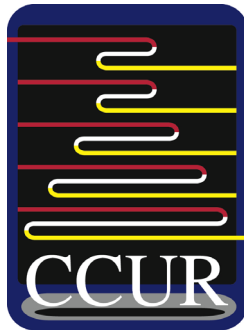




Bulk Material Tracing Needs

Charles R. Hurburgh, Jr.,
Professor
Agricultural and Biosystems Engineering



May 12, 2009





Traceability



Ability to trace the history, application or location of an entity by means of recorded identifications. (EU #1830)

- **Respond to security threats**
- **Respond to food safety problems**
- **Document chain-of-custody**
- **Document production practices (eg. organic)**
- **Meet consumer desires or social preferences**
- **Provide safety/quality assurance or uniformity**
- **Protect integrity of brand name; control risk**
- **Authenticate claims (eg. Regional foods)**
- **Regulatory compliance**
- **Improve logistics and reduce production costs**
- **Organized, uniform response to unusual conditions**
- **Carbon footprinting**

BULK GRAIN SUPPLY CHAIN

**SEED
PRODUCTION**



FARMING



HANDLING



PROCESSING



DISTRIBUTION



- Processor ID³
- Shipment ID³
- Shipment Date³
- Contract Number
- Elevator ID²
- Grain Type²
- Variety²
- Quantity
- Moisture
- Test Weight
- Damaged Mat
- Foreign Mat

- Processor ID³
- Final Processor ID⁴
- Shipment ID⁴
- Product ID⁴
- Product Name⁴
- Product Composition⁴
- Manufacture Date⁴
- Expiry Date⁴
- Final Product ID⁵
- Final Product Name⁵
- Final Product Comp⁵
- Manufacture Date⁵
- Expiry Date⁵
- Date Sold⁵
- Distributor ID⁵
- Quantity Sold⁵
- Shipment ID⁵

- Final Processor ID⁴
- Final Product ID⁵
- Final Product Name⁵
- Final Product Comp⁵
- Manufacture Date⁵
- Expiry Date⁵
- Date Sold⁵
- Distributor ID⁵
- Quantity Sold⁵
- Shipment ID⁵

Seed Company

Farmer

Elevator

Ingredient Processor

Final Processor

Distributor

Retailer



- Company Name¹
- Seed Lot ID¹
- Seed Brand
- Variety
- Hybrid
- Certifying Agency

- Farmer ID²
- Field ID
- Lot ID
- Lot Coordinates
- Lot Area
- Grain Type²
- Variety²
- Seed Company¹
- Seed Lot ID¹
- Yield
- Harvest Date
- Chemical Application
- Date Sold²
- Elevator ID²

- Elevator ID²
- Scale Ticket
- Farmer ID²
- Purchase Date
- Grain Type²
- Variety²
- Quantity
- Moisture
- Test Weight
- Damaged Mat
- Foreign Mat
- Bin Number
- Shipment ID³
- Shipment Date³
- River Terminal ID³
- Processor ID³

- River Terminal**
- Processor ID³
 - Shipment ID³
 - Shipment Date³
 - Contract Number
 - Elevator ID²
 - Grain Type²
 - Variety²
 - Quantity
 - Moisture
 - Test Weight
 - Damaged Mat
 - Foreign Mat

Export Terminal

Overseas Importer

Ingredient Processor

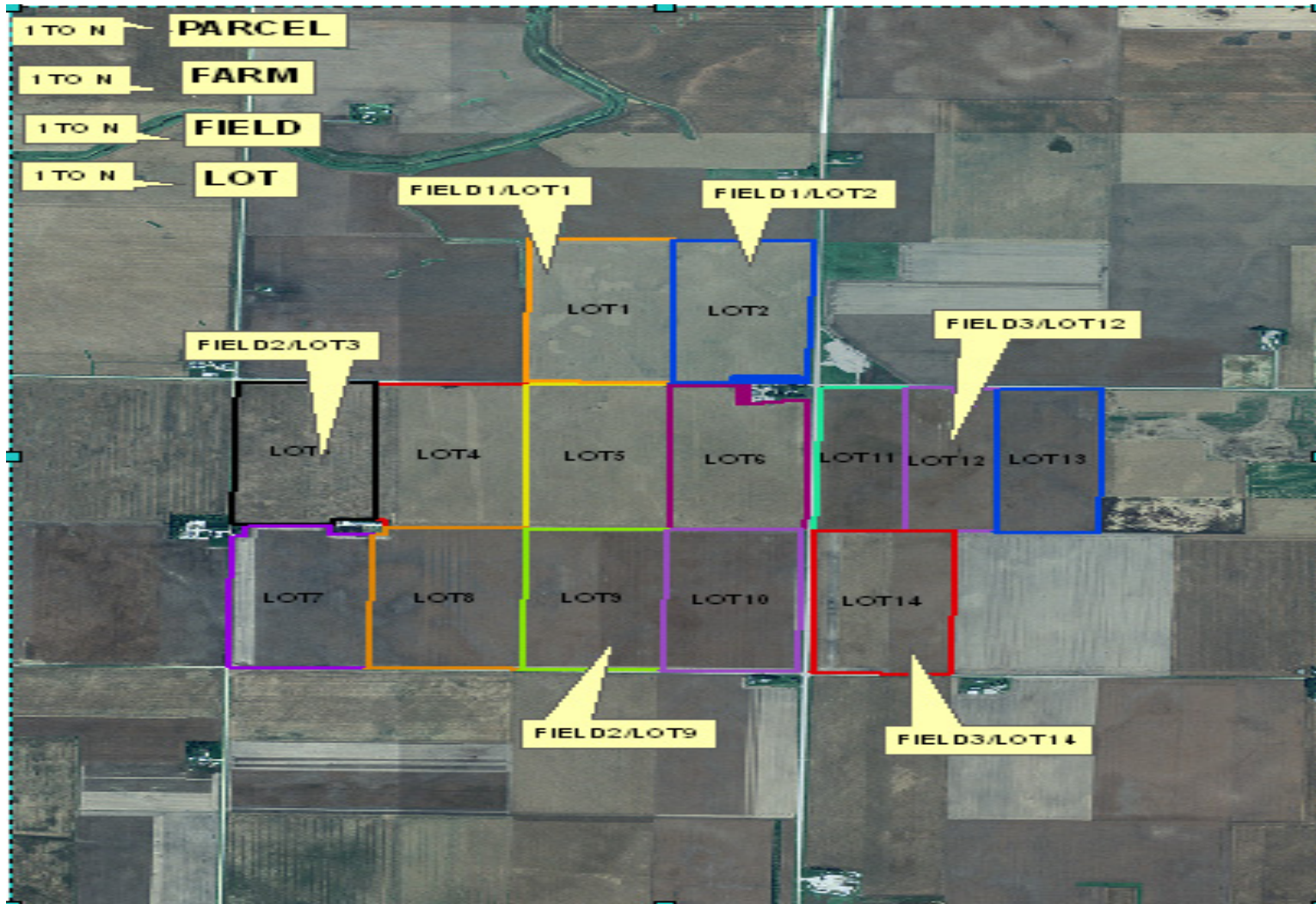
Final Processor

Distributor

Retailer

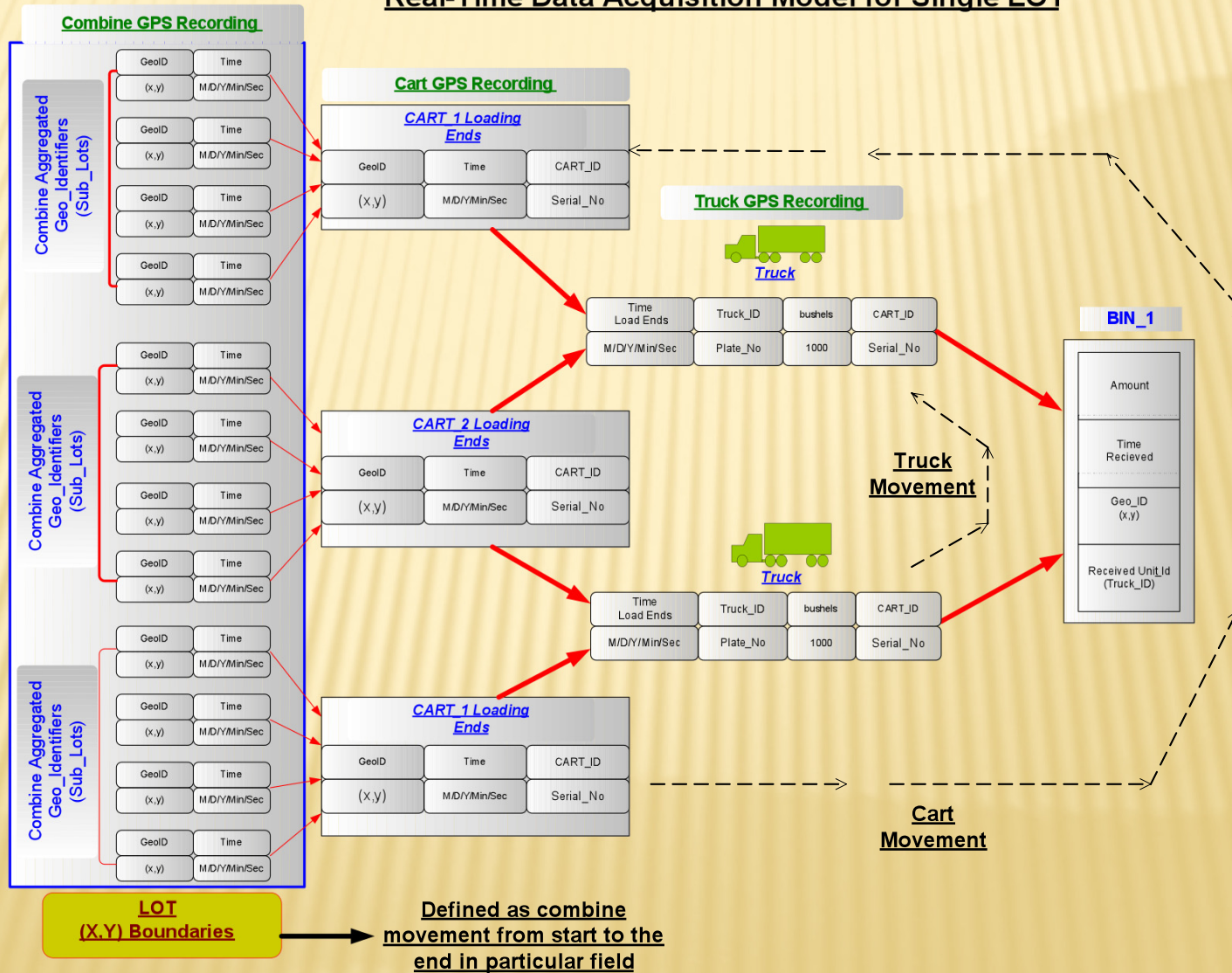


Tracking Unit – Farm Level



Carrying GPS Records to the Storage

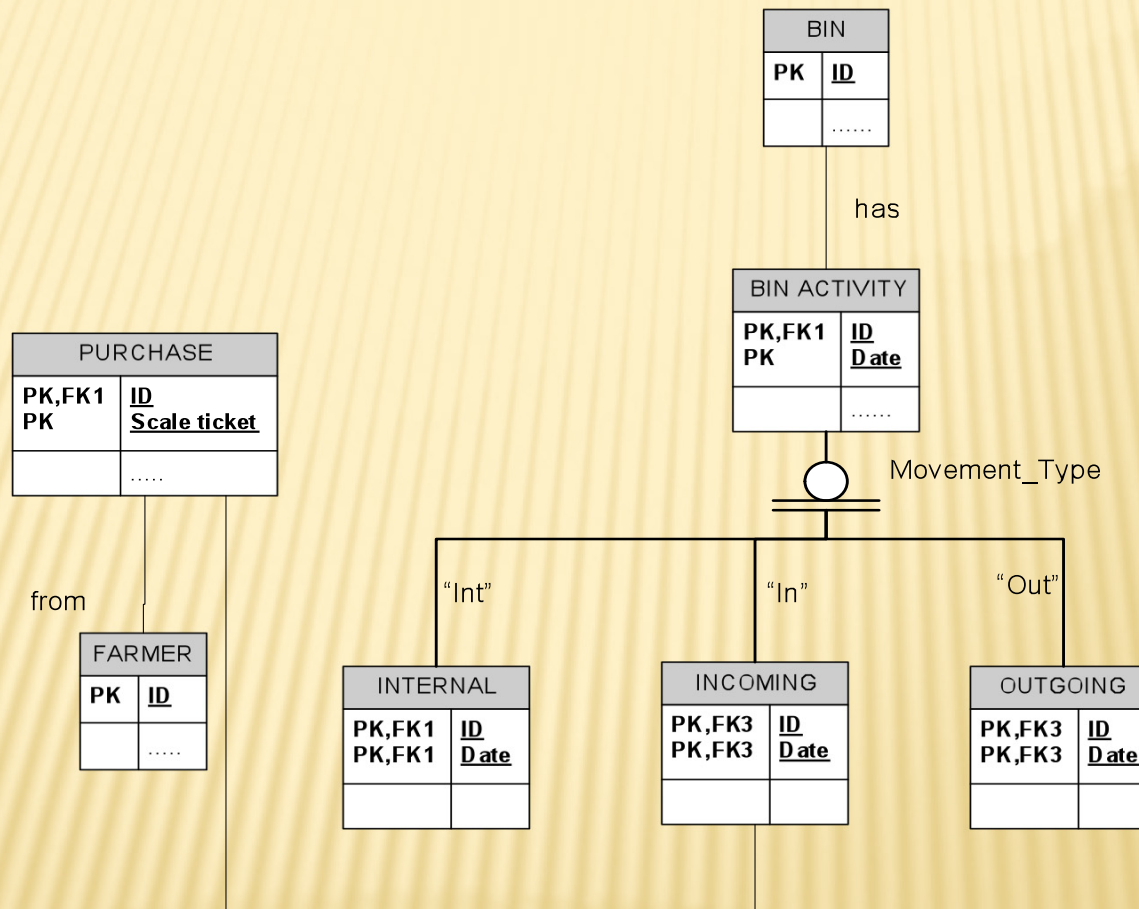
Real-Time Data Acquisition Model for Single LOT



Heart of Iowa Cooperative Nevada, Iowa

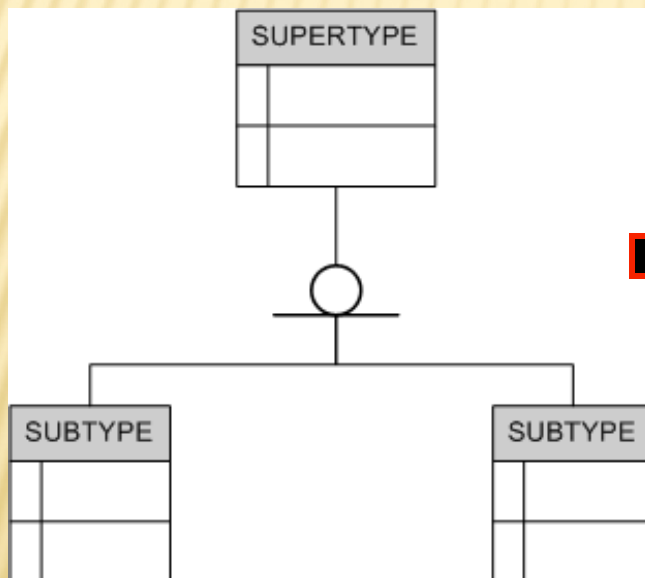


Database Structure - Elevator

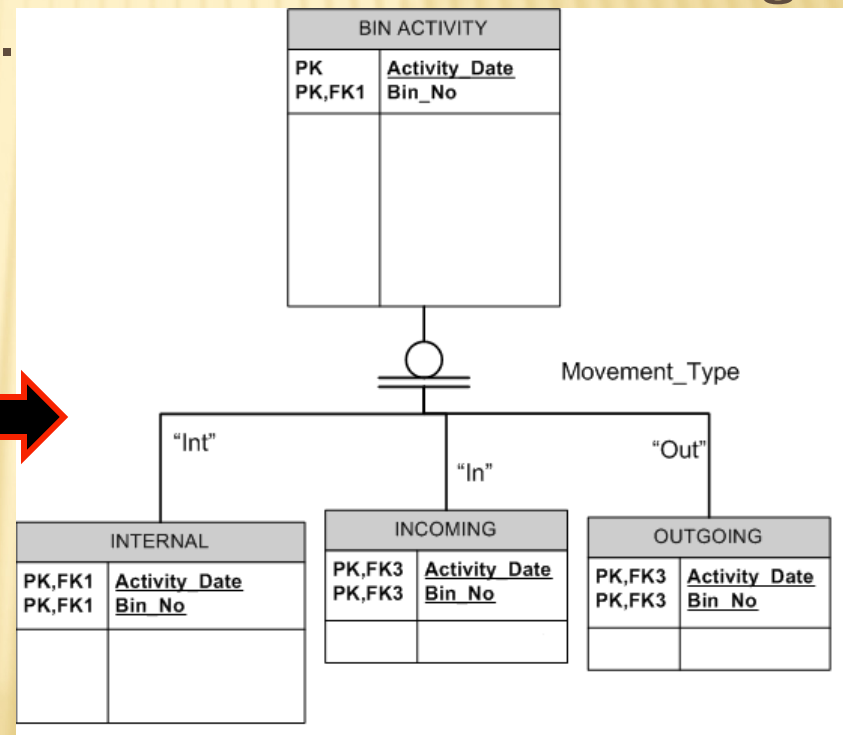


Internal Traceability E/R Model

- ✘ Objective: To capture all information related to all incoming, internal and outgoing grain lot activities.
- ✘ Triggers used to store data in different tables according for different grain activities.

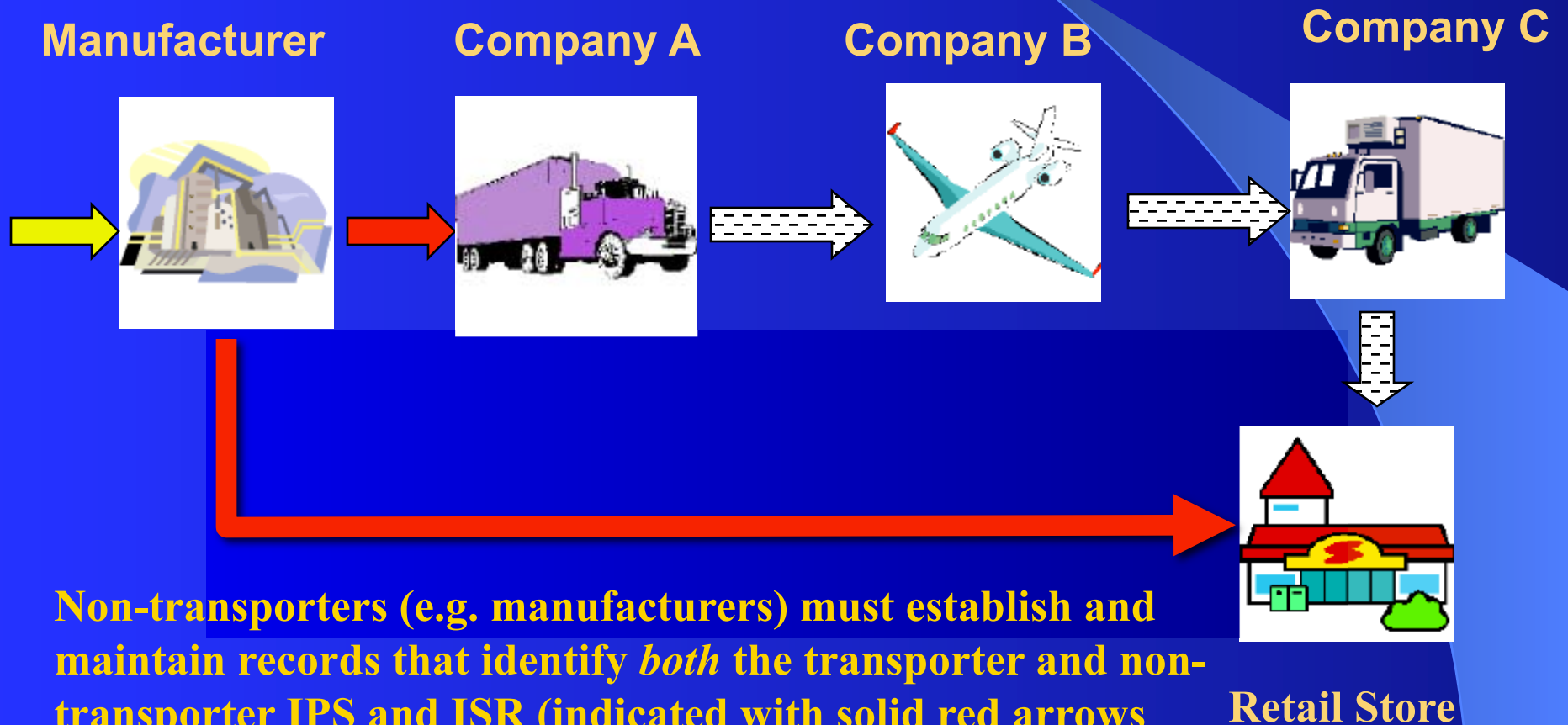


General Form



Grain bin activity sub-types

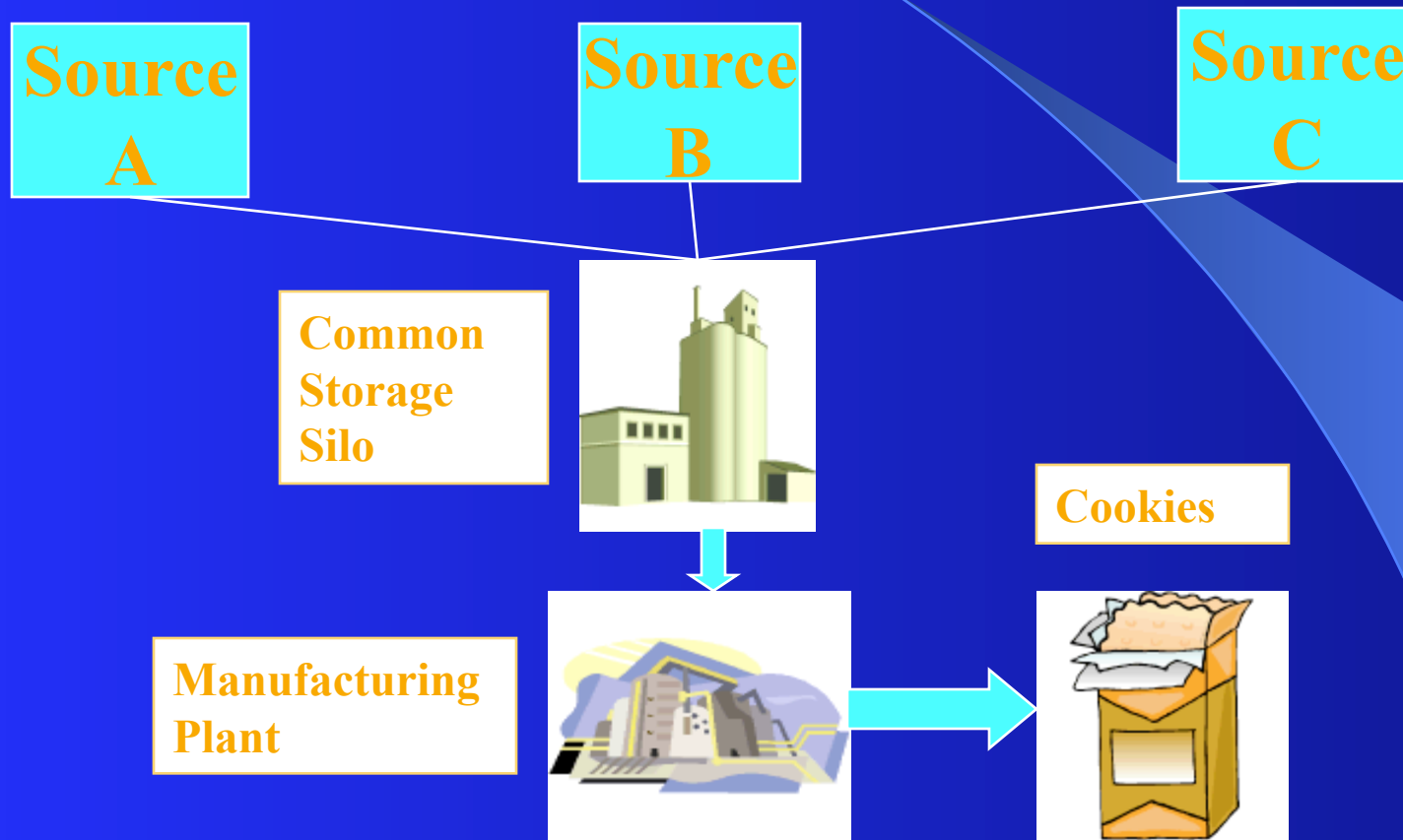
Establishment and Maintenance of Records by Non-Transporters



Non-transporters (e.g. manufacturers) must establish and maintain records that identify *both* the transporter and non-transporter IPS and ISR (indicated with solid red arrows above)

Retail Store

Example 1: Common Storage Silo for An Ingredient (e.g., Flour)



Information reasonably available is the identity of all potential sources of the flour for each finished product

East Coast Recall – All Diamond Brand Dog Food Aflatoxin Cases December 2005



Company had Q/C protocols; was not using them

Wheat Gluten in Pet Food



Mass recall of dog and cat food after pets die

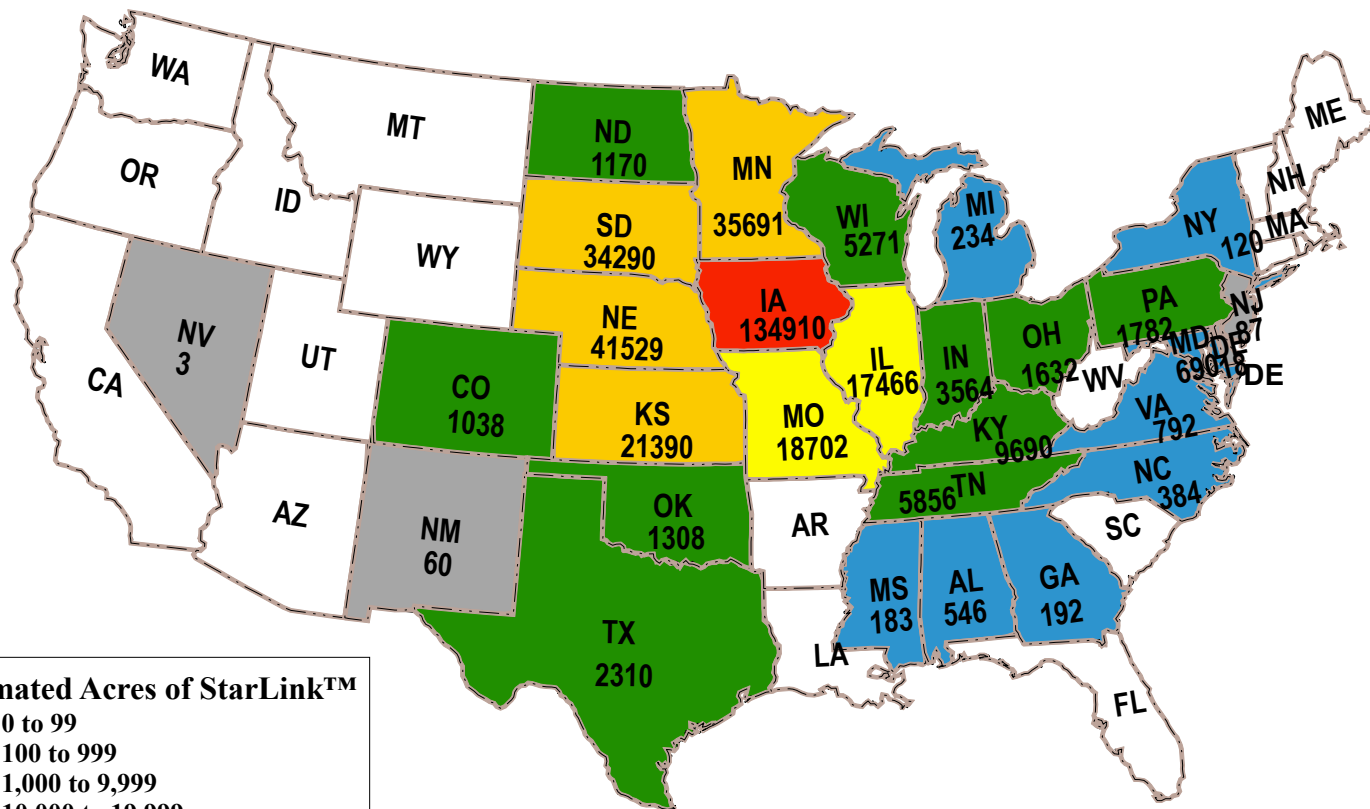
FDA Announces New Chemical Found in Recalled Pet Food

**Breaking News From FDA Confirms ASPCA's
Suspicious on Pet Food Toxin**

***Presence of Melamine Identified in Contaminated
Food***

Estimated Acres of StarLink™ Corn - U.S., 2000

Based on seed ordered

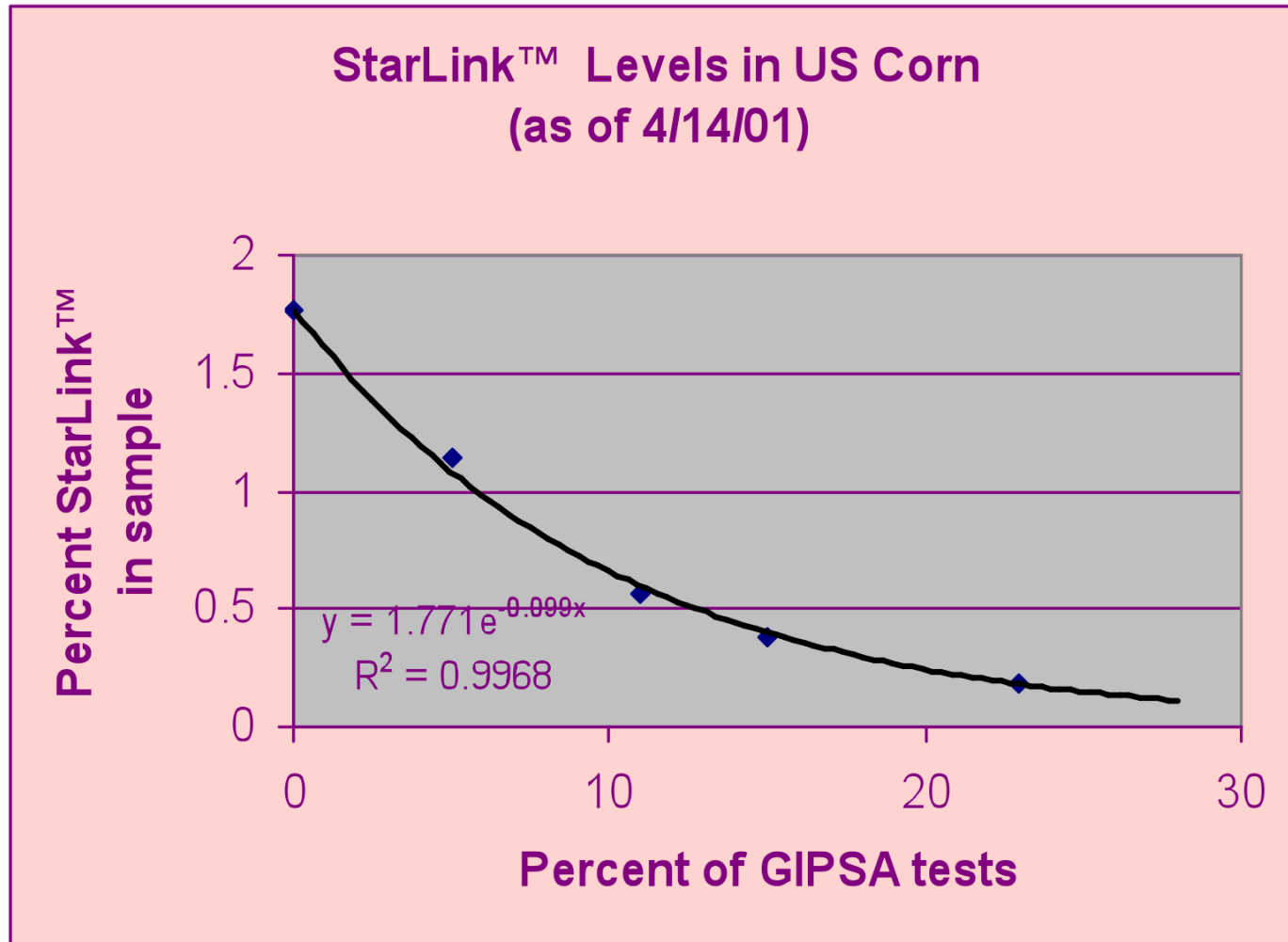


Estimated Acres of StarLink™

0 to 99
100 to 999
1,000 to 9,999
10,000 to 19,999
20,000 to 99,999
100,000 to 1,000,000
None reported

Total Acres: 340,908; 0.5%

StarLink™ Levels



Corn Sales Through April 2001

<u>Destination</u>	<u>% Change</u>
Japan*	(17.2)
Taiwan*	(13.0)
South Korea*	(32.3)
Total - All Exports	(10.2)

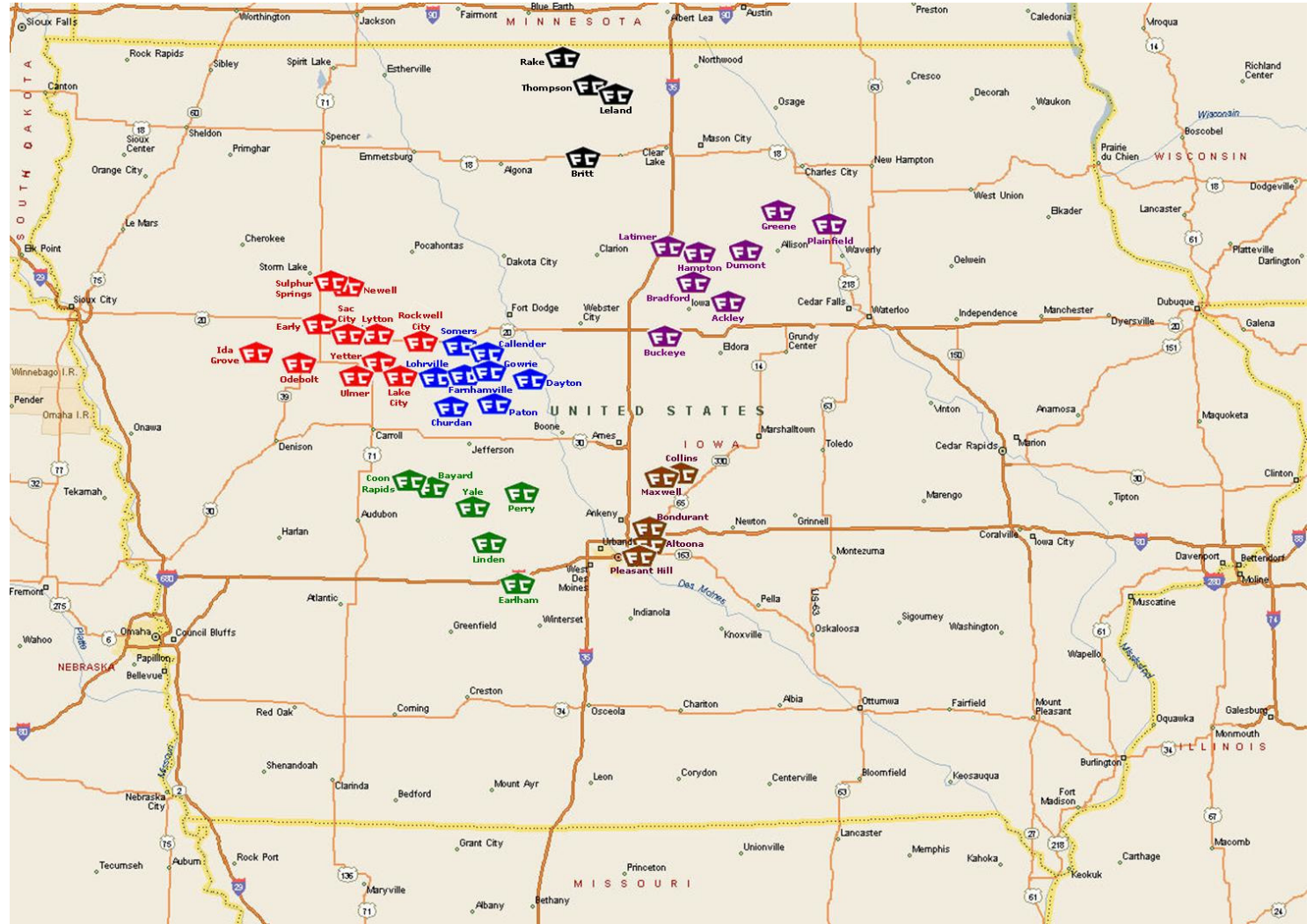
*Combine for over half of all U.S. export sales

Farmers Cooperative Company Odebolt Facility



- First Site for ISO Certification
- Replicate at Other Locations





Quality Policy:

TOTAL CUSTOMER SATISFACTION THROUGH OPERATIONAL EXCELLENCE!

IOWA STATE UNIVERSITY
University Extension

Source: FC, 2006

Inventory Control: Start of Traceability

	CORN SUMMARY FOR TRAIN xxxxxxxx					
	Bushels	Moist (%)	TW (Lb/Bu)	DKT (%)	FM(%)	Total Value
Beginning Measured Inventory:	1,406,259	15.30	57.31	2.68	2.29	\$57,427
Manually Estimated Train Blend:	440,675	15.11	57.09	2.11	2.19	\$10,603
Computer Generated Train Blend:	440,000	15.00	57.12	2.17	2.23	\$10,405
FC Grades/Weights (If House Graded):	440,953	14.95	57.00	2.34	2.58	
TCS Grades/Weights:	441,268	15.10	56.95	2.58	2.36	\$10,784
Ending Measured Inventory:	965,306	15.38	57.42	2.95	2.33	\$46,643
Measurement Difference	-315	-0.15	0.05	-0.24	0.22	

Basic Actions – Test Yourself

Mock Recall Report.doc
Original Version: 07-15-02; Last Revision: 08-14-02; By: CRH
AIB Reference Section(s): 7.3

1/1

Next Scheduled Revision: 12-01-03

Farmers Cooperative Elevator Company Commodity Grain Recall Report

Date: July 1, 2002

Lot ID: CN 384228, 51 cars of soybeans shipped June 25, 2002 to Bunge, Cairo, IL.

Origin of Problem:

Bunge, Inc., Cairo, IL reported to FC Grain Marketing that the 35th car in the train, CN383493, contained treated seed corn as part of the FM fraction. Two seeds were found in the coarse FM of the Official work sample when the train was unloaded June 28, 2002. The sample with the treated seeds has been retained. No treated seeds were found in the file sample portion for this car. Grain from this car and the next three cars is isolated at the Bunge facility (13,500 bu) and is incurring storage charges. No treated seed was found in any other sample from this train.

There have been no previous reports of treated seed shipped from Odebolt. No treated seed was found in the house grade samples, which have been retained.

Documentation: Retained samples from house grades
Grading comparison for CN383493 and BN458937

Source Grain:

Grain (174,761 bushels) was loaded on this train June 25, 2002. Of this, 153,081 bushels originated from bin 37, which was empty to loadout level on May 15, 2002 when the previous train (BN458937 shipped to Regassa, Mexico) was loaded. Loading CN383493 emptied bin 37 to the same level. During loading, 1760 bushels was received directly to the train, 2375 bushels of splits (from bin 26) and 9883 bushels of sample grade (from bin 18) were blended and 7682 bushels were transferred from bin 16.

Documentation: Quality-Quantity Blend Spreadsheet both trains

History of Grain:

The grain in bin 37 originated from 76,884 bushels of farmer receipts, 55,862 bushels transferred from Early to Odebolt, 19,400 bushels from Ida Grove to Odebolt, and 863 bushels from Sac City to Odebolt. The 1760 bushels received during loading represented two farmer deliveries early in the day. The splits had been transferred from Farnhamville in April, and this train used 2375 of the 4396 on hand as of June 25, 2002. The sample grade soybeans were from preharvest (fall 2002) bin bottom cleanout of bin 37. The 7682 bushels of soybeans transferred from Bin 16 were received at harvest.

Documentation: Scale ticket summary 5/15/02 – 6/21/02
Inter Company Transfer Summary 5/15 – 6/21
Bin Entry Permit for Bin 37 Cleanout

EMPLOYEE TRAINING RECORD

Training Approved and Authorized: _____ Date: _____

Employee Signature: _____ Date: _____

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Grain Traceability

Results: Traceability Index (Precision)

	First Set	Second Set
Locations	22	15
Complete Data	7	12
=====		
Tracking Index		
Average	374	227
High	942	945
Low	8	9

- **Average traceability index improving over time**
- **Locations with high traceability index lacked QM systems**
- **Low index values at manageable levels**

September 2007: 20 recalls; TI = 160; Range 3 - 1130

July 2008: 26 recalls; TI = 145; Range 5 - 698

Tracking Bulk Grain

- **Initial bin assignment all inbound tickets**
- Data fields for other information related to scale ticket
- Date, time stamp establishes position within bin
- **Current technology – all possible scale tickets in every outbound.**
- **Translation – any tracking is a process of elimination**
- **Where the grain cannot be.**
- **Reduce the possibilities with management decisions**
 - **Controlled movement**
 - **Grain quality management**

Annual Cost-Benefit Summary for QMS



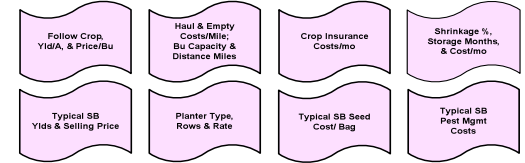
Operation	Cost Savings
Grading	\$1,085
Inventory Control	10,675
Operations Efficiency	2,180
Regulatory Compliance	5,300
Employee Development	3,400
Total	\$22,640
Cost of QMS	\$11,250
Ratio:	2:1
Source: Farmers Cooperative Elevator Co., Farnhamville, Iowa	



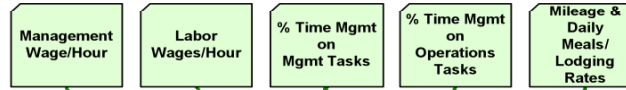
Cost-Benefit Analysis: Costs Associated with Farm Level Identity Preserved Production



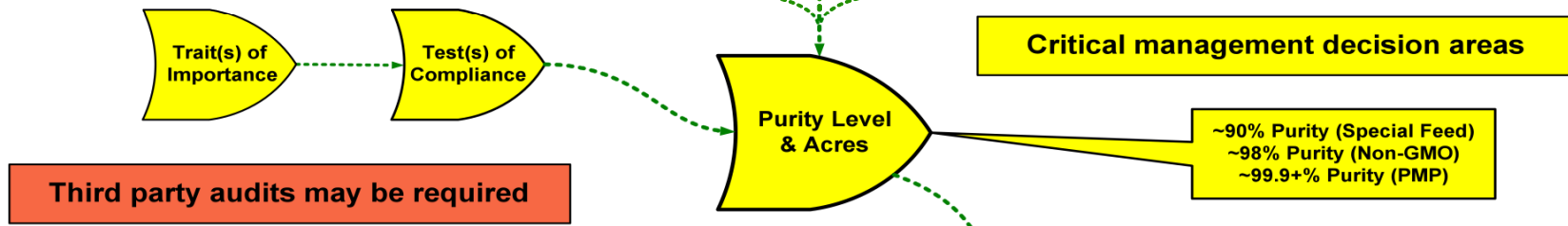
Normal or Standard Operations



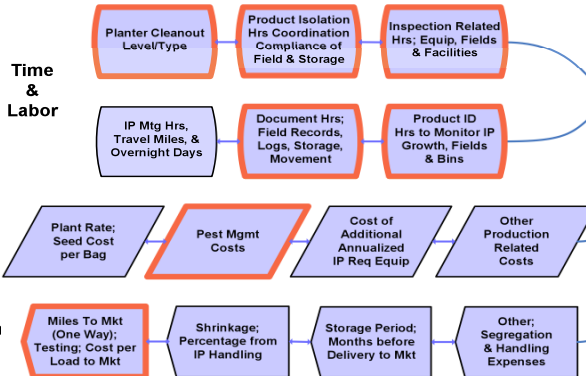
Background Information



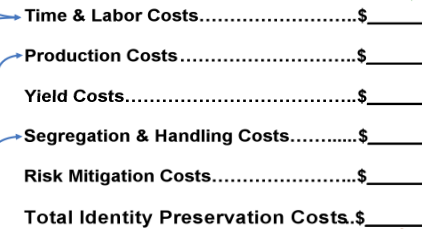
Gregory S. Bennet (gsbennet@iastate.edu)¹
 Major Professor, Dr. Charles R. Hurburgh, Jr. (tetry@iastate.edu)²
¹ Ph.D. Student, Dept. of Agricultural & Biosystems Engineering, Iowa State University, Ames, Iowa
² Dept. of Agricultural & Biosystems Engineering, Professor-in-Charge of Grain Quality Lab, Iowa State University, Ames, Iowa



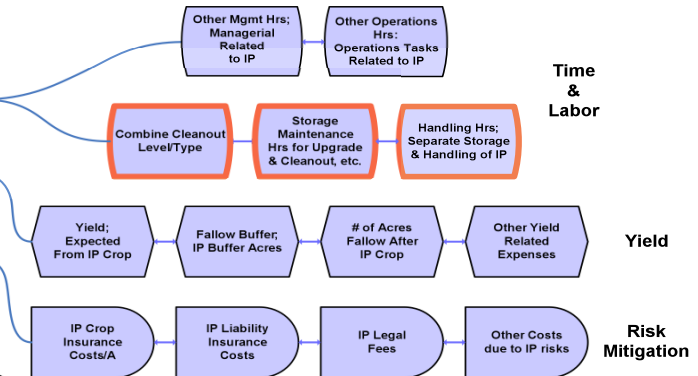
Identity Preservation Costs—Inputs



IP Costs—Outputs; Summation



Identity Preservation Costs—Inputs



Summary: Producers compare IP costs to benefits (premium paid) when determining what to grow



Participants: Members and shareholders of Asovia™, LLC <http://www.asovia.com> and Innovative Growers <http://www.innovativegrowers.com>

April 2007. Property of Gregory S. Bennet © Graphical presentation is an expanded version of the National Corn Growers Association IP Calculator <http://ncga.org/IPCalculator.asp>.

Scorecard Matrix			Breadth			Depth			Accuracy			Difference
			Std (required)	Measured (actual)								
IPT Trait(s) / Attribute(s) Success Scorecard (e.g., organic product, fair- wage, pasture-fed, etc.)	= Σ	1) Controlling Std (contract/Regs.)										
		A) Seed Purity (98%)										
		(i) Output Purity ± 0.002-0.005	1	3	0.980	1	3	0.978	1.00	1.00	0.9980	
		(ii) Other purity data (pts.)	1	1		1	1		1.00	1.00		
		B) Tolerance Level (pts.)	1	1		1	1		1.00	1.00		
		(i) Other tolerance data										
	* Σ	2) Performance Measurement			(as %)			(as %)				
		Entity/Parameters										
B = Breadth (actual number of measurements and/or data points)		A) Primary Entity (farmer, etc.)										
		(i) Inputs (pts.)	2	3		1.0	3.0		0.50	1.00		
		(a) Seed purity-98.0%	200	4		185.0	3.1		0.93	0.78		
		(ii) Operations (pts.)										
D = Depth 1 = farmer 2 = farmer + 1 entity 3 = farmer + 2 entities		(a) Chemicals data										
		(b) Storage										
		(c) Cleanouts										
		(d) Inspections crop/field			0.98			0.9800			1.0000	
		(iii) Tests (pts.)	15	3		13.5	2.2		0.90	0.73		
	(a) Field tests (A)			0.98			0.9600			0.9796		
	(b) Laboratory tests (A)			0.98			0.9750			0.9949		
	(iv) Administrative (pts.)	50	3		45.0	2.0		0.90	0.67			
		(a) Training periods										
		(b) Data collection										

Scorecard Matrix Continued			Accuracy			Accuracy			Accuracy			
			Breadth	Depth	Accuracy	Breadth	Depth	Accuracy	Breadth	Depth	Accuracy	
			Std (required)			Measured (actual)			Difference			
A = Accuracy (degree of conformity and/or measurement parameters; determined by tests, audits, etc.)		(c) Inspection, records										
		(v) Certification (pts.)	1	3		1.0	3.0		1.00	1.00		
		(a) Organic										
		(b) ISO										
		B) Buyer inspections										
		(i) Operational (pts.)	8	4		4.8	3.2		0.60	0.80		
		(ii) Administrative (pts.)	7	3		5.2	2.1		0.74	0.70		
		(iii) Tests (A)			0.98			0.9700				0.9898
		C) Third-Party inspections										
		(i) Operational (pts.)	20	4		14.9	3.7		0.75	0.93		
		(ii) Administrative (pts.)	15	3		13.0	2.0		0.87	0.67		
		(iii) Tests (A)			0.98			0.9780				0.9980
	D) Grader (pts.)	5	2		4.5	2.0		0.90	1.00			
	* Σ	3) Communications (Producer/Buyer)										
		A) Production Nomenclature (pts.)	25	3		22.0	2.4		0.88	0.80		
		(i) Unit size										
		(ii) Product										
		(iii) Other inputs/Byproducts										
		B) Trait(s)/Attribute(s) (pts.)	50	3		46.5	2.1		0.93	0.70		
		(i) Data/process(s) of interest										
		(ii) Measurements										
		(iii) Test Methodology										
									Weighted Average Score			
Accuracy Range (Min, Max)						0.960	0.980		0.901	0.895		

Back Ground Information

Item	Measu		Std.	IPT 1	IPT 2	IPT 3	IPT 4
Personal Information							
ID Number			1	2	3	4	5
Name			Bill Smith				
Address			Ames IA 50014				
Phone #			515.123.4567				
Email			isu@iastate.edu				
General Information							
Crop Planted			Soybeans	UL Soybeans	UL Soybeans	UL Soybeans	UL Soybeans
Crop Variety Planted				DKB 2752			
Purity Level (Required)	%		n/a	5.0%	2.0%	1.0%	0.1%
Crop Acres	acres		200	200	200	200	200
Grain Yield	bu/acre		55	55	55	55	55
Previously Planted Crop in Field			Corn	Corn	Corn	Corn	Corn
Type of IP System			None	Non-GMO	Non-GMO	Non-GMO	Non-GMO
Trait(s) and/or Attribute(s) of Interest			None	Ultra Low Linolenic	Ultra Low Linolenic	Ultra Low Linolenic	Ultra Low Linolenic
Hourly Wage Information							
Management	\$/hr		\$25.00	\$25.00	\$25.00	\$25.00	\$25.00
Labor	\$/hr		\$15.00	\$15.00	\$15.00	\$15.00	\$15.00
Meeting, Off Season	\$/hr		\$40.00	\$40.00	\$40.00	\$40.00	\$40.00
Contract or Hired Professional	\$/hr		\$50.00	\$50.00	\$50.00	\$50.00	\$50.00
Operating Assumptions							
Grain Hauling, Semi	\$/mile		\$0.250	\$0.250	\$0.250	\$0.250	\$0.250
Interest, Carry-on Operating Money	%/yr		8.00	8.00	8.00	8.00	8.00
Capital Interest	%/yr		6.00	6.00	6.00	6.00	6.00
Personal travel mileage	\$/mile		\$0.500	\$0.500	\$0.500	\$0.500	\$0.500
Personal travel meal expense	\$/day		\$50.00	\$50.00	\$50.00	\$50.00	\$50.00
Personal travel overnight expense	\$/day		\$100.00	\$100.00	\$100.00	\$100.00	\$100.00

Maize to Milk: An Analysis of the Traceability Systems of Bulk Commodities

Brittini R. Brown

Dr. Charles R. Hurburgh Jr.

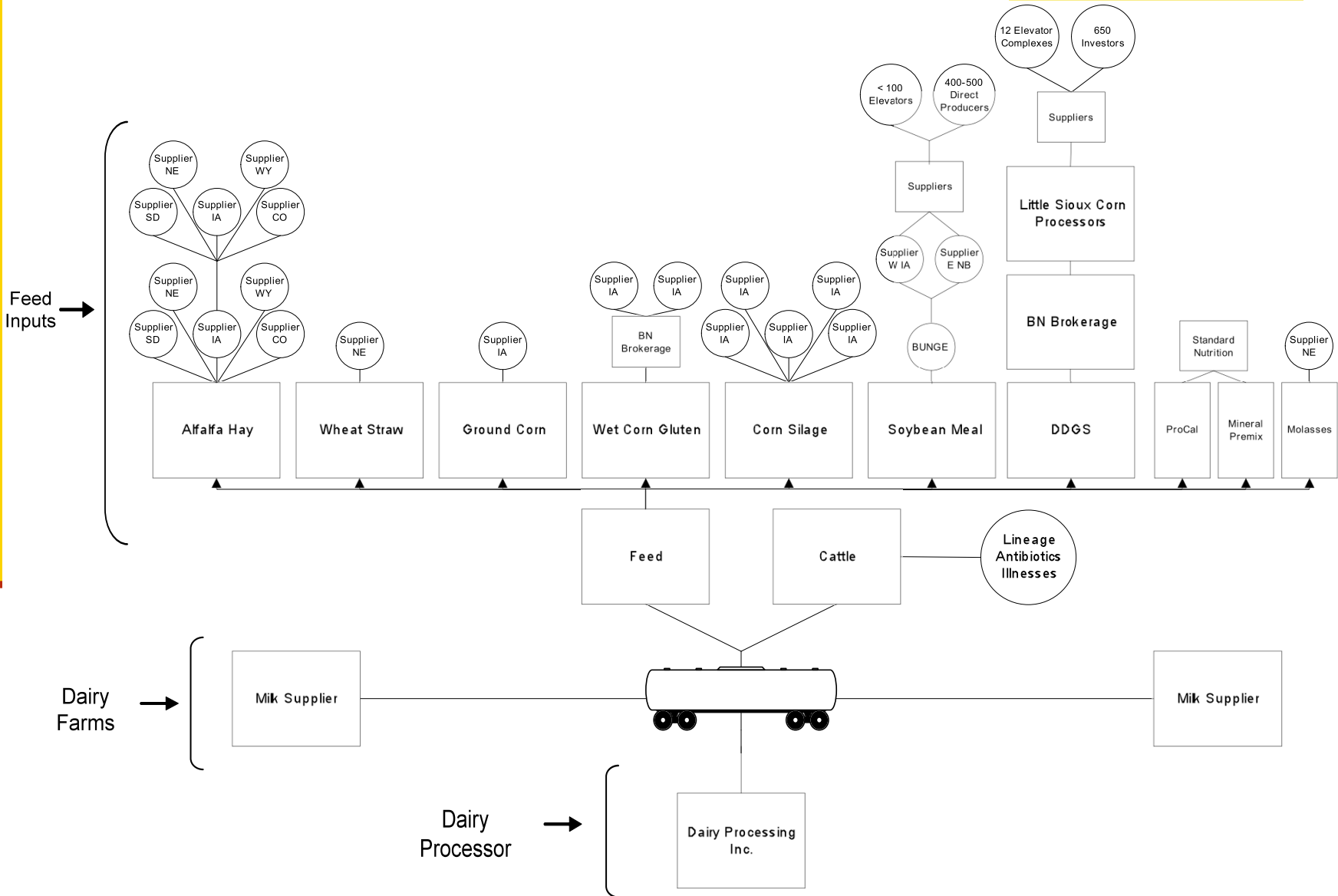
Department of Agricultural & Biosystems Engineering
Iowa State University

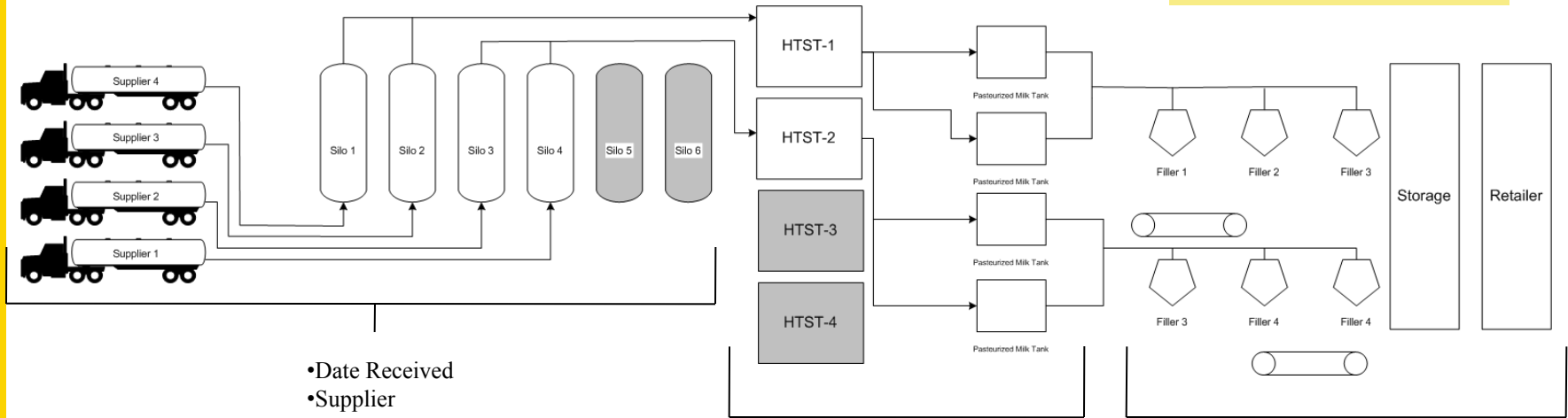
NC-213 “Marketing and Delivery of Quality Grains and BioProcess Coproducts

February 18-20, 2009

Kansas City, MO

Supply Chain Mapping





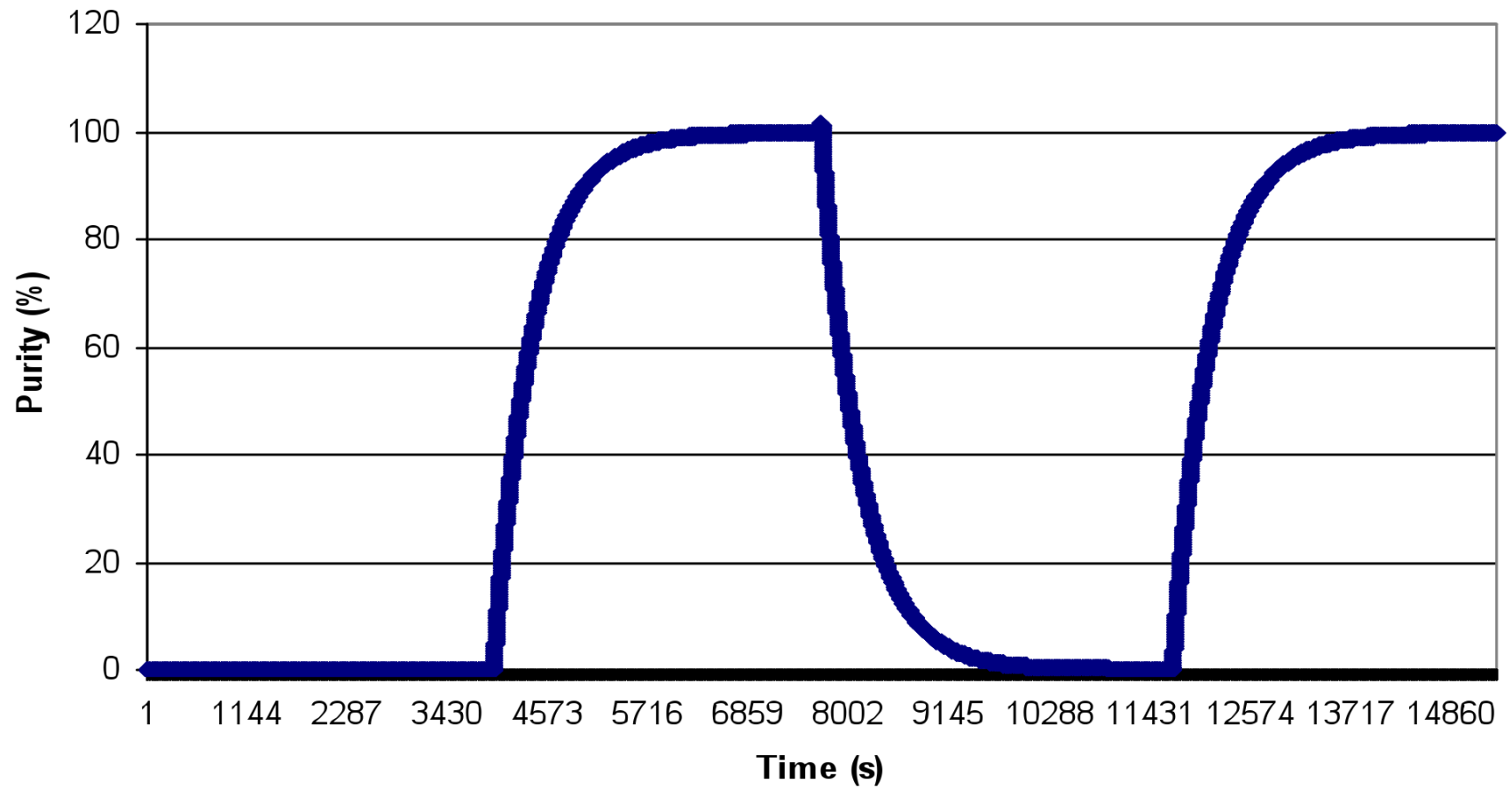
- Date Received
- Supplier
- Bill of Lading
- Operator
- Silo Destination
- Silo Level

- Silo Source
- Product
- Product Total
- Product Destination
- Cream Destination
- Cream Total

- Filler ID
- Product Description
- PT Tank Source
- Date Received
- UPC Number
- Sell By Date
- Cooler Location
- Pallet ID
- Quantity
- Product Destination
- Route ID
- Order Number

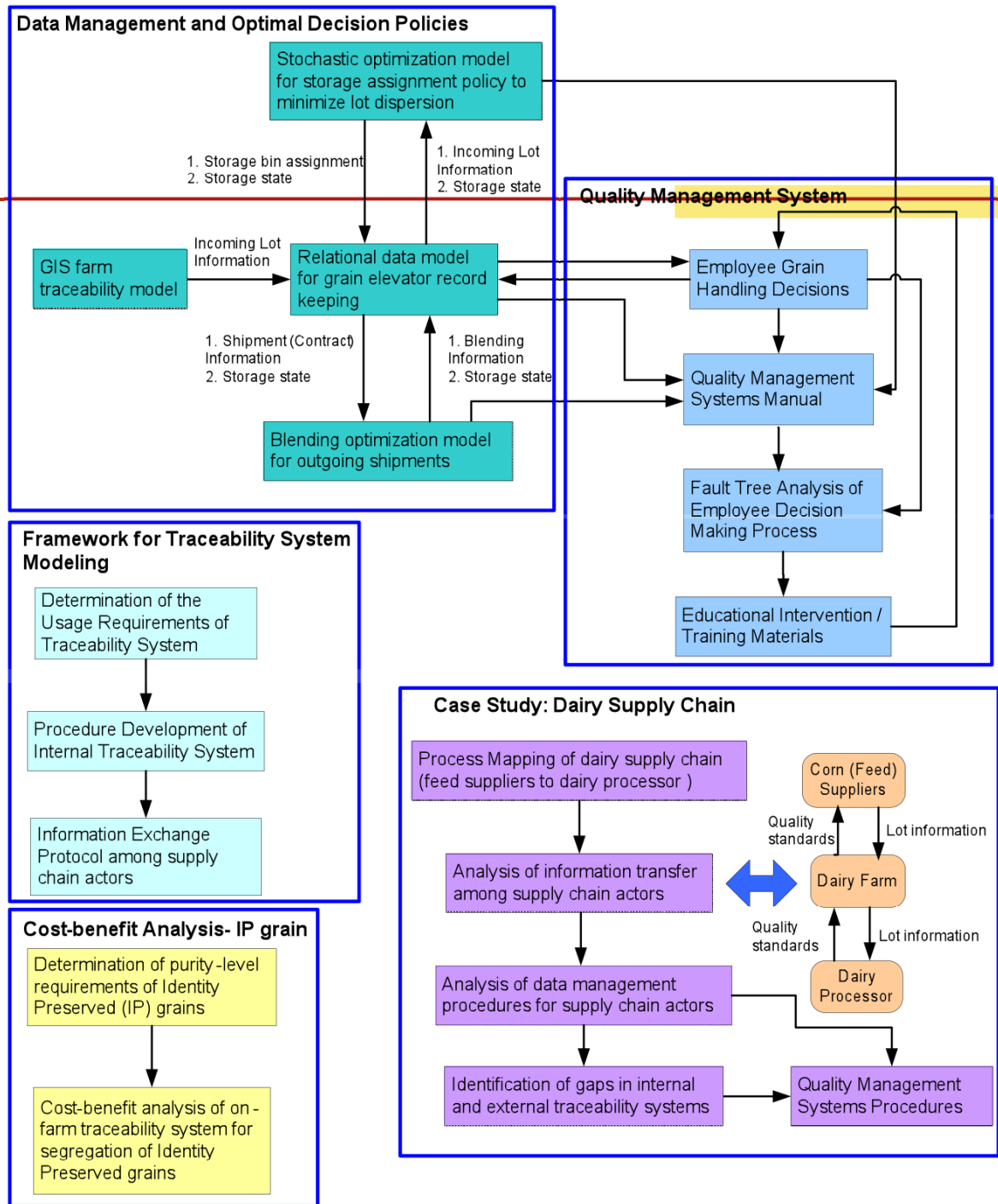
Result

The Changing of Grain Purity After Exiting Bucket



Traceability Research Programs

- Data Management and Optimal Decision Policies
- Traceability System Modeling
- Cost-benefit Analysis
- Quality Management System
- Case Study: Dairy Supply Chain



Summary

- **Traceability serves several functions related to product quality, safety, security and authenticity.**
- **Traceability of bulk commodities can be more accurate than generally believed.**
- **Traceability = operational efficiencies.**
- **Traceability back through farming operations to land parcels?**
- **Quantitative versus probability**

Summary

- **The best system will become the regulatory and world trade standard.**
- **International standards must prevail; ISO 22000/22005/22006 already**
- **How precise will be good enough?**
- **Gaps:**
 - Ontology, linkages and models
 - Operating practices integrated with tracking integrated with cost efficiency integrated with C tracking.
 - Application templates designed around cost analysis and assessment of objectives.



Food & Agricultural Traceability Conference

Des Moines, Iowa, USA

June 9 and 10, 2009 (Conference)

June 11, 2009 (Workshop)

Solutions-based

- Interactive sessions focused on
 - Adding value to agricultural commodity products using traceability
 - Why adopt traceability?
 - What are risks and rewards of traceability for agricultural and food businesses?
 - How can traceability help meet the needs of modern food and agricultural businesses?



**For more information on
the Conference or the
Workshop or to register,
visit:**

<http://www.extension.iastate.edu/grain/>



June 9 -10, Des Moines, Iowa
Agricultural and Food
Traceability Conference



www.iowagrains.org