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A National Workshop on "Precision Poultry Farming" in Australia

A report for the Australian Egg Corporation Limited

by Thomas Banhazi

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Foreword

"Precision Farming" (PF) principles and techniques are already widely utilised within the broad-acre industries. The principal component of precision farming in these industries is the development of accurate real time performance monitoring systems. The development of new sensing and data management systems enabled the development of analogous systems within the Intensive Animal Industries.

Therefore, it is important to introduce a better integrated, information-based and better controlled production system in the Australian egg industry. Applying modern methods of "Production management" involves establishing data acquisition systems, analysing of the recorded information, triggering management actions and activating either automatic control systems and/or human intervention. Utilising more advanced control procedures as well as monitoring the outcomes of control action is an important part of advanced production management. New technologies, such as PLF practices, have to be pursued and explored by the Egg Industry. They have the potential to improve production efficiency as well as welfare and health of animals, and could also reduce the environmental impact of poultry production. The 1st Egg Industry Precision Livestock Farming workshop aimed to introduce these concepts and was the first important step towards establishing a structured research program expected to lead to the introduction of advanced management procedures into the Australian Egg Industry.

This project was funded from industry revenue which is matched by funds provided by the Federal Government.

This report is an addition to AECL's range of research publications and forms part of our R&D program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry.

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Irene Gorman
Research Manager
Australian Egg Corporation Limited

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About the Author

Thomas M. Banhazi is a Research Scientist at the South Australian Research and Development Institute – Livestock System Alliance and his research interests are related to intensive livestock housing. Recently he has undertaken studies to investigate the relationship between environmental/drinking water temperatures and management factors in pig sheds. He has also investigated methods for reducing the impact of poor air quality on the respiratory health of both humans and animals. He is recently developed interest in the advancement of data acquisition and data management systems for the livestock industries to improve the precision of production management. He is actively involved in a number of scientific organisations, including the “International Society for Animal Hygiene” and the "Australian Biosystem" group. He is the Secretary of the "International Commission for Agricultural Engineering (CIGR) - Section II: - Farm buildings, Equipment, Structures and Environment" group.

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Abbreviations

ACPLF	Australian Centre for Precision Livestock Farming
DSS	Decision Support Systems
GPS	Global Positioning System
IT	Information Technology
KPI	Key Performance Indicators
PF	Precision Farming
PLF	Precision Livestock farming
PM	Production Model
R&D	Research and Development
UK	United Kingdom

Executive Summary

The marketing conditions for animal products have changed dramatically in the last few decades. Customers are now demanding high quality and safe products, at an acceptable price and animal production systems which are animal welfare and environmentally friendly. Of course, livestock production must also remain profitable. To fulfil these requirements simultaneously can be an overwhelming task for livestock producers. Livestock production is a very complex biological process and therefore any attempts to achieve these targets concurrently will almost inevitably result in conflicts. However, when full understanding of the process is developed and modern control techniques are applied, even such complex processes can be controlled and managed.

Thus, the main objective of this project was to conduct a national workshop to introduce the concept of precision livestock farming (PLF) and discuss the practicality of implementing PLF technologies on poultry farms to improve profitability of these farms by improving technical efficiency. The workshop was the first step towards developing strategies to (1) introduce methods of measuring key performance indicators, (2) develop tools for improved decision making and (3) demonstrate benefits of adopting these management tools within the Egg Industry.

The fist step in the project was the identification of relevant and interested parties wishing to participate in the proposed Workshop. An information package was mailed out to provide sufficient background information to all potential participants. This was done to achieve a level of common understanding regarding terms, current status and potential opportunities of the technology. A representative cross-section of the industry was invited to identify the level of interest and potential expertise in the PLF area.

The 1st National Egg Industry PLF Workshop was held in Adelaide in November 2002 and the workshop was successful in attracting a dedicated group of high quality participants. In the morning, delegates were presented with an extensive review of major issues related to PLF technologies. The main aim of the afternoon session was to evaluate the capacity of the Australian industry to adopt these technologies and develop a plan for the appropriate implementation. The participants of the meeting agreed that there were potential benefits from introduction of precision farming systems and principles into the Australian egg industry, including reduction in labour costs, improved animal welfare standard, an improvement in reliability of operations, better targeted nutrition, improved marketing and an improvement in quality control. It was also recognised that, some components of precision farming systems within the egg industry are available, but none have been developed into fully comprehensive systems. Many of the independent components of a likely system are not compatible in terms of hardware and software and therefore additional work is required to ensure the compatibility of system components. The development of an integrated data analysis tool for the industry was identified as a potentially critical enhancement for the egg industry and could lift management standards on farms.

Delegates agreed, that more work will be required to identify the most critical areas affecting profitability and development of Critical Control Points for incorporation into management systems. Such work might be more efficiently undertaken using an independent review of industry practices. A related review of the precision farming technology potentially available to the layer industry, its current state of development and likely benefit to the industry also has to be undertaken. Finally a second Workshop with members of the Australian Egg Corporation, egg producers and companies supplying precision farming technology to identify the most efficient ways for introducing precision farming systems into the Australian egg industry needs to be conducted.

Introduction

"Precision Farming" (PF) principles and techniques are already widely utilised within the broad-acre and row-crop industries of Australia and overseas. The principal component of precision farming in these industries is the development of accurate real time performance monitoring systems utilising GPS technology. The development of new sensing and data management systems will allow the development of analogous systems within the Intensive Animal Industries (Naas 2001). In other industries the key benefit of these technologies has been in allowing producers to target specific areas in their production more efficiently for improvement (Lemin *et al.* 1991). A key element of the system's success will be the additional potential to allow effective on-farm research trials at a minimal cost to the producer.

In Europe the introduction and implementation of precision livestock farming (PLF) principles and techniques into the pig and poultry industries are well advanced and have the potential to improve production efficiency (Petersen *et al.* 2002; Schofield *et al.* 2002; Frost *et al.* 2003; Seshasai *et al.* 2005). A number of projects are currently progressing at the Silsoe Research Institute and aimed at linking up existing technologies so appropriate information will be made available on-line for producers for strategic decision making (Frost *et al.* 1997; Whittemore *et al.* 2001). Researchers in the UK are exploring further potential uses of the system and looking at measuring on-line ammonia emission values from the sheds, which in turn can be used as input information for further diet modification aimed at reducing nitrogen output (Chamberlain-Ward 1998; Cumby and Phillips 2001). The potential of the system is considerable, given the fact that all information measured on-line can then be used as input information for management models (Black *et al*. 1999).

Most of the technological components of a futuristic Precision Livestock Farming (PLF) systems such as climate control equipment, automated feeding systems, computer models and decision support softwares are well developed and readily available commercially. However, the integration and data management aspects of PLF systems need further research & development work (Frost *et al.* 1997).

Potential benefits of the system

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- Improved production efficiency and lower costs.
- Improved product quality and return
- Improved monitoring of animal welfare
- Reduced pollutant emission from waste product
- Better health control as both feed usage and growth rate change will alert managers to early signs of disease problems.
- Improved scientific understanding of nutritional, health and environmental effects on the animals as almost all important parameters will be monitored by the system and later on new measurement parameters can be added as necessary.
- The opportunity to undertake detailed on farm production R&D at limited extra cost to the producer.
- Improved awareness and potentially greater adoption of IT related technologies on farms.
- Better identification of inefficiencies within the production system.

Objectives

The main objective of the project was to conduct a national workshop to discuss the practicality of implementing precision livestock farming technologies on poultry farms within Australia to improve profitability of poultry farms by improving technical efficiency. The following steps were seen to be important to achieve the main objective:

- Identify key performance targets (e.g. profit/hen housed, profit/m^2 shed area, improved animal welfare etc)
- Identify key performance parameters (e.g. feed conversion efficiency, labour units per bird, desirable welfare standard etc)
- Identify key performance indicators for these parameters (e.g. feed intake, water intake, percentage first quality eggs, shed temperature, indicators of welfare etc)
- Identify current and novel methods of measuring key performance indicators and any gaps in available technology
- Identify tools available and tools required to utilize data on key performance indicators in making management decisions

The desired outcome of the process would be to develop R&D strategies to:

- Develop methods of measuring key performance indicators identified as currently unavailable
- Develop tools for management decision making identified as currently unavailable
- Demonstrate benefits of adopting measurement and management tools

Project and Workshop methodology

The project was divided into three phases:

- Phase I – **Identification of** relevant and interested parties wishing to participate in the proposed Workshop in collaboration with industry leaders and RIRDC and **provide** sufficient background **information** for the potential delegates, so their participation will be productive.

  1. A list of potential participants was compiled and circulated among Industry leaders and relevant RIRDC project managers to ensure that all interested parties were invited to participate in the workshop.

  2. After a confirmation of interest received from invited delegates, an information package was mailed out to provide sufficient background information to all participants. This was done to achieve a level of common understanding regarding terms, current status and potential opportunities of the technology. (Appendix A)

- Phase II - **Organised** a well-promoted workshop. A representative cross-section of the industry was invited to identify the level of interest and potential expertise in the PLF area. The workshop itself comprised of two major parts
  (1) Morning presentations and
  (2) Afternoon group discussion

- Phase III - **Produced** a final report to summarise the issues encountered during the Workshop and prepare an embryonic R&D plan for the Egg Industry in the Precision farming area.

Table 1. List of workshop participants

Surname	First name	Company	Expertise	Email
Baker	Andrew	AJ McLean & Co	Producer	andrewb.bgardens@bigpond.com.au
Banhazi	Thomas	SARDI - PPPI	Organiser	banhazi.thomas@saugov.sa.gov.au
Black	John	J. Black Consulting	Facilitator	jblack@pnc.com.au
Brown	Paul	AJ McLean & Co	Producer	andrewb.bgardens@bigpond.com.au
Cadwallader	Steve	Big Duchman	Speaker	stevecad@bigpond.com.au
Durack	Matthew	NCEA-QLD Uni	Speaker	durackm@usq.edu.au
Gorman	Irene	RIRDC	Research	irene@aeia.org
Holland	Nevin	Koolpari Tradings Pty Ltd	Producer	nholland1@bigpond.com
Kratzmann	Noel	D.A. Hall & Co	Producer	noeljulie@bigpond.com.au
Munzberg	Geoff	Munzberg & Co Pty Ltd	Producer	munzco@ozemail.com.au
Ronan	Glen	PIRSA	Government	ronan.glenn@saugov.sa.gov.au
Rutley	David	LSA-Uni of Adelaide	Speaker	drutley@waite.adelaide.edu.au

Results - issues discussed

Morning presentations

The 1st Egg Industry PLF Workshop was held in Adelaide on 18 November 2002 and the main participants were members of the Australian egg industry, poultry scientists and experts in PLF technologies. The workshop was successful in attracting a dedicated group of high quality participants. In the morning, delegates were presented with an extensive review of major issues related to PLF technologies. Several presentations were made outlining the principles of precision farming and its current application within broad acre agriculture and the pig and poultry industries (Please see Appendix B). The following presentations were given:

- Introduction and review of principles of Precision Farming – T. Banhazi
- Technical review of Precision Farming in Australia & Overseas – M. Durack
- Data analysis, interpretation and its value – D. Rutley
- Review of Decision Support Systems – J. Black
- Big Dutchman representatives – S. Cadwallader
- Review of the Egg Industry – I. Gorman

Many components of precision farming technology have been integrated into an egg production system designed by 'Big Dutchman'. The system includes full and continuous measurement of environmental conditions within layer sheds, measurement of feed intake for groups of caged birds, egg counts, automatic egg collection, weighing and separation systems. Manure drying systems have also been automated.

The participants of the meeting agreed that there were many potential benefits from introduction of precision farming systems and principles into the Australian egg industry. The most important potential benefits were seen as:

- reduction in labour costs (Lokhorst and Vos 1994; Lokhorst 1996a)
- improvement in reliability of operations (Lokhorst and Keen 1995; Lokhorst 1996b; Barnett and Newman 1997; Aerts *et al.* 2001; Naas 2001)
- opportunity to reduce the labour needed for routine inspections of watering-feeding systems and bird health (Kettlewell *et al.* 1997; Sergeant *et al.* 1998; Chen *et al.* 2002)
- improvement in animal welfare (Van Compernolle *et al.* 1992; Barnett and Newman 1997; Harris *et al.* 2001)
- improvement in quality control (Roush *et al.* 1992; Patel *et al.* 1998)
- Improved nutritional management of birds (Pesti and Rogers 1997; Moura and Naas 2001)

The potential management from computer driven technology from a central office was seen as attractive.

Some components of precision farming systems have already been incorporated into various Australian layer enterprises. However, none have developed fully comprehensive systems. The meeting participants saw potential advantages for the industry from a more integrated approach to the adoption of precision farming technologies. With the exception of the Big Dutchman system, many of the independent components of a likely system were not compatible in terms of hardware and software. Work is needed to ensure the compatibility of system components.

In addition, to the above mentioned issues, there is a considerable opportunity exist within the poultry industry to incorporate non-intrusive welfare monitoring instruments into the production system. Images of acquired in real time and/or acoustic signals emitted by the birds can be

potentially used to assess the welfare and health status of the birds on-line (Moshou *et al.* 2001; Marchant 2003).

Afternoon "group discussion"

The main aim of the afternoon session was to evaluate the capacity of the Australian industry to adopt these technologies and develop a plan for the appropriate implementation. That work involved identifying and developing a clear understanding on the nature of main production constrains that are limiting the achievement of higher production levels. Therefore, most of the afternoon session of the Workshop was spent developing a 'Decision Tree' for the layer industry. The principle of the Decision Tree is to identify in logical order the independent factors within a production system that determine enterprise profitability and their relative importance. Once the Decision Tree has been constructed the areas where profitability can be most affected are identified and the opportunity for developing Critical Control Point and Standard Operating Procedures to maximise quality control and profitability can be implemented. Some progress with developing the Decision Tree was made, but lot more work is required to complete the Decision Tree, identify the most critical areas affecting profitability/sustainability and development of Critical Control Points for incorporation into management systems. Obviously, important issues such as animal welfare and environmental sustainability aspects also have to be taken into consideration, when formulating management decisions.

The complex discussion was managed skilfully by the group facilitator (Dr J. Black). However, the novel and complex nature of the topic discussed and the obvious time constrain on participants meant that a clear consensus on important factors affecting profitability did not emerge at this first workshop. There was, however, a clear support from delegates to follow up the potential of technologies and concepts discussed.

It was also felt after the workshop that perhaps an independent review would be a better tool to identify these independent factors within egg production systems.

General issues related to PLF

The 'market place' for food items derived from animals has changed dramatically in the last few decades. Customers are now demanding high quality and safe products, at an acceptable price and animal production systems which are animal welfare and environmentally friendly (Beattie 2001; Cumby and Phillips 2001). Livestock production must also be profitable, otherwise food production will not remain a viable and attractive economical activity for future generations (Webster 2001).

To fulfil these requirements simultaneously can be an overwhelming task for livestock producers (Schofield *et al.* 2002). Livestock production is such a complex biological process that any attempts to achieve all these goals will almost inevitably result in conflicts. However, when full understanding of the process is developed and modern control techniques are applied, even such complex processes can be controlled and managed (Gates and Banhazi 2002). The main presumptions in promoting a PLF approach to poultry producers are as follow:

- Monitoring and managing performance/welfare and environmental variables on a very short time frame will reduce the time during which birds perform at a sub-optimal level and/or endure welfare compromised conditions (Durack 2002).

- The utilisation of modern "production management" principles in the egg industry will create a framework, which will ensure the identification of inefficiencies and allow for continuous improvement of egg production, which in turn will improve profitability (Black 2001).

Therefore, areas, which need urgent improvements, are:

- Collection of management information. Data needs to be collected in a strategic fashion (on-line) and available information needs to be managed more efficiently and in a timely fashion. To achieve this, better utilisation of available information technology (IT) techniques are required (Stafford 2000).

- The collected data need to be analysed and interpreted, so the resultant information can be used for decision making (Thysen 2000). The main purpose of any PLF system should be to turn data into information and then into knowledge to improve profitability.

- Implementation of 'System Approach" - integration of currently independently controlled processes is needed (Schofield *et al.* 2002).

- Introduction of more advanced production control methods is also needed (Frost *et al.* 1997).

Components of advanced production management

The essential components of a well-designed and controlled production process are:

1. Incorporating data acquisition systems into the production chain, involving improved manual and/or automated data recording (Frost 2001)

2. Plan the changes needed by establishing protocols for data-integration and (preferably) automated data analysis to identify inefficiencies and facilitate analytical decision making (Schofield *et al.* 1994)

3. Transferring the results of data analysis as inputs into automated decision making processes and triggering certain management actions (Banhazi *et al.* 2002)

4. Implement changes by activating control systems, which could be either automated or appropriately documented and pre-determined manual control system. Alternatively external control agents can be notified and called upon to fulfil certain highly specialised control functions (Gates *et al.* 2001; Gates and Banhazi 2002)

5. Using different monitoring procedures (feedback-loops) to monitor the outcome of control actions and document it for quality assurance (QA) purposes (Black 2001)

Suggested data management and control diagram for livestock industries can be seen in Figure 1.

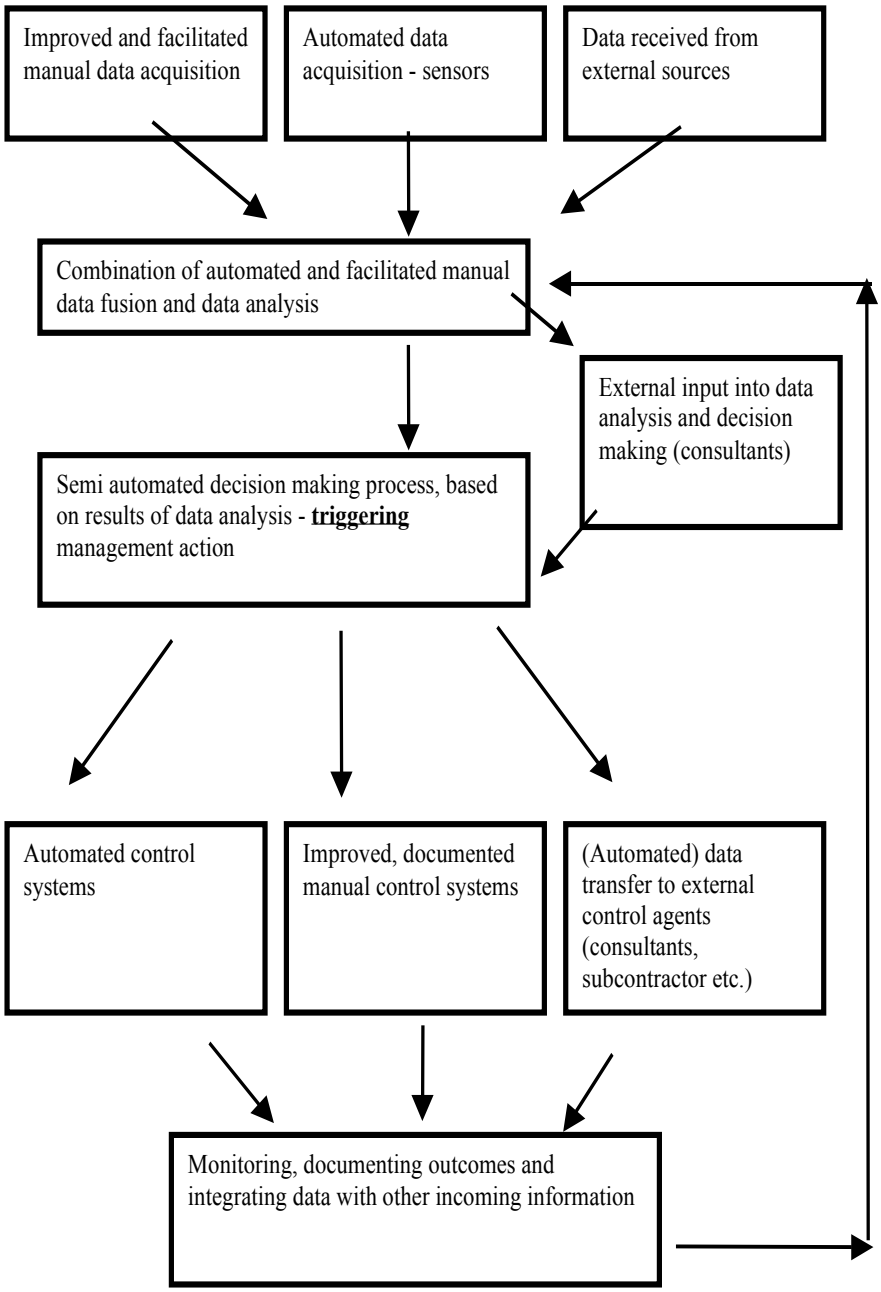

Figure 1. Data management and control diagram for a livestock enterprise (Banhazi et al. 2002)

A brief outline of these important management steps is detailed below.

Data Collection Systems

Electronic capture of the information is essential to reduce the labour cost and improve reliability of the information that must be collected if advanced production management practices are to be readily accepted by commercial poultry enterprises. In the past, information collection on such wide ranging parameters has been difficult and costly and was therefore often neglected (Black *et al.* 2001). However, recent advancement in sensor, computer technology and modern analytical tools have made the collection and analysis of large amounts of data highly feasible (Black *et al.* 2001).

Data integration, analysis and modelling

Automated Decision Support Systems (DSS) and Production Models (PM) should in the future become an integral part of poultry management systems (Aerts *et al.* 2001; Aerts *et al.* 2003). The DSS and PM models would be capable in real time of assessing whether groups of animals have an excess to appropriate diet and whether ambient temperature is above or below the zone of thermal comfort (Black 2002). The factors limiting feed intake could be predicted and diets could be reformulated automatically at specified times to most economically meet the nutrient requirements of each group of birds. Potentially, feed intake could be modified to achieve greatest economic efficiency of feed utilisation (Wathes *et al.* 2001). Shed temperatures and air movement could be controlled to ensure that the animals were in the zone of thermal comfort for sufficient time each day to maximise profit in relation to constraints on growth and costs of environmental control (Gates and Banhazi 2002). This is an important aspect. Nutrition and environment is often automatically controlled in layer buildings applying best practice management. However, these factors (even in buildings using advanced management) are usually controlled independent of each other. One of the significant improvements delivered by PLF systems is the ability to concurrently manage environment and nutrition considering these important factors in concert.

A variety of approaches can be used for analysing recorded information from simple graphing and spreadsheet analysis to sophisticated statistical analyses and computer simulation modelling (Lokhorst 1996b; Stafford 2000; Aerts *et al.* 2001; Bird *et al.* 2001; Schmoldt 2001; Durack 2002). Although the simpler techniques can provide useful insights into production inefficiencies, they are often limited and do not account for important interactions between factors that affect bird performance and poultry enterprise profitability (Black 2001). Consequently, combining data (data-fusion) obtained from different areas of the livestock enterprise is essential and best achieved by using computerised and automated information management systems (Thysen 2000). The utilisation of “data-mining” and other statistical techniques for interpreting production data needs to be carefully investigated (Lovell 1983; Glymour *et al.* 1997; Kouris *et al.* 2005). Data-mining is a statistical process designed to explore large data sets, searching for consistent patterns and/or systematic relationships between variables (Masseglia *et al.* 2003; Nuthall 2004). As data-mining was originally designed for large corporate applications, so it has a very significant potential of being used for data interpretation in manufacturing processes (Mitchell *et al.* 1996).

The development of a combined data analysis tool for the egg industry, which would incorporate PM and DSS as well as the relevant statistical tools, would provide a major benefit for the egg industry. Such analysis tool would standardise and improve the data analysis outcomes for the whole industry and would help to lift industry management standards. The experience and knowledge of the best managers within the industry could be captured within the data analysis system and made available to other industry players.

It would be also advantageous to modify these data interpretation systems, so they are available 'on-line' (collect and process incoming information continuously) and either automatically modify certain

aspects of the livestock production process and/or prompt the farm manager to execute certain actions in order to achieve the optimal overall outcome (Wathes *et al.* 2001). One of the main objectives of a methodological data collection and analysis is to improve the economic performance of the poultry enterprise. Therefore it is necessary to include economic models in the "heart" of the system, to ensure that while satisfying all other requirements farm profitability is also maximised (Frost 2001).

In summary, a better integrated, information-based and better controlled production systems are needed in the Australian egg industry. Applying modern methods of "Production management" involves establishing data acquisition systems, analysing of the recorded information, triggering management actions and activating either automatic control systems and/or human intervention. Utilising more advanced control procedures as well as monitoring the outcomes of control action is an important part of advanced production management. New technologies, such as PLF practices, have to be pursued and explored by the Industry. They have the potential to improve production efficiency as well as welfare and health of animals, and could also reduce the environmental impact of poultry production (Gonder 1997; Banhazi *et al.* 2002).

Summary of issues discussed

- The participants of the meeting agreed that there were many potential benefits from introduction of precision farming systems and principles into the Australian egg industry, including reduction in labour costs, an improvement in reliability of operations, an improvement in animal welfare, better targeted nutrition, improved marketing and an improvement in quality control.

- Some components of precision farming systems within the egg industry are available, but none have been developed into fully comprehensive systems. Many of the independent components of a likely system are not compatible in terms of hardware and software and therefore additional work is required to ensure the compatibility of system components.

- The ability to control many variables simultaneously (such as nutrition and environment) was identified as an important benefit of PLF systems.

- The development of an integrated data analysis tool for the industry was identified as a potentially critical enhancement for the egg industry and could lift management standards on farms.

- More work is required to complete the Decision Tree, identify the most critical areas affecting profitability and development of Critical Control Points for incorporation into management systems. Such work might be more efficiently undertaken using an independent review of industry practices.

Implications and recommendations

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Immediate R&D opportunities

As a general principle, establishing good information management practices on farms can significantly improve the efficiency and profitability of intensive livestock enterprises. To transform the information management systems currently used on farms to a more sophisticated system, data collection and more importantly data analysis needs to be automated (Schon and Meiering 1987). Automated data collection, management and analysis would transform the currently used segregated systems into a powerful information based PLF system (Enting *et al*. 1999).

Some overseas companies developing technologies for the Egg Industry are in the process of developing integrated systems, similar to PLF systems. However, the overall challenge is to ensure that the Australian Livestock industries (including the Egg Industry) are not left behind in the technological race. The Australian livestock industries could find themselves in a situation, when production monitoring and data analysis services will be provided by foreign corporations operated here in Australia. The real risk is that the owner of the PF consortium may also become keeper of the data set generated by the system. Over time this intellectual property will become an extremely valuable asset and one which our industry could be forced to pay ongoing access charges (Durack 2002).

Therefore the immediate R&D opportunities presented by the 1st Egg Industry PLF workshop are:

- Further work to be undertaken by a small number of industry representatives and facilitators to complete a Decision Tree for the layer industry and to identify the potential value from introducing Hazard Analysis Critical Control Point technology into the industry. That could be best done by relaying on the knowledge of a very small number of "industry best" farm managers and on the outcomes of a limited literature/strategic review.

- Conduct a review and survey of the precision farming technology potentially available to the layer industry, its current state of development, its costs in implementation and likely benefit to the industry. Especially available data analysis tools have to be carefully reviewed. Combining existing data analysis tools to deliver a sophisticated data analysis "centre" for the egg industry should be seriously considered.

- Conduct a second Workshop with members of the Australian Egg Corporation, egg producers and companies supplying precision farming technology to identify the most efficient ways for introducing precision farming systems and Decision Tree outcomes into the Australian egg industry.

- Evaluate potential technologies, such as signal processing, which can be used to monitor/assess animal welfare. The development of such technological tools can help layer industry to demonstrate improvements in animal welfare.

Potential for collaborative research

In addition to immediate R&D opportunities focusing on the Egg Industry, there is a real opportunity to combine resources with the pig industry (in the first instance) and undertake collaborative, co-funded research, which could significantly enhance the efficiency of available R&D funding. By the establishment of an integrated precision farming program for the Intensive Animal Industries in Australia there would be a real opportunity to rapidly capture the strength of the concept locally to deliver:

- A more cost effective production system;
- A reduced environmental foot print; and
- A more reliable product to the consumer.

The R&D program identified under this banner is large and diverse requiring a truly collaborative and cross disciplinary approach. A formal organisational structure would assist greatly the implementation of PLF into the Australian livestock industries (including the egg industry) and would enhance the capabilities of all participating industries. Many of the PLF technologies would apply across the livestock industries, including pigs, poultry, feedlot cattle, dairy cattle and sheep. Several of these industries are already investigating the role of PLF technologies for enhancing their international competitiveness (Banhazi *et al.* 2002; Banhazi *et al.* 2003). The proposed Australian Centre for Precision Livestock Farming (ACPLF) would play a major role in coordination of activities across Australia, accessing funds from Government and industry and integrating R&D.

Description of potential R&D areas

In addition to the immediate research opportunities, there are other areas where long-term R&D efforts can deliver significant benefits for the Egg Industry. These longer-term opportunities will be listed and discussed briefly below.

Animal welfare monitoring

Vocalization is an expression of a distinctive inner state of an animal and has partly evolved as communication signal to indicate some type of "need". Hence, it is reasonable to regard vocalization as an easy indicator of an animal's state of welfare. Therefore, it might be possible to assess the welfare of the farm animals by non-invasively monitoring livestock buildings. For example, studies in pigs demonstrated that that early detection of cough sounds might be used to alert piggery managers to possible respiratory infection of pigs (Chedad *et al.* 2001; Moshou *et al.* 2001). Images of various animals could also be analysed in real time to provide a basis for objective welfare assessment (Xin and Shao 2002; Yanagi Jr *et al.* 2002). Both image and voice analysis provides important future opportunities for the real time and objective assessment of animal welfare.

Industry coordinated data management

Centralised data collection sites (data-warehouses) are essential component of a well functioning PLF system. Such centralised data management will enable uniform data analysis and appropriate interpretation of available data. On-farm data processing could provide valuable support for farm managers in everyday management, but the real gains would come from using in-depth data analysis provided by remote data-warehouses via the Internet (Geers 1994; Petersen *et al.* 2002).

Environmental management

Well designed monitoring systems could be used to objectively monitor and document the quantity and quality of waste product generated on farms (Beattie 2001; Cumby and Phillips 2001; Frost 2001; Frost *et al.* 2003).

Housing management
Air temperature and other important parameters such as air speed, humidity, nutritional and health status, stocking rate, age and size of the animals etc. all need to be taken into consideration, when predicting the thermoneutral range of individual animals (Wathes *et al.* 1981; Hao and Leonard 1995; Banhazi *et al.* 2001). A PLF system would enable producers to monitor and consider these other factors, when setting upper and lower temperature limits in livestock buildings (Timmons *et al.* 1995; Lacey *et al.* 2000; Gates 2002). Another important aspect is the economical value of environmental management of livestock buildings. Ideally, the temperature of livestock buildings should be set to maximise profit and not necessarily biological production levels (Gates *et al.* 2001; Gates and Banhazi 2002). The proposed PLF system would enable poultry producers to consider the cost-benefit ratio of environmental modification in real time.

Air Quality monitoring
Airborne particles and gases are associated with sub-optimal air quality in sheds predisposing both livestock and staff to potential health problems (Banhazi *et al.* 2004a; Banhazi *et al.* 2004d; Banhazi *et al.* 2004b; Banhazi *et al.* 2004c). Pollutant emissions from intensive livestock production facilities are also associated with internal pollution levels and dust plays an important role in ammonia and odour transfer (Zavaleta and Wilson 1976; Hammond *et al.* 1979; Liao and Singh 1998; Bottcher 2001; Oehrl *et al.* 2001; Takai *et al.* 2002). Accurate, low cost monitoring of these pollutants is essential if appropriate reduction strategies are to be implemented (Banhazi 2003; Banhazi 2005).

Remote animal monitoring
Physiological parameters, such as heart rate, body temperature, respiration rate, could be used to indicate the health and metabolic status of animals and some of these parameters can be used as an input to control the environmental parameters of livestock buildings (Kettlewell *et al.* 1997; Aerts *et al.* 2001; Mitchell *et al.* 2001; Aerts *et al.* 2003).

Production management
Intensive monitoring of the feeding behaviour of animals can indicate changes in welfare and health (Halachmi 2000; Puma *et al.* 2001). Automated feeding can also provide the means for adjusted daily rations (Pesti and Rogers 1997; Moura and Naas 2001). Growth models, such as AUSPIG within the pig industry are used to calculate the daily ration based on the production and environmental conditions of the animals. Similar system can be developed for the egg industry as well. Automatic monitoring of egg quality is also a technical possibility (Patel *et al.* 1998; Coucke *et al.* 1999).

Disease control
Detecting irregularities in food and water intake, body temperature, change in movement and body weight could be used as early warning system for detecting diseases (Roush *et al.* 1992; Mottram 1997; Sergeant *et al.* 1998; Pedersen and Madsen 2001; Chen *et al.* 2002).

Management of labour
The management of labour involved in livestock production would be another significant area to be monitored under the PLF system (Jongebreur 2000).

Monitoring of market conditions
A PLF system would be able to automatically gather information and/or be updated automatically by processors about the requirements of the market-place (Noordhuizen and Frankena 1999; Stafford 2000). This information combined with intensive performance monitoring would provide producers with a powerful decision support tool in relation to marketing.

Improved record keeping

A well designed data collection system would reduce the need for manual recording of farm production data, and would provide producers with appropriate information (Schon and Meiering 1987).

Summary of recommendations and implementation strategy

This is a unique opportunity for funding organisations to initiate a program of research and commercialisation which not only has the capacity to deliver high class research outcomes in its own right but most importantly to deliver a series of tools and programs which will ensure maximal returns from the adoption of other R&D outputs. In summary, the suggested steps to be undertaken during implementation of PLF technologies within the Egg Industry are:

- Select a team of collaborators with a clear commitment to the concept and undertake further work with the small team to complete a Decision Tree for the layer industry.

- Conduct a review and survey of the precision farming technology potentially available to the layer industry, its current state of development, its costs in implementation and likely benefit to the industry. Especially, assess the possibility of improving the data analysis function of the system by producing a combined production model (AUSBIRD), which could be based on the principles of AUSPIG model used within the pig industry. In addition, reviewing technologies currently available to monitor the health, physiological and welfare status of animals non-intrusively would greatly help the Egg Industry to deal with perceived animal welfare problems.

- Organise a follow-up (second) Workshop with members of the Australian Egg Corporation, egg producers and companies supplying precision farming technology. The main aim would be to identify the most efficient ways for introducing precision farming systems and Decision Tree outcomes into the Australian egg industry and establish an overall strategy for the adoption and commercial exploitation of PLF technologies in Australia.

In additional to these immediate steps, a longer-term, collaborative strategy could be implemented within the egg industry in association with projects to be undertaken within the pig industry. It would consist of the following steps:

- Install enhanced data collection tools on some selected farms to collect data from the production sites for review and analysis.
- Apply an in-depth analysis, modelling and investigation of the available data with the clear focus of demonstrating direct financial benefits for producers via manipulating KPIs.
- Improve the "control functions" of poultry buildings by linking up output from the analysis system with automatic control tools and enhancing the system's ability to concurrently control different production factors, such as nutrition and environmental conditions.
- Demonstrate the financial advantages of using PLF system on farms and commercialise the resultant PLF system first within Australia and then potentially overseas.

Appendix A (pre-workshop booklet)

RIRDC Funded Project

PRECISION LIVESTOCK FARMING WORKSHOP

PRE-WORKSHOP INFORMATION PACKAGE

18th October, 2002
South Australian Aquatic Sciences Centre,
2 Hamra Ave, West Beach

Welcome

On behalf of RIRDC and PPPI, I would like to welcome you, as a valued participant in the National Precision Livestock Farming workshop. I believe that during this workshop we will have a unique opportunity to improve current livestock management practices by making management systems more responsive and information rich. Information technology is very much part of life these days and IT-related technologies should be part of modern livestock management systems as well; creating benefits and opportunities for the present and future farming generations.

We will have a couple of hundred years of combined experience present during the workshop and this workshop will also present an excellent opportunity to strategically plan for future research directions.

I encourage you to present your views and, contribute your experience and knowledge during the workshop. We will need your input to accomplish our main task – the identification of future research needs in this area.

Of course, as with any major undertaking, this workshop would not been possible without the generous support of many individuals and organisations. There are many people, not individually mentioned here, who helped the organisation of this workshop. I wish to particularly acknowledge the support and assistance of the following colleagues and organisations:

- Dr Irene Gorman, Rural Industries Research and Development Council (RIRDC).
- Mr Karl Hillyard and Dr Paul Hughes, Pig and Poultry Production Institute - South Australian Research and Development Institute
- Dr Matthew Durack, National Centre for Engineering in Agriculture
- Prof. John Black, John Black Consulting
- Prof. Richard Gates, University of Kentucky

We do hope that you can join us for what should prove to be a rewarding day for both you, your clients and/or your poultry production enterprise.

I look forward to seeing you in Adelaide.

Best wishes

Thomas Banhazi

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Background information

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Key project personnel:
Prof. JOHN BLACK, John Black Consulting
Dr MATTHEW DURACK, National Centre for Engineering in Agriculture

Introduction

"Precision farming" (PF) principles and techniques are already widely utilised within the broad-acre and row crop industries of Australia and overseas. The principal component of precision farming in these industries is the development of accurate real time yield or performance mapping systems utilising GPS technology. The development of new sensing and data management systems will allow the development of analogous systems within the Intensive Animal Industries. In other industries the key benefit of these technologies has been in allowing producers to target specific areas in their production more efficiently for improvement (Lemin *et al.* 1991). A key element of the system's success will be the potential to allow effective on farm research trials at a minimal cost to the producer.

In Europe the introduction and implementation of precision livestock farming principles and techniques into the pig and poultry industries are well advanced and have the potential to improve production efficiency (Schofield *et al.* 1994; Wathes *et al.* 2001) . The main principle of precision farming is quite simple: by using advanced technology (usually related to better information management) the efficiency of production can be improved as the application of resources can be more targeted. In the livestock area it usually means a more precisely targeted nutritional regime, combined with close monitoring of production performance. A project currently progressing at the Silsoe Research Institute is aimed at linking up existing technologies so appropriate information is available on-line for producers for strategic decision making (Frost *et al.* 1997; Whittemore *et al.* 2001). In addition, by linking up and consolidating information from different sections of the piggery or poultry enterprise, a self-correcting system can be established (Schofield *et al.* 1994). An example is the currently available computerised dry feeding system could be linked up to a real-time, "intelligent" weighing system within the sheds (commercially available for poultry producers) so animal diets can be finetuned daily based on body weight and age (Slader and Gregory 1988; Aerts *et al.* 2001). Researchers in the UK are exploring further potential uses of the system and looking at measuring on-line ammonia emission values from the sheds, which in turn can be used as input information for further diet modification aimed at reducing nitrogen output (Chamberlain-Ward 1998; Cumby and Phillips 2001). The potential of the system is considerable, given the fact that all information measured on-line can then be used as an input information for management models (Black *et al.* 1999).

Most of the technological components of PF systems such as climate control equipment, automated feeding systems, computer models and decision support softwares are well developed and readily available commercially. However, the integration and data management aspects of PF systems need further research & development work (Frost *et al.* 1997).

Potential benefits of the system

- Improved production efficiency as a result of more targeted diet formulation.
- Reduced ammonia and odour emission from waste product as a result of on-line diet formulation based on measured ammonia emissions.
- Better marketing of animal products as the production rates of animals are surveyed.
- Better health control as both feed usage and production rate change will alert managers to early signs of disease problems.
- Improved scientific understanding of nutritional, health and environmental effects on the animals as almost all important parameters will be monitored by the system and later on new measurement parameters can be added as necessary.
- The opportunity to undertake detailed on farm production R&D at limited extra cost to the producer.
- Improved IT management on farms, including the increased adoption of management softwares within the Industry.

Workshop Program

Adelaide – Monday 18th November 2002
9:00 AM

Session 1

Short Reviews:

- Introduction and review of principles of Precision Farming – T. Banhazi
- Technical review of Precision Farming in Australia & Overseas – M. Durack
- Data analysis, interpretation and its value – D. Rutley
- Review of Decision Support Systems – J. Black
- Fancom & Big Dutchman representatives
- Review of the Egg Industry-I. Goreman

LUNCH

Session 2:

What is known and what needs to be known (all participants)

Session 3:

Group Discussions, Project formulation

AFTERNOON TEA

Session 4:

Future directions for research, development and extension – Project Planning

Optional: We are planning a social get-together and light drinks (further discussions?) at a nominated restaurant after the Workshop with all participants. (Place and cost involved will be discussed at the workshop.)

RIRDC
RURAL INDUSTRIES RESEARCH
AND DEVELOPMENT CORPORATION

Profile and summary – presenters

T. Banhazi

Thomas Banhazi is the Leader of the Housing and Environment Research Group at the South Australian Research and Development Institute – Livestock System Alliance and his research interests are related to intensive livestock housing.

Recently he has undertaken studies to investigate the relationship between environmental/drinking water temperatures and management factors in pig sheds. He has also investigated methods for improving air quality in both pig and poultry sheds to reduce the impact of poor air quality on the respiratory health of humans and animals. One of his current interests is to improve the utilisation of IT and related technologies in livestock farming.

He has produced over 40 scientific publications and is actively involved in a number of scientific organisations, including the "International Society for Animal Hygiene" and the "Australian Biosystem" group. He has been recently elected as the secretary of the "International Commission for Agricultural Engineering (CIGR) - Section II: - Farm buildings, Equipment, Structures and Environment" group.

Introduction and review of principles of Precision Farming

The market place demands continual improvements in the delivery of safe, uniform, cheap, environmental and welfare friendly livestock products that meet defined specifications. However the currently used experience-based, traditional management systems are not capable of facilitating appropriate data acquisition, data-integration, automated data-analysis and the utilisation of advanced control techniques necessary for continuously improving livestock products as required by consumers. Management information is not captured and not used as much as it could to improve the profitability and the long-term sustainability of the livestock industry. Precision Farming principles need to be implemented on farms to provide the technological means for producers to use better-integrated, information-based and better-controlled production systems. To encourage research in this area, a National Workshop will be held in Adelaide in 2002 to provide a forum for interested parties to discuss Precision Farming issues, as they relate to livestock farming in Australia.

The full article is included in the "Reading material – major articles and reports" section of this booklet under the title: ***Precision Livestock Farming.***

J. Black

Prof. John L. Black AM FTSE received his PhD from the University of Melbourne in 1970. He joined CSIRO Division of Animal Physiology at Prospect, Sydney in 1971, where he continued the study of amino acid and energy requirements of sheep for body and wool growth. A major component of his research was the integration of physiological and biochemical concepts into mechanistic simulation models. He led the team that developed the AUSPIG Decision Support Software for pigs and became Assistant Chief of the Division in 1992. In 1996 he left CSIRO and started a consulting company specialising in research management for government and commercial organisations.

Increasing the competitiveness of pig production: Electronic aids including AUSPIG and continuous improvement strategies

Improvement in the competitiveness of an individual pig enterprise relies on increasing the efficiency and lowering the costs of production while improving the quality of the final product in relation to buyer specifications and price paid. Maintaining a competitive advantage requires the adoption of a process that will ensure identification of inefficiencies and allow for continuous improvement to the production and marketing of the pig meat product. The steps in continuous improvement systems are now well established and involve:

- recording essential information about the production and marketing system,
- analysing the recorded information to identify inefficiencies and the most critical factors controlling production efficiency, costs and financial return,
- planning and documenting the changes needed to improve current practices,
- acting to change current practices in relation to the plan,
- recording that critical procedures were carried out correctly and
- checking by others that the actions were correctly conducted and recorded.

Precision farming through the adoption of low labour input, electronic aids has the potential to improve production efficiency and reduce costs during major steps of the continuous improvement process. Ongoing recording of both inputs and outcomes from a pig production enterprise is essential if continuous improvement in competitiveness is to be achieved. The efficiency of the enterprise and of each area of activity can be assessed only from the analysis of factual information. Records are required for all major factors that influence feed intake and growth rate of pigs, reproductive efficiency of the herd and cost of operating the enterprise as well as records on pig performance and marketing results. A full description is needed for all physical inputs to and conditions within the piggery including, for example, the ingredient and nutrient composition of all diets, the period each diet is offered, air temperature, speed and humidity within each shed, floor area, type and temperature, number of pigs per pen. Records are required for the actual growth rate of pigs and feed disappearance during different periods of growth as well as for final carcass characteristics including fat, eye-muscle and other measurements specified by buyers. Indicators of stress or disease status such as body temperature would also be valuable.

In the past, collection of much of the required information has been difficult and costly. However, computer technology and modern analytical apparatus has made the collection of large amounts of data highly feasible. For example, feed silos or individual feed bins can be placed on load-cells and the rate of feed disappearance monitored continuously. Pens can be constructed with load-cell platforms to weigh individual pigs each time they stand to feed. The mean and variance in the weight of pigs in each pen and the efficiency of feed use can be monitored continuously and used to identify inefficiencies in diet formulation, temperature control systems, feed supply mechanisms and other components of the enterprise such as feed wastage. Deep body temperature can be monitored remotely. Near-infrared (NIR) spectroscopy can be used to measure rapidly the nutrient composition and available energy content of either individual ingredients or complete diets offered to different classes of pig. In addition, systems are available for the continuous monitoring of shed temperature, air speed and humidity. Carcass weights, dressing percentages, fat and eye muscle measurements, prices obtained, grading grids and other relevant information can be transferred electronically from buyer and meat processor records to the enterprise. However, the recorded information must be analysed to be useful for determining the best management strategies.

A variety of approaches can be used for analysing recorded information from simple graphing, regression and spreadsheet analysis to sophisticated statistical analyses and computer simulation modelling. Although the simpler techniques can provide useful insights into production inefficiencies, the value of the analyses are often limited by the small number of factors that can be considered simultaneously. Consequently, the use of computerised herd management programs like PigPulse and AUSPIG enhance the analysis of records relating to the reproductive performance of

the herd and the efficiency of animal growth. AUSPIG is particularly useful in determining reasons for variation in performance and for identifying likely inadequacies in the environment, diet or management systems employed. For example, AUSPIG has been used to identify probable reasons for the low efficiency of feed use seen when pigs were offered liquid diets in ecosheds. AUSPIG can be used also to determine the optimal sale weight of individual pigs when sent to different buyers.

The advantages obtained through the use of AUSPIG and other analytical software depends on obtaining accurate and continuous measurements of pig weight, climatic conditions, feed intake and diet composition. In addition, methods that can achieve the cheap and reliable removal of pigs from a pen when they reach a weight and carcase characteristics that will optimise returns are essential for reducing costs and improving competitiveness. Automatic weighing and drafting systems within a pen are essential to take advantage of the output from simulation models like AUSPIG.

The next step following analysis of recorded information involves planning actions and documenting procedures to improve productivity, reduce costs and increase financial returns. The rigorous approach to planning has led to the development of the Hazard Analysis Critical Control Point (HACCP) theory which is now used widely in many manufacturing industries and is extremely appropriate for all forms of animal production. The two principal objectives of the HACCP concept are to identify critical control points, which are defined as the last opportunity in each process where failure in a procedure will result in an outcome that is less than desired, and to document procedures in order to prevent such failures. The documentation normally takes the form of Standard Operating Procedures (SOP's), which are a concise list of every action that should be taken to ensure that the desired outcome is obtained every time for every process.

A vital component in continuous improvement systems is the monitoring of critical control points and recording either the specific values or that procedures were correctly carried out. Critical limits for each critical control point are set during the planning phase. Both maximum and minimum critical limits for specific critical control points are normally set. The second component of monitoring and recording relates to recording the values of specified variables and comparing these with the predetermined critical limits. The records provide proof that the system is functioning correctly at the time of recording and, if not, SOP's would be followed to diagnose and remedy the problem. The recording system ensures that, irrespective of the staff member on duty, the time that any system failure occurred will be clear and the extent of any resulting inefficiency can be minimised. Again, electronic recording systems are the basis of these monitoring and recording systems.

In conclusion, the remote recording of vital information determining animal growth and enterprise productivity, analysis of the information through computer software packages, the remote control of management processes and the monitoring of critical control points within predetermined limits is the basis of precision farming. Adoption of such procedures should lead to continuing improvement in the competitive position of individual piggeries and of national pig industries.

M. Durack
Matthew Durack, BVSc MBA; director of NCEA, has a Veterinary Science and biological research background as well as post-graduate business training with extensive practical commercial agribusiness management experience in horticulture, food processing, export marketing, and broad acre and row crop farming. His skills have been developed in a range of working environments including consultancy practice, commercial management roles and public sector research institutions.

Technical review of Precision Farming

Agriculture has entered the information age in a big way. Australian Agribusiness has adopted computer and Internet technology faster than any other sector of the Australian economy. Up to this

point the primary source of data being accessed and analysed by producers has been externally derived material from research trails or marketing information.

Some producers are now developing internally "Data Rich Farming Systems". The data sets they are working with are derived on farm from their own commercial operations or independently undertaken research trials.

Two key elements of these data sets at least in broad acre agriculture are:

- The Data is Temporally specific – much of the data accessed is now "Real Time" and not historical – we no longer review our finances on an annual basis we can do it daily, we no longer review feed price or exchange rate fluctuations weekly – but hourly; and

- The Data is Spatially specific – "Precision" data is now available – we no longer review industry wide growth rate trends - we access our own data, we no longer access regional weather forecasts – we get farm based predictions, we no longer talk in terms of tonnes of wheat per hectare – we examine yield maps and spatial variability.

This change has been made possible because of the improved data processing capacity associated with our computing and Internet services, and improvements and reductions in the cost of sensor technology.

The ability to convert these massive and ever expanding data sets into a profitable sustainable competitive advantage still remains a challenge in many cases.

There has now been a wide range of papers published within the engineering and pig production disciplines, describing the use of technology in this way and introducing the concept of an "Integrated Management System". The future is now very definitely with us in this regard.

This paper will draw on our experience with a number of agricultural industries (grains and cotton) as they move down the "Precision Agriculture Path" and show the similarities with the "Integrated Management System" concepts being developed for pig production.

The full article is included in the "Reading material – major articles and reports" section of this booklet under the title: ***Where are your pigs and what are they up to?***

D. Rutley
David Rutley runs a data analysis business Animal Genetic Technologies (AGT) and is currently completing a PhD in Animal Selection and Marketing.

Since 1994 AGT has been undertaking analyses of large commercial databases with the aim of looking for repeatable variation to allow discrimination and consequent improvement of production systems. These analyses include both comparative and process benchmarking studies. AGT has also developed a system for value-based marketing that is currently being developed for commercial application.

Data analysis, interpretation and its value

Much of the work of AGT has been inspired and given a business framework by the work of W. Edwards Deming (Walton M., 1994). In 1950 Deming introduced the concept of statistical quality control to Japan. The Japanese attribute much of their post war success to the work of Deming. By

studying both the mean and variation associated with effects in a production system we can move the mean to the desired value and minimise the variation thus increasing product consistency and quality. As part of this analysis of variance, by removing variation due to known effects (eg. year, season, abattoir etc.) we can increase the predicability of performance, that is the repeatability.

The value of repeatability is, to a degree, intangible but it allows us to use less data to draw conclusions. For example from beef feedlot studies AGT has found that the repeatability of producer financial performance is around 0.4 (Rutley and Pitchford, 1995). This means that to predict vendor performance with an accuracy of 90% only requires 6 years data. In contrast, if known effects such as year, season, abattoir etc. are not taken into account 20 years data is required to produce the same accuracy. The correlation between the raw mean of 5 years data and the next year's data was 0.1. Thus raw means were not useful for prediction of future financial performance.

One of AGT's major clients annually requires benchmark information on over 1,000 store cattle producers. This client has over 10 years data on these producers. About 300-400 supply 24,000 steers annually. In these analyses a client and market driven index is used to value steers. The variation due to known effects is removed and vendor financial producing ability is predicted. The vendors are then ranked. If the bottom 40% of vendors could avoided when purchasing steers we would increase the value of feeder steers by $20 per head i.e. approximately $500,000 per annum. This is a comparative benchmarking analysis that simply aims to determine which supplies should be preferentially targeted. Other questions that could be answered include which breed, sire, abattoir or combination are most valuable. These analyses are only limited by the data collected.

Another important client of AGT's requires studies to determine what Key Performance Indicators are influencing profitability. These are process benchmarking studies with the aim of understanding why some producers are more profitable than others. This improves the ability of consultants to direct their clients when trying to improve their clients business. This is worth approximately $0.20 - $0.50 per Dry Sheep Equivalent to the consultant's clients.

The interpretation of market information to allow value-based marketing in preference to the current average based marketing systems is considered one of the major impediments to value adding by economists. Improving market signals in such a way will enable supply chains to continuously improve their products instead of produce the cheapest product that satisfies the minimum market specification. The change to value based marketing will be slow and difficult as it requires a culture shift from profiting through negotiation to profiting by adding value.

Compendium Summary

Project Title:	A national workshop on "Precision Poultry Framing" in Australia
AECL Project No.:	EGG02-27J
Researcher:	Thomas Banhazi
Organisation:	South Australian Research and Development Institute
Phone:	(08) 8303 7781
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Objectives	• The main objective of the project was to conduct a national workshop to discuss the practicality of implementing precision livestock farming technologies on poultry farms within Australia to improve profitability of poultry farms by improving technical efficiency.
Background	The 'market place' for food items derived from animals has changed dramatically in the last few decades. Customers are now demanding high quality and safe products, at an acceptable price and animal production systems which are animal welfare and environmentally friendly (Beattie 2001; Cumby and Phillips 2001). Livestock production must also be profitable, otherwise food production will not remain a viable and attractive economical activity for future generations (Webster 2001). To fulfil these requirements simultaneously can be an overwhelming task for livestock producers (Schofield et al. 2002). Livestock production is such a complex biological process that any attempts to achieve all these goals will almost inevitably result in conflicts. However, when full understanding of the process is developed and modern control techniques are applied, even such complex processes can be controlled and managed (Gates and Banhazi 2002).
Research	The 1st National Egg Industry PLF Workshop was held in Adelaide in November 2002 and the main participants were members of the Australian egg industry, poultry scientists and experts in PLF technologies. The workshop was successful in attracting a dedicated group of high quality participants. In the morning, delegates were presented with an extensive review of major issues related to PLF technologies. The main aim of the afternoon session was to evaluate the capacity of the Australian industry to adopt these technologies and develop a plan for the appropriate implementation.
Outcomes	The participants of the meeting agreed that there were many potential benefits from introduction of precision farming systems and principles into the Australian egg industry, including reduction in labour costs, an improvement in reliability of operations, better targeted nutrition, improved marketing and an improvement in quality control. Some components of precision farming systems within the egg industry are available, but none have been developed into fully comprehensive systems. Many of the independent components of a likely system are not compatible in terms of hardware and software and therefore additional work is required

	to ensure the compatibility of system components. The development of an integrated data analysis tool for the industry was identified as a potentially critical enhancement for the egg industry and could lift management standards on farms.
Implications	More work is required to complete the Decision Tree, identify the most critical areas affecting profitability and development of Critical Control Points for incorporation into management systems. Such work might be more efficiently undertaken using an independent review of industry practices. A related review of the precision farming technology potentially available to the layer industry (especially as it related to welfare monitoring), its current state of development and likely benefit to the industry needs to be also undertaken. Finally a second Workshop with members of the Australian Egg Corporation, egg producers and companies supplying precision farming technology to identify the most efficient ways for introducing precision farming systems into the Australian egg industry needs to be conducted.
Publications	Nil

References

EN.REFLIST