostly in the 5S area and in standardising procedures. The development of simple standardised procedures with pictures of each step (during the ‘off-season’) reduced the number of questions and issues arising during the season.
Several themes were identified (table 3):

**Table 3: Emerging themes in action research packhouse/coolstore organisation**

<table>
<thead>
<tr>
<th>No.</th>
<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>It takes time to transform to Lean, specifically with a seasonal industry</td>
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<tr>
<td>2.</td>
<td>Packing complexities in the industry place high demand on planning and control due to continuous changes and packing multiple products simultaneously</td>
</tr>
<tr>
<td>3.</td>
<td>There is a certain informational disconnect between grower, packhouse and exporter that must be fixed</td>
</tr>
<tr>
<td>4.</td>
<td>Most Lean elements can be applied in a packhouse situation</td>
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</table>

**Case study: Packhouses/coolstores**

Two case studies of packhouse/coolstore companies were included in the study. One organisation (CSP) had employed a manager with Lean experience and had sent several key staff to TQM/Lean introductory workshops. The other organisation (CSPC) had employed a Lean consultant to assist with Lean implementation. These two different approaches offered triangulation opportunities. More than 20 visits in total to these case study packhouse/coolstores provided data. At the request of the organisations, identifying features are generalised.

The CSP packhouse/coolstore drew up its own Lean transformation programme with the Lean packhouse manager being the champion, supported by a senior manager. A number of basic elements were tabled by the champion with target dates for achievement. These included daily stand-up meetings, 5S split up in sequential target dates, Lean thinking training and visual management improvement. The champion reported after a period of approximately a year that staff started to think along the lines of continuous improvement to the point where they would simply effect the improvement and report afterwards.

**Figure 5: Lean assessment before starting lean and at the end of 2013 (Tapping et al, 2002)**

A Tapping et al (2002) Lean assessment before Lean was started and at the end of 2013 showed progress made in terms of lean criteria. Packhouse scores at the start of Lean and at the end of 2013 are shown in figure 5.
A distinct culture change took place in the CSP packhouse and several other Lean champions supported the packhouse manager with the achievement of the targets. A number of interviews showed that despite limited Lean knowledge, key staff were picking up on Lean principles and taking pride in their achievements. At the end of 2013, significant changes had been made during the Lean implementation period. These included improvement of the packhouse lay-out, standardised 5S, leadership group meetings, the beginnings of total productive maintenance, the formation of a skills matrix, standardising and various others.

The researcher had made a number of photos at the start of his research and found that visual management and 5S had improved substantially. It also appeared as if the packhouse operated with less tension. Both the packhouse manager and several of the interviewed supervisors agreed that there had been ‘a bit of a culture change’. Several supervisors displayed a composed enthusiasm for the developments within the company.

The CSPC packhouse followed the programme of the Lean consultant. During the year, the consultant visited once each month for several days and combined ‘walking-around’ with training sessions, education, tasks set to achieve before the next visit, before and after photos and value stream mapping exercises.

The consultant was new to the industry and adapted to the specific environment during the process. The consultant provided a number of tools during each visit and reinforced tool use where necessary. He provided consistent reports after each visit, highlighting all individual observations, including celebrating the positive outcomes but also subtly expressing areas of concern. In this sense, the consultant was an external champion who gradually became accepted as an internal champion. The consultant company provided a plan to gradually release the company to its own implementation process by reducing the number of visits.

During an open day in 2013, organised by Pipfruit NZ Inc., the general manager presented the fact that it had not all been easy and that he expected the process to be ongoing without end. He presented a graph (figure 6) of the labour cost to pack a carton which showed that the company was reducing its cost in 2013 to levels experienced in 2007. With increasing wages over that time, this appears to support the effectiveness of Lean. The general manager explained that he could not quite empirically attribute the lower cost to Lean but that Lean was the only change they had made; the transformation through Lean appeared to create financial results.

Themes identified included:

<table>
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<th>No.</th>
<th>Theme</th>
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<tbody>
<tr>
<td>1.</td>
<td>It appeared at times difficult to achieve Lean methods and use the tools; there were periods when it appeared too hard</td>
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<tr>
<td>2.</td>
<td>Packing complexities were unknown to the consultant and proved to be challenging</td>
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<tr>
<td>3.</td>
<td>The packhouse environment was clean, tidy and staff experienced significantly less stress</td>
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<tr>
<td>4.</td>
<td>A number of Lean elements were applied in the packhouse situation; all the beginnings of a culture change were present</td>
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Financial indicators
All three packhouses provided financial data to assist determining if progress had been made. The orchard was not asked for financial indicators. Working in the industry, the researcher is aware that most NZ pipfruit packhouse operations have excellent database systems to provide for market access, quality and traceability. Linked with these systems there is often an abundance of financial indicators, mostly based on traditional cost accounting.

![Graph showing wage costs per carton packed]

Figure 6: Wage costs per packed carton (Graph provided -sic- by case study organisation)

Two packhouses provided ‘labour cost per bin packed’, while one packhouse provided ‘labour cost per carton packed’. The data that were provided may only be seen as indicative because both bin labour costs and carton labour costs depend on seasonal influences such as fruit size, colour and quality, and are affected by wage increases. Traditional cost indicators are not Lean indicators because of these confounding factors. A company could have improved its efficiency and effectiveness, but have deteriorated financially due to e.g. minimum wage rises. Nonetheless, the data are not counter-indicative to earlier presented Lean progress findings and in fact correlate with Lean progress; they are presented as illustration only.

Case study: Exporters
The study’s purpose required a representation of the industry; exporters presented a relevant component of the within-industry supply chain but no exporter responded to the initial request for participant companies. In May 2013, the situation was discussed with Pipfruit NZ Inc., the industry’s governance body, and a decision was made to approach a number of suitable and representative exporting companies direct. Most of the selected top fifteen exporting companies which had not responded earlier were shortlisted and approached using emails, phone calls and personal meetings to explain the purpose of the research project and attempt to diffuse any concerns that might exist.
Most companies declined or did not answer. Reasons for not participating were quoted as being too busy and not wanting to share information. One company agreed to participate conditionally, while another agreed to be interviewed but would not allow the researcher to interview or observe any team members as they would be too busy.

The researcher proposed to include limited case studies in the future to at least explore some of the exporter functionality within the supply chain.

**Discussion**

Results show that NZ pipfruit organisations are generally unaware of Lean principles methods and tools, or are using these relatively sparsely. Does this mean that Lean simply does not apply to this horticultural industry or does it mean that the industry, despite its competitive standing (World Apple Review, 2013), has no interest in the translation and implementation of proven business paradigms? Some of the organically developed methods such as e.g. stretching the harvest period forward and backward to reduce overburdening appear to be fitting the Lean paradigm. An appropriate explanation for its standing in the world may be offered by the fact that the industry has been assessed as innovative, but more through the introduction of technology than through people and process management (Doevendans, 2010).

Although neither case studies nor action research was completed at the time this paper was written, there are a number of findings at the end of the first complete season of the inquiry that are significant. Measurements showed that the research organisations had developed Lean knowledge and had implemented a reasonable level of Lean within the research period. The research organisations demonstrated common experiences that it was not easy to implement Lean. A number of the interviewees across the research companies indicated that since the implementation of Lean, they felt better prepared, experienced less stress and generally enjoyed work more. These observations are positive indicators of the effectiveness of Lean.

The distinct difference between a machine and a tree is the level of variability to which the tree and thus its crop is exposed. Contemporary research has investigated how the variability in tree crop production can be reduced by using different growing systems (e.g. Robinson et al, 2013). Other studies show that variability can be reduced regardless of growing system (e.g. Brookes, 2013). These developments are based on growing- and management design with reduction of waste in mind, and may well point towards a direction for the Lean way forward.

Of concern is the fact that initially no exporters could be found to participate in the research project, and that personal approaches by the researcher were required to entice two out of over-eighty exporters to be prepared to take a restricted part in the research project. This leads to the inference that exporters have no knowledge and/or no interest in Lean or value stream management. The response to the questionnaire shows that there is no focus on value stream management across industry; organisations are focussed on monetary returns and cost factors within their organisations. The restrictions imposed by the two exporters that eventually were prepared to participate in a mini case study were indicative of the perceived commercial sensitivity (i.e. high) and the relevance attributed by exporters to the value of the research project (i.e. low). When combined with the fact that the orchard group would not have the necessary information from the exporter to start the growing season by pruning towards customer demand, there can only be the supposition that there is waste through ignorance in the industry value stream. This despite best intentions from stakeholders (Doevendans, 2010).
There is little incentive in the industry to consider implementing the Lean paradigm. Exporters have little financial investment; they do not purchase the crop, they merely handle the crop. They will receive commission depending on volumes and returns. The risk that exporters are exposed to is low. A concern is the competition between exporters for market share. The sheer increase in number of exporters since deregulation (Doevendans, 2010) from one to over ninety has led to major disruptions in both supply and value chains and has shifted focus away from value streams. It appears that there is a certain extent of destructive behaviour within the industry and that the industry has not yet matured enough to address the industry value stream cohesively.

**Conclusion**

Within the NZ pipfruit industry supply and value chain, stakeholders have little understanding of Lean principles, methods and tools. The industry is technically innovative (World Apple review, 2013) but appears to have relatively little knowledge of Lean management. In an industry dominated by manual labour (Doevendans, 2010), one could expect that more attention would be placed on the creation of flow and reduction of waste in the internal value stream processes. Similarly, the industry value streams could be expected to be improved. From the findings described, it appears that those organisations engaging in Lean are making progress, both in waste reduction as in creating better flow in the internal value stream. There are few indications of value stream improvement within the whole of the supply chain.

The disconnect between the final station of the on-shore supply chain, the exporter, and upstream elements, particularly the grower is concerning. In a Lean supply chain, supply chain elements work together to remove waste from the value stream, particularly where fluctuating demand and level scheduling meet (Naylor et al, 1999). Supply chains compete, not individual companies (Christopher & Towill, 2001). There are no indications that this principle is understood in the NZ pipfruit industry.

The case study and action research companies involved in this study each made significant progress during the course of the first 1 ½ years. Importantly, all four research companies displayed internal qualitative improvements. This means that more progress can be made in the future. However without involvement of the entire direct supply and value chain stakeholders, management of the value stream to ‘Lean up’ the supply chain cohesively, will be limited.

**Relevance/contribution**

Lean has not been implemented in many horticultural organisations nor in the NZ pipfruit supply chain. If Lean can be made to work in a horticultural setting, it may contribute to achieving the ambitious targets set by governments and industry bodies.

**References**


Pollard, 2013. Presenting the strategy for Pipfruit NZ at the annual Pipfruit conference in August 2013.


