



Australian Government
Sugar Research and
Development Corporation

A COOPERATIVE SYSTEMS MODEL FOR THE MACKAY REGIONAL SUGAR INDUSTRY

G.F. Fleming¹, J.A. Markley¹, A.J. Raines¹, I. O'Hara^{1,2}, J.A. Crane¹

¹ Mackay Sugar Cooperative Association Limited
PO Box 5720, Mackay Mail Centre, QLD 4741

² Australian Sugar Milling Council
GPO Box 945, Brisbane, Qld 4001

**Sugar Research
and Development Corporation**

**FINAL REPORT
PROJECT N^o. MSA003**

February 2006

*The Research Organisation is not a partner, joint venturer, employee
or agent of SRDC and has no authority to legally bind SRDC,
in any publication of substantive details or results of this Project*

Sugar Research and Development Corporation

FINAL REPORT

Project Reference No. MSA003

Project Title: A cooperative systems model for the Mackay Regional Sugar Industry

SRDC Program: A: Value Chain Integration

Organisations: Mackay Sugar Cooperative Association Limited
Canegrowers Mackay
Queensland Mechanical Cane Harvesters Association
BSES Limited

Address: Mackay Sugar Corporate Office
Peak Downs Highway
Racecourse via Mackay Q 4740

Project Supervisor: G.F. Fleming

Location: Mackay Sugar Corporate Office
PO Box 5720
Mackay Mail Centre, Q 4741
Telephone: 07 4953 8263
Facsimile: 07 4953 8341
E-mail: g.fleming@mkysugar.com.au

Commencement Date: 1 July 2003

Completion Date: 31 July 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
BACKGROUND	6
<i>Value Chain Management</i>	6
<i>Cooperative Systems</i>	6
OBJECTIVES	8
METHODOLOGY	9
<i>Project Plan</i>	9
<i>Social Component</i>	9
<i>Technical Component</i>	10
THE COOPERATIVE SYSTEMS MODEL	12
<i>Web Portal and Database</i>	12
<i>Communications and End User Interfaces</i>	13
<i>Value Chain Management Applications</i>	13
OUTPUTS: REQUIREMENTS ANALYSIS AND DESIGN	18
<i>Mill Systems</i>	18
Systems Design	19
On-Line Analysis	19
New Cane Payment Scheme	19
Cane Quality Incentive Schemes.....	20
Electronic Consignment.....	21
<i>Harvesting Systems</i>	24
Systems Design	24
Harvester Monitoring.....	25
Harvesting Costs	26
Cane Quality	27
<i>Farm Management Systems</i>	28
Systems Design	28
Paddock Records.....	28
Variety Selection.....	30
Irrigation Management.....	30
Fertiliser (Nitrogen) Management.....	30
Pest and Disease Management	30
Costs	31
OUTPUTS: SYSTEM TRIALS	32
<i>Mill Trials</i>	32
NIR	32
Cane Payment Scheme.....	32
Electronic Consignment	32
<i>Harvesting Group Trials</i>	34
Harvester Monitoring and Reporting	34
Cane Quality Reporting.....	34
<i>Farm Management System Trials</i>	35
Costs – Grower Positioning Program.....	36
INTELLECTUAL PROPERTY	37
ENVIRONMENTAL AND SOCIAL IMPACTS	37

EXPECTED OUTCOMES.....	38
<i>Participant Surveys.....</i>	<i>38</i>
Baseline Survey	38
Project Evaluation Survey.....	39
<i>Evaluation of Outcomes.....</i>	<i>39</i>
FUTURE RESEARCH NEEDS.....	41
CONCLUSIONS AND RECOMMENDATIONS	42
ACKNOWLEDGMENTS	45
LIST OF PUBLICATIONS.....	45
BIBLIOGRAPHY	46
APPENDICES	47
APPENDIX A: WEB REPORTING OF NIR RESULTS.....	48
1. <i>NIR Cane Analysis</i>	<i>48</i>
2. <i>NIR Cane Quality Results</i>	<i>49</i>
APPENDIX B: HARVESTING SYSTEM REPORTS.....	52
1. <i>Area Harvested</i>	<i>52</i>
2. <i>Thematic Maps.....</i>	<i>53</i>
APPENDIX C: FARM MANAGEMENT TOOLS.....	55
1. <i>Variety Selector.....</i>	<i>55</i>
2. <i>Pest and Disease Management</i>	<i>57</i>
3. <i>Central Region Sugar Group Financial Benchmarking.....</i>	<i>58</i>
APPENDIX D: SURVEY RESULTS	60
Baseline Survey	60
Project Evaluation: Participant Feedback.....	62

EXECUTIVE SUMMARY

In 2000-2001 the Mackay sugar industry embarked on a path of rapid and major change, driven by a depressed world sugar market and specific regional problems of drought and disease. The changes were initially directed purely at cost reduction, and employed a raft of technologies including a web portal to reduce staff numbers and streamline grower-harvester-miller interfaces.

Following the first round of changes, the industry established a Consultative Group comprising representatives from all industry sectors to review subsequent changes and plan for the future. This forum led to discussions of whole of industry issues and concepts of value chain management. The group realised that the technologies that had been introduced, particularly the web portal and its underlying database, could be used to add value and integrate operations across industry sectors. The Cooperative Systems project was initiated to develop value chain management strategies for the region underpinned by technology. The technological component would consist of web portal, shared regional database and software tools that would link the members of the value chain and facilitate the sharing of information for mutual benefit.

A project team drawn from Mackay Sugar, Canegrowers, QMCHA and BSES was formed. Reference groups of growers and harvester operators were appointed to work with sub-groups of the project team to develop strategies, design systems and evaluate outputs for the major value chain sectors of farming, harvesting and milling. This consultative and participative approach was maintained throughout the project to ensure that outputs were relevant to end users and addressed their priorities. The existing Consultative Group was also used for ongoing evaluation at a whole of industry leadership level.

Each group examined their sector to determine the key decisions and operations where the Cooperative Systems model could add value, and what requirements the systems should aim to meet. This produced a priority list of systems for further investigation:

Mill Systems

- On-line Analysis (NIR)
- New cane payment schemes
- Electronic Consignment

Harvesting Systems

- Harvester monitoring
- Cane quality
- Harvesting costs (Harvest Haul Model)

Farming Systems

- Paddock inputs and yield recording
- Variety selector
- Pest and disease management
- Harvest scheduling
- Financial benchmarking

Specifications for these systems were drafted, and the project team set out to build them through a combination of in-house development and external

resources. Not all of the specified systems were delivered in full. Some are still being completed. Others have been linked to third party projects and proposals that are still to be finalised. However, the majority of the outputs have been delivered sufficiently for the participants to evaluate their impact and make recommendations on their broader implementation.

Mill systems exceeded expectations in delivery and implementation. During the course of the project, Mackay Sugar established a formal alliance between the farming, harvesting and milling sectors and set a business objective of implementing new systems for cane analysis and payment for the 2005 season. This added significant emphasis to the project.

A new cane payment scheme based on NIR analysis was developed by the project and implemented across Mackay Sugar for the 2005 season. The system is based on value chain principles of sharing risks and rewards, and removing obstacles to cooperation between the sectors.

A prototype electronic consignment system was developed using a touch screen interface and mobile data communications to transmit delivery details direct from harvesters to the mill. The system showed promise in trials but requires further R&D before it can be widely deployed.

The Harvesting systems team trialled harvester tracking and data units that also use the mobile data network to relay harvester position, operating data and time to the central database. The data is processed by the "CHOMP" software package to produce thematic maps and reports of speed, area harvested, field efficiency etc.

NIR analysis of cane quality data including dirt and extraneous matter and on-line reporting via the web portal was also trialled, with the ultimate objective of drafting new harvesting contracts between the milling, growing and harvesting entities based on market signals, cane quality and best practice incentives.

Farming systems, with the exception of financial benchmarking, are still under development. The main output will be the ability to record paddock inputs (fertiliser, irrigation etc) via a web-based farm map interface, and outputs (yields, sugar content etc) from NIR analysis and satellite imagery, in a geographical database, to provide spatial queries and reports at a sub-paddock level. This will assist fertiliser management, irrigation plans, and pest and disease management to name but a few applications. Decision support tools based on research models are being provided to assist with on-farm variety selection and harvest scheduling.

A web application has been developed in partnership with the Central Region Sugar Group to record income and costs with productivity data to benchmark growers' financial performance and help them assess the ongoing viability of their enterprise. This has been used by growers in all Central Region mills, as well as the Burdekin.

Evaluation of the project and its outcomes by industry participants has been overwhelmingly positive. They see tangible benefits from the information and tools being provided, and the value chain strategies they support. The widespread adoption of project outputs including NIR analysis, a new cane payment system, and mobile tracking and monitoring of harvesters and locomotives in Mackay

demonstrates that Cooperative Systems has also gained acceptance in the Mackay industry generally, and that value chain management strategies will continue to evolve in the region based on the model.

New proposals are emerging to extend the tool set provided by the project, and most encouragingly to extend the model across regions. A proposal under way to develop integrated applications for productivity services based on a shared industry database is one example of Cooperative Systems in action. The potential for integrated value chain management across the industry is large, and the benefits considerable.

BACKGROUND

Value Chain Management

The terms “supply chain management” and “value chain management” are often used interchangeably, and in general discussion this matters little provided the focus of the discussion is on a whole of industry approach. The distinction adopted in this research is that supply chain management focuses mainly on the interfaces between industry sectors and the efficient movement of goods between them, whereas value chain management focuses more on the value added and costs incurred by each sector in the context of the overall industry. Value chain management therefore tends to add broader economic and customer-based considerations to the narrower logistics and cost focus of the supply chain.

The importance of value chain management to the sugar industry was highlighted by the 2002 Hildebrand Report urging the adoption of “a whole of value chain systems approach to all aspects of operations” (Hildebrand, 2002). Since then an increasing number of researchers have explored the broader value chain (or at least sections of it). A paper by Higgins et al (2005) provides a comprehensive summary of value chain research in the industry to date, and notes how the scope of such projects has been expanding to include a broader range of industry sectors.

The Mackay industry has undergone a similar evolution over the past five years. Major economic challenges since the start of the decade forced the industry to adopt new, predominantly technology-based ways of doing business to reduce costs and employee numbers. This was a supply chain based approach, driven by the miller and focused on the grower-miller interface.

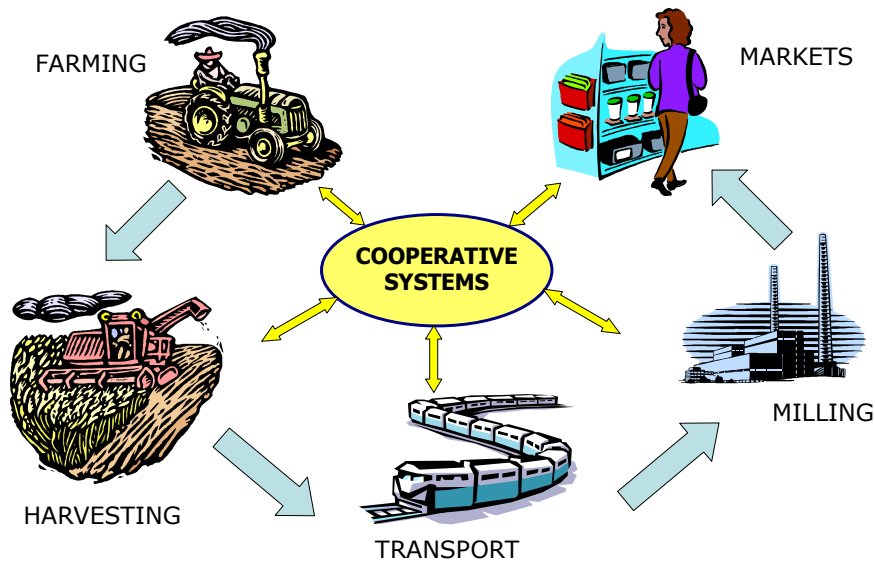
Subsequently, to try to improve the management of change in the region, a forum (the Cane Supply Consultative Group) was created for millers, growers and harvesting contractors to review and discuss changes in the regional industry. This led to a better understanding of the way that the different industry sectors could collaborate and cooperate for mutual benefit, and the potential of technology to facilitate such an approach. This was the genesis of a value chain approach in Mackay, and culminated in the Cooperative Systems project.

Cooperative Systems

The information linkages between different sectors are an integral part of a value chain management strategy. It is impossible for individual members of the chain to make whole-of-system management decisions without timely and relevant information from other sectors. Furthermore, to implement an agreed management strategy across the value chain requires appropriate systems and tools to facilitate and support the strategy.

The Cooperative Systems project was conceived to provide the information linkages and systems required to implement a management strategy for the sugar industry value chain, as illustrated in Figure 1.

Figure 1: Cooperative Systems



The term "cooperative systems" originates from information systems theory and refers to inter-organisational computer systems where two or more parties with different objectives collaborate on their development and operation (McNurlin and Sprague, 1989). In essence, they are systems that work together for the mutual benefit of separate organisations that share a common business relationship.

OBJECTIVES

The formal objective of the project was:

To develop a whole of value chain management strategy to underpin reduction of costs and improved profitability and sustainability for all sectors of the Mackay Sugar industry.

The management strategy would use a participative action learning approach to:

- Develop a “cooperative systems” model that integrates the links of the value chain in order to add value to its component parts. (Cooperative systems are computer-based systems used by individual businesses in a value chain that are also integrated and work together to support management decision making across the chain).
- Demonstrate the performance and benefits of the cooperative systems model on a pilot scale.
- Develop an implementation strategy for adoption by the Mackay Sugar industry based on the learning gained from the pilot process.
- Document project outcomes and lessons for wider industry benefit.

At the commencement of the project the objectives were not necessarily clear-cut. The project team knew that it had the building blocks for a value chain management strategy underpinned by some emerging technologies that were being used in Mackay. However, not even the team was clear on just what that strategy would look like and what the real potential of the Cooperative Systems model was.

It is therefore pleasing to report that at the end of the project many expectations have been exceeded. The Mackay industry is leading the way in many of the project’s areas of investigation, and undertaking initiatives and partnerships across the value chain that would not have been thought practical only a few years ago.

The Cooperative Systems model has evolved from information systems theory to a practical concept that is starting to be grasped by all sections of the industry. Despite the fact that the project has fallen short in its delivery of fully developed systems tools in some areas, the concept and the prototypes that have been demonstrated appear to have captured people’s imagination and catalysed genuine systems thinking in the region. This coupled with some visionary industry leadership has promoted real change in the commercial and logistical relationships across the value chain.

The project has therefore in many respects both developed an implementation strategy and applied it, as significant outputs have already been adopted by the regional industry – a new payment system and harvester monitoring and tracking systems being two examples. These initiatives have evoked interest across the industry, and the project’s learnings have already been communicated in various forums. Follow-up Cooperative Systems type proposals are being discussed, including one for common databases for regional productivity services.

METHODOLOGY

Project Plan

The principal stages of the project were:

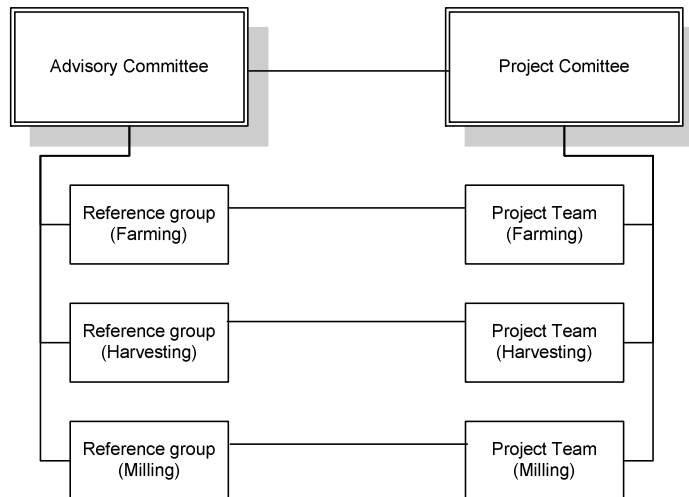
1. Mobilisation: formation of project teams and reference groups, initial workshops, and development of a detailed project plan and evaluation methodology.
2. Cooperative Systems Design: project teams and reference groups developed management strategies for their sectors of the value chain, and specifications for systems to support them.
3. Cooperative Systems Development: the outputs from stage 2 were integrated into an overall systems model for value chain management; individual systems and tools were developed.
4. System Trials: the systems were trialled in pilot groups and evaluated.
5. Evaluation and Extension: trial results were discussed and evaluated by the various groups.
6. Implementation Plan: plans and recommendations were developed to implement the cooperative systems model across the Mackay Sugar industry, and presented to the industry for adoption.

It was recognised at the outset that a value chain management strategy and the systems supporting it would never be accepted and effective unless developed in close consultation with industry stakeholders. If the project became a purely technical exercise, it would fail. It was essential for the research to have both a social focus to engage stakeholders, and a technical focus to develop the system components.

Social Component

The social component was aimed at overcoming barriers to change by engaging stakeholders (millers, growers and harvesters) throughout the project, in the process building their capacity for ongoing change and development. This was achieved through an organisational structure that matched groups of stakeholders with researchers at all levels of the project, as show in Figure 2.

Figure 2: Project Organisation



- The advisory committee (the Cane Supply Consultative Group referred to previously) worked with the project researchers to coordinate, review and evaluate the overall project.
- Reference groups of growers and harvesting contractors were formed to work with project teams for each value chain sector, defining management strategies and system requirements and monitoring and evaluating development.
- Pilot groups of growers and harvesting contractors tested and evaluated the systems.

The capacity of these groups was developed through a number of targeted workshops covering:

- Value chain management concepts
- Communication techniques
- Evaluation methodologies

Technical Component

The technical focus was on developing and integrating information systems and related technologies to underpin value chain management strategies. This involved the project teams consulting with their reference groups to:

1. Gain an understanding of the major operations and decisions involved in each sector of the value chain.
2. Define the information required to assist those operations and decisions, and the data flows required to provide the information

3. Specify, develop and/or source computer applications to capture the required data and provide information and tools.
4. Develop suitable end user interfaces for people to interact with the applications as required.
5. Build the technical architecture to support the systems.

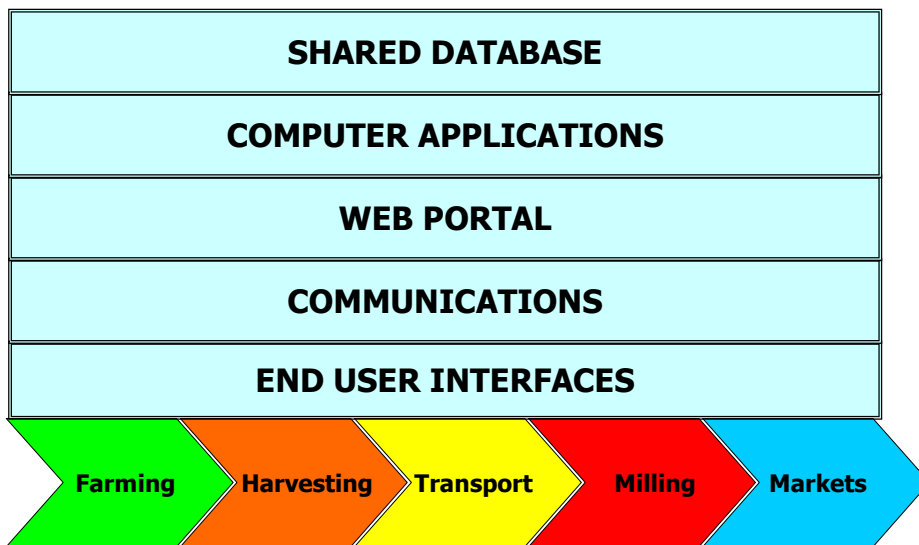
To maintain a manageable scope, the project focused on the three principal value chain sectors of farming, harvesting and milling. The transport sector was briefly considered in the context of harvesting systems, and some of the communication and information systems developed for harvester management can be applied to transport as well. The market and shipping sector was for the purposes of this project considered a provider of pricing information rather than an active participant in the chain.

The systems development as far as possible employed a participative approach where prototypes were evaluated by reference groups, revised, modified and evaluated again.

THE COOPERATIVE SYSTEMS MODEL

The Cooperative Systems model is an information systems architecture supporting value chain management applications across the value chain. It consists of a central industry database and computer applications housed on a web portal. Members of the value chain interact with the model directly using end-user interfaces and communications channels appropriate to their situation and requirements. This model is illustrated in Figure 3.

Figure 3: Cooperative Systems Model



Although the project focused on the three principal sectors of farming, harvesting and milling, the model is adaptable to all value chain sectors (or indeed other value chains), and it is the intention of the stakeholders to continue to adapt and extend it across the chain. This will become increasingly important as the industry moves towards alternative products and balancing production on the farm and in the mill to meet market demands.

Web Portal and Database

The hub of Cooperative Systems is the web portal with its central database. It builds on existing Mackay Sugar web site architecture which has been documented in an ASSCT paper (Crane and Fleming, 2003).

The web site has been custom written using Microsoft ASP and Visual Basic languages. Cooperative Systems modules and other recent developments are being written using the latest versions of these tools, which employ Microsoft's .NET framework.

The database management system used is Microsoft SQL Server.

Security and privacy are important issues for a central, shared database. The basic principle is to ensure that access to individuals' information is restricted to those individuals and others that they may authorise. For "cooperative" purposes such as benchmarking or performance measurement, only aggregated data is to be used, and at a sufficient sample size that individuals' data cannot be deduced from the aggregated results.

Security is controlled by a login system that associates the user with a variable number of farms, at different access levels. For example, a user may have grower-level access to their own farm, allowing them to view all information, but only harvester operator access to another, allowing them to view bins, tonnes and cane quality, but not payment information.

The existing portal includes a "web mapping" interface that allows users to interact with a MapInfo GIS system to display farm maps overlaid on satellite imagery, aerial photographs, soil maps and any other spatial layer. This interface was further developed for Cooperative Systems to allow growers to interact with maps and enter records of paddock inputs and operations.

The project also investigated MapInfo Spatialware, which allows the spatial data in a GIS to be integrated with the traditional "lineal" data in an SQL Server database. This enables powerful queries to be performed on the data, enhancing capabilities for farm and harvesting management applications.

Communications and End User Interfaces

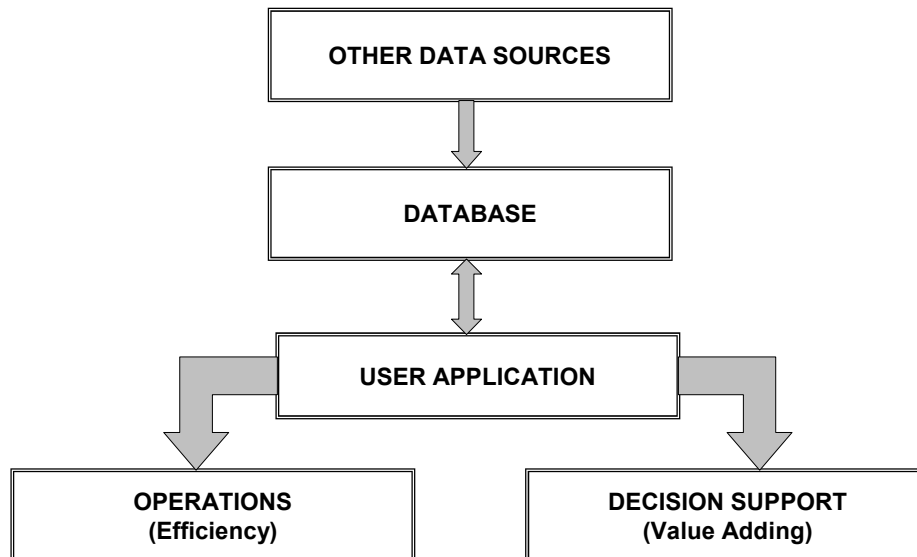
To be effective, cooperative systems information must be available to value chain members when and where they need it. Their means of access to the systems must be appropriate to the task. For example, it may be adequate for growers to review productivity reports and cost information from a home computer, but a harvester operator is unlikely to use a consignment system that involves them entering delivery ticket information over the Internet after harvesting is finished for the day.

The project team therefore investigated alternatives to the standard home Internet connection to connect users to the systems. Chief among these were mobile devices, with touch screens for the user interface and the mobile data network (GPRS or CDMA-1X) as the communication medium.

Value Chain Management Applications

The Cooperative Systems model relies on the reciprocal exchange of data between all members of the value chain. This voluntary flow of information is encouraged by the model itself. It provides applications that add value to an individual's business; however to use those tools, the individual must provide data which is then shared with the rest of the value chain for applications beyond the individual's sector. It is a "give and take" principle, which is facilitated where possible by automating data capture to minimise the effort involved for the individual. This is illustrated in Figure 4.

Figure 4: Cooperative Systems



The data that the applications use may come directly from the user, from other users in the same sector, from other sectors of the supply chain, or from external sources. For example: the model provides tools for a harvester operator to measure their machine's operational efficiency and costs. To avail themselves of these tools, the operator has to fit a unit that relays operating data to the shared database. This data can be used not only to provide the required information about the harvester's own operation: it is also pooled with that of other operators to allow benchmarking between them; it is transformed into area harvested maps to assist in managing overall harvesting operations; and it is combined with delivery data from the mill's weighbridge and NIR analysis systems for both growers and harvester operators to monitor harvesting performance and its effects on yields and cane quality.

The "give and take" principle also extends to third parties. Some such as Productivity Services will provide data because that is their role. Bodies such as BSES and CSIRO may do so in exchange for access to aggregated data, which they can in turn use to develop and refine models. Financial advisers may provide data on a simple fee for service basis, while fertiliser suppliers may do so in return for advertising opportunities, or even e-business opportunities linked to the industry portal.

To develop the detailed model and its underlying applications, project teams and their reference groups considered the following questions:

- What are the key operations and decisions for this sector?
- How can the Cooperative Systems model reduce costs and/or add value?

- What outputs will the resulting applications produce, (e.g. models, maps, reports, schedules)?
- What data inputs are required to produce these outputs?
- What are the sources of this data?
- How will it be captured (e.g. by manual entry through this or another application; directly from an instrument or sensor; from an external information source)?
- What are the business rules, calculations and procedures to be used in processing this data?
- How will the user interact with the application (e.g. from a fixed PC at home; from a mobile device in a harvester or tractor; from a hand-held device)?

This process produced a list of application and information requirements for the various sectors, which are summarised in Table 1.

Table 1: Cooperative Systems Requirements		
<u>Operation/Decision</u>	<u>Information</u>	<u>Source/Method</u>
FARMING SECTOR		
Productivity performance	<ul style="list-style-type: none"> ○ Paddock yields ○ Benchmarking 	<ul style="list-style-type: none"> ○ Mill – maps, GIS/satellite data, paddock records, weights and analysis. ○ Harvester – consignment, area harvested.
Financial performance	<ul style="list-style-type: none"> ○ Payment information ○ Paddock inputs ○ Other costs ○ Benchmarking 	<ul style="list-style-type: none"> ○ Mill – payment systems. ○ Farm – paddock input records, costs. ○ Harvester – actual costs from operating data
Variety selection	<ul style="list-style-type: none"> ○ Soil type ○ Topography ○ Water/irrigation ○ Varietal performance ○ Plant availability 	<ul style="list-style-type: none"> ○ Mill – GIS data, weights and analysis ○ Satellite data ○ Farm – paddock input records ○ Paddock detail from agronomist surveys ○ BSES variety information and trial data
Irrigation	<ul style="list-style-type: none"> ○ Climate data ○ Soil type / geography ○ Crop data (when planted, when to cut) ○ Irrigation history 	<ul style="list-style-type: none"> ○ Weather stations inked to web portal + manual entry. ○ Mill systems – GIS data, harvest records ○ Farm – paddock input records
Fertiliser	<ul style="list-style-type: none"> ○ Soil analysis / crop analysis ○ Yield vs. input data ○ Product information 	<ul style="list-style-type: none"> ○ Agronomist inputs ○ Farm – paddock input records ○ Mill systems – NIR nitrogen ○ Suppliers
Weed, pest and disease management	<ul style="list-style-type: none"> ○ Identification / information ○ Infestations/extent (maps) ○ Treatments 	<ul style="list-style-type: none"> ○ BSES etc ○ Mill systems – GIS ○ Suppliers
Land management	<ul style="list-style-type: none"> ○ Crop cycles ○ Fallow crops ○ Environmental data 	<ul style="list-style-type: none"> ○ BSES etc ○ Mill systems - GIS ○ Grower input
Harvesting program (which paddocks when)	<ul style="list-style-type: none"> ○ Variety CCS data 	<ul style="list-style-type: none"> ○ Mill systems ○ SugarMax model

HARVESTING SECTOR		
Harvesting performance	<ul style="list-style-type: none"> ○ Best practice guidelines ○ Operating data ○ Cane quality ○ Benchmarking 	<ul style="list-style-type: none"> ○ BSES etc ○ Mobile monitoring system ○ Mill – NIR results
Financial performance	<ul style="list-style-type: none"> ○ Operating costs ○ Benchmarking 	<ul style="list-style-type: none"> ○ Harvest Haul model
Harvesting contracts	<ul style="list-style-type: none"> ○ Paddock-specific costs ○ Paddock conditions ○ Cost of cane quality and HBP 	<ul style="list-style-type: none"> ○ Mill – GIS data, quality and yield results ○ Mobile monitoring system
TRANSPORT SECTOR		
Optimal delivery schedules	<ul style="list-style-type: none"> ○ Harvest schedules ○ Siding rosters 	<ul style="list-style-type: none"> ○ ACRSS, ACTSS, TOTools etc. ○ Siding booking system on web portal
Delivery performance (on time, in full)	<ul style="list-style-type: none"> ○ Measurement of delivery fulfilment 	<ul style="list-style-type: none"> ○ Running slips and delivery slips via on-board loco application (MT Data units)
Cost performance	<ul style="list-style-type: none"> ○ Operating data and costs 	<ul style="list-style-type: none"> ○ MT Data monitoring units.
MILLING SECTOR		
Efficiencies and cost reductions	<ul style="list-style-type: none"> ○ Automated analysis ○ Improved consignment 	<ul style="list-style-type: none"> ○ NIR ○ Electronic consignment
Process control	<ul style="list-style-type: none"> ○ Improved analysis of factory inputs 	<ul style="list-style-type: none"> ○ NIR
Processing efficiency and quality	<ul style="list-style-type: none"> ○ Cane quality 	<ul style="list-style-type: none"> ○ NIR ○ Harvester management ○ Payment systems
New cane payment schemes	<ul style="list-style-type: none"> ○ Analysis additional to CCS ○ Cane quality data 	<ul style="list-style-type: none"> ○ NIR

From this list, the teams chose a subset of systems for further investigation. Systems were chosen on the basis that they would have a significant impact, were reasonably achievable but at the same time sufficiently innovative in their use of technology. The areas chosen for further investigation were:

Mill Systems

- On-line Analysis (NIR)
- New cane payment schemes
- Electronic Consignment

Harvesting Systems

- Harvester monitoring
- Cane quality
- Harvesting costs (Harvest Haul Model)

Farming Systems

- Paddock inputs and yield recording
- Variety selector

- Pest and disease management
- Harvest scheduling
- Financial benchmarking

Specifications were developed for these components through consultation between the project teams and reference groups. The project teams designed systems to meet the specifications, trialling any required technology in the process.

Some components were completed and tested; some encountered problems and are incomplete or discontinued; others did not proceed as planned because of other projects and initiatives in the same area, e.g. there have been a number of recent projects under the "farm management systems" banner.

OUTPUTS: REQUIREMENTS ANALYSIS AND DESIGN

This section documents the development of the cooperative system components selected by the reference groups for further investigation. Each group discussed their sector's role in the value chain as well as the requirements of that sector in the context of the project, and identified specific objectives and areas of investigation for the project team.

Mill Systems

The mill is the main "information pump" in the value chain, collecting information about paddocks, deliveries etc, processing it and feeding it back to growers, harvesters and others. Mackay Sugar already recorded a substantial amount of information including farm maps, aerial and satellite imagery, paddock details including estimates and yields, and tonnes and CCS analysis of cane deliveries. On-line access to much of this data was being provided through a web site.

However, a major value chain initiative of the Mill Systems team and indeed the overall project was to investigate alternative payment schemes that encouraged and rewarded best practice throughout the chain, aligned the objectives of the different sectors, and facilitated diversification into different product streams. To achieve this required the measurement of constituents in cane other than the traditional CCS and fibre. Consequently, the project investigated the use of NIR technology to measure the contribution of individual cane deliveries to products other than sugar, as well as cane quality indicators such as dirt and extraneous matter.

NIR as a method of on-line analysis also promised cost reductions by requiring less analysts in mill laboratories.

The other business issue addressed was the process of consigning cane to the mill. There are significant costs and inefficiencies associated with the paper handling involved in the current system and the resultant errors. The goal was to develop a method of electronically associating a delivery or even a bin with the paddock that it came from, reducing costs and unproductive labour, and increasing the accuracy of yield and quality data.

The objectives established by the Mill Systems team were therefore:

- To investigate new payment systems incorporating on-line analysis, cane quality and components other than sugar.
- To develop and trial a system for electronic consignment of cane.

The following areas of investigation were identified:

1. Trials of NIR and on-line analysis.
2. New payment schemes.
3. Electronic Consignment – matching bins to paddocks.

Systems Design

On-Line Analysis

It was apparent that to analyse all the required constituents in cane for proposed new cane payment and quality systems (sucrose, impurities, clean fibre, dirt, extraneous matter) NIR was the only feasible option. The team also trialled the SRI sucrose meter ("Sugar Baby") and an on-line refractometer as potential cheaper technology for the automation of existing juice analysis. However while these technologies showed some promise, there was no reason to use them in conjunction with NIR if trials of that technology were acceptable.

The project had originally intended to use a single NIR unit installed at Racecourse mill for trial work. However Mackay Sugar broadened the scope when they decided to install Foss NIR systems at each of their four mills and modify sample trackers to match the NIR output stream to individual bins.

The NIR data is returned as a series of time-stamped scans. This is matched to bins and hence deliveries via corresponding time-stamped data from the mill sample tracker. The data is averaged to provide analytical results for each delivery. It is possible however to determine an analysis for each bin, which would enable the tracking of variations across a paddock provided consignment data is accurate enough.

Analytical results are obtained for pol, brix, fibre and ash. Results are then calculated for sugar content, dirt (from ash) and extraneous matter (as pol/fibre ratio). The results are stored in the mill's cane payment systems and the Cooperative Systems database as soon as they are available. Stakeholders can view them in tabular and graphical form via the web portal. Examples of web output for NIR results are shown in Appendix A.

New Cane Payment Scheme

The traditional cane price formula is not conducive to a value chain management approach because:

- It divides millers and growers. Growers receive all the benefit of increased CCS and millers receive all the benefit of improved sugar recovery. This has been the root of traditionally adversarial negotiations over issues such as season length: why should the mill invest capital to shorten the season for a higher CCS?
- It does not adequately reward individual performance. Growers are not sufficiently rewarded or penalised for cane quality, especially when class fibres are used to determine CCS.
- It does not allow growers to share in the revenue from products other than sugar. Mills receive all the income from molasses, cogeneration, ethanol, and so on. Why should growers change any practices to assist diversification?

The Mill Systems team therefore investigated alternative payment schemes that would encourage all members of the value chain to cooperate on increasing the size of the revenue pool instead of competing for a share of it. They aimed to develop a formula and system that:

- Does not divide Growers and Millers
- Sufficiently rewards individual performance
- Sends the right economic signals
- Provides for non-sugar revenue streams

The investigation gained considerable impetus when Mackay Sugar adopted a strategy to introduce such a system in conjunction with new cane supply agreements for the 2005 season.

The new system proposed by the team involved changes to both grower-miller equity and grower-grower equity to address these requirements. Grower-miller equity would no longer be based on sugar alone and vary with CCS and Coefficient of Work as in the old cane price formula. Instead, the growers and the miller would receive fixed shares of the combined revenue from sugar, molasses and electricity generation, and any other products produced from cane. The fixed shares would be based on the average total cane payments over a ten year period as a proportion of the total revenues from all income streams. The revenue pool would also include sugar quality premiums. This scheme means that both growers and millers share the risks and rewards of issues such as season length, cane quality affecting sugar quality, and so on.

Grower-grower equity would no longer be based on CCS alone. It would instead be based on a new measure of sugar content named Percent Recoverable Sugar, or PRS, as well as the clean fibre and impurities in cane (which contribute to the manufacture of electricity and molasses). All components would be measured by on-line analysis (NIR) and would incorporate individual fibre analysis of each delivery. Daily relativity would continue to be applied to PRS, as for CCS.

PRS is calculated as the pol in cane minus expected losses in bagasse, mud, molasses and undetermined sources. The expected losses are also based on ten year average data.

Cane Quality Incentive Schemes

The project team also considered how a cane quality incentive scheme might be incorporated into the payment system, and there has been considerable debate about it. The Harvesting Systems section of this report discusses the measurement and feedback of cane quality data to harvester operators and growers. The problem is in establishing a scheme that sends the right market signals and compensates the parties for the costs involved in achieving particular targets.

A good example is extraneous matter. Extraneous matter can be reduced by simply increasing the fan speed on the harvester's extractor. However this will also increase the loss of sound cane in the field, which is not the desired effect. Instead the harvester operator should slow down and adopt other "best practice" harvesting measures, but this will increase harvesting costs for no real benefit to the harvester.

The team believes that the answer lies in new harvesting contracts that incorporate the variable cost of harvesting different paddocks in different ways, and include quality bonuses for growers and harvest best practice incentives for

the harvesting contractor. Discussions are continuing with growers and contractors. Meanwhile the emphasis is on measurement and reporting of cane quality data, and sending the correct signals with the data.

Electronic Consignment

An electronic consignment system needs to determine not only what farm the cane came from for payment purposes, but also as closely as possible the area of land that produced it, so that yield and quality data can be produced at a paddock and even a sub-paddock level. Manual consignment systems rely on the harvesting contractor entering a block/paddock number on the consignment note. GPS tracking systems offer a better solution.

GPS systems can record the geographic coordinates, and hence the paddock that a harvester is cutting at any given time. The problem is to associate the cane coming out of the harvester at that time with the bin it is subsequently loaded into in the siding.

The system designed for the Cooperative Systems project involved determining in advance the identification numbers of the bins dropped off at each siding, downloading them to an on-board harvester system and having the operator record the bins that are filled, as far as possible in time sequence. By combining this information with continuous GPS tracking data from the on-board system, a bin-location association can be made with reasonable accuracy.

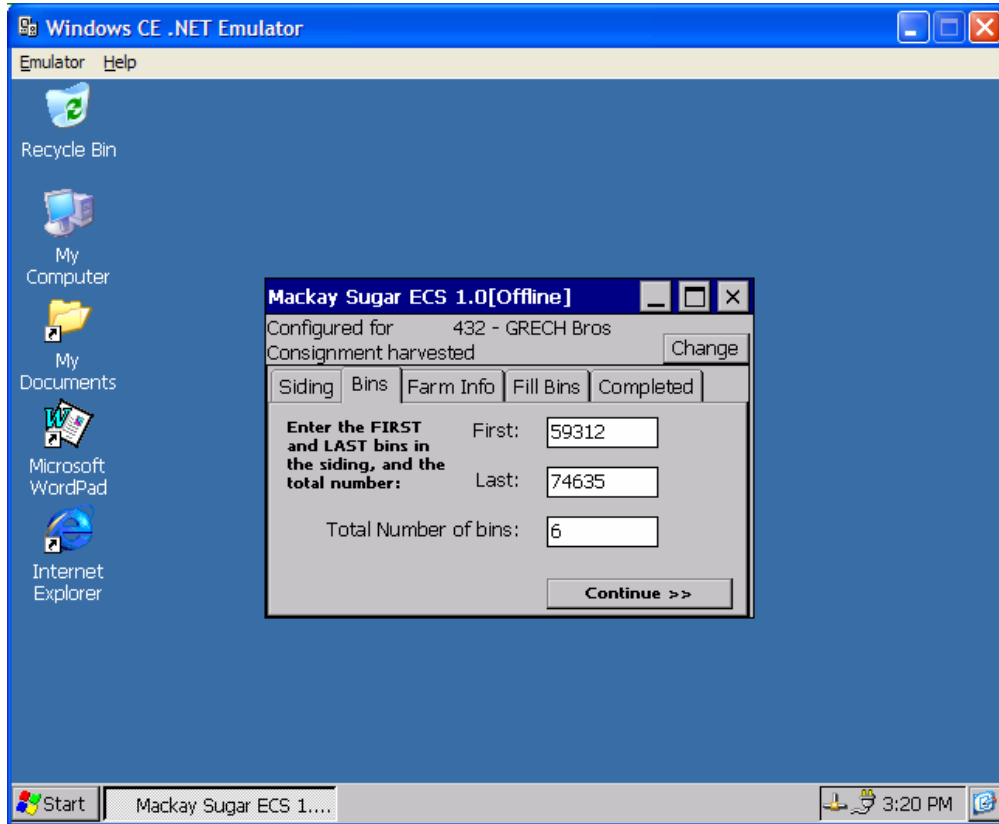
The harvester data will not necessarily be transmitted to the mill before the cane is crushed; hence the system needs to cater for "post consignment". This is possible with on-line analysis, because unlike manual methods a discrete sample representative of the entire delivery does not have to be taken. With NIR or other on-line methods, a continuous stream of results is associated with the stream of bins being tracked through the mill. A delivery's results are obtained by averaging the stream of results for the bins in that delivery. That can be done, and indeed changed, at any time after the bins have been read.

A pilot system was developed using the GPS tracking units trialled on harvesters by the Harvesting Systems team, which are described in more detail in that section. The units were equipped with an optional touch screen interface, which incorporated a processor running the Windows CE operating system.

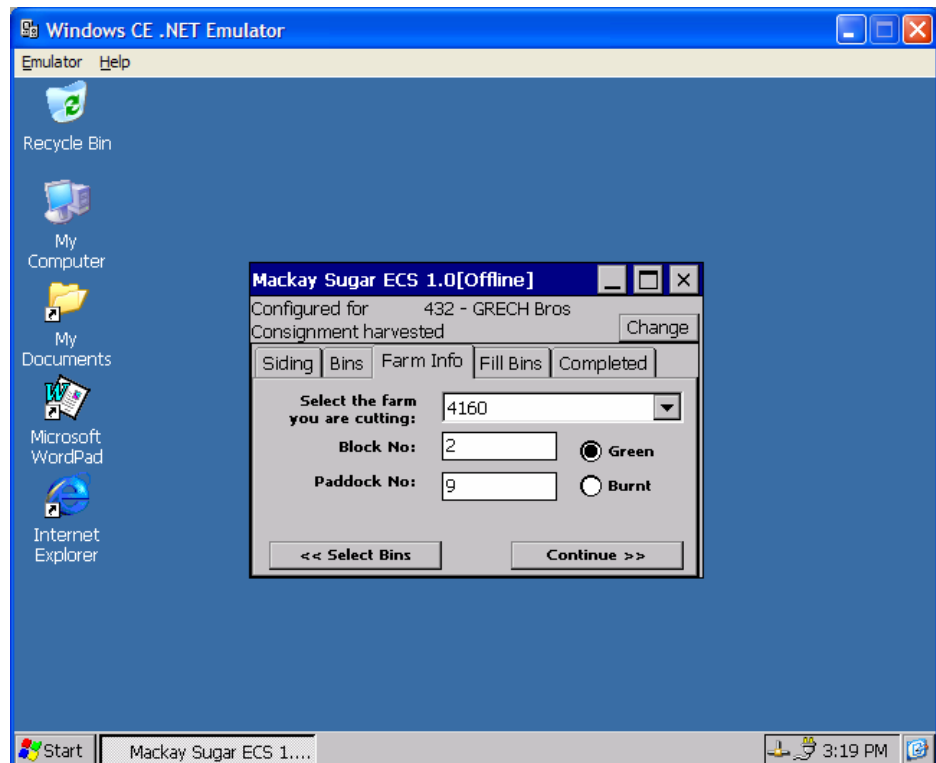
A Visual Basic .NET application was written for the device, communicating with the central Cooperative Systems database using the same mobile data network connection employed by the harvester monitoring unit. The application operates as follows:

- Deliveries of bins are read as they leave the mill yard (all Mackay Sugar bins carry Radio Frequency Identification (RFID) tags that reference the bin number). The ordered lists of bins are recorded in the Cooperative Systems web portal database.
- At the commencement of the day's harvesting the operator enters the numbers of the first and last bin on the siding, and the number of bins, and transmits them to the web portal. From its records of the bins that left the yard (in sequence), the system determines the numbers of all the bins in the siding and

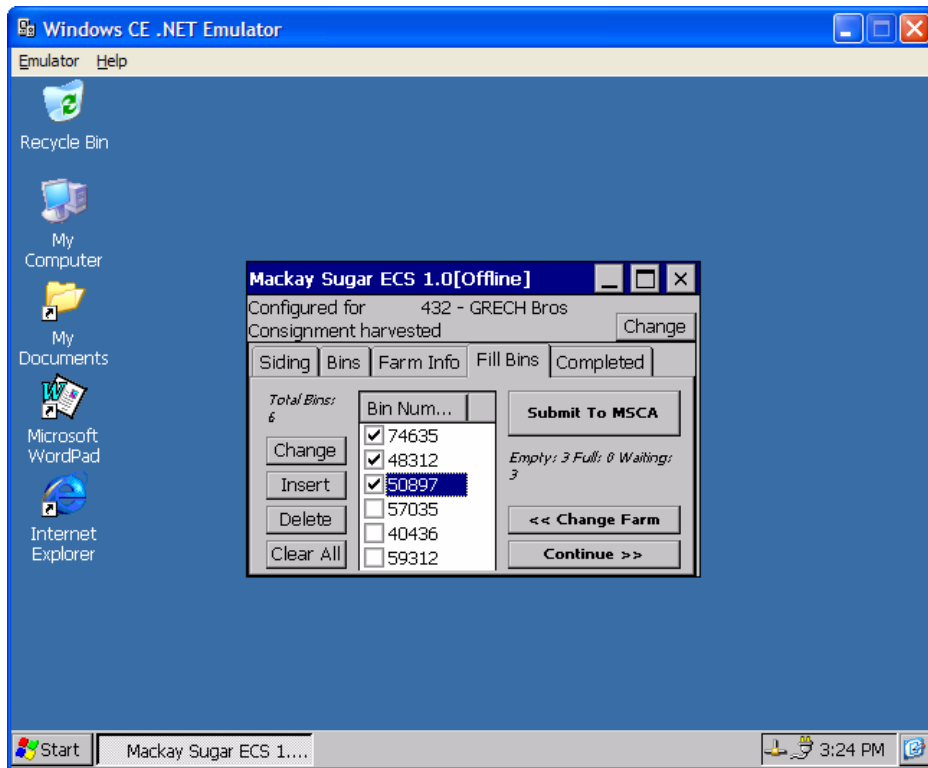
downloads them to the harvester. (The group can add and delete bins at any time to reflect changes to the order that may have occurred on the line).



- The operator enters the farm number and other details of the paddock being harvested.



- The operator checks off the bins as they are filled.



- At any stage (normally when the full bins are collected) the operator presses the "Submit to MSCA" button to send the consignment header and the full bin details to the web portal.
- With NIR analysis, consignment can actually occur after the cane is crushed. Because the analysis is continuous, the bins and their associated results can be grouped and regrouped for payment at any stage.
- Because we are recording the time that the bins are filled, and also the location of the harvester at that time, we are able to associate each bin with reasonable certainty not only to the paddock but also the part of the paddock that it came from, and with NIR analysis of individual bins this gives a picture of variations across a paddock, or with changes in harvesting parameters.

To maximise the accuracy of the process, the team believed it preferable for the harvester driver to enter the data. However, some groups expressed the view that it would be a lot more practical for the haulout driver to do the entry, so we trialled both methods. The complication is that the touch screen needs a GPS tracking unit to communicate with the mill, but a unit is required in the harvester for Harvesting Systems purposes. Therefore the group would require a second complete unit just for the haulout operator to enter consignment information.

A fully operational system would also require fallbacks in the event of system or communications failure (apart from reverting to a paper system). Two options were proposed. In the event of a communications failure, provision can be made for the data to be downloaded to a memory stick, then transmitted to the portal

later via the Internet. In the event of a system failure, the harvester would record consignment details manually, then enter them via a web portal application after harvesting had been completed.

There was insufficient time to build and test these fallback systems.

Harvesting Systems

The Harvesting sector generally is focusing on costs and cane quality. In Mackay, the industry is preparing to negotiate new methods of payment based on market signals and shared risks and benefits. A central issue is that best practice harvesting can yield large improvements in cane quality and reductions in losses. However, the costs are largely incurred by the harvester, while the benefits flow to growers and millers.

The answer to this problem probably lies in a combination of (i) harvesting contracts that reflect the true costs of cutting cane at an individual paddock level, and (ii) cane quality schemes that encourage best practice harvesting. This requires the ability to measure the parameters involved, and provide timely feedback to users.

The Harvesting Systems team therefore concluded that the basic requirements for cooperative systems were to measure and report the parameters relevant to harvesting operations and cane quality, and provide tools that will assist people to use the information for the benefit of the value chain – for example to change farm configuration or harvesting practices, or as a basis for contract formulation.

The basic objectives established by the Harvesting Systems team were:

- To develop improved systems for harvester management using GPS tracking and logging of operating data.
- To investigate Cane Quality measurement and reporting as a basis for incentive payment schemes.

The following areas of investigation were identified:

1. In-field harvester monitoring and data applications - area harvested recording; harvester operating reports (e.g. ground speed, field efficiency); yield mapping.
2. Harvesting costs analysis.
3. Cane quality information.

Systems Design

The requirements discussed above involved two measurement systems: one for harvester performance and operating parameters, and one for the measurement of cane quality. These measurements can then be associated with the paddock from which the cane originated, and the results recorded and displayed via the web portal's database and GIS/mapping interface.

Cane quality measurement occurs at the mill using the NIR units discussed in the Mill Systems section of this report. Cane quality indicators are measured for every delivery of cane.

Harvester performance is measured by an on-board system that continuously records operating conditions (engine on/off, chopper pressure etc) and GPS position and time from an integrated monitoring unit. The measurements are transmitted on demand to the web portal and stored in the central database.

The data is displayed graphically, spatially (in maps) and in reports, available on the web site. Tools will be included for harvester operators to analyse their costs.

Harvester Monitoring

Harvesting groups were equipped with a mobile data and tracking system incorporating a GPS, a communications module using the public mobile data network (GPRS or CDMA-1XRTT) and a processor with a touch screen running the Windows CE operating system. The units used were supplied by Mobile Tracking and Data Pty Ltd (MT Data).

The project team also evaluated "BIGmate" monitoring units from G&S Engineering, and "Sweet Tooth" units used in NSW Sugar. MT Data's product was chosen for this project on the basis of flexibility, programmability, touch screen interface, and price.

The MT Data units include an interface module that can monitor a range of digital and analogue inputs including engine on/off, elevator on/off, fan speed and chopper pressure. The GPS unit adds position and time, and hence ground speed. Data packets containing all these variables can be broadcast at time and/or distance intervals, and when the unit changes direction.

Data packets are transmitted via the mobile data network to the Internet, and thence to the web portal. There it is stored in the central database and processed for various reports. Examples of these reports may be found in Appendix B.

Processing of GPS-referenced harvester data to produce maps showing area harvested is accomplished using a software product called "CHOMP", developed by Agtrix Pty Ltd in collaboration with Mackay Sugar and NSW Sugar. CHOMP converts harvester "tracks" to polygons and overlays them on farm maps to display the paddocks harvested. The maps are displayed on the web portal's mapping interface. CHOMP and the mapping interface can be used to display any geo-referenced data on a thematic map.

The data can also be used by harvester operators to analyse their operations. Data showing the time actually cutting versus the total time the harvester is operating can produce information like that shown in Figure 5.

Block Number	Total Time	Cutting Time	Field Efficiency	Ground Speed
MILL FARM BLK1 PAD1	1.84	1.42	77%	6.0
MILL FARM BLK2 PAD1	4.31	2.03	47%	10.1
MILL FARM BLK3 PAD1	0.19	0.08	42%	9.1
MILL FARM BLK5 PAD1	7.12	4.74	67%	8.4
MILL FARM BLK5 PAD2	2.42	1.32	55%	6.0
MILL FARM BLK6 PAD1	2.61	1.39	53%	6.1

Figure 5: Harvesting Efficiency Reporting

When combined with cane quality data from deliveries that are also geo-referenced, one can start to look at the costs of meeting particular quality and operating standards, facilitating new methods of payment based on results.

There is also some promising research correlating tonnage throughput to operating parameters such as chopper pressures, which would make it possible to measure yield variation across a paddock more accurately than by consignment methods.

Harvesting Costs

The BSES Harvest Haul model is a MS Access application that calculates the total cost of harvesting based on manual input. The team investigated the possibility of incorporating the model in the web portal and feeding it with live data from the harvester monitoring systems.

An example of the model’s output is shown in Figure 6.

Group Harvesting and Haul-outs Costs

Monday, 5 April 2004

Group 115 - Example Group

	Total				Harvester				Haul-outs			
	\$/tonne	\$/eng. hr	\$/ha	\$	\$/tonne	\$/eng. hr	\$/ha	\$	\$/tonne	\$/eng. hr	\$/ha	\$
Non-Cash												
Depreciation	\$0.73	\$38.89	\$49.54	\$28,530	\$0.53	\$28.30	\$36.05	\$20,759	\$0.20	\$10.59	\$13.49	\$7,771
Capital	\$0.51	\$26.98	\$34.38	\$19,800	\$0.26	\$13.81	\$17.80	\$10,140	\$0.25	\$13.16	\$16.77	\$9,880
Total Non-Cash	\$1.24	\$65.87	\$83.92	\$48,330	\$0.79	\$42.11	\$53.85	\$30,899	\$0.45	\$23.75	\$30.26	\$17,431
Cash												
Capital	\$0.51	\$26.98	\$34.38	\$19,800	\$0.26	\$13.81	\$17.80	\$10,140	\$0.25	\$13.16	\$16.77	\$9,880
Overheads	\$0.42	\$22.40	\$28.53	\$16,430	\$0.21	\$11.20	\$14.27	\$8,215	\$0.21	\$11.20	\$14.27	\$8,215
Wages	\$2.08	\$109.30	\$139.23	\$80,176	\$0.53	\$27.98	\$35.85	\$20,528	\$1.53	\$81.32	\$103.58	\$59,848
Fuel	\$0.91	\$48.08	\$61.65	\$35,285	\$0.45	\$23.88	\$30.42	\$17,516	\$0.46	\$24.20	\$30.82	\$17,750
R and M	\$1.50	\$79.49	\$101.25	\$58,305	\$0.70	\$37.09	\$47.25	\$27,209	\$0.80	\$42.39	\$54.00	\$31,098
Blades	\$0.07	\$3.71	\$4.73	\$2,721	\$0.07	\$3.71	\$4.73	\$2,721				
Total Cash	\$5.47	\$289.96	\$369.77	\$212,697	\$2.22	\$117.67	\$149.92	\$86,329	\$3.25	\$172.27	\$219.44	\$126,369
Total Cost	\$6.71	\$355.82	\$453.68	\$261,027	\$3.01	\$159.79	\$203.58	\$117,228	\$3.70	\$196.02	\$249.70	\$143,800

Inputs					
Tonnes	38,871	t	Season Length	102	days
Area	578	ha	Roster - On	5	days on
Yield	67	t/ha	Roster - Off	2	days off
Row Length	578	m	Haul Distance	5.55	km

Other Reported Outputs					
Field Efficiency	68	%	Harvester Fuel	0.9	l/t
Engine Hours	734	hrs	Haulout Fuel	0.91	l/t
Elevator Per-Rate	79	t/hr	Total Fuel	1.81	l/t
Delivery Rate	53	t/hr	Shift Length	12.0	hrs
			Shifts Per Day	1	

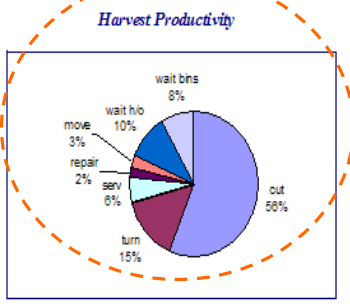


Figure 6: Harvest Haul Model

The model is not currently in a form suitable for interactive use on the web portal and will require conversion work which is beyond the scope of this project. It was demonstrated that the model can be run manually using data collected from the portal.

Cane Quality

Good cane quality with minimal in-field loss is an outcome of harvesting best practice that benefits both miller and grower. It should be one of the key drivers for the Harvesting sector. Before that can occur, cane quality measures need to be developed and made available to stakeholders in a timely and appropriate manner for them to act on.

The project team decided to work with three measures that with NIR analysis are available for every delivery as soon as it is crushed. The measures are:

- o Dirt
- o Extraneous matter
- o Bin weight

NIR provides on-line analysis of every delivery and can provide approximations of dirt and extraneous matter. Dirt is calculated from ash, and the ratio of NIR fibre to pol is an estimate of extraneous matter. Both are approximations, but were considered reasonably reliable indicators of performance.

These measurements were displayed on the web portal as shown in section 2 of Appendix A. The format allows contractors and growers to benchmark their performance against other deliveries on the day in question, and with other members of the harvesting group.

Farm Management Systems

The focus of the Farming sector is on farm management to increase yields and reduce costs. Growers need information and decision support tools to assist with varietal selection and agronomic decisions such as fertiliser application, chemical treatments and irrigation. They also need to understand their cost structures and how their financial performance compares with similar farms.

The reference group met on a number of occasions and also arranged a workshop attended by specialists from BSES, CSIRO and agronomic service providers. The team established the following basic objective:

- To identify information systems that enhance key on-farm management decisions, and make them available to the farm manager.

The following areas of investigation were identified:

1. Paddock input records – fertiliser, chemicals, irrigation etc.
2. Variety information and selection tools.
3. Irrigation management.
4. Fertiliser (nitrogen) management.
5. Pest and disease management.
6. Costs.

Systems Design

Paddock Records

The main data needed from the farming sector and not otherwise available is paddock inputs. To quantify varietal performance and benchmark productivity and costs, we need records of the inputs to the crop in terms of chemicals and fertiliser, mill mud, water and so on.

The basic requirements for a paddock records system were that it be GIS-based, i.e. the user interacts with the system through a map interface rather than text-based menus, and that it be suited to, or readily customisable for, the farming of cane. A number of paddock recording systems are commercially available, including CaneMan and PAM (from Fairport Technologies). However, those examined for the project did not fit the basic requirements well enough.

Mackay Sugar already had a GIS-based system to manage farm maps and record paddock data such as variety, yield and soil type. This data was already available to users on the web portal through a browser-based mapping tool, which is used extensively by growers. The tool was primarily display only, but already incorporated some limited data entry capability.

This represented all the components necessary for a full paddock records system. It just required the facility to capture and record an expanded set of paddock data and report on it appropriately.

The project team therefore decided to develop the paddock records system “in-house”, thereby leveraging a system that had already gained wide acceptance for functionality and ease of use, and also providing flexibility to maximise value adding for the industry.

We have almost completed development of a “paddock log” tool based on the existing web interface growers have to their farm maps. The tool will allow growers to indicate an area on their map and open an application where they

Mackay Sugar IT Staff and Robert Crossley of Agtrix Pty Ltd have extended the web mapping interface to allow a grower to “point and click” to a paddock on a map, revealing pop-up menus to choose from a list of inputs and enter the date/time and rate of application. The data will be recorded spatially and will be able to be correlated against yields, etc. A prototype has been written (see Figure 7), but it was not possible to deploy it on the web portal during the 2005 season as some software upgrades are required. This will be completed in 2006.

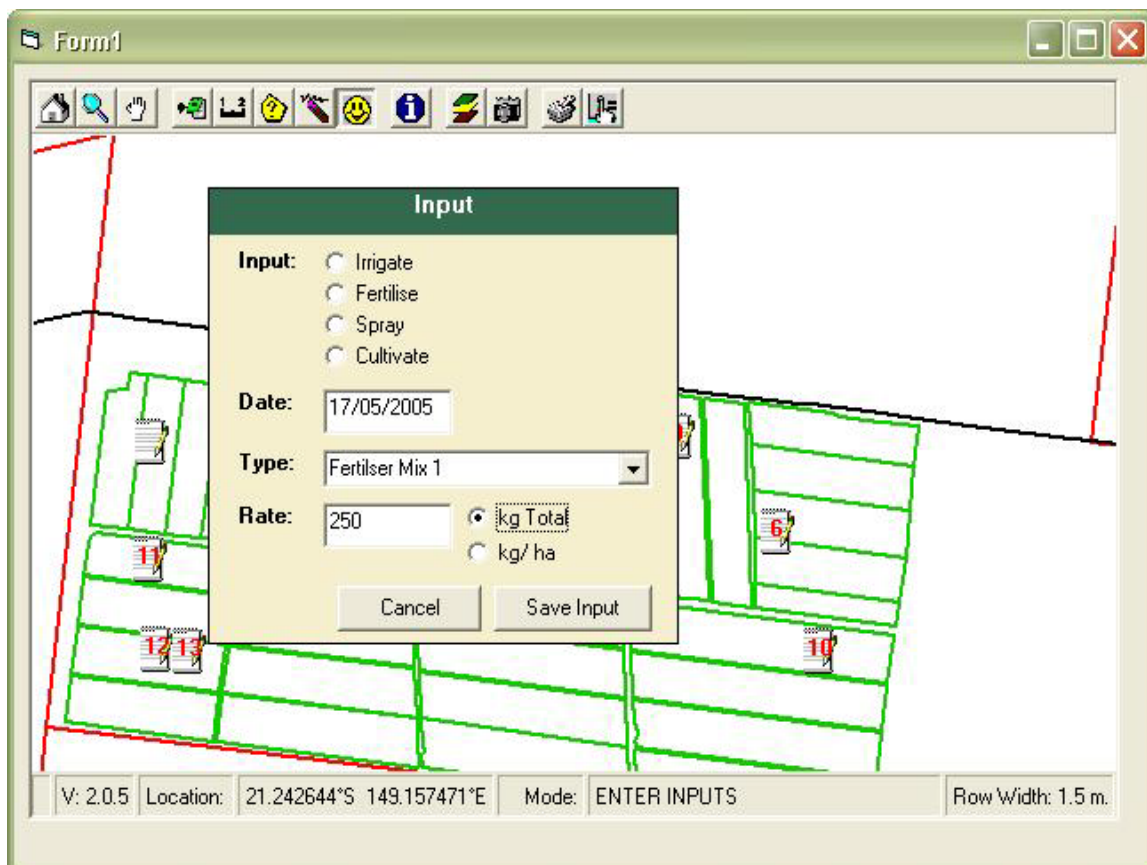


Figure 7: Paddock Input Entry Tool

Variety Selection

In the “post-Q124” era in Mackay, maintaining a viable mix of varieties is essential for the industry’s sustainability. The selection of a variety suited to a paddock’s geography is also fundamental to maximising farm outputs. Several new varieties are now available, but performance history under different conditions is limited.

The design goal was to provide a web-based variety selector based on BSES tools and information, backed by performance data related to geography from the Cooperative Systems database. Essentially, the grower would be able to choose a paddock, and the variety selector will evaluate it against a number of criteria, based on what is recorded in the database plus information entered by the user, to generate a list of recommended varieties.

Nearly completed is a prototype variety selection tool, which based on some key factors such as soil type, district and irrigation will provide a more comprehensive filter across varieties that should perform well in that geography to assist growers make the best choice of variety for a particular paddock.

Screens for the prototype are shown in Appendix C.

Irrigation Management

Water is a major issue in Mackay and the project team investigated ways that the web portal could be used to provide tools for irrigation management. The SASA site for the South African industry incorporates an interactive growth model that uses rainfall records from weather stations and data input from growers to recommend an optimum irrigation schedule.

CSIRO’s APSIM model could be adapted to sugar cane and provide this functionality by linking it to the Cooperative Systems database, augmented by climatic and rainfall data. Mackay Sugar supported a CSIRO proposal to investigate this work, but it was not successful.

Fertiliser (Nitrogen) Management

Management of fertiliser application is another important issue, both for cost reduction and environmental management. The team looked for ways of measuring nitrogen requirements and efficiency of use in a way that could be fed back to growers via the web portal. Studies have indicated a viable correlation between nitrogen in juice (via NIR) with nitrogen requirements in the soil, and it was hoped that this relationship could be developed to provide information to growers.

Mackay Sugar supported a CSIRO proposal for this research, but it was unsuccessful.

Pest and Disease Management

The design goal was to assist growers in the identification and management of pests and diseases. In its simplest form this would comprise an on-line searchable knowledge base, perhaps combined with a simple “expert system” that asks a

series of diagnostic questions to suggest possible causes and remedies for the symptoms described.

A desirable extension of such a system is to provide proactive advice and alerts based on information gathered by the Cooperative Systems model. For example, satellite or aerial imagery has potential to detect some types of pests and diseases on a broad scale, and could mandate more detailed field studies of affected areas. More simply, reported infestations can be recorded geographically in the GIS system, patterns and progress tracked and alerts issued.

Some preliminary work has been done on satellite detection of grub damage through measurement of crop stress. An example appears in Appendix C.

Costs

Farming costs were originally to be considered at the level of attaching costs to paddock input records, with overall financials to be left to the individual. However, the region's response to the recent Sugar Industry Reform Package utilised the Cooperative Systems model to allow growers, in consultation with their financial advisers, to quantify and benchmark their financials either on an annual basis or over a rolling five year history.

The Central Region Sugar Group, comprising Mackay Sugar, Proserpine and CSR Plane Creek commissioned a web development to allow growers to perform a stage 1 "viability assessment" of their operations. This was known as the Grower Positioning Program or GPP.

Production history was loaded into the database (in Mackay Sugar's case directly accessible through the web portal) and financial advisers added costs and income figures and some details of the farm such as the extent of irrigation available. The system calculated a simple profit and loss, allowing the grower to benchmark their results against the average of growers in selected groupings – e.g. same productivity zone, all irrigated farms, Marian area only etc. It also allowed them to run some scenarios for the future, varying sugar price, yield, CCS etc.

This development represents an early adoption of the Cooperative Systems model, and more importantly, a regional one. It is envisaged that it will remain part of the Cooperative Systems tool kit, and has the scope to be extended to a stage 2 implementation supporting farm business plans to maintain viability.

Example screens from the GPP are shown in Appendix C.

OUTPUTS: SYSTEM TRIALS

Mill Trials

NIR

An NIR unit was trialled at Mackay Sugar between 1999 and 2003. The original intention was to use this unit for Cooperative Systems trials at Racecourse. However, in 2004 Mackay Sugar adopted a new cane payment system as a mainstream business strategy and purchased NIR units for its four mills, enabling detailed studies of NIR analysis for brix, pol, fibre and ash.

Trials during 2004 concentrated on proving the reliability and reproducibility of NIR analysis for payment purposes, as well as building the library of results for calibration of the system. By the end of the season, successful sample rates of between 95% and 98% were achieved at the four mills, with representation indices of the order of 70%. These results were good enough for NIR to be used for payment analysis.

During the 2005 season NIR was used for fibre and ash payment results (ash is used in the Percent Recoverable Sugar formula), but laboratory analysis continued to be used for payment brix and pol. This was done to give growers further confidence in the system. Payment based purely on NIR results is expected to commence in November 2005.

Cane Payment Scheme

During the latter half of the 2004 season, NIR results for all deliveries were published on the web portal in parallel with traditional laboratory results for CCS analysis, as shown in Appendix A:1. The results included the Percent Recoverable Sugar (PRS) figures proposed as the basis for the new cane payment scheme. Material explaining the proposed new scheme to growers was also published on line, giving growers the opportunity to study results in detail and compare the schemes.

Agreement was reached with Canegrowers to progress with the scheme. A series of grower meetings were held to further discuss it, and it was ultimately included in cane supply agreements for the 2005 and 2006 seasons.

With the high price of molasses and a relatively low PRS, the price difference compared to the old scheme has been in the growers' favour in 2005, but this can easily swing the other way. The main desired outcome is to focus growers on the impact and contribution of the components and quality of their cane on the whole value chain: they are paid for the revenue contributions of their fibre and non-sugar constituents; they share in the sugar quality premium payments that their cane quality assists; they share in the improved sugar recovery from a regular, clean cane supply.

It is too early to assess whether this raised value chain awareness will produce value-adding changes in the field, but there is now closer alignment between the farming and milling sectors than there has been in the past.

Electronic Consignment

MT Data units equipped with touch screens were fitted to three Racecourse harvesters for the 2004 season. The units were running the electronic consignment system prototype explained previously. (The Racecourse area was

chosen because the system requires bin numbers to be read as they leave the mill, and Racecourse had a tag reader available for this purpose).

The first stage of the trial was to establish reliable communications with the units over the mobile data network (the GPRS network was used for the trials). Harvesters in areas with good mobile coverage were deliberately chosen for the trial so that the results were not compromised by external factors. Coverage is a separate issue to the performance of the application. Basically, the technology worked well. The main issue was tuning the application to respond correctly to particular communication states, such as not receiving an acknowledgment that transmitted data was received, or power being turned off in the middle of a transmission.

Once the communications were sufficiently robust, the application was tested. The system, as described in the preceding systems design section, was run in discrete trials for the three pilot groups. Hardware problems were encountered with the unit and/or the installation on one of the harvesters, and no substantial trials were conducted. For the other two groups, one installed the unit on the harvester, the other in a haulout vehicle.

The trials demonstrated that the technology was basically sound. The units (apart from the one with the fault) were robust and the operators had little difficulty with the touch screens. The data transmission was successful. The application software required work to reliably handle communication drop-outs at any stage of the processing, but these deficiencies were being overcome.

The main problem yet to be fully answered is the location of the data entry unit itself. The harvesting groups used in-field tippers, as do the large majority of groups in Mackay, so the harvester operators do not see the actual bins. These groups clearly preferred to have the data entry done by the haulout driver. However, part of the application is to associate the GPS location of the harvester with the bins being filled to automatically acquire the paddock or even sub-paddock details. If the data unit is on the haulout, this association is essentially lost. Even if a second unit is installed on the harvester, it becomes difficult to subsequently match the two streams to obtain the consignment information.

A possible solution is to split the application between two units: a standard MT Data unit in the harvester, and a simpler data entry unit in the haulout, with no GPS or mobile communications modules, but with "Blue Tooth" short range communications with the harvester unit. The bin numbers would be entered by the haulout, and transmitted to the master unit in the harvester whenever the two vehicles came in close proximity. The bin numbers and the GPS locations would be combined in the harvester unit before transmission to the mill.

The harvester operators involved in the trials were quite positive about the application. They could envisage considerable time savings and increases in accuracy resulting from it. They could also see the further applications for the units in communications and coordination with the mill and the transport sector. They believed further research on the system would be worthwhile.

Harvesting Group Trials

Harvester Monitoring and Reporting

The same groups equipped for electronic consignment trials were used in the trials of monitoring and reporting harvester operations. The MT Data units were equipped to monitor ignition on/off (hence operating hours), elevator on/off (hence cutting hours), and position and time (and hence speed).

The main use made of this data was to calculate area harvested, which is critical to accurately updating the crop estimate for effective management of harvesting and transport operations. This data was reflected in weekly updates of area remaining to harvest and bin allotments, and proved more timely and reliable than that obtained by satellite imagery. Harvesters and growers were able to review and confirm the updates via area harvested maps on the web site.

Some of the data was also processed via CHOMP to generate graphical reports of operating data, for example harvester "tracks" superimposed on farm maps, thematic maps showing speed variation in paddocks, and reports of field efficiency (actual cutting time as a percentage of total operating time). It was also demonstrated that this data could be related to delivery data that had been geo-referenced by the consignment system, so that one could study, for example, variations in cane quality measurements as operating parameters changed.

To date these reports have only been produced at a desktop level, i.e. the data has been manually processed through CHOMP and reports/maps generated individually. The goal is to have the tools available on line, on demand so that growers and harvesters can generate them interactively via the web portal. The software development to achieve this is still being completed. A limiting factor has been the availability of Agtrix (the developers of CHOMP and FarmMap), who have been used for the bulk of the external programming work. Since FarmMap and CHOMP are used by the majority of the industry, the project team elected to leverage and extend the existing functionality of these products rather than develop tools internally.

CHOMP modifications and web portal upgrades should be completed in early 2006 to allow the maps mentioned above to be generated on demand as GIS layers on the web portal's farm mapping interface.

Cane Quality Reporting

NIR analysis was used not only for payment information, but also to measure cane quality. The indicators agreed on by the project team were published on the web portal, as shown in Appendix A:2, available for all harvesting groups and growers. The objective was to encourage discussion and comment, with no specific recommendations made about incentive or penalty schemes.

Feedback has been obtained from reference group and consultative group meetings, as well as shed meetings and individual growers. Most comments centre on the validity of the measures in all circumstances, and on the importance of ensuring that the correct signals are sent. For example, there have been questions about the effect of early morning harvesting on Cane Quality. Extraneous matter is thought to be higher when the cane is damp with dew. We do not want to discourage early harvesting by a penalty system. Neither do we

want to achieve better quality at the expense of in-field losses by raising basecutters and increasing fan speed.

The intention in Mackay is to progress discussions on these trials with the data obtained in the 2005 season, with a view to developing cane supply and harvesting contracts that incorporate incentives to adopt harvesting best practices for maximum cane quality and minimum losses. The Cooperative Systems model would provide the platform to administer the contracts and monitor the performance of all the parties involved.

Farm Management System Trials

Pilot farm management systems are still being completed and have not yet been deployed in trials. This is for three main reasons:

1. This part of the project lagged the others in determining user requirements and designing systems. The lost ground is still being recovered.
2. The programming has taken longer than planned, partly due to limited availability of suitably skilled resources, and partly because technology is still emerging in this area and different options for achieving the programming outcomes have had to be researched.
3. For some of the outcomes, further research is required. The APSIM model promises the required functionality for growth and irrigation models, but requires further development. Studies indicate a viable correlation between nitrogen in juice (via NIR) with nitrogen requirements in the soil, but again further research is required.

Nevertheless, farm management system pilots will be completed and deployed, even if some testing has to occur after the season. The most important priority is to have systems in place to capture base data, even if tools to provide all the information potentially derivable from that data take a bit more time to develop.

The main data needed from the farming sector and not otherwise available is paddock inputs. To quantify varietal performance and benchmark productivity and costs, we need records of the inputs to the crop in terms of chemicals and fertiliser, mill mud, water and so on.

We have almost completed development of a “paddock log” tool based on the existing web interface growers have to their farm maps. The tool will allow growers to indicate an area on their map and open an application where they choose from a list of inputs and enter the date/time and rate of application. The data will be recorded spatially and will be able to be correlated against yields, etc.

A prototype variety selection tool based on some key factors such as soil type, district and irrigation will provide a more comprehensive filter across varieties that should perform well in that geography to assist growers make the best choice of variety for a particular block and/or paddock.

In terms of pest and disease management, the initial intention is to provide map views showing the extent of nominated problems. We also hope to be able to use satellite imagery to recognise certain problems such as grub damage, but this research is yet to be completed.

Costs – Grower Positioning Program

The Grower Positioning Program (GPP), incorporating a Farm Performance Improvement Program (FPIP) was developed by the CRSG and is key to many facets of the Central Region sugar Industry Plan developed by the Mackay Regional Advisory Group under the banner of the Sugar Industry Reform Program 2004. The GPP, which already has some 600 growers participating, is a continuous improvement tool enabling individual growers to record their financial and production data annually to facilitate meaningful benchmarking so that the FPIP can assist growers to identify the adjustments that are suitable in their situation.

The FPIP is also intended to help facilitate farm aggregation by identifying those growers who would benefit from leasing or share farming their cane land and those who would benefit from the increased economies of scale by taking up the leases or share farming opportunities.

INTELLECTUAL PROPERTY

There are no intellectual property issues that prevent free access by the industry to the technology and outputs of the project.

ENVIRONMENTAL AND SOCIAL IMPACTS

The farm management tools being developed will provide a platform to record and manage farm inputs for both cost control and environmental management and recording purposes. Combined with the potential precision agriculture applications of remote sensing and NIR analysis of deliveries consigned at the sub-paddock level, such systems can potentially reduce the use of chemicals and fertilisers by applying them in measured quantities only where they are required.

The social effects of Cooperative Systems are in the cooperation and trust built between the sectors when the principles of value chain management are understood and applied. "Cooperating to compete" was a slogan used during the project to encapsulate the ideal of a united value chain working together to compete against Brazil and other external threats, and maximise the returns for the whole industry.

The representation and input by all sectors to the project team was an example of what can be achieved, and the agreement between sectors evident in the new cane payment scheme and other initiatives is evidence that in Mackay at least that cooperation is being reflected in the wider industry.

EXPECTED OUTCOMES

The stated outcomes by which the success of the project would be measured were:

1. Increased **awareness and knowledge** of the principles, benefits and application of value chain management in the regional sugar industry.
2. A **model and tools** to capture, share and apply data and information for integrated management across the value chain.
3. **Cooperation** between industry sectors to share information and manage the industry across the whole value chain.
4. **Commitment** to the implementation of a whole of value chain systems approach in the Mackay Sugar region.

Participant Surveys

Two formal questionnaires were used with the project reference groups and the advisory committee: a baseline questionnaire at the commencement of the project to establish the “going in” position of the participants; and a project evaluation / feedback questionnaire at the end to evaluate the perceived impact and success of the project.

The following table shows the distribution of responses between the groups.

Survey	Advisory Committee	Harvesting Group	Mill Group	Farming Group	Total
Baseline	30	8	6	6	50
Evaluation	23	12	6	11	52

Table 2: Survey Responses

The aggregated and summarised results of both surveys may be found in Appendix D. Some comments follow:

Baseline Survey

The baseline survey showed that people were already making use of the tools and information available to them via the Mackay Sugar web portal. It also indicated a degree of understanding of the objectives of the Cooperative Systems project (although this was primarily from the Advisory Committee, who had been involved in the formulation of the proposal, and less evident in the initial responses of the Reference Groups). This indicated that the project was starting from a firm foundation where people were already accepting of the underlying technology, and were starting to adopt a systems approach to the industry.

This augured well for the success of the project if the expectations of the participants could be met, and the survey identified a number of opportunities for value chain improvement which were incorporated into the model.

Project Evaluation Survey

The project outputs were evaluated in detail through the participative approach adopted in the development and trial phases. The evaluation survey was designed to provide a general assessment of the success and impact of the project.

The results were overwhelmingly positive from all the groups involved, with the most critical responses coming from the project team themselves. It was apparent that despite the outputs falling short in some areas (as reflected on the project team's response), the participants believed that the overall objectives had been achieved and the project had made an impact.

Evaluation of Outcomes

The survey results indicate that at industry leadership level and amongst the project participants there is now a higher level of appreciation of the principles of value chain management, and acknowledgment of the potential benefits for the industry. This knowledge and awareness is demonstrated by the degree to which project outputs have been adopted by the regional industry and are being incorporated into business plans and strategies. For example:

- Mackay Sugar growers have adopted a **new Cane Payment system** developed during the project. The system has been promoted largely on value chain principles of sharing risks and rewards, and removing obstacles to cooperation between sectors to maximise returns for the whole industry.
- **NIR** has been accepted for cane payment and quality analysis during the 2005 season, with savings in laboratory costs to follow.
- People were encouraged by the **electronic consignment** prototype, and funding is being sought to develop it to a production system.
- **MT Data units** have been installed on a further forty Mackay Sugar harvesters for the 2005 season, to measure area harvested, provide information for operators and provide an in-field interface for other applications.
- **MT Data units** are also being installed on Mackay Sugar locomotives and track vehicles, principally for tracking and collision avoidance, but also with the clear objective of measuring and improving the scheduling and delivery of bins.
- There has been considerable discussion of **cane quality**. Although no financial incentives have been put in place, the measurement and reporting of the figures has stimulated dialogue between growers and harvester contractors.
- Moves to bring the Mackay Area Productivity Service on line to Cooperative Systems data has prompted a broader discussion on combining and **sharing data** held by the mill and other service providers – a logical progression of the model. A proposal is being developed for SIIF funding to assist this work.

Developments such as these are evidence of the awareness, knowledge and commitment of the regional industry to the principles of value chain management and their endorsement of the Cooperative Systems model. The degree of cooperation between the industry sectors in achieving these outcomes has been a major step forward.

The project has fallen short of some targets in the actual delivery of fully functional tools to exploit the model, notably farm management tools, and on-line interfaces to harvester management data. The delay in most cases is one of securing appropriate programming resources, which are stretched both internally and externally. The work is still proceeding as outlined in this report, and will be completed.

This project and the related changes taking place in the Mackay industry demonstrate the potential benefits of a whole of industry systems approach, and a model for implementing value chain management strategies that is adaptable to the whole industry. The level of interest from other regions is encouraging, as is the development of further proposals building on the Cooperative Systems model.

FUTURE RESEARCH NEEDS

There are a number of areas where further research would be of benefit:

- While the electronic consignment system developed for the project showed promise, there are a number of issues to be addressed before it could be broadly implemented. Further research to determine the best way to relate bins as closely as possible to the GPS coordinates from which they were harvested is recommended.
- Once that relationship can be reliably established, the full benefits of NIR analysis down to the individual bin level can be realised by showing the variation of different measurements across paddocks. Further research on the application of NIR to other constituents of juice is indicated. For example, initial studies relating nitrogen in juice to fertiliser requirements show some promise and should be progressed.
- Farm management systems research needs review and coordination. There are a number of different projects and proposals in this area that could potentially detract from one another. The Cooperative Systems model does not prescribe particular software, but it clearly illustrates the importance of shared data for benchmarking and regional management information. Therefore any farm management tools and systems that are developed should not be designed as discrete systems, but as modules integrated into a regional database.
- In this vein, the Mackay industry is developing a SIIF proposal for a common database and tools for Productivity Services to be shared by all regions. Part of this project is to consider the legal and logistical issues associated with data that is shared between organisations. This is an important area of research that the industry needs to come to grips with as the Cooperative Systems concept broadens in scope.

CONCLUSIONS AND RECOMMENDATIONS

The Cooperative Systems project has demonstrated that the sugar industry *can* work together, and that real shared benefits can be obtained when they do. It has gone a long way towards providing the knowledge, the willingness and the capability to implement value chain management strategies in the Mackay region. This is already happening, notably in a new cane payment system and large scale introduction of harvester tracking and monitoring leading to cane quality and Harvesting Best Practice initiatives.

The following recommendations reflect key lessons about developing a value chain management strategy and managing a VCM project, as well as recommendations regarding the further development and implementation of the Cooperative Systems model.

1. Develop regional consultation mechanisms

The Cooperative Systems project exceeded expectations in the implementation of its findings because the value chain management principles it was researching became a central component of regional plans for the industry. Consequently, a lot of the research was actually being implemented “on the run”.

Clearly, Mackay was already “primed” for the project, and this was largely due to the consultation mechanisms and industry partnerships that had already been developed in the region, namely the Mackay Sugar Consultative Group, the Central Region Sugar Group and the Mackay Sugar Industry partnership previously referred to.

Value chain management strategies will not work without “peak bodies” such as these to make decisions on behalf of the whole value chain. However, it takes time (in our case at least two years) to establish the trust and openness necessary for groups like this to function effectively.

In Mackay, the industry has evolved further to establish a formal “Alliance” or partnership between the milling, growing and harvesting sectors, with joint objectives and a brief to make decisions on behalf of their respective members.

The message for the industry as a whole is that consultation and participation are essential for any successful value chain project, and there is a significant lead time to establish groups where this can occur - regional bodies that can legitimately represent the stakeholders. Regions should be starting now (if they have not already) to establish the mechanisms for consultation and partnering to enable collective action in the future.

2. Organise projects for participation

The greatest strength of the Cooperative Systems project was its level of stakeholder involvement. The momentum maintained over more than two years, and the adoption of the outputs clearly demonstrate the value of participation and action learning in projects such as this that rely on cooperation between sectors and education rather than coercion to achieve results.

This was achieved by the project organisation, with the project committee being accountable to an industry advisory committee (the Mackay Sugar Consultative Group) for ongoing consultation and evaluation, and individual project teams working actively with reference groups of growers and harvester operators in both design and evaluation phases.

The project was able to utilise Mackay Sugar's existing Consultative Group to facilitate this organisation structure. In fact, the project was actually initiated by this group, so industry ownership was substantial from the outset. This was a key factor in its success.

3. Get the economic drivers right

The objective of a value chain management strategy is to increase the profitability of the industry as a whole, for the benefit of all. This usually involves expenditure or risks on the part of one sector to benefit another. For example, Harvesting Best Practice involves higher costs for the harvesting sector, with the payoff in increased yields and improved cane quality benefiting the grower and the miller.

People will only participate in such strategies if the risks and rewards are shared equitably. So in the quoted example the harvester will expect to be paid for adopting higher cost practices, from the additional income that the growers and mill will receive.

Regions planning to adopt VCM strategies need to devote considerable effort to ensuring that payment schemes adequately address these issues.

4. Continue the work in Mackay

The project team strongly supports the Mackay industry continuing to develop and implement the Cooperative Systems model, particularly by:

- Reviewing and refining the new payment scheme to allow it to continue successfully beyond the initial two-year cane supply agreement.
- Pursuing new harvesting contracts between the milling, growing and harvesting sectors based on market signals, cane quality and harvesting best practice incentives.
- Completing and installing the web-based tools still under development for farm and harvester management for the 2006 season.
- Developing and delivering training for all stakeholders based around new payment systems and explaining how to use Cooperative Systems tools to maximise the benefits for individual businesses and the whole value chain.

5. Apply the model across the industry

The Cooperative Systems Model is not prescriptive. It is a model – a framework, management strategies and a set of tools. It can be adapted in whole or in part to any region of the sugar industry (or indeed other industries) on a variety of technical platforms.

Apart from the consultation and industry partnerships referred to above, the other essential aspect of the model is the sharing of data between the members of the value chain, which the project implemented as a shared database attached to a web portal. Value chain management strategies simply cannot be implemented without cross-sector data on which to base decisions.

The model uses a “quid pro quo” principle to encourage widespread data sharing: individuals who contribute to the database gain access to tools that allow them to benefit from the data contributed by others, such as benchmarking, varietal performance and so on.

Regions will need to determine their approach to shared data irrespective of any value chain management initiatives. Current directions in Farm Management Systems, Environmental Management Systems and the like demand that more aggregated regional data are available, and issues of collecting and managing that data will have to be considered. The Cooperative Systems model provides a way of making this a positive, win-win process rather than just another regulatory requirement.

ACKNOWLEDGMENTS

This has been a complex project, and the writer wishes to acknowledge the many people who have participated and contributed to its success. First and foremost, the researchers who have been part of the project team:

- Ian O'Hara of Mackay Sugar and now ASMC, for leading the Mill Systems team and the detailed design of new payment systems;
- John Markley and Tony Raines of Mackay Sugar for their work on farm and harvesting management systems and the technology infrastructure;
- Trevor Wilcox and Brad Hussey of BSES Mackay for their agronomic advice and input;
- Doug Neville (retired), Dave Langham, Mark Gayton and Jim Crane of Mackay Sugar, Burn Ashburner of Canegrowers Mackay and the Mackay Area Productivity Service and John Powell of Queensland Mechanical Cane Harvesters' Association for their leadership and input to the management and social aspects of the project for our various industry sectors;
- Bill Andrew of AEC Consulting and now CSIRO, for facilitating workshops and meetings, and assisting the evaluation process.

Thanks also to other industry representatives and experts who have been of particular assistance: Ken Griffin of Mackay Sugar for his work on NIR; Gary Sandell of BSES; Robert Crossley of Agtrix Pty Ltd; Donald Alexander of Central Queensland University;

Thanks to our advisory committee, the Cane Supply Consultative Group representing our industry leadership, who have remained supportive of the project from its inception.

We are particularly grateful for the patience, support and hard work of the reference groups who helped design the systems and the pilot groups who helped trial them. Without their input and insights, the project would not have been the success it has been.

And last but not least, our thanks to SRDC for their foresight in funding this project, and their assistance when the going got tough.

LIST OF PUBLICATIONS

- Fleming, G.F.** (2005). Cooperative Systems: An information systems model for industry value chain management. Proc. Aust. Soc. Sugar Cane Technol. 27: 40-50.

BIBLIOGRAPHY

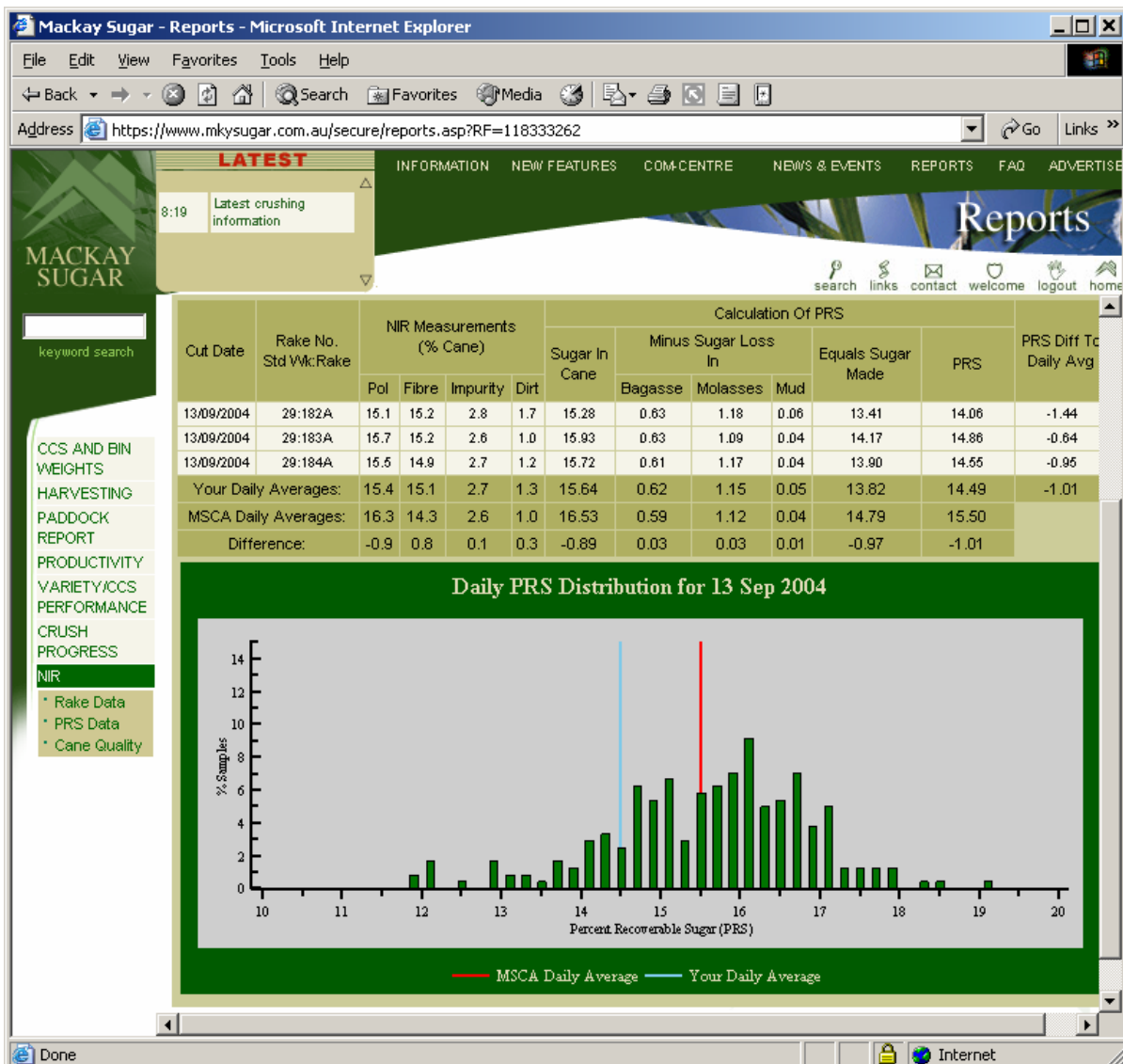
- Crane, J.A. and Fleming, G.F.** (2003). Improving information flows in the sugar industry supply chain: the Mackay Sugar Web Portal. Proc. Aust. Soc. Sugar Cane Technol. (CD-ROM), 25: 8p.
- Higgins, A., Archer, A., Jakku, E., Thorburn, P. and Prestwidge, D.** (2005). Value Chain Research in Sugar: A Review of Successes and Learnings. Final report on SRDC Project reference CSE013.

APPENDICES

APPENDIX A: Web Reporting of NIR Results

1. NIR Cane Analysis

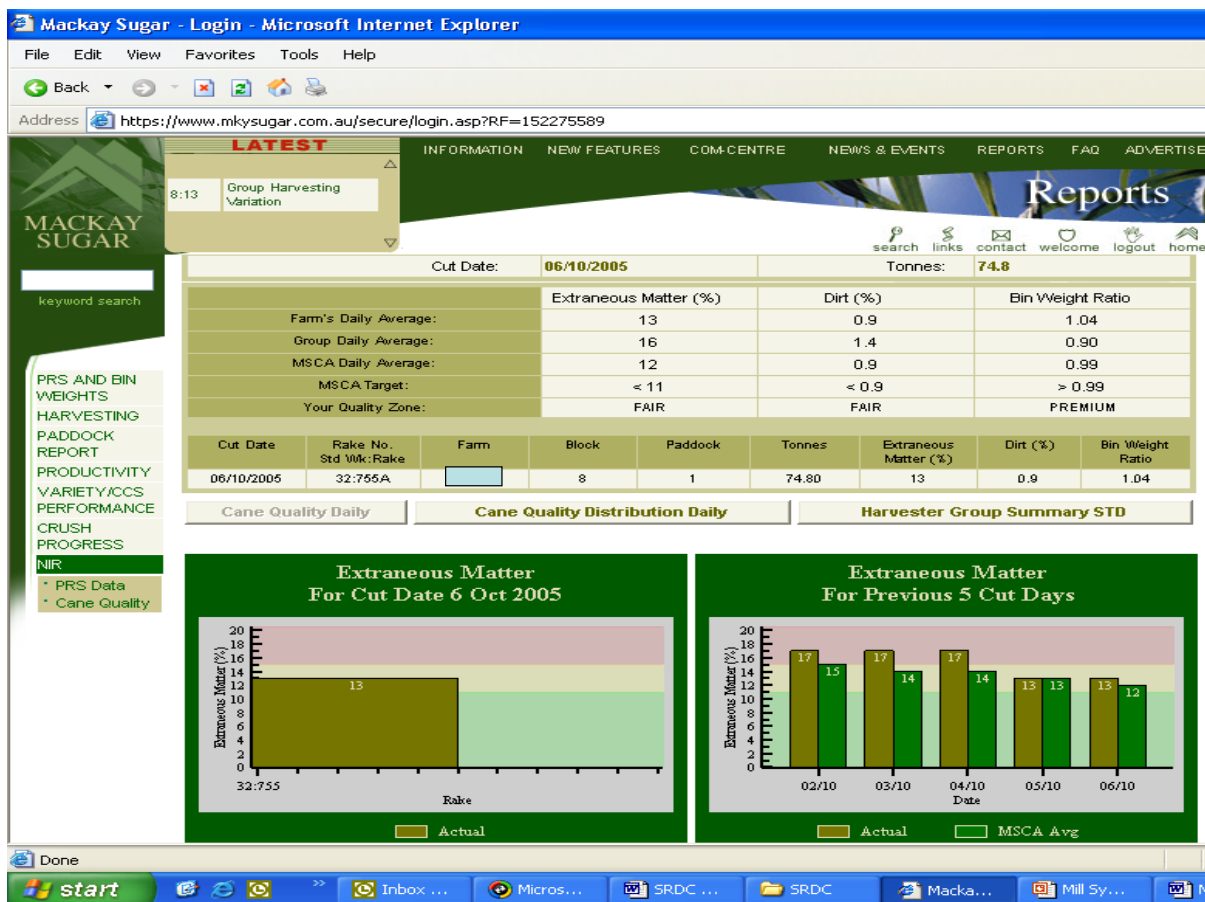
NIR results are posted to the web site as soon as they are available, which is very shortly after the cane is crushed. Growers use this web page to view the results for each of their deliveries on any given day. The report shows the base NIR measurements and the derivation of Percent Recoverable Sugar, which is the basis of payment for sugar in cane. The graph shows the distribution of PRS results for all deliveries from all growers on the day in question, with the grower's daily average and the mill daily average highlighted.



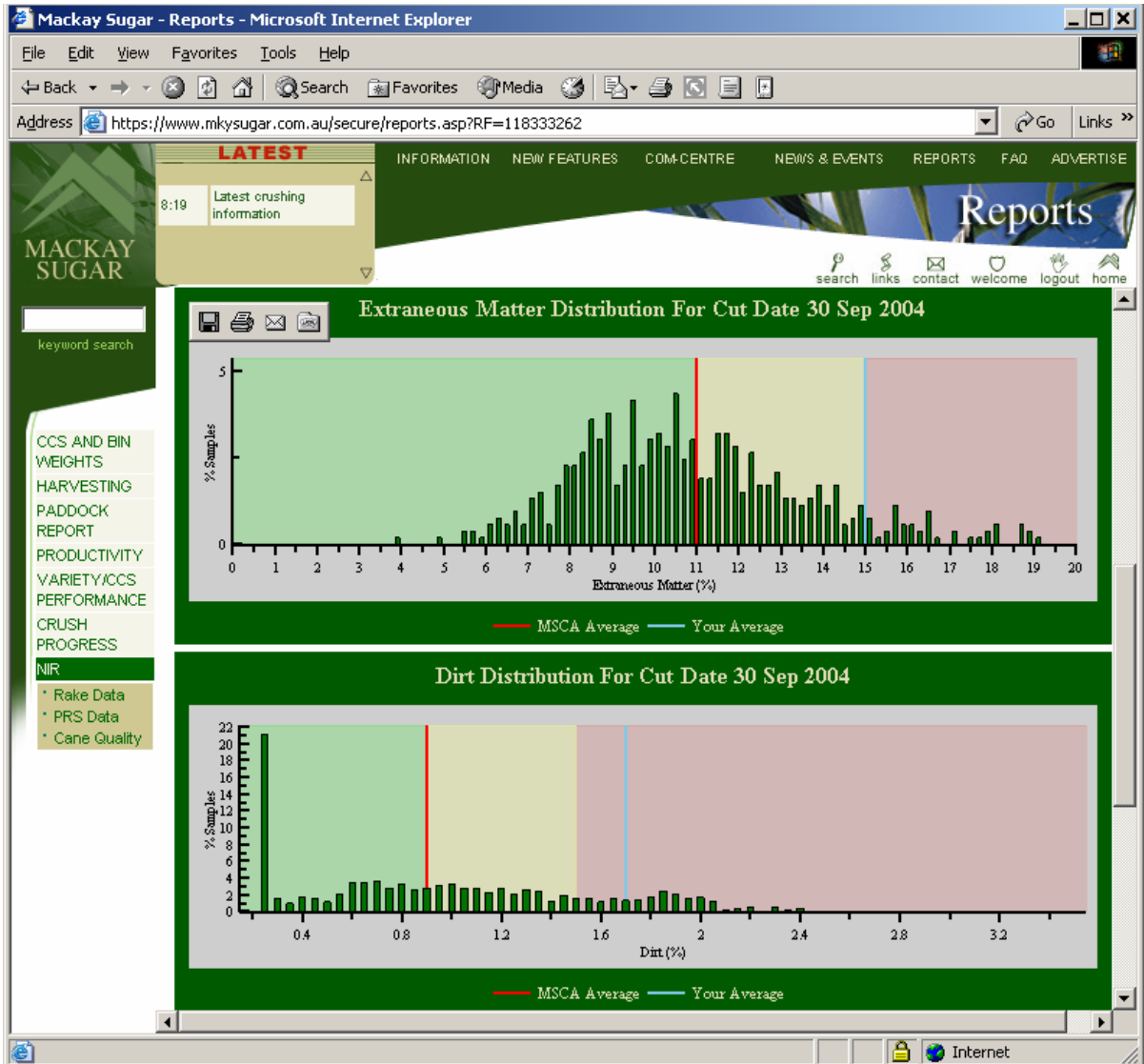
2. NIR Cane Quality Results

This series of web pages reports cane quality results for growers and harvester operators. The cane quality indicators used are Extraneous Matter (calculated as fibre / pol), dirt (calculated from ash) and average bin weight.

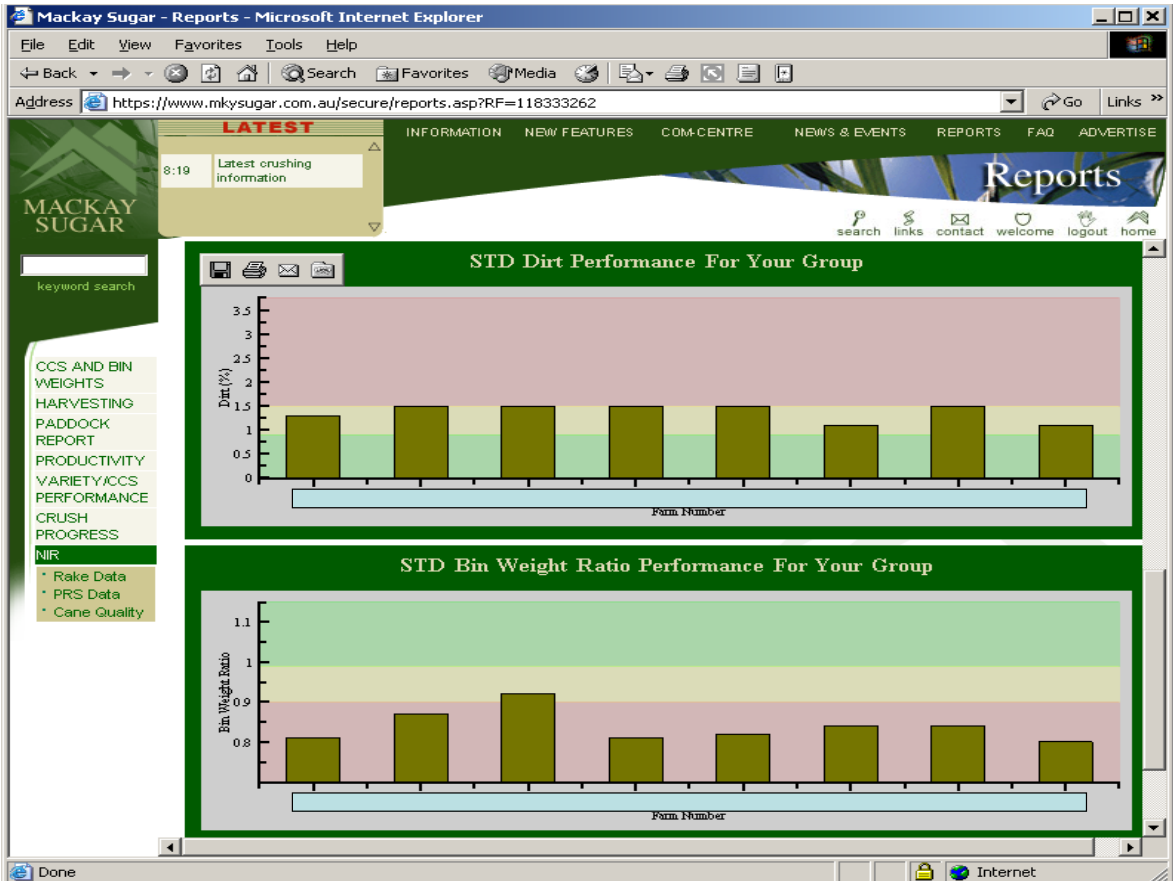
The table below shows a farm's averages and rake details for a given day. The accompanying graphs show individual rake details for the day and performance versus mill average for the previous five days of supply. (Only the extraneous matter graphs are shown – the same format is displayed for dirt and bin weight). The coloured zones in the background represent what is considered premium, fair and poor performance.



Graphs are available for each quality indicator showing the distribution of results for a nominated day, as well as the farm average and the mill average. Again, coloured zones are used to indicate performance.



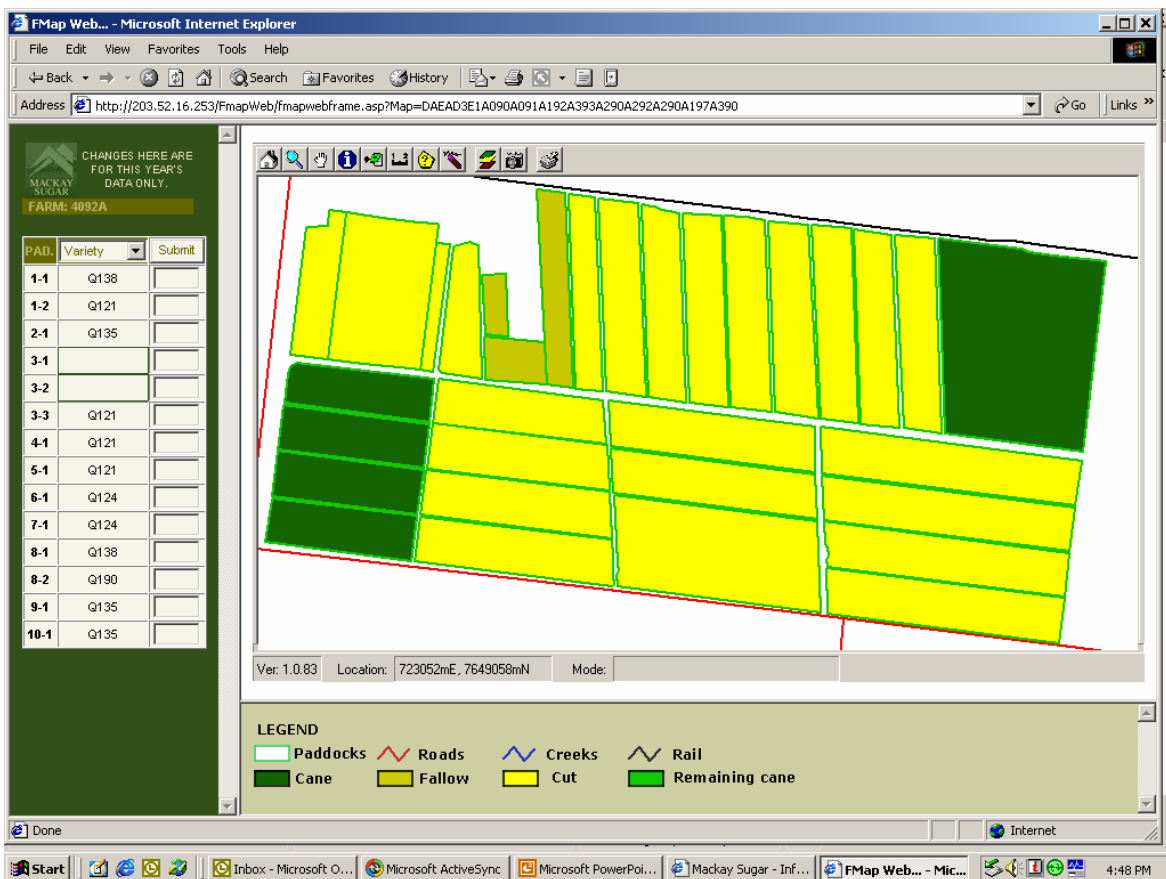
Graphs can also be produced showing the season to date performance of all the members of the farm's harvesting group. This is useful for both growers and harvester operator's in highlighting performance variation from farm to farm.



APPENDIX B: Harvesting System Reports

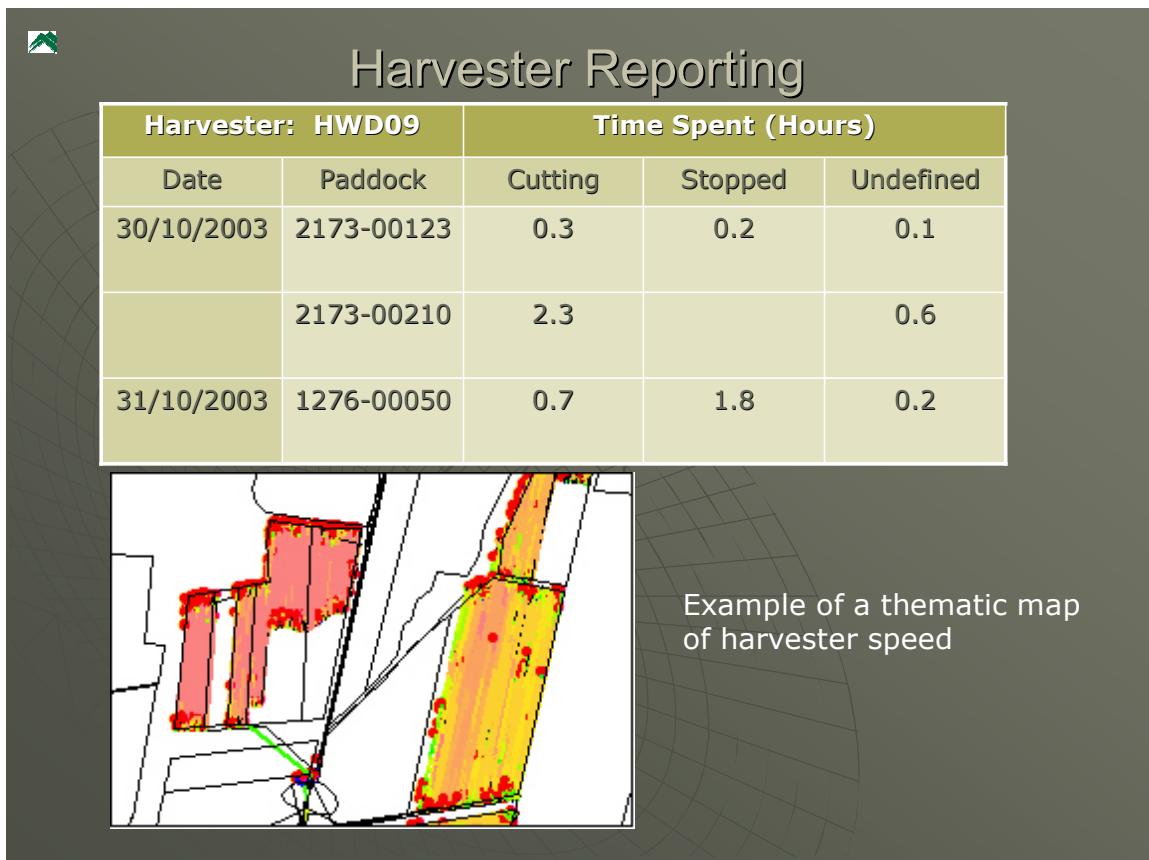
1. Area Harvested

Area harvested obtained by processing the harvester “tracks” from MT Data units using CHOMP software are displayed as a GIS layer on the farm mapping interface on Mackay Sugar’s web portal.

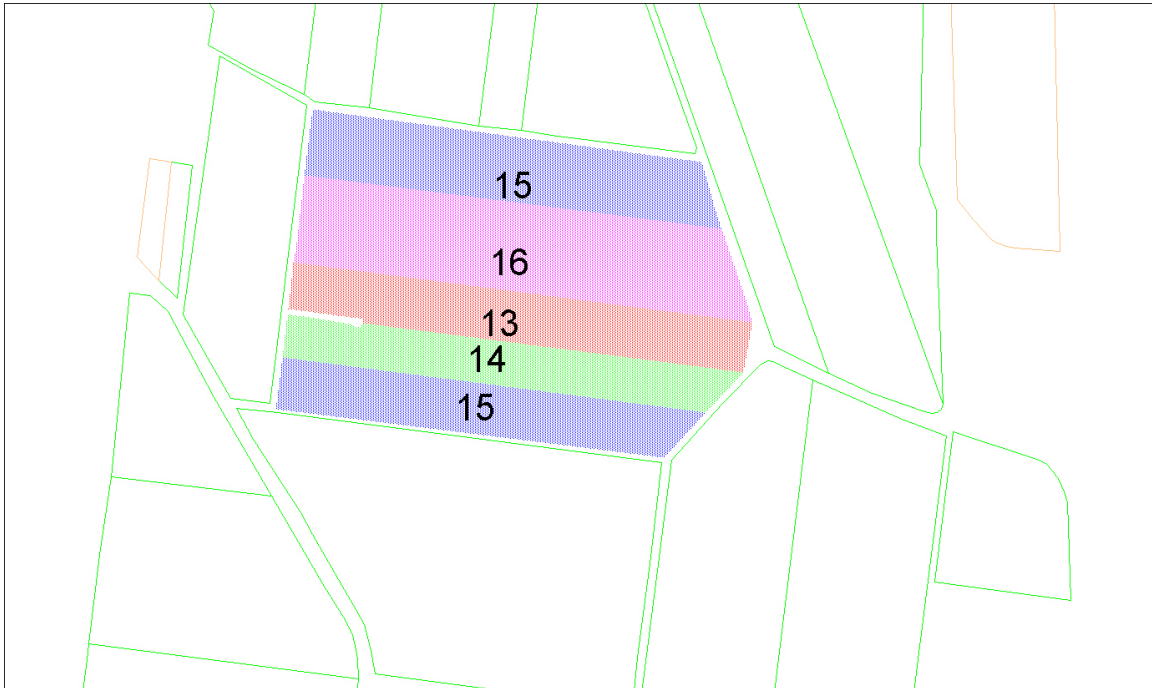


2. Thematic Maps

Any other geo-referenced data can be related to farm maps and displayed using CHOMP. This example shows a thematic map of harvester speed and an associated report of field efficiency.



This is an example of a CCS (or PRS) map for a paddock where individual deliveries have been geo-referenced.

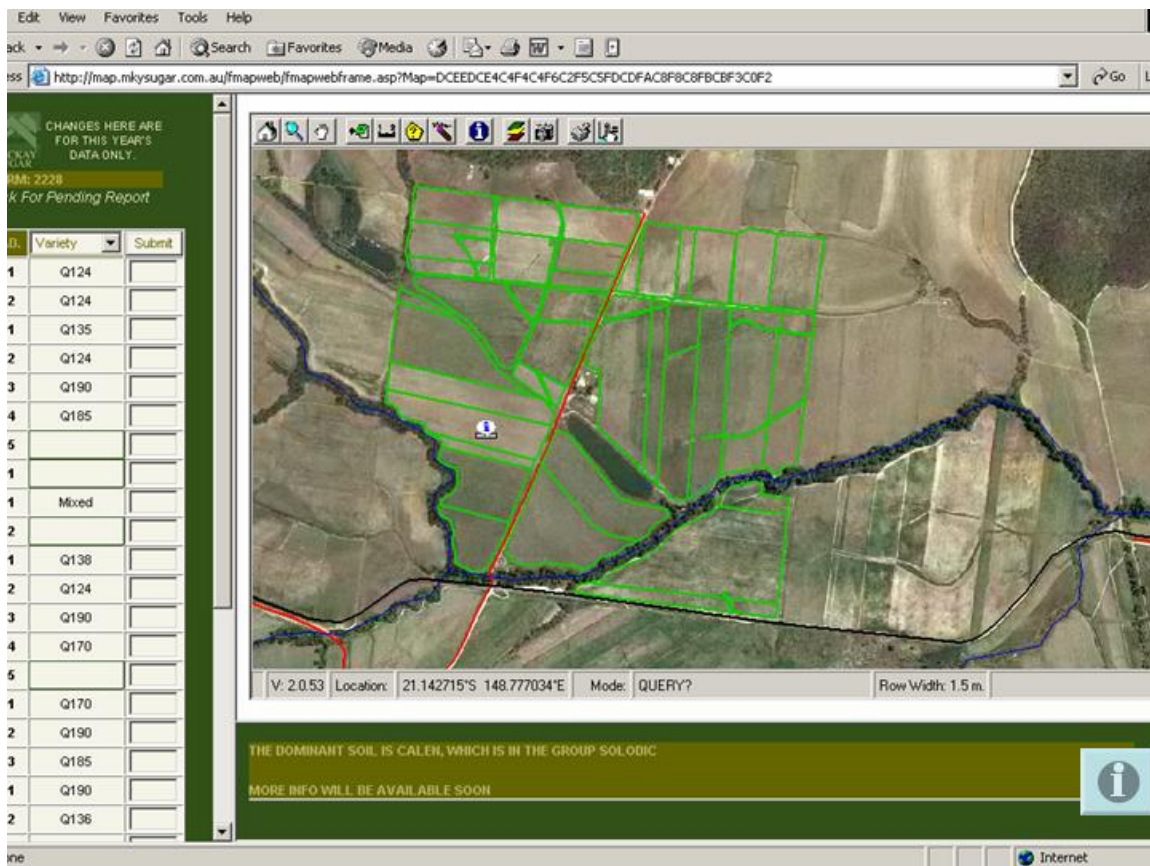


APPENDIX C: Farm Management Tools

1. Variety Selector

The variety selector tool is being developed as an interactive extension of the paddock information tool on the web site's farm mapping interface.

The user can currently select a paddock using the Information tool to display data such as soil type.



A new tool opens the Variety Selector dialogue to add qualitative information as shown in the next screen.

The tool then uses Cooperative Systems' historical data to compare the performance of different varieties in paddocks with similar characteristics, in conjunction with data from BSES.

A list of the most suitable varieties for the paddock is displayed.

CHANGES HERE ARE FOR THIS YEAR'S DATA ONLY.
 MM: 2228
 For Pending Report

B.	Variety	Submit
1	Q124	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
1	Q135	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
3	Q190	<input type="checkbox"/>
4	Q185	<input type="checkbox"/>
5		<input type="checkbox"/>
1		<input type="checkbox"/>
1	Mixed	<input type="checkbox"/>
2		<input type="checkbox"/>
1	Q138	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
3	Q190	<input type="checkbox"/>
4	Q170	<input type="checkbox"/>
5		<input type="checkbox"/>
1	Q170	<input type="checkbox"/>
2	Q190	<input type="checkbox"/>
3	Q185	<input type="checkbox"/>
1	Q190	<input type="checkbox"/>
2	Q136	<input type="checkbox"/>

Variety Selector
 Please check the boxes that best describe the details for this block.

- History of padymetra problems
- Suitable for dry land farming
- Smut resistant
- High yielding
- High CCS
- Early season variety
- Mid season variety
- Late season variety

V: 2.0.53 Location: 21.142715°S 148.777034°E

THE DOMINANT SOIL IS CALEN, WHICH IS IN THE GROUP SOL ODIC
 MORE INFO WILL BE AVAILABLE SOON

CHANGES HERE ARE FOR THIS YEAR'S DATA ONLY.
 MM: 2228
 For Pending Report

B.	Variety	Submit
1	Q124	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
1	Q135	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
3	Q190	<input type="checkbox"/>
4	Q185	<input type="checkbox"/>
5		<input type="checkbox"/>
1		<input type="checkbox"/>
1	Mixed	<input type="checkbox"/>
2		<input type="checkbox"/>
1	Q138	<input type="checkbox"/>
2	Q124	<input type="checkbox"/>
3	Q190	<input type="checkbox"/>
4	Q170	<input type="checkbox"/>
5		<input type="checkbox"/>
1	Q170	<input type="checkbox"/>
2	Q190	<input type="checkbox"/>
3	Q185	<input type="checkbox"/>
1	Q190	<input type="checkbox"/>
2	Q136	<input type="checkbox"/>

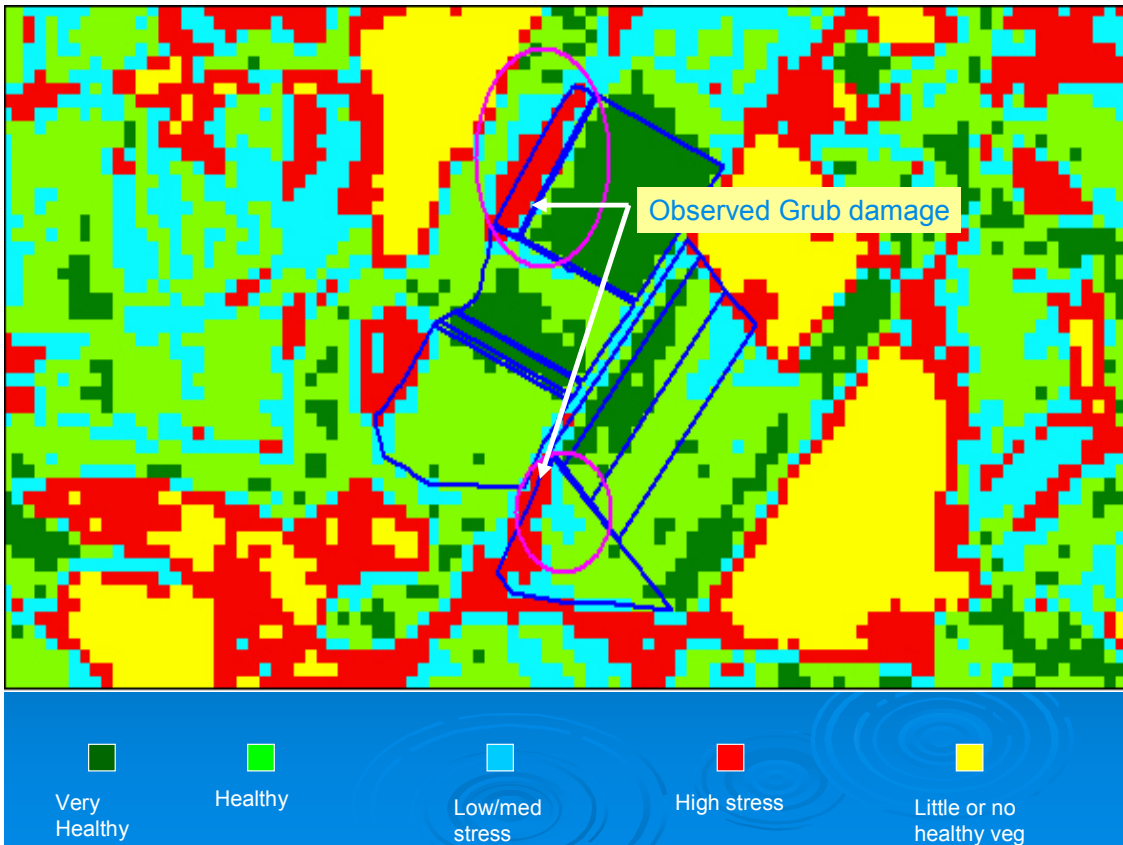
Variety Selector
 The most suitable varieties for planting in this block are:
Q135; Q190; Q205; Q207
 Please click on the variety name for more details.

V: 2.0.53 Location: 21.142095°S 148.78829°E Mode: QUERY? Row Width: 1.5 m.

THE DOMINANT SOIL IS CALEN, WHICH IS IN THE GROUP SOL ODIC
 MORE INFO WILL BE AVAILABLE SOON

2. Pest and Disease Management

Some limited trials have been done analysing satellite imagery for crop vigour (or stress). The image thus obtained was compared with known areas of grub damage. There appears to be a possibility of establishing a correlation that will at least indicate problem areas. Coupled with on-line maps of recorded infestations, it is hoped that this will assist growers to monitor and manage such pests.



3. Central Region Sugar Group Financial Benchmarking

The Central Region Sugar Group (CRSG) web site incorporates a Grower Positioning Program. This combines productivity data (from Cooperative Systems data) with farm data financial data entered by growers and their advisors. This allows growers to generate a performance report for their own enterprise, and benchmark their results against other similar enterprises as defined by a set of filters applied to the data.

Farm Details

Farm Number	Group
Farm Name	
Season	4 year average
Area Harvested (Ha)	135.93
Tonnes of Cane / Ha	79.10
Tonnes of Cane Crushed	10771.82
CCS	14.31
Sugar Price	278.95

Filter Group Information

Mill Area: Proserpine
 ALL Zone
 IrrigationArea: Area Irrigated (>75%)
 Irrigation Classification: Regulated
 Contracted cane harvesting
 Farms between 100 and 200 hectares
 Total sample size is: 28

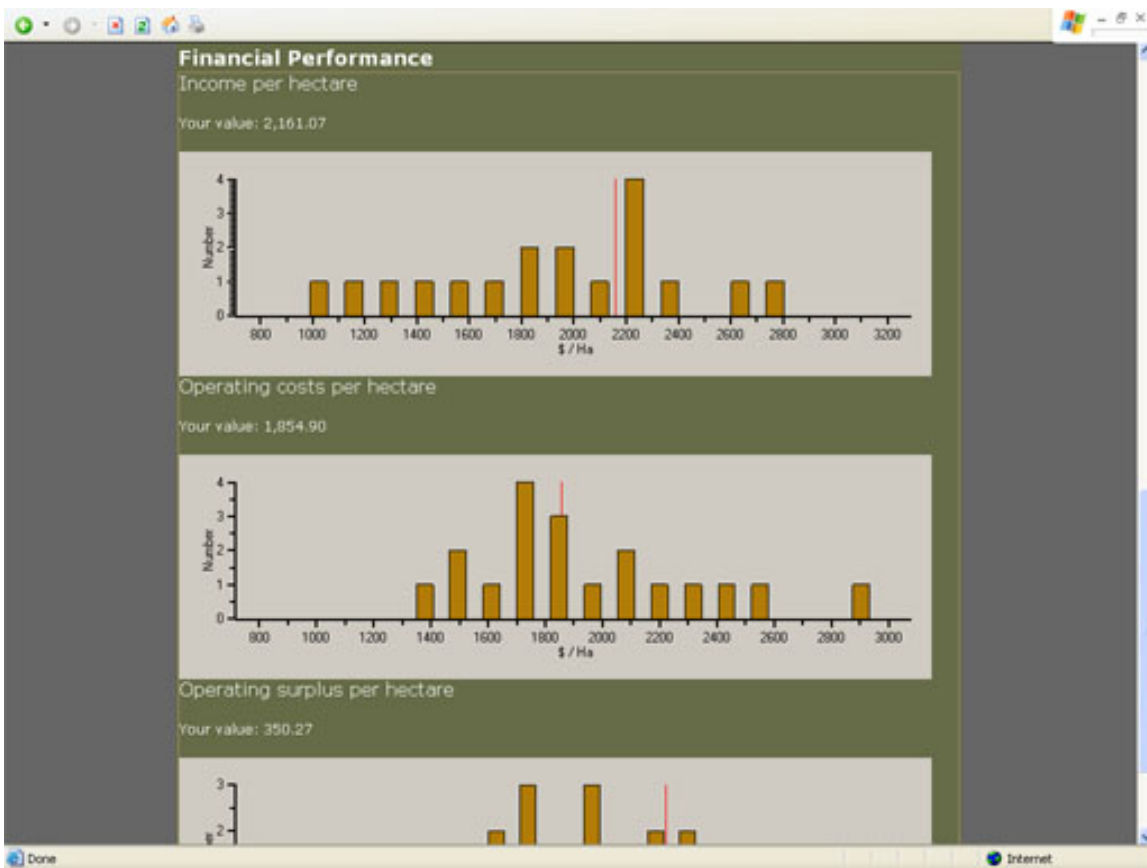
Performance Report

Item	Value	per Hectare		Rank	per Tonne		Rank
		Value	Average		Value	Average	
Cane Income	294,447.87	2,161.07	1,971.41	9	26.77	25.99	6
Mill Allowances	6,005.13	44.10	37.65	9	0.54	0.51	10
Other Cane Income	0.00	0.00	25.93	9	0.00	0.40	9
Total Cane Income	300,453.00	2,205.17	2,035.03	10	27.31	26.90	9
Harvesting & Transport	71,709.84	526.88	497.71	15	6.59	6.58	15
Leases	6,040.87	44.64	36.75	20	0.60	0.49	21
Variable Costs per Tonne	77,758.73	571.52	534.47	16	7.19	7.06	18
Fertilizers	59,412.59	435.18	341.19	14	5.28	4.63	16
Chemicals	8,410.00	61.60	85.58	9	0.75	1.19	9
Electricity	200.00	1.47	5.80	9	0.02	0.08	9
Fuel & Oil	7,378.74	54.65	86.23	8	0.74	1.18	7
Irrigation	25,973.64	191.99	181.96	14	2.97	2.42	12
Repair & Maintenance	16,282.97	120.02	143.19	14	1.56	1.94	12
Other Growing Costs	1,881.90	14.23	42.02	13	0.24	0.62	11
Paid Labour	484.46	3.46	106.74	9	0.05	1.49	8
Variable Costs per Hectare	128,824.38	882.98	992.69	11	18.98	17.52	8
Overheads	19,502.33	143.24	155.09	13	1.85	2.14	0
Unpaid labour FTE	35,000.00	257.64	284.37	12	3.38	3.90	11
Total Fixed Costs	54,582.33	488.89	439.45	11	5.23	6.07	10
Total Operating Costs	232,277.36	1,874.98	1,966.61	11	23.48	26.64	7
Operating Surplus	48,175.64	358.27	88.42	5	3.91	8.26	6
Finance Costs	49,386.05	363.15	228.00	20	4.86	3.26	19
Surplus	-1,487.41	-14.88	-159.59	15	-6.95	-3.08	15
Net Farm Debt	641,239.90	4,720.02	2,642.23	18	62.13	38.20	18

Buttons: Print, Display Graphs

Performance comparisons can be represented graphically.

Data is also provided in a farm viability model that allows growers to change parameters and perform simple "what if" queries for different crops, prices and so on.



http://www.crsq.com.au/temp/67c10cca-c1ea-4a57-827a-b06ec6002d40.xls - Microsoft Internet Explorer

Address: http://www.crsq.com.au/temp/67c10cca-c1ea-4a57-827a-b06ec6002d40.xls

Search: 176 blocked, Check, Autolink, AutoFill, Options

A1 FARM VIABILITY INDICATOR

FARM VIABILITY INDICATOR						
Indicator Data						
	Historical Data - 5 Year Average	Base Data	Change Data	%	After Change Data	
4	Sugar Price	\$260.00	\$260.00	\$0.00	0.00	\$260.00
6	Farm Data					
7	Area Harvested	49.94	49.94	0.00	0.00	49.94
8	Tonnes Cane /ha	80.39	80.39	0.00	0.00	80.39
9	Cane Crushed	4014.60	4014.60	0.00	0.00	4014.60
10	CCS	13.93	13.93	0.00	0.00	13.93
12	Income					
13	Mill Allowances	\$1,961.09	\$1,961.09	\$0.00	0.00	\$1,961.09
14	Other Cane Income	\$0.00	\$0.00	\$0.00	#DIV/0!	\$0.00
16	Variable Costs / Tonne Cane					
17	Harvesting	\$6.35	\$6.35	\$0.00	0.00	\$6.35
18	Levies	\$0.45	\$0.45	\$0.00	0.00	\$0.45
19	Total Variable Costs / Tonne Cane	\$6.79	\$6.79	\$0.00	0.00	\$6.79
21	Variable Costs / Hectare					
22	Fertilizers	\$448.97	\$448.97	\$0.00	0.00	\$448.97
23	Chemicals	\$149.61	\$149.61	\$0.00	0.00	\$149.61
24	Electricity	\$12.03	\$12.03	\$0.00	0.00	\$12.03
25	Fuel & Oil	\$98.16	\$98.16	\$0.00	0.00	\$98.16
26	Irrigation	\$134.81	\$134.81	\$0.00	0.00	\$134.81
27	Repairs & Maintenance	\$215.53	\$215.53	\$0.00	0.00	\$215.53
28	Other Growing Costs	\$13.69	\$13.69	\$0.00	0.00	\$13.69
29	Paid Labour	\$0.00	\$0.00	\$0.00	#DIV/0!	\$0.00
30	Total Variable Costs / Hectare	\$1,072.81	\$1,072.81	\$0.00	0.00	\$1,072.81

start Microsoft Active... Inbox - Micros... Microsoft Excel... http://www.crsq... Adobe Photoshop 2:53 PM

APPENDIX D: Survey Results

Baseline Survey

OVERALL

- (1) How often do you access the Mackay Sugar website during the season? The majority use the site at least daily during the season, especially when harvesting.
-
- (2) What information do you access? Overwhelmingly delivery details, followed by harvesting progress reports; variety performance; news and notices
-
- (3) How do you use that information (eg to make decisions on.....)? Most respondents make decisions on which paddock/variety to cut next based on the CCS information. They also use delivery information to check on correct consignment.
-
- (4) How often do you access the Mackay Sugar website outside of the season? Access frequency drops to around once a month during the non-crush.
-
- (5) What information do you access? Access is mainly for news and grower circulars, and paddock information via farm map tools.
-
- (6) How do you use that information (eg to make decisions on.....)? Apart from general interest, the site is consulted for farm management decisions, especially on planting programs.
-
- (7) What would you like to be able to do/what information would you like to be able to have in order to better manage your farm business?
- Faster download of CCS and bin weights eg no time delay between when the cane is crushed to when it is entered onto the website
 - Farm and paddock data – yield, better farm recording program other than CANEMAN
 - Better soil map, block data, ability to input block information eg fertilizer application
 - More detail in productivity of blocks as it is harvest – electronic consignment
 - Value of tonnes of cane in terms of per tonne at the Australian dollar rate, advance weather reports
 - Dollars per hectare for each block and varieties harvester productivity
 - More quality linking to like of BSES and CPPB – a one-stop information source. Keep Mackay Sugar news really up to date
 - R&D information, better variety, variety information
 - Apply farm overlays on farm map eg underground, pipes
-
- (8) What is your level of knowledge about/understanding of the Cooperative Systems Project currently underway in the Mackay region/district?
- | | No knowledge at all | | | | | A good understanding of the project |
|--|---------------------|-----------|-----------|------------|------------|-------------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | 0% | 0% | 0% | 40% | 30% | 30% |

(9) What opportunities do you see for improvements in the local sugar industry value chain? ie planting – growing – harvesting – transporting – milling

- Co-generations, mill owned harvesting groups (geographical harvesting), other valued byproducts (plastics etc)
- Milling, transport, harvesting
- Working towards making efficient system and viable systems
- Barns harvest system, technology improvements (quality)
- A lot – easy extension tool, harvest control
- Easier access to information
- Harvesting and transport
- Plant cane, better control of bins for road transport, that is a more orderly delivery
- Better information for management, productivity relative to varieties, productivity relative to farm layout
- Development of new varieties, better data on nutrition requirements for different varieties, soil types etc, better data on soil parasites (general soil health), better information on transport costs and cross subsidisation
- Minimum till, controlled traffic situations, utilising results of research into N applications and productivity, micro nutrients and “alternative” fertilizers, area harvesting to take advantage of cane ripening patterns, value added opportunities for by products
- Information to flow through from research bodies etc on all of the above in a format that doesn’t take a long time to download due to slow Telstra lines
- Harvesting rationalisation, reduce harvest management costs

(10) How would you rate your level of optimism about the local sugar industry at present?

Not optimistic at all						Very optimistic					
1	0%	2	25%	3	25%	4	30%	5	20%	6	0%

(11) How satisfied are you with:

	Not at all satisfied					Very satisfied						
- current level of access to data to assist you to manage your farm business?	1	0%	2	0%	3	15%	4	65%	5	20%	6	0%
- the use you make of the information currently available?	1	0%	2	0%	3	30%	4	45%	5	25%	6	0%
- the information and ‘tools’ at your disposal to help you manage your farm business?	1	0%	2	0%	3	25%	4	40%	5	25%	6	10%

Project Evaluation: Participant Feedback

1. Were the **outcomes/results** from the project useful in your view?

Not at all 1 **0%** 2 **0%** 3 **6%** 4 **31%** 5 **63%** Very (Circle the appropriate point)

Comments:
.....

2. Was **your participation** in the project useful from your perspective?

Not at all 1 **0%** 2 **2%** 3 **10%** 4 **35%** 5 **53%** Very (Circle the appropriate point)

Comments:
.....

3. Did the project **achieve what it set out to do** in your opinion?

Not at all 1 **0%** 2 **0%** 3 **12%** 4 **52%** 5 **36%** Very (Circle the appropriate point)

Comments:
.....

4. Did the project **meet your expectations**?

Not at all 1 **0%** 2 **2%** 3 **8%** 4 **54%** 5 **36%** Very (Circle the appropriate point)

Comments:
.....

5. Was the project **successful** in your view?

Not at all 1 **0%** 2 **0%** 3 **6%** 4 **34%** 5 **60%** Very (Circle the appropriate point)

Comments:
.....

6. Do you believe **your understanding** of the use and value of farming systems tools and data has been improved by your participation in this project?

Not at all 1 **0%** 2 **0%** 3 **6%** 4 **43%** 5 **51%** Very (Circle the appropriate point)

Comments:
.....