

Adding Value in Viticulture

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Abstract

Successful growth of the Australian wine industry has followed a classic value-adding model. In 1985 bulk wine represented the majority of wine exports; high value-added bottled wine exports now represent over 90 per cent of sales by value. A quality, branded image product with a retail/export value about 5 times the farm-gate price is created from winegrapes using professional skill and purchased inputs. Opportunities for further growth, underpinned by innovation in viticulture and natural advantages, have been identified in a rapidly changing global scene and against significant international competition for export markets. This paper describes key viticultural innovation and adoption strategies.

Introduction

Viticulture in Australia contributes to three products: dried vine fruits, table grapes, and wine. The total export value of each product group in 1998/99 was \$37m, \$69m and \$991m respectively. Grapes are produced in each State from a total area of 122,915 hectares.

Winegrapes account for over 78 per cent of Australia's grape production. Wine exports have risen from a modest \$98m in 1987-88 to \$1,000m in 1999/2000 at a compounding growth rate of more than 20 per cent per year in value (Anderson and Berger 1999). This success has been achieved by following a classic value-adding model. Whereas a decade ago bulk wine exports represented the majority of wine exports, high value-added bottled wine exports now represent 90 per cent of sales by value. A quality, branded image product with a total retail/export value at about five times the farm-gate price of winegrapes is created from an agricultural commodity using professional skill and purchased inputs. This generates domestic wine tax revenue of over \$600m, additional to company taxes and employee personal taxes. According to the 1996 Census there were almost 16,000 Australians employed in 1000 wineries and 50 grapegrowing regions throughout Australia. Considerable further growth has occurred since 1996. In addition, it is estimated that casual and part time employment adds a further 3500 full-time equivalent jobs. It is estimated that an additional 40,000 jobs are generated in support industries such as wholesaling, retailing, transport, research, education services, packaging and tourism (Winemakers' Federation of Australia 1998).

Innovations in viticulture and wine processing technology have been key factors supporting the growth of the industry, and Australia is internationally recognized as being at the forefront of such innovation. Opportunities for further growth have been identified but in a rapidly changing global scene and against significant international competition for export markets. An easing of the price of winegrapes in the short term is expected to increase the competitiveness of exports. Within a broad industry context this paper describes the key viticultural innovations and the adoption strategies that are expected to equip the industry to meet the wine industry's challenging growth targets, and to add value to other sectors of the viticultural industry.

Adding value

The Australian wine industry takes \$800 million worth of grapes and turns them into \$3 billion worth of wine in wholesale sales, generating well over \$4 billion in retail/export sales (Dept. Industry, Science and Resources 1999). In other words, the industry adds significant value to grapes, the cost of which represents about 4 per cent of the cost of a bottle of premium quality Australian wine (Spawton and Forbes 1997). With quality defined as 'suited for a purpose', the general strategy of the wine industry is to raise quality at every price point to increase value for money for consumers. The value function is a useful approach to describe the relationship between the key components of value. It distinguishes between two aspects of quality.

$$\text{Value} = \frac{\text{Intrinsic Quality} \times \text{Perceived Quality}}{\text{Cost}}$$

Product value is directly proportional to both the intrinsic qualities of a product and its perceived quality i.e. image, and is inversely proportional to its cost. This semi-quantitative construct provides a framework from which we may view the relative abilities of the Australian wine industry to provide value to wine consumers.

Intrinsic quality

Australian wine is recognised for its consistent quality at all price points. This is attributed largely to grape quality and relies on technical leadership in vineyard management and winemaking technology. Indeed the position of international competitors in wine has been strengthened through the adoption of Australian technologies. Features of Australian viticulture and winemaking related to intrinsic wine quality include:

Grape quality

All of the popular grape varieties of international commerce are grown in Australia and the relatively warm, dry climate is well suited to ripening of fruit suitable for all internationally popular wine styles. There is a relatively low incidence of quality-deteriorating diseases and in consequence compliance with international limits on agrochemical residues is readily achieved.

Product consistency

Meeting intrinsic quality specifications for wine products is facilitated by the absence of restrictive controls on grape sources and blending.

Product range

Opportunity does exist to increase the range of wine products through an increase in the range of grape varieties. Most significantly, the quality of existing products may be enhanced by the ability to define, measure and specify grape quality attributes and thus send clearer signals to grape producers. Similarly the reduction in the variability of vine performance within vineyards and/or segregation of grape batches according to quality specifications will allow value-adding through segregation according to product price points.

The key to enhancing intrinsic quality is the development of responsive management systems.

Image

Perceived quality or image is a most important component of adding value, particularly in distinguishing between a commodity and a high value product. The contribution of technical expertise to product image often tends to be underestimated but in many aspects the contribution of science and technology in supporting image-related concepts can be very significant. Some important aspects of image that are important to the Australian wine industry include:

Product purity

Australia has a sound reputation for 'clean, green' wine products well within international limits of purity. This reputation is highly valued by the consumers and is protected by the industry through strict codes of practice.

Environmental ethic

International concern for the environment and the impact of industry is being rapidly reflected in the value that consumers place on producers who demonstrate responsibility for the environment. Wine producers recognise this concern and are embracing environmental management systems to avoid environmental impacts and protect the image of their products.

Gene technology

The Australian industry's position in respect to gene technology is that no genetically modified grapes or yeasts are used in the production of Australian wines. There will be no commercial use of genetically modified organisms to produce Australian wine until it is clear that they are safe, of high quality and beneficial to consumers.

Geographical Indications

The Australian wine industry has only recently embraced a system of branding by geographic origin. This approach has long been recognised by traditional European wine producers as a very significant way of adding value. A significant challenge to the adoption of such systems is to credibly inform consumers without imposing innovation-constraining limits.

Persona of the Australian winemaker

In international markets Australian winemakers are generally recognised as being approachable, friendly and technically competent in discussing the attributes of wines. This feature is valued highly by wine consumers who are keen to be knowledgeable about this complex product.

Terroir

The concept of 'terroir' is used by the French to describe the contribution of vineyard site-related features to the unique character of the wine. In effect the term reflects the total contribution of local ecosystem. Though largely immeasurable, this can be a powerful tool in product differentiation. This aspect is likely to become increasingly important as producers seek to differentiate themselves in a crowded market.

Costs of Production

Major viticultural production costs may be ascribed to availability of natural resources, the intrinsic characteristics of grapevine germplasm and the control of pests and diseases.

Natural Resources

To ensure long term natural resource supply and cost competitiveness, the Australian viticultural industries must accelerate the adoption of environmentally sustainable policies and practices. Environmental sustainability not only provides a secure production future for the viticultural industries and guarantees current investment trends; it will also attract significant consumer support and lead to commercial stability.

Traditionally viticulture has been based around small plots. Large tracts of flat land are needed to achieve economies of scale and international competitiveness.

Australia is well endowed with cheap land and suitable soils. Vines will flourish on a wide range of soils, some of which are not well suited for other forms of intensive agriculture.

Water resources are not expected to restrict expansion toward industry targets. However, efficient water use and effective salinity and soil water-table management are critical to the long-term viability of irrigated vineyards.

Grapevine germplasm

Notwithstanding that the vine itself is remarkably adaptable, it is recognised that grapegrowing in Australia is based on an introduced plant that is not specifically adapted to the Australian environment. An opportunity exists to develop grapevine genotypes with specific quality attributes, resistance to pests and diseases, salt tolerance and greater water use efficiency.

Pest and disease management

Australian viticulture takes place in climatic conditions that are relatively unfavourable to common diseases of the grapevine and with freedom from some of the most devastating pests and diseases of grapevines elsewhere. These factors significantly contribute to the competitive cost structure of the industry.

A cohesive industry, Strategy 2025 and the CRC for Viticulture

The single, most important advantage that the Australian wine industry has over its international competitors is its national unity in terms of strategic planning, regulation, sharing of knowledge and international promotion. The Cooperative Research Centres initiative of the Commonwealth Government in the early 1990s provided the opportunity for the industry to include the direction of research and development and education to those elements of national unity. The subsequent establishment of the Cooperative Research Centre for Viticulture (CRCV) in 1992 initiated this national collaboration.

In 1995, a comprehensive analysis of the whole industry based around the value function and coordinated by the Australian Wine Foundation led to the development of the industry's 30-year plan, Strategy 2025. Strategy 2025 provided a broad national blueprint for progress toward the target of \$4.5 billion in annual sales by 2025 by being the world's most influential and profitable supplier of branded wines, pioneering wine as a universal first choice lifestyle beverage.

The industry's success in 1999 in attracting a further 7 years' support for a new CRCV, with its significant financial inducements, and with the strong support of the Grape and Wine Research and Development Corporation, has enabled it to focus its resources and those of the key providers of viticultural research and development and education toward a common vision of outcomes. Addressing key technical and educational objectives of Strategy 2025 and issues in common with the dried vine fruit and table grape sectors the wine industry now has, in the CRCV, a national, industry-driven research, development and education program to focus on generating required scientific knowledge and to enhance the application of that knowledge in technological innovations. Combined with the required commitments of cash and in-kind contributions from all participants in the joint venture the Commonwealth funding will provide for an industry-driven program of research and education amounting to \$63m.

Objectives of the CRCV

The aim and objectives of the Cooperative Research Centre for Viticulture are to:

Accelerate quality viticultural management from 'vine to palate', ensuring the economic and environmental sustainability of Australia's grapegrowing industries through nationally integrated strategic research, proactive technology diffusion and education which:

- § develops and promotes innovative viticultural practices which will improve grape qualities;
- § develops and promotes environmentally and economically sustainable vineyard management systems;
- § develops and promotes genetically improved grapevines for quality production and sustainable management;
- § expands the professional skill base of the viticultural industry from researchers and technologists to vineyard and winery workers; and
- § consolidates a cooperative research and education culture leading to an enduring industry -funded facility based on the CRC model.

The CRCV has three research programs and an innovative education program designed to deliver the knowledge generated from research into all streams of education and training for the viticultural industries i.e. tertiary, vocational, workplace and professional development. Scientific research and development are focussed on three major areas, namely: vineyard management to meet grape quality specifications, sustainable vineyard systems, and molecular improvement of grapevines.

Vineyard management to meet grape quality specifications

The aim of this program is to develop measurements and vineyard management techniques to meet grape quality specifications.

The expected outcomes are:

- § reduced variability in grape intake loads through the application of precision viticulture technologies;
- § the capacity to specify parameters of grape colour, tannin and flavour;
- § rapid instrumental techniques for the measurement of grape quality parameters; and
- § vineyard management strategies for the production of grapes that meet quality specifications.

It is expected that a greater understanding of those attributes of grapes that make them suited for particular products and being able to produce or at least identify and segregate those grapes to specification will add value across the full range of Australian grape and wine products. Precision viticulture is expected to allow identification, definition and selective deployment of resources and management to reduce variability in grape quality. Alternatively the same methods of detection may be used to selectively harvest and segregate crop batches according to product requirements.

Grape quality parameters currently routinely measured in grape samples in industry such as total soluble solids, pH and acidity are insufficient as quality indicators. Grape compositional measures are sought which can provide the industry with tannin, colour, flavour and other specifications for grapes that relate to wine quality or end use. Conventional measures have proven to be inadequate due to the constraint of slow, complex and expensive analytical procedures, and/or a lack of fundamental knowledge as to which grape components, and at what levels, are responsible for particular wine quality attributes. This program addresses both of these deficiencies in current knowledge. The research will provide a strong basis for quality improvement for the Australian viticultural industry to allow greater profitability on the world market.

The program is seeking knowledge of:

- § identification of the principal grape-derived components which positively impact on wine quality attributes, and derivation of grape quality specifications for tannin, colour and flavour wine attributes;
- § specification parameters for attributes which negatively impact on quality such as the physical condition of berries, disease level, and agrochemical residues;
- § improved analytical methods to measure quality with an aim to provide the simplest and most rapid methods possible for use in the field or at weighbridge;
- § appropriate production practices which result in grape lots that conform to quality specifications and tolerances.

Sustainable vineyard systems

The aim of this program is to develop integrated vineyard management systems to maximise grape quality and secure sustainability of the viticultural industry.

The expected outcomes are:

- § advanced irrigation scheduling techniques;

- § best practice vineyard management protocols for sustainable management of problem soils;
- § diagnostic methods and management systems for wood and root pathogens; and
- § integrated vineyard management systems for a range of Australian viticultural regions.

Sustainability is understood as “the ability to use, develop and live with the natural resources without degrading those resources or their dependent ecosystems.” This program will address the combined aspects of economic and environmental sustainability through an improved understanding of the interaction between the grapevine and its soil water environment, including soil-borne pests. It will also address issues such as trunk diseases which are a potential threat to long term vineyard sustainability.

The program is seeking knowledge of:

- The interaction between the grapevine and its soil-water environment.

An integrated approach to management of the basic resources of soil, water and grapevine genotype will be developed to ensure both economic and environmental sustainability. The key research areas will be: - (i) grapevine water use efficiency, (ii) stress response mechanisms, (iii) vine growth and resource use modelling and (iv) development of improved understanding and management of soil borne pests such as nematodes and phylloxera through classical and molecular approaches.

- Trunk diseases and long term vineyard sustainability.

The role of the various fungi associated with trunk diseases will be elucidated.

Molecular markers and microspectroscopy-based identification will be developed for key trunk pathogens, including *Eutypa*, as research tools to assess the efficacy of cultural, chemical and biological control practices and for use in disease diagnosis.

- Optimising grape production and quality through an integrated crop management approach.

Grapevine production within an integrated crop management framework takes a holistic approach. It is based on effective and efficient use of the resource base to ensure economically viable, yet environmentally responsible production.

Molecular improvement of grapevines

The aim of this program is to improve existing grape cultivars by genetic modification. Australia’s viticulture depends on production from relatively few, well-established cultivars but the application of molecular breeding offers the potential for significant improvement. The technologies to produce genetically modified grapevines have now been developed in Australia and an integrated plan has been developed in consultation with industry for the production, evaluation and commercial adoption of transgenic grapevines to benefit the Australian grape industries. The program includes projects aimed at improving resistance to pathogens to reduce

reliance on chemical control and ensure security of supply, improving berry quality, developing the tools for molecular breeding of grapevines and an integrated adoption and communication plan. Development of genetically improved cultivars will provide the Australian grape industries with a continued competitive edge in quality, cost of production and sustainability.

The expected outcomes are:

- § existing cultivars with improved resistance to the fungal pathogens, Powdery Mildew and Botrytis Bunch Rot;
- § improved resistance to the root pests, phylloxera and nematodes; and
- § industry-led adoption and communication strategies

Gene technology is providing the capacity for a much greater understanding of how grapevines function. It is expected that the technology will eventually lead to more effective vineyard management techniques and to better grape varieties. This program is intended to keep the Australian viticultural industry strategically positioned, alongside those of other countries, in terms of capturing the benefits of this technology.

Education, training and professional development for a sustainable industry

The aim of this CRCV program is to secure a highly skilled, responsive and innovative workforce for the viticulture industry

The expected outcomes are:

- training of 42 PhD graduates in an industry setting;
- enhanced skills and understanding of viticultural processes by personnel at all levels; and
- education and training to industry-prescribed skills and competencies at all levels.

The Australian wine industry believes that to increase its competitive advantage it must implement a national industry training initiative to expand quickly the supply of skilled personnel and to broaden and upgrade the skills of existing employees. It must also further develop the existing industry 'learning' culture of innovation and cooperation to compete.

The industry's research strategy has a strong educational component with a relatively high number of postgraduate students and postdoctoral fellows associated with the projects. High quality postgraduate and postdoctoral training will produce scientists with an insight into industry and an appreciation of the challenges and rewards of applying the scientific approach to industry specific needs.

This program is regarded as essential to the successful application of any new knowledge and technologies generated by all of the CRCV research programs. It is planned to be the communication and integration strategy for the research programs in education and training forums and to facilitate upgrading the skills and knowledge of industry participants, in turn enabling them to be more receptive of, and responsive to, the new knowledge and technologies being introduced.

Realising potential value - technological adoption

Fast and effective diffusion of information and novel exploitation of knowledge in new processes and products are key attributes of those countries in which a quick translation of R and D into manufacturing and product development takes place (Hoj and Hayes 1998). Central to achieving rapid application of the CRCV's research outcomes is the Viticare Initiative. This initiative is designed to overcome the challenges of an innovation environment in which:

- scientific knowledge is generated in relatively few sites;
- the viticultural industry is geographically dispersed
- there are over 7000 individual grapegrowing and winemaking enterprises
- new technologies arising from research need regional validation
- environmental impacts are becoming an increasingly important issue

Viticare will become a national network of new and/or existing regional groups in key regions to undertake three broad functions:

- to serve as a link for dissemination of information generated by the CRCV's research programs;
- to provide a forum for the development of regionally-specific environmental management systems; and
- to provide a forum for the validation and adaptation of new viticultural technologies within regional vineyards

Further action

From a technological perspective, among the greatest challenges facing the continued capacity of the Australian viticultural industries to grow and add value are:

- *maintaining the capacity to attract and train talented researchers;*
- *maintaining a research funding infrastructure that encourages cooperation between industry and research and education providers and remains appropriate for an industry with many small producers each individually unable to directly capture the benefits of research and development;*
- *capturing the benefits of technological advances for Australia;*
- *fostering consumer confidence in gene technology;*
- *implementing sound environmental management; and*
- *avoiding introduction of exotic pests and diseases,*

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