

Establishing a NIR Center of Excellence: A Solution for Successful Management of Multiple Instruments and Programs

An aerial photograph of a farm at sunset. In the foreground, there are several black and white cows grazing in a green field. A paved road runs along the right side of the field. In the middle ground, there are several farm buildings, including a large red barn, a smaller red barn, and three tall, cylindrical metal silos. A large tree is on the left side of the silos. In the background, there are rolling hills and a small town with houses and buildings. The sun is setting on the right side of the image, creating a warm, golden glow over the entire scene.

Anitra Payne, NIR COE Manager

Agenda

- Overview of Land O'Lakes
- Our NIR History
- Establishing the NIR Center of Excellence
- Challenges & Solutions
 - Dairy
 - Feed



LAND O'LAKES, INC.

FEEDING HUMAN PROGRESS

Land O'Lakes has an exceptional reputation with a 95-year history

More than a “butter business”

Powerful, respected brands

Industry-leading operations



Answer Plot[®]

Mazuri[®]



LAND O' LAKES[®]
ANIMAL MILK PRODUCTS CO.

CROPLAN[®]

By WINFIELD
UNITED

KOZYSHACK[®]

Answer Tech[™]



vermont
creamery

Feed: A leader in animal nutrition



B2C: Lifestyle, Livestock & Exotic

B2B: Milk Replacer & Premix

1,200-acre farm dedicated to research

Dairy Foods: #1 butter brand in the U.S.



Retail: Butter, cheese, pudding

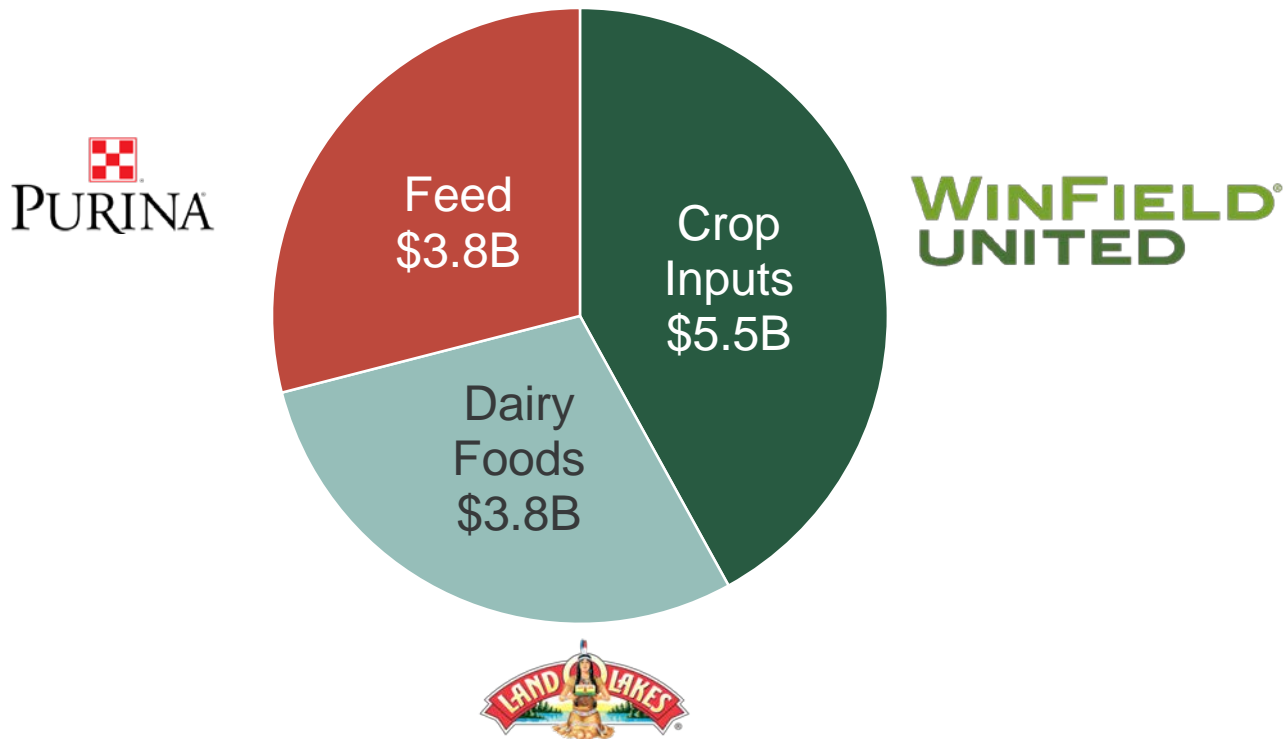
Foodservice: K12 and commercial

Global Dairy Ingredients: B2B

An icon in our nation's kitchens

Our 2016 revenue as a company was \$13 billion

Net sales by business unit



Our NIR History

1990s to early 2000's

Dairy

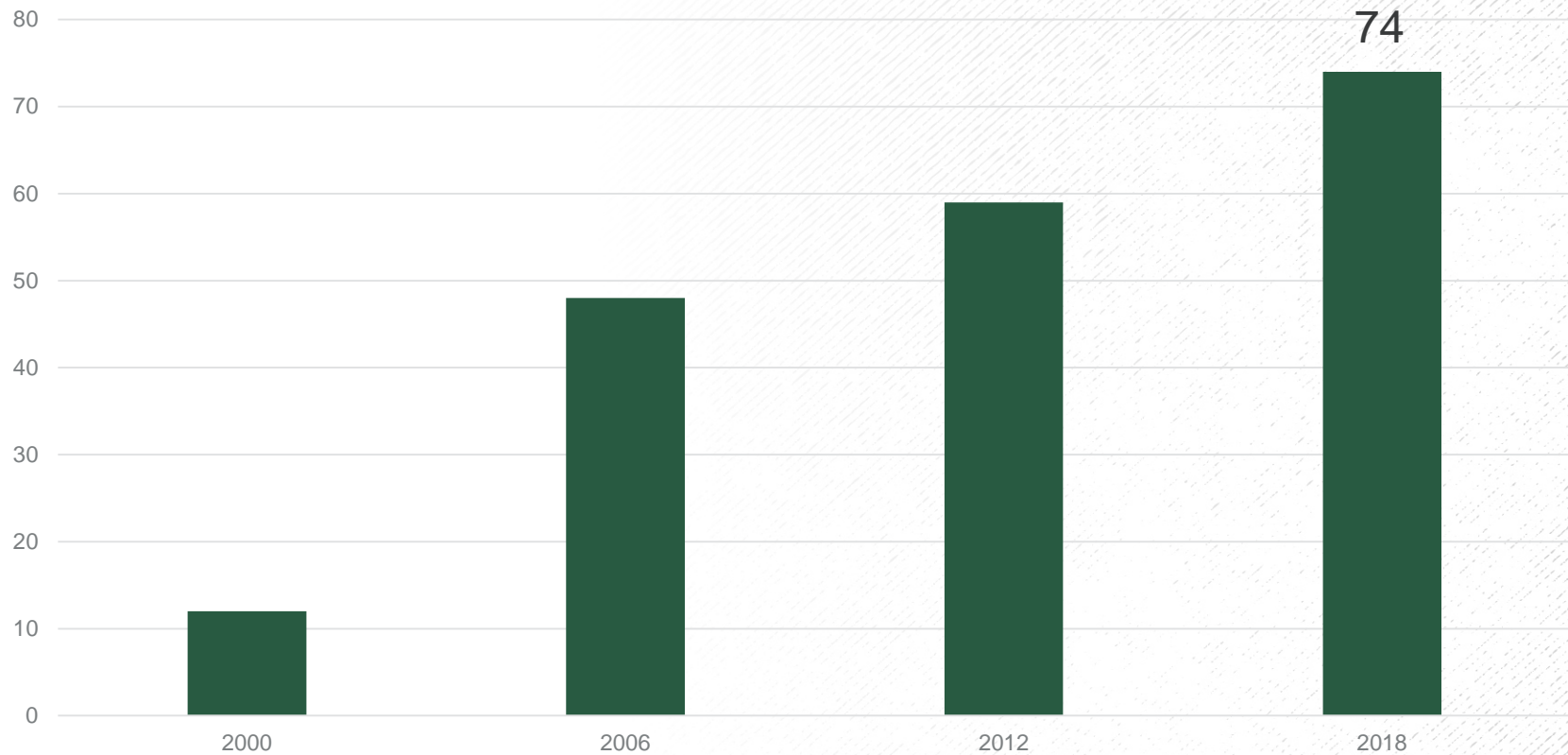
- NIR used minimally
- Moisture, Fat, Protein - Finished Goods
- Plants purchased whatever equipment they wanted and managed themselves
- Infrequent verification (if at all)

Feed

- Purchase of Purina (2001) expanded the use of NIR



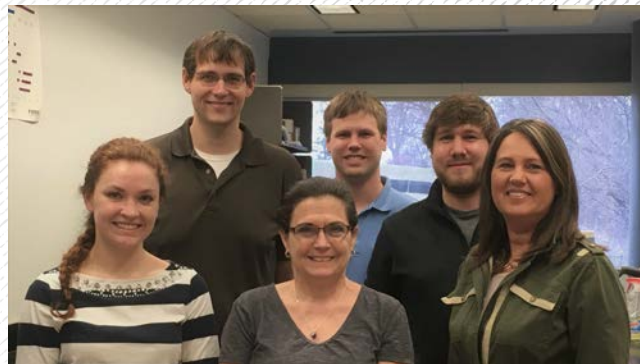
NIR Instruments 2000-2018



Establishment of NIR Center of Excellence

Establishment of NIR Center of Excellence (NIR COE) - 2009

- Brought Feed and Dairy NIR groups together at our corporate headquarters in Arden Hills, MN
- Expanded knowledge and capabilities
- Eliminated need for NIR experts at each location
- Resource for all of Land O' Lakes
- Cross-functional resources
- Started using the internal lab for feed wet chemistry
- Continuous improvement of current programs and practices
- 6 fulltime employees (2018)



Support all NIR activities at feed and dairy plants

- Calibration model development & updates (99% of all models internally developed)
- Troubleshooting & Technical issues
- Management of multiple programs
- Training and Education
- Running of samples for non-NIR plants
- International – Kenya, China, Philippines
- Co-manufacturers, Outside labs



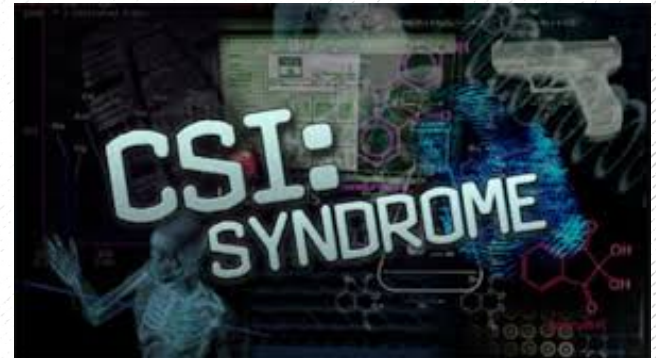
2,000,000+

Number of results generated by our NIR
Instruments Annually

Challenges & Solutions

Reality of NIR: Educating Users, Operations, and Management

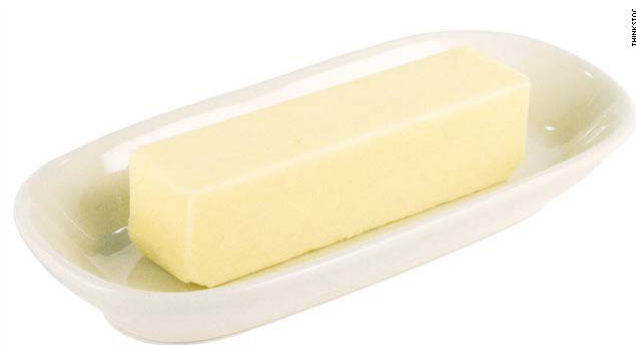
- Realistic expectations
- Results are predicted values
- Validation and ongoing verification



Land O'Lakes Dairy Programs

LAND O'LAKES, INC.





25 benchtop instruments and 5 inline instruments at 11 locations

- Dairy Powders, Cheese, Butter, Spreads, Cheese Powders, Thick Liquids, Whey
- Moisture, Fat, Protein, and Salt
- ~60 Calibration models
- ~80 Channels
- In-process control and Finished Goods testing
- Traditional verification using wet chemistry

Business Impact

- Reduced Labor costs or increased time for other quality tasks
- Increased volume of testing
- Minimal error, reduces need for retests due to lab mistakes
- Environmentally friendly – reusable cups, no reagents or waste
- Finished Goods
 - Fast, efficient release of product
- In-process control
 - Immediate composition feedback allows for process adjustments
 - Improved quality with less defects
 - Optimized composition



1,000,000

Number of Samples Run on One of our
NIR Instruments (so far)

Some Challenges

Proper verification

Real time samples used for verification

Seasonality

Process Changes

Tracking verification data

Chasing the bias

Sufficient samples to perform a bias change

Pressure from operations to make bias adjustments

Blaming the instrument

Large number of instruments, locations, channels,
ingredients, calibration models

Dairy Solution #1

Formal Verification Program

- Specific requirements for all
- Frequent, routine verification throughout the year
- Verification samples added to calibration models
- Monthly review by NIR COE
 - Bias adjustments only made by NIR COE
 - Statistically valid (20+ data points)
- Verification metrics
- Mandatory remote access
- Shared file locations
- Confidence in results

A person wearing a dark t-shirt and jeans is holding a large red bucket. The bucket has the Purina logo, which consists of a red and white checkerboard square above the word "PURINA" in white capital letters. The background is a dimly lit barn or stable with wooden walls and metal structures.

Purina Feed Programs

LAND O'LAKES, INC.

44 Instruments, Multiple Purposes

- 3 Corporate (Arden Hills, MN)
- 32 Feed plants - incoming ingredients
- 3 Animal Milk Replacer Plants – ingredients and finished goods
- 1 Finished product
- 1 Raw material identification
- 1 Kenya, 2 Philippines, 1 China
- Multiple Programs



Formulation Program

- 58 different feed ingredients w/ multiple constituents
 - Moisture, Fat, Protein, Fiber, ADF, NDF, Ash, Minerals, Fatty Acids, Sugars, etc.
 - Calibration models for each
- 32 Plants with a NIR onsite run a sample from every unload
- 20 Plants without NIR send in every unload to the NIR COE





Business Impact

- Best cost formulation of product
- Ingredient claims and acceptability
- Quality Assurance
- Eliminates need for laboratory and lab technician at each location

Feed Challenges

- Limited Budget, traditional verification not practical
- Large number of ingredients
- Multiple Suppliers
- Multiple Instruments/locations
- Different Ingredient Mixes at each location
- Ingredient Variability
 - Suppliers
 - Regionality
 - Seasonality
 - Sample Homogeneity



Feed Solutions

- Modified verification
 - Selected sample sets get wet chemistry in duplicate and sets are passed to all the instruments that run that ingredient
 - The most critical ingredients get more attention. Routinely send in samples and compare to our master instrument
 - All plants are required to send in samples that exceed M-distance limits or outside of our calibration ranges
- Monthly ingredient request
- Use of spreadsheets for tracking instrument info, calibrations, contacts, ingredients, etc.
- Automated transfer of data



General Challenges & Solutions – Feed and Dairy

Difficult Matrices/Sample Homogeneity

- Duplicate wet chemistry
- Large cups, specialty cups

Wet chemistry accuracy & variability

- Internal wet chemistry
- Duplicates
- Lab assessments
- Proficiency programs

Communication

- SharePoint sites, Webinars
- Group email and phone line

Critical NIR COE Solution: Remote Access Software

- Allows us to more readily manage calibrations and bias settings across all of our plants
- Can use from our own desktop rather than a shared designated computer
- Multiple people can be using the system at the same time
- Easily make changes, pull spectra or run reports
- We can quickly check on plant compliance of our programs or just view their data
- Assists in troubleshooting
- Having different levels of access allows us to give the tool to individuals
- Allows personnel to easily use the data for their needs (QA, Finance, Technical Service, Production, etc.)



Critical Solution for NIR COE: Vendor Partnerships



- Leveraging Vendor Partnerships
 - Customer and Technical Service
 - Work with us on our projects including custom setups for instrument with special IT needs
 - Ask for our input on software needs and improvements
 - Desire to share knowledge and calibration models
 - Competitive pricing
 - Willingness to let us trial new instrumentation
 - Direct access to resources

Thank you!

.....