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A Learning Model of Technology Transfer for the Kiwifruit Industry

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Summary

In July 2003, ZESPRI International merged the Technology Transfer team that had historically been focused on achieving uptake of new technologies with ZESPRI Innovation, the team that had been responsible for the development of new technologies. This change has combined skills in research, development and extension into a single, co-ordinated grouping to improve grower profitability through a greater contribution to supply chain developments and grower learning.

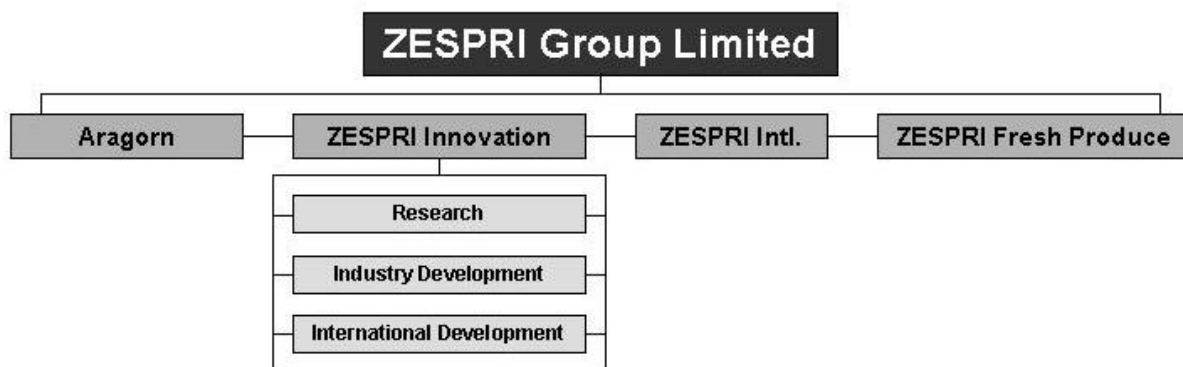
The Industry Development strategy of ZESPRI Innovation is based upon a model of industry learning. The model takes into account the needs of a range of stakeholders in the supply chain, the technologies, the necessity for the industry to have clear market signals, and the different learning styles of growers. Applying the model will involve ZESPRI staff in traditional industry development events such as field days and industry development communiqués (e.g. newsletters) and a website, together with new technology development projects e.g. monitor orchards and “industry is the lab” projects.

ZESPRI Innovation is moving beyond a historical “recipe-based” approach in technology transfer, to one that empowers industry participants to make effective commercial decisions based upon their own learning and knowledge. The application of developments in learning theory is an important component to the new strategy and to its on-going development.

Background to Industry Structure

ZESPRI International Ltd. is a custom-built, consumer-driven, grower-owned company dedicated to the global marketing of kiwifruit. It markets to over 70 countries and has a number of offshore offices. The ZESPRI brand was launched in 1997 and the company corporatised in 2000 at which time ZESPRI Innovation Company Ltd. was formed. Since then a number of other subsidiary companies have been formed (Figure 1) which include ZESPRI Fresh Produce, responsible for developing and sourcing 12 month supply from offshore suppliers, and Aragorn, which is responsible for developing and marketing processed kiwifruit products.

Figure 1. ZESPRI Company Structure



Historical Approach and the Need for Change

The Kiwifruit Industry began with a commodity product. In the early stages, it was competing with other sub-tropical fruit such as citrus fruit. At that time marketing was based on the unique properties of kiwifruit (Earp 1988) with new technologies and management practices tending to be universally applicable to most orchards. With time, the marketing of New Zealand kiwifruit changed from selling a commodity product into the marketing of a specialist or niche product. Now, ZESPRI has developed a lifestyle brand with unique characteristics distinguishing it from all other kiwifruit. The brand's characteristics are its vigour, health, effervescence, nutrition, zest, fun, life and energy (ZESPRI 1997) and more recently an emphasis on taste with the introduction of the Taste ZESPRI™ programme.

At the time the kiwifruit industry was establishing and beginning to supply overseas markets, the New Zealand government had followed the British model of establishing research stations linked to government controlled, extension services. During the 1940s, the kiwifruit industry was developed by farmers who liked growing the plants and had a vision for its potential as a uniquely New Zealand sub-tropical fruit. Growers learnt how to grow and manage the vines and harvest and grade the fruit through their own practical experience. This experience was openly shared by the farmers who initially established plantings, and later as the industry expanded, by people who often only had a limited background in agriculture. The export market was established early on by the opportunistic activities of innovative growers and fruit exporting companies. Figure 2 follows some of the significant changes in the industry. This ranges from the initial commercialisation, a name change from Chinese Gooseberries, to the industry expansion as overseas markets grew. The industry has always been concerned about the necessity (or otherwise) of centralised planning.

Figure 2. Timeline for the Kiwifruit Industry and Extension Activity

Kiwifruit Industry Development	first commercial export sales of Chinese gooseberries	change to kiwifruit name	export expansion	research capability established, government advisory service	Kiwifruit Authority	industry restructuring, Zespri established	GOLD fruit orchards	???????????
	1940	1950	1960	1970	1980	1990	2000	2010
Research & Extension Developments	growers, practical experience		subtropical Hort. Advisory Officers product specifications	specialist Hort Advisory Officers production	specialist Hort advisory Officers,	ZESPRI, brand establishment, industry took over extension	industry re-organisation	???????????

As the industry grew, an export promotional committee was established and voluntary levies were obtained from growers for its activities. Later, the Kiwifruit Authority was established to replace the Committee, and the levies became compulsory. More recently, ZESPRI has replaced the Authority, and a branded approach taken to marketing, to reduce the effects of overseas competition and commodity boom-bust cycles (ZESPRI 1997).

Later, as the industry expanded even further, government advisors became involved. To start with, they had to use information they had obtained from other subtropical crops as the basis of their advice. They added to that by learning from the practical experience of leading growers. In the 1970's, professional researchers at government-run research centres started to become involved with the industry. They were able to study the reasons 'why' things happened as well as 'what' things happened. This extra understanding meant that the industry's extension arm were no longer restricted to information based upon observation; they could also provide advice based upon inference and conceptualisation, i.e. using their understanding to explore situations beyond the industry's current practice.

By the 1980's, consultants and extension agents were moving from advising on kiwifruit practices that focussed upon increasing yield to advising about all issues in kiwifruit management decision making for improving grower profitability. This meant that advice had to be customised to reflect the conditions of individual properties rather than being general grower practices that could be applied universally. In the middle of the 1980's the government's extension services, and later their research services were restructured as fully commercial organisations.

Before its merger with ZESPRI Innovation, the Technology Transfer team provided growers with advice about best practices based upon industry standardised recipes. Two successes in this approach have been the introduction of KiwiGreen, an Integrated Pest Management (IPM) crop protection programme, and the commercialisation of Hort16A, the gold-fleshed variety.

To meet rapidly changing market demands and remain economically competitive, the industry has to consider how to develop and adopt technology more rapidly and in more complex areas (eg. Taste ZESPRI™). The “one shoe fits all” approach is unlikely to be successful in this new environment and the approach taken to industry learning has had to be adapted to empower the industry to help itself. A recent Innovation workshop on industry development revealed that a number of agricultural industries both in New Zealand and Australia were adopting an approach in which industry development specialists worked within the supply chain to foster and facilitate the generation and transfer of information.

The New ZESPRI Plan for Technology Transfer

Only by continually innovating and developing the value proposition of its products, in the eyes of consumers, can ZESPRI stay ahead of the competition and maintain, over the long term, the premium that it returns to New Zealand growers. New Zealand kiwifruit growers have used the centralised marketing structure of their industry to manage the development and promotion of innovation amongst growers and between growers and research agencies. This approach builds upon the early history of government funded research and extension for horticultural industries by providing a more commercial focus and greater industry accountability.

The vision of the new Innovation team in ZESPRI is to achieve a consistently superior quality product, underpinned by continuous innovation in the ZESPRI™ System, as the basis for developing the value potential of the ZESPRI™ brand.

Identification of knowledge requirements

With a very large array of opportunities for innovation and limited resources to encourage innovation, it is important that the Innovation team focuses resources on appropriate targets. These relate to:

- Grower capacity to produce fruit with desired product attributes (e.g. taste, shelf-life, integrity of the production system, pest-free) that maximise in-market value
- Supply chain (on-orchard and postharvest) capabilities to improve the industry’s ability to deliver a desired product at reasonable cost.
- Having new vines bear quickly for growers producing high yields of good sized fruit with a good grade-out.

Currently the Innovation Team’s research portfolio includes activities that are categorised into eight outcome areas:

- Early Fruit
- Long Storing Fruit
- New Cultivars
- Optimised Fruit Size and Yield
- Taste ZESPRI™
- Market Access
- Processed Products
- Year-round Supply

ZESPRI Stakeholders

One of the key functions of the Innovation team is to work with stakeholders to identify, evaluate and select opportunities for investment of resources. Stakeholder input is sought from workshops held with the Innovation Advisory Board and key industry groups. These include the three ZESPRI Product Groups, GREEN, GOLD and ORGANIC, NZ Kiwifruit Growers' Incorporated (NZKGI), supplier entities, and Hort+Research, the industry's major research provider.

Key targets are identified in each outcome area and then various pathways are developed which offer ways to achieve the target. A number of factors are used in choosing the optimal pathway(s) where resources will be focussed. These include probability of success, cost, delivery time, impact on the business, risk etc. The implementation of new technologies will clearly be influenced by factors such as financial benefit to the stakeholders, cost, complexity and labour/skills required.

Generating, Communicating and Adopting New Knowledge and Tools

Industry innovation requires encouraging people to identify and implement the new knowledge created by their peers or other supply chain participants (Paine 1996). The activities of the ZESPRI Industry Development team within Innovation provide learning packages and new management tools to assist people in these processes. The Innovation team needs to support the development, adaptation and application of technologies to achieve targets within the eight outcome areas and address the needs of all the stakeholder groups (Table 1).

Table 1. Stakeholder groups for ZESPRI Innovation

Operational Environment	Stakeholder Group
Internal to ZESPRI	Marketers Operations
Kiwifruit Supply Chain	Growers Postharvest operators Shippers Off shore ZESPRI Wholesalers Retailers Consumers
Allied Product and Service Industries	Research providers Consultants Fertiliser and chemical companies

The Innovation team needs to provide:

- Leadership and forums to support detailed scientific knowledge and industry experience to be brought to bear on key industry issues
- An auditing function to ensure that the knowledge disseminated is correct or effective
- Tools and systems that enable supply chain participants to input and interpret the data flowing through their operations

- Communication channels through which data, information and debate can flow
- Technical support for developing the incentive frameworks required to motivate delivery of superior fruit
- An effective evaluation process.

Two very different approaches are used by the team to encourage and support industry innovation. At one end of the innovation spectrum, industry learning approaches are very linear. Targeted research projects, which are usually contracted, deliver outputs that are communicated to passive recipients. At the other end of the spectrum lies the networked mode of learning (or Industry is the Laboratory) where the industry itself provides the context for ‘on-the-job’ learning in which informal processes provide diverse amounts of information via a range of media to individual decision makers.

The linear innovation process, of separately developing technologies for implementation in the supply chain, will continue as there is value in conducting research and development in an environment that is freed from the constraints of commercial fruit production and delivery. It enables a strong focus on straightforward questions, tending to deliver uncomplicated answers with a limited range of direct applicability (Parminter and Parminter 1994).

A practical example of this is the ready-to-eat (RTE) programme, in which fruit are treated with ethylene or temperature to soften fruit to eating firmness prior to retail delivery. The programme has significantly increased repeat purchase rates in markets where it has been implemented. It involves relatively simple procedures where science has provided treatments that can be applied to fruit of a known maturity to provide a known result, with little variation or need for interpretation.

The “Industry is the Laboratory” approach facilitated by the Innovation Team compliments the linear process described above by fostering opportunities for communal styles of innovation. In this model, the process of innovation remains integrated within industry activities, and replaces linear-style research and technology transfer with a mixture of leadership and facilitation. In the “Industry is the Lab” approach, innovation occurs as a result of continual application of the learning cycle by all participants in the system (Coutts 2003).

Real learning is not just about acquiring information but about engaging with it so it not only affects your thinking but your behaviour. This can be encouraged by facilitating four parts to the learning cycle.

1. Experiencing or doing
2. Reviewing
3. Concluding
4. Planning

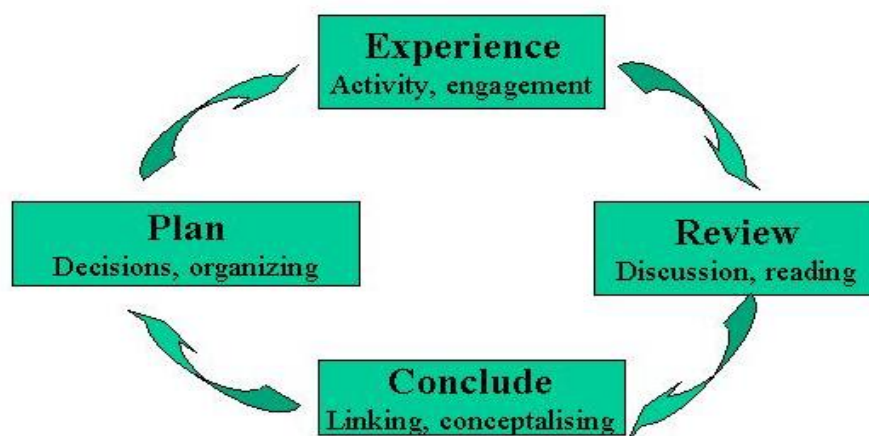
Since learning is an ongoing process it can be seen as a continuous cycle (Fig 2). Most people are more comfortable in one or two parts of the cycle than the others, but to maximise the learning effect it is important to engage in all stages of the cycle.

The Learning Cycle can be demonstrated reflecting on the industry's need to gain a better understanding of changes in Hort16A (ZESPRI Gold) fruit flesh colour. Over a three year period, the Innovation team has devised and implemented a Colour Index that provides the basis upon which decisions are made about when to begin harvest. The goal is to ensure harvested fruit will have a consistent golden colour when they are delivered to the market. The Colour Index takes account of both the average and variability of fruit colour in lines of fruit. This concept is new to the industry and core to its function because delays in harvesting have significant financial logistical impacts. The Innovation team has developed a package of technical and communication initiatives to maximise the industry's ability to cope with these diverse changes. One component of this was to develop a low cost, accurate way to measure flesh fruit colour as the only other device available was a \$20,000 chromameter.

Experience

Twelve desktop colour scanners were trialled in the various packhouses. Staff gathered samples and trialled the technology. They learnt about fruit colour by cutting fruit, seeing the colour measurements the scanner generated and how different values for fruit colour affected the Colour Index.

Figure 2. Learning Cycle for 'Industry is the Laboratory'



Review

In teaching others in scanner operation and in identifying problems, discussion occurs among packhouse staff, other users, and Innovation team members. The next stage of learning is occurring here, as people review and reflect upon other related information they have come across, in Kiwifruit Journal articles for example.

Conclude

People who enjoy conceptualising prefer the next stage of the learning cycle. This is where connections are made between the ideas and experiences they have had. Reasons for problems that arose with calibration against the chromameter were found to be due to variation in the thickness of skin removed prior to scanning. For this conclusion to be reached, the staff had to have known about the way fruit colour

changes close to the skin and the ability of the slicer to produce consistent slice thickness.

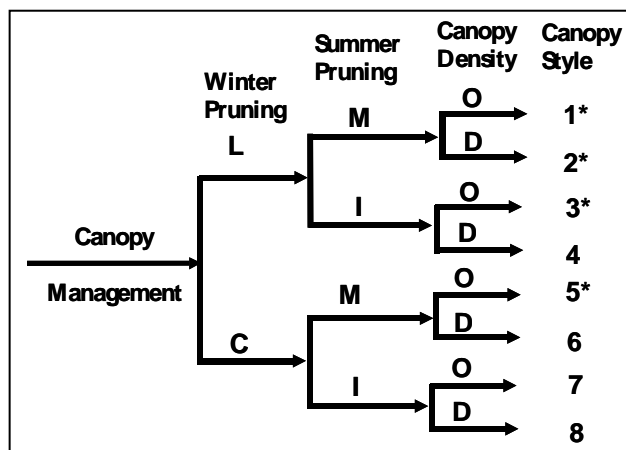
Plan

The most empowering stage of the cycle is where we look to make improvements from what have learnt in the preceding stages. Future actions are modified and decisions on how to do things differently next time are made. Using the simple slice thickness example, measuring the effect of different slice thickness with callipers and comparing the results would occur. This rolls into the Experience part for the cycle, starting the whole process again.

The contextual learning provided by this model is highly effective in generating knowledge in its participants. It is analogous to the Technology Development model referred to by Coutts (2003). In this approach, the role of the Innovation team is to continually engage supply chain participants in projects that would generate new knowledge about growing and delivering superior fruit to consumers. This applies most particularly to growers who are responsible for building desirable attributes into fruit through superior production practice.

A further example of the “Industry is the Lab” approach is a recent project that looks at orchard factors that influence the taste of fruit and thereby the desirability of fruit to consumer. Fruit taste is known to be strongly influenced by its dry matter content. An assessment of canopy composition on 30 Hayward grower properties identified several canopy styles associated with higher fruit dry matter outcomes (Figure 3). In this example, the concept of using orchard-derived data to identify potential improvements to growing practice on one group of growers can be further developed and validated with further groups of growers.

Figure 3. Canopy Assessment Methodology



This model is already being piloted with groups of growers from two Suppliers. If successful, it could usefully be extended to include much larger numbers of growers who would collect a simplified array of data that relates to their own orchards. Such data can be fed into a web-hosted database, providing access for growers to benchmark their own management practice. In this way, growers would be directly

empowered to take innovation into their own hands, and have a direct opportunity to understand and manage the implications of implementing new technologies on their own orchards. At the same time, the large volumes of data made available through the databases would enable the Innovation team to continually update and enhance the models being used. In this way, the activities of the Innovation team would become involved with those of the industry through a series of projects focused on areas of identified potential, generating a seamless integration of supply and innovation activities.

Channels for Communicating Information

Maintaining a diverse range of Industry Learning media is critical to reaching participants with different learning styles and for reinforcing messages by ensuring that they are received via more than one media (Parminter 2002).

The historical Tech Transfer team used a variety of forums through which to share information. These included field days, seminars, technical bulletins, manuals, videos, web site and personal contact. Recent kiwifruit industry surveys indicate a high level of satisfaction with industry Field Days and KiwiTech events. It is important to maintain a baseline component of these events to retain stakeholder satisfaction and to build upon their proven effectiveness in delivering industry development outcomes in the past. However, the adoption of a more learning type of approach has resulted in the format of some events being changed to encourage opportunities for greater learning (Table 2). This new approach still provides a range of channels through which to encourage industry learning and innovation including:

- Specifically designed training events such as seminars, field days and workshops.
- Committees and project teams charged with responsibility for achieving particular outcomes.
- Widely distributed information made available through journals, fliers and websites.

Industry Development Events

The role of the Field Day programme has been to take grower-related issues to an orchard environment where orchardists feel comfortable and are able to discuss key issues with a practical production focus. The opportunity to view one another's properties, interact with an array of people, including industry consultants and ZESPRI staff, has proved very popular. While increasing attendances nation-wide have been pleasing, large group numbers have hampered the effectiveness of two-way discussion. It is also difficult to cater to all knowledge and skill levels of participants at such events, resulting in some frustration for more progressive growers. The number of field day events at each round has been increased to assist in reducing group size and encouraging more interaction between growers and invited participants which include high performing growers and technical experts.

Kiwitech Seminars are also held throughout the major growing regions, usually twice a year. There are forums where presenters update the industry on new research findings or topical issues. Recent changes have seen this information become available to the whole industry rather than just technical representatives and industry consultants. This change occurred because of grower concern that information was not flowing through to them effectively.

Table 2. Channels for Proving Kiwifruit Industry Learning and Innovation

Channel	Purpose	Examples
Industry Development Events: <ul style="list-style-type: none"> ○ Seminars and Forums ○ Field Days ○ Workshops 	For a wider scale exchange of ideas, presentation of models that provide the frameworks within which individual chunks of information will develop meaning for stakeholders	KiwiTech and Crop Protection Seminars, GOLD, GREEN and Frost Field Days
Industry Development Communiqués: <ul style="list-style-type: none"> ○ Journal articles ○ Bulletins ○ Handling guidelines and manuals 	Blanket coverage for key information, models and guidelines Ready access to facilitate effective learning	Hort16A Technical Advisory Notice Cane girdling bulletin Pruning video
Website: <ul style="list-style-type: none"> ○ Industry data ○ Innovation Library ○ Production summaries 	Database development, analysis, and interpretation	Benchmarking tools, and metrics
Technology Development Projects: <ul style="list-style-type: none"> ○ Focus orchards ○ Discussion Groups ○ Industry is the lab projects 	Contextual learning Conduits for facilitating transfer of ideas, feedback and development of mutual awareness and understanding	Growing high dry matter fruit, packhouse processes, inventory management and pest free fruit

Industry Development Communiqués

KiwiTech bulletins, guidelines and videos will continue to be developed and updated as industry feedback indicates the need for information or to report latest research findings in grower-friendly language.

Web Site

The Innovation website is used to provide current copies of all KiwiTech Bulletins and Field Day / Seminar Handouts. The web site is gradually being built up to provide abstracts of all previously funded projects and complete reports for more recent projects. The site is being developed to provide tools that will entice growers to it so they can experience the benefits of the web. To date, 12 different calculators have been developed that enable growers and packhouse staff to estimate such things as Maturity and Dry Matter Indexes.

Technology Development Projects

Focus orchards have been identified as a useful tool to provide an opportunity for hands-on exploration of alternative orchard management techniques in addressing a wide range of technically based opportunities. The core principle of the concept is to work with a group of growers assisted by a facilitator, a technical consultant and accounting support, to assist the orchardist in making management decisions through a number of seasons. By tracking of costs and income, participating growers are provided with an excellent learning environment for issues in orchard performance

and profitability. From a supplier perspective this represents a highly visible and effective way to enhance Orchard Gate Return of their grower clients. It also provides a co-branded opportunity for innovation activity with ZESPRI.

We propose to trial this concept in a pilot project initially by engaging some suppliers in identifying suitable properties, drawing the groups of growers together and providing much of the communication among participants. ZESPRI Innovation would provide, through team members seconded from Hort+Research, a framework for developing this approach, coupled with data analysis capabilities that would support the exchange of processed information among Suppliers.

Conclusions

There is substantial value for ZESPRI in providing an effective innovation framework for the industry. By ZESPRI Innovation providing continuous innovation into the ZESPRI System, the ZESPRI brand value can be maximised. ZESPRI Innovation is adopting a stronger industry learning style approach into its industry development function. This includes changes to existing programmes as well as new initiatives such as “The Industry is the Laboratory” projects. These changes will improve growers’ ability to produce fruit with desired market attributes and increase the supply chain’s capacity to supply a desired product at reasonable cost.

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