



## National Applied Research Project:

*Study of radio frequency identification systems at livestock auction markets across Canada*

March 2010



## Executive Summary

In July of 2009, the federal, provincial and territorial Ministers of Agriculture held a meeting at Niagara-on-the-Lake, Ontario and agreed that a national traceability system for livestock is critical for managing animal health and food safety as well as expanding market access and driving efficiencies. It was agreed that a mandatory national traceability system for livestock be in place by 2011. Key elements of a traceability system are animal identification, premises identification, and movement tracking. The third pillar of traceability, movement tracking, will require significant technological investment and infrastructure modifications.

This applied research project was funded through Agriculture and Agri-Food Canada, Growing Forward program, to research the impact of implementation of RFID systems at livestock auction markets in Canada in support of movement tracking.

The project installed eight new RFID systems from three manufacturers at both the receiving area and the sale ring (both before and after) and collected data from one pre-existing system. Custom software was developed for the test environment that collected the tag numbers from the RFID readers for data evaluation and submission of reports to the Canadian Livestock Tracking System (CLTS). The RFID system configurations were: single alley, dual alley and wide alley. Data was collected throughout eleven weeks from October 5 to December 20, 2009 from 144,197 head of cattle in 31,376 groups.

### *Impact on Business Process Efficiency, Effectiveness and Speed of Commerce*

Every auction market has a unique design configuration and process flow. The design of the RFID system must also be unique and located in an area that is well integrated with normal process flow in order to be efficient. It was found that the location of the system had more impact on business process than the design of the system. An effective system must take into account animal behaviours, employee safety, group sizes, cattle breeds and temperaments.

Systems that were installed outside normal business process flow had a significant impact on speed of commerce as a result of increased movement and handling. The installations at the receiving area also created a few challenges. Most markets have more than one unloading area, as such, some cattle had to travel an additional distance through the market to the one RFID system for scanning. Even with a small increase in processing time per group, at peak times during the day the producer may have a longer wait to unload cattle. Although there was no benchmark to measure this wait, it is known to be a critical factor to the market. Any additional handling increases the impact on animal health/safety, shrink and employee safety. In markets with the system well integrated with business process and located at the receiving area, speed of commerce was affected in increments of seven to 10 minutes per some groups and a few minutes on others.

Installations at the sale ring (both before and after) had the least impact on process efficiency as the cattle must flow through to the sale ring whether before or after. Therefore, systems at this location are perfectly integrated with business process without any additional movement or handling. The only minor change in cattle movement was at one market that installed a long curved alley which had an impact of 14 minutes over an eight hour sale. It was also noted that when selling larger groups, all the cattle may not fit into the alley and therefore back up into the ring. This caused a few seconds delay in the time to sell one draft and may result in an additional two to six minutes for a four to nine hour sale. Further, this location processed a high percentage of cattle in smaller groups which scanned with higher read accuracy.

*Identify the Positives and Constraints of Each RFID Scanning System and Evaluate the Ability to Achieve a High Level of Accuracy and Reliability. The Project Team Established a Benchmark of 95 Percent or Higher as a High Read Accuracy.*

It was found that the effectiveness of the systems varied from week to week and market to market. The same technology would provide highly consistent read accuracy in one market, but inconsistent read accuracy in another. This may be a result of numerous factors including: electrical interference, tags or tag placement, animal behaviour and size of cattle. Market volumes, time of year and size of groups processed will have an impact on the advantages and disadvantages of the system.

### **SINGLE ALLEY SYSTEMS**

The two new single alley systems processed the least amount of cattle with only three percent (936) of the total groups and 12 percent (17,543) of the total head. This system configuration had the lowest variance of only three percent with weekly averages between 96 and 99 percent, and had the highest overall read accuracy of 97 percent. The system had relatively consistent reads throughout all group sizes as a result of the single file processing through the scanner alleys. However, the narrow alley contributed to a reduced flow of cattle at high processing times, impacting speed of commerce. This design had the highest impact on animal health and safety as the narrow width could lead to larger cattle getting stuck, bruising as they push up against the side walls, cow/calf pairs entering side-by-side and small calves attempting to enter the alley in a group.

### **DUAL ALLEY SYSTEMS**

The project installed one new dual alley system and collected data from an existing three year old system. These systems processed five percent (1,607) of the total groups and 15 percent (23,746) of the total head. The variation in group size read accuracy was five percent from a high of 93 percent and a low of 88 percent. There was no definitive pattern in the group size read accuracy. The weekly accuracy ranged from 86 percent to 93 percent with a total accuracy of 90 percent, which was the lowest overall reading in the project and the highest day over day variance of seven percent. As a dual alley system is two single alleys with a narrow island in the middle, these systems had the same impact on animal and employee health and safety as the single alley systems.

### **WIDE ALLEY**

There were five wide alley systems installed that processed 72 percent of the cattle, almost three times more than the other two systems combined. The variation in group size accuracy was the highest at eight percent (88 to 96 percent) showing a definitive trend of higher accuracy in smaller groups. The smaller groups had a read accuracy of 96 percent (one to five cattle) and 93 percent (six to 10 cattle) which is important as four markets has systems at the sale ring which processes 95 percent of the cattle in groups under 10 head. As group size increased the read accuracy dropped. The week over week accuracy only had a four percent variance with all weeks except one being over 90 percent. These systems, with five feet wide alleys, had the least amount of impact on animal health and safety as all sizes of cattle could comfortably move through the system two to three wide with minimum to no stress and bruising.

	GROUP SIZE ACCURACY					WEEKLY ACCURACY				GLOBAL ACCURACY	
	Low Read	High Read	Variance	# Groups	% of Total	Low Read	High Read	Variance	# Head	Average	% of Total
Single Alley	95%	98%	3%	936	3%	96%	99%	3%	17,543	97%	12%
Dual Alley	88%	93%	5%	1,607	5%	86%	93%	7%	23,746	90%	15%
Wide Alley	88%	96%	8%	28,833	92%	90%	94%	4%	102,908	93%	72%
At Receiving	88%	91%	3%	2,902	9%	88%	92%	4%	38,226	90%	26%
At Sale Ring	87%	95%	7%	27,538	86%	92%	95%	3%	88,428	93%	62%
Other locations*	95%	98%	3%	936	3%	96%	99%	3%	17,543	97%	12%
<b>TOTALS</b>	<b>90%</b>	<b>95%</b>	<b>5%</b>	<b>31,736</b>	<b>100%</b>	<b>91%</b>	<b>94%</b>	<b>3%</b>	<b>144,197</b>	<b>93%</b>	<b>100%</b>

\* same as single alley

## *Identify the Business Case Regarding Feasibility and Cost/Benefit to Enable Traceability*

This phase of the research project did not implement full commercial software or assess the viability of the computer networks at the auction markets to support integration of data collection from the RFID systems. Benefits of traceability need to be defined and assigned an economic valuation by government or industry agencies. As such, there is not sufficient cost data to support a full cost/benefit analysis at this time.

It was determined that there are approximately 150 auction markets in Canada that will require the installation of an RFID system. Based on the data from the research, it is suggested that all of the large volume markets and 90 percent of the medium volume markets would be best equipped with a wide alley system. 10 percent of the medium markets would be best supported with a dual alley system and the fifteen small markets could be accommodated with a single alley system. It was estimated that capital cost of the equipment would be \$7,722,000 based on current market value of the hardware. Further, capital costs for infrastructure modifications, with 75 percent of the markets locating the system at the sale ring, is estimated to be another \$860,000. The estimated total cost to equip the 150 auction markets in Canada, at this time with RFID system hardware, scanning alley construction and infrastructure changes is estimated to be \$8,582,000.

It was determined that the auction markets will have additional operating costs as a result of implementation of RFID systems. These costs will result from administration and submission of the tag reporting to the CLTS, maintenance on the hardware and the likelihood of additional personnel. Total annual operating costs per market are estimated at \$12,650. Extended warranty and maintenance agreements are recommended to ensure the equipment has the highest read accuracy. Two of the vendors provided estimates for these services at \$6,500 annually for wide alley systems.

Annual operating costs for the industry, including maintenance and warranty, can be expected at almost \$2.6 million. Approximately five million cattle were sold through auction markets in 2009. With operating costs and replacement of the electronic systems, the annualized cost per head equates to \$0.51 not including capital expenditures, software or computer upgrades.

## *Delivers an Opinion on the Feasibility of the Existing Hardware/Software Supporting Full Traceability*

It was determined that the RFID scanning hardware used in this test will provide a daily read accuracy between 86 and 99 percent. It is not reasonable to expect each system to perform at the same level of accuracy everyday, variances must be taken into account when determining an effective read accuracy rate for the industry. The global weekly read accuracy was 91 percent to 94 percent with an average of 93 percent. Based on the suggested configuration of systems in markets across Canada with 85 percent of the markets installing wide alley systems and 15 percent dual or single alley systems, the read accuracy rates would extrapolate to the same level as what was found in the test.

It must be noted that the systems tested were not able to reach, on a global average, this research target of 95 percent of the RFID tags. Any requirement for collection and reporting of RFID tags above the read accuracy documented in this research will impact auction markets speed of commerce and cost of labour to a level that may not be sustainable. This research is the basis by which industry and government can come to an agreement on an acceptable protocol for implementing and operating RFID systems at auction markets across Canada.

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## TERMS AND ACRONYMS

- ATQ: Agri-Traçabilité Québec
- CCIA: Canadian Cattle Identification Agency
- CFIA: Canadian Food Inspection Agency
- CLTS: Canadian Livestock Tracking System
- CRT: Cathode-Ray tubes (used in computer monitors)
- FRA: Field Research Associate
- LMAC: Livestock Marketing Association of Canada
- RF: Radio frequency
- RFID: Radio frequency identification
- RFID System: Automated tracing technology. Includes electronic panel antenna attached to the walls of a scanning alley, readers that collect data from the antenna and some sort of electronic process that collects the tag numbers into a report format.

Group: number of animals in a consignment (owner)

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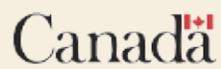
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*Growing Forward, a federal - provincial - territorial initiative.*

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