



trace r&d | 2009

Diamond/Diamant

Canada 

Platinum/Platine



Gold/Or



Silver/Argent



Bronze/Bronze

Alberta Farmer Express
Canadian Poultry Magazine
Canadian Wheat Board /
Commission Canadienne du blé

Consumer & Marketing Demand Network
Gallagher Canada
Grainnews
Intelliware Development Inc.

Manitoba Co-operator
On Trace
Trace it Solutions

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Technological Vision in Traceability

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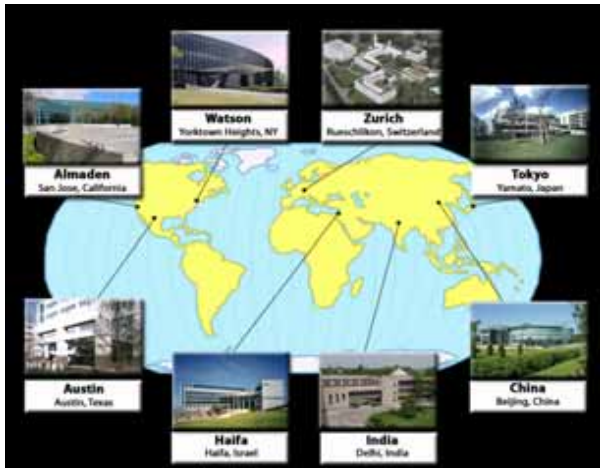
Trace R&D 2009 – Winnipeg, Manitoba

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- Professor Curtis Rempel, Department of Food Science, University of Manitoba
- Susan Wilkinson, Solutions Executive, Agri-Food Traceability Team, IBM Canada
- John Graham, Services Executive, IBM Canada



Background: IBM Research - 3000 Researchers in 8 labs around the world



Behavioral Sciences



Chemistry



Computer Science



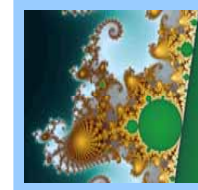
Electrical Engineering



Materials Science



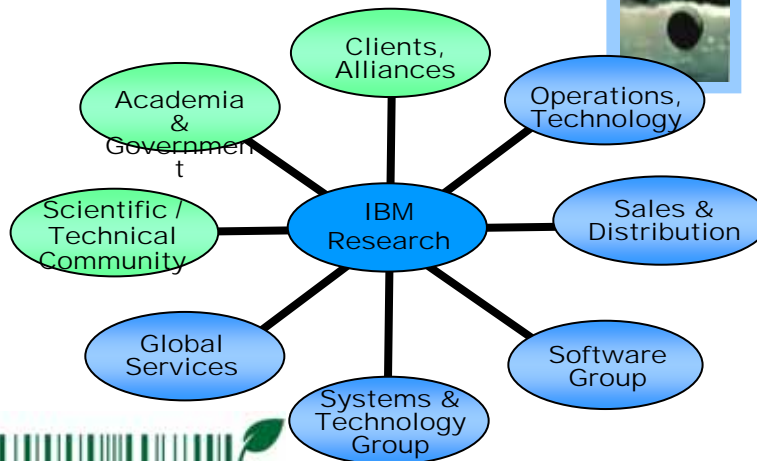
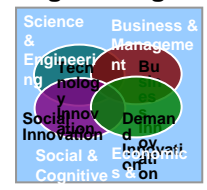
Mathematical Sciences



Physics



Service Science, Management & Engineering



Technological Vision in Traceability: Objectives

- **Enable Food Safety**

The future technology efficiently and effectively facilitates handling, preparation, and storage of food in ways that prevent food-borne illness (i.e. resulting from the consumption of food). This technology helps insure that food is free of both accidental and intentional contaminants.

- **Enable Food Security**

The future technology protects the availability of food as well as producers' access to ingredients and individual consumers' access to nutrition. Examples of threats to food security include nutritional deficiencies, unsafe food, land degradation, plant disease, etc as well as certain political and economic conditions.

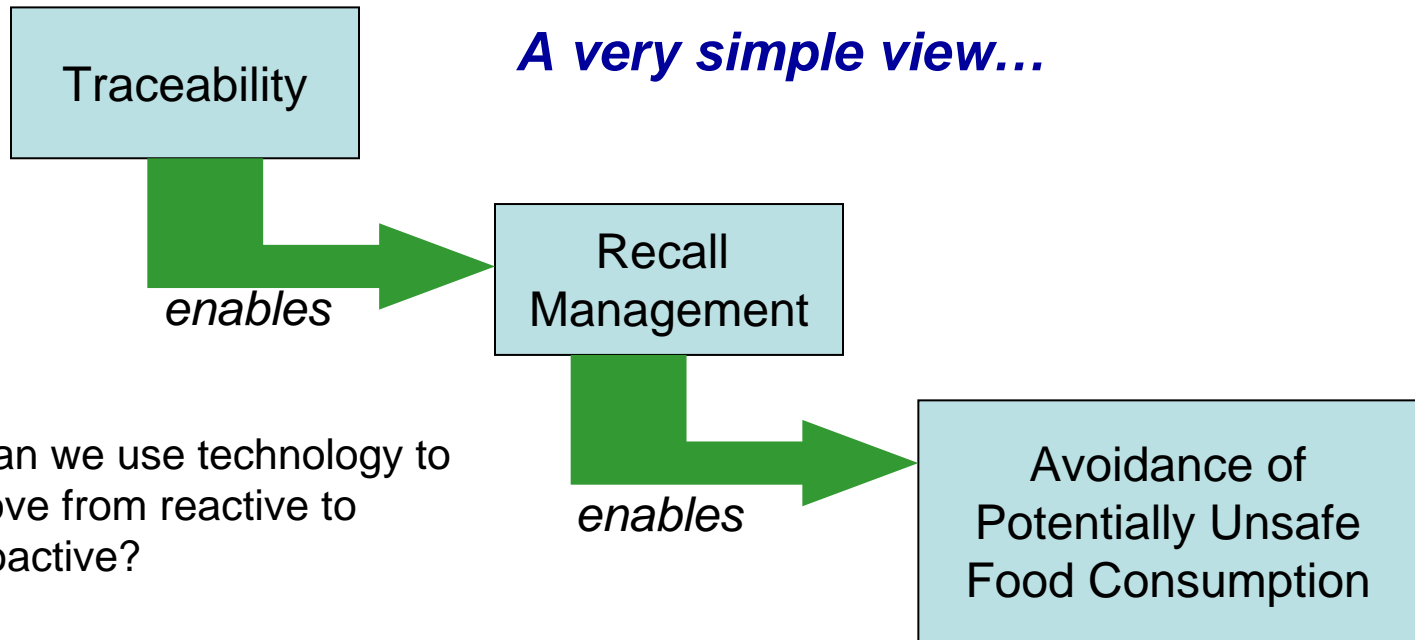


Threats to food safety

- Bacterial pathogens (e.g. E coli, Salmonella, Clostridium Botulinum)
- Viral pathogens
- Mycotoxins
- Allergens and allergen cross-contact
- Protein Boosters (e.g. melamine)
- Amino Acids
- Rancidity markers
- Flavors and off loaders
- Banned ingredients (e.g. banned dyes)
- Overdosing of nutrients
- Pesticides
- Metals
- Nonmetal foreign bodies (e.g. glass)
- ***Unknowns***



Why enable traceability?



• Can we use technology to move from reactive to proactive?

• Isn't there more value in the information that is captured thru traceability?



System safety has a widely accepted precedence for dealing with hazards

1. Hazard elimination
2. Hazard reduction
3. Hazard control
4. Damage reduction

Precedence means that higher levels are more desirable

* Reference: N. Leveson's adaption in *Safeware: System Safety and Computers*, Addison-Wesley, 1995 of the safety precedence described by W. Hammer, *Handbook of System and Product Safety*. Prentice-Hall, Inc. Englewood Cliffs, NJ, 1972.



In system design for safety, the highest priorities are assigned to hazard prevention. Advanced data analytics help to move in this direction.

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Hazard Elimination

Complete elimination of the possibility for future hazard events.

Hazard Reduction

Minimize the probability of future hazard events occurring.

Hazard Control

A hazard event has occurred. Mitigate the effects.

Damage Minimization

A hazard event has occurred. Minimize the damage.

Traceability enables improved reaction given a food safety hazard has occurred

Advanced data analytic methods take large volumes of data from various sources, including from traceability solutions, to enable prediction and avoidance

Hazard event occurs

Time



* Reference: N. Leveson's adaption in Safeware: System Safety and Computers, Addison-Wesley, 1995 of the safety precedence described by W. Hammer, Handbook of System and Product Safety. Prentice-Hall, Inc. Englewood Cliffs, NJ, 1972.

Traceability Technology

Today's Technology Emphasis:

- Data capture
 - RFID, DNA testing, ...
- Information management
 - Architecture, retrieval, ...



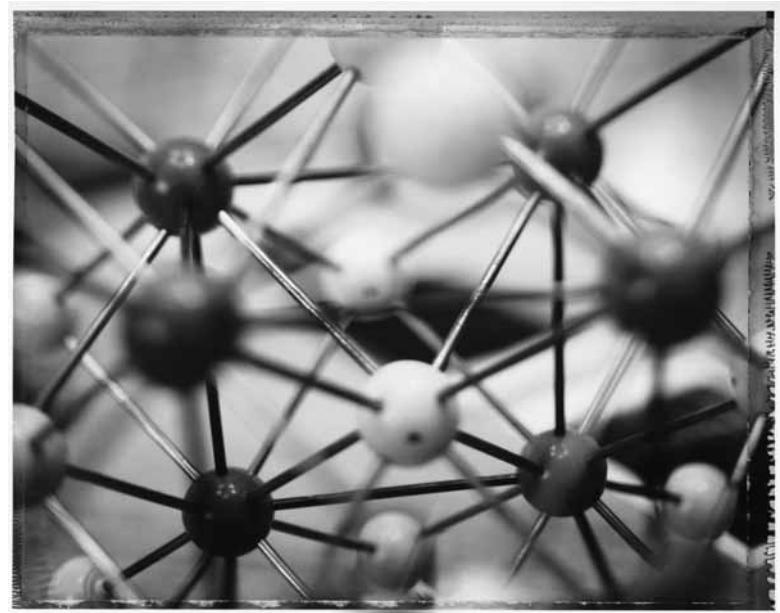
Traceability Technology Vision: What's Ahead

- More more more information
 - Advanced detection technologies
 - Non-entity specific data
 - The characterization of uncertainty
- Advanced analytics
 - Resource optimization
 - Prediction
- Alternative approaches to computation
 - E.g. Cloud computing, digital collaboration



Advanced Detection Technologies

- Mass spectrometry is a technique for determining the elemental composition of a sample or molecule
- Shows promise for screening food for contaminants
- Current issues: detecting *unknowns*; use in production environments



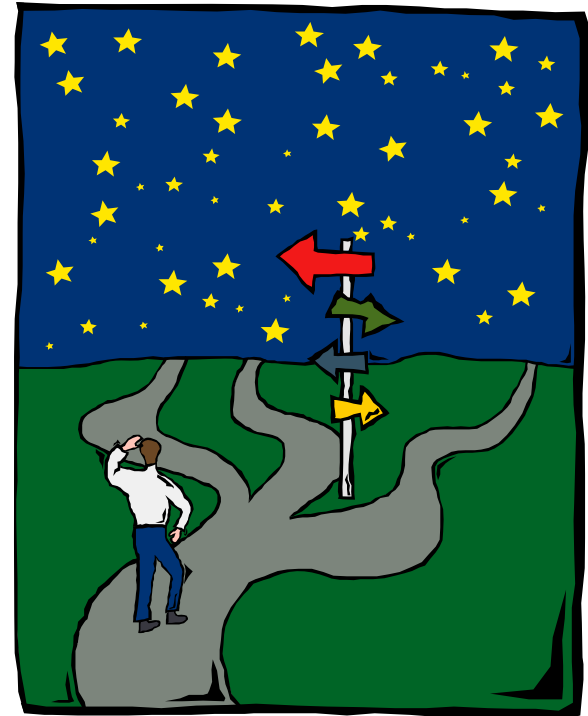
Non-entity specific data

- Tomorrow's data includes not only where an entity came from, what's in it, ... it will include environmental, cultural, economic conditions that occurred while it was being produced
- One likely source: the internet



The Characterization of Uncertainty

- Uncertainty will be systematically characterized and used in decision making
- For example, consider:
 - *This produce came from an animal that came in contact with a diseased animal*
 - *There is a .09% probability that this product came from an animal that had contact with a diseased animal*



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Why advanced analytics will emerge in traceability and food safety solutions?

- First major attention to food safety with respect to adulteration...1800's, coinciding with:
 - The first widespread use of applied chemistry to solve practical problems
 - The industrial revolution
- What's happening today?
 - Proliferation of advanced analytics for decision making / practical problems
 - The information technology “revolution,” including the availability of mass quantities of data in digital format



Resource Optimization

- The use of mathematical models to make optimal decisions when there are limited resources
 - Linear, nonlinear, integer, mixed programming
- Many examples
 - What/when to deploy tracing technology; how to best utilize limited monitoring and inspection resources; what products to recall to minimize possible exposure to contamination; etc



Prediction

Data Mining

- The process of extracting hidden patterns from data
- Increasingly important tool as the volume of data increases

Predictive Modeling

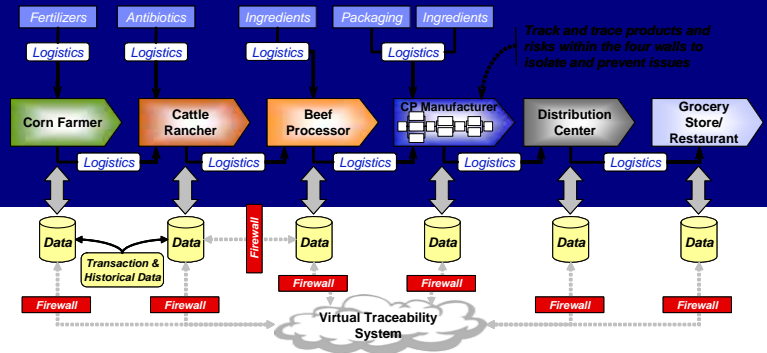
- The process of trying to best predict the probability of an outcome

Risk Analysis

- The process of identifying and assessing factors that jeopardize the success of a goal

Statistical Analysis and Forecasting

- The mathematical science of collection, analysis, interpretation, explanation, and presentation of data, and estimating unknown quantities



What conditions existed prior to a food safety event?

Based on identified patterns, predict the probability of a future food safety event

Make decisions on risk mitigation.
For example, product recall prior to a food safety event

Support impact analysis by forecasting demand under different hazard scenarios



Traceability Technology Vision: What's Ahead

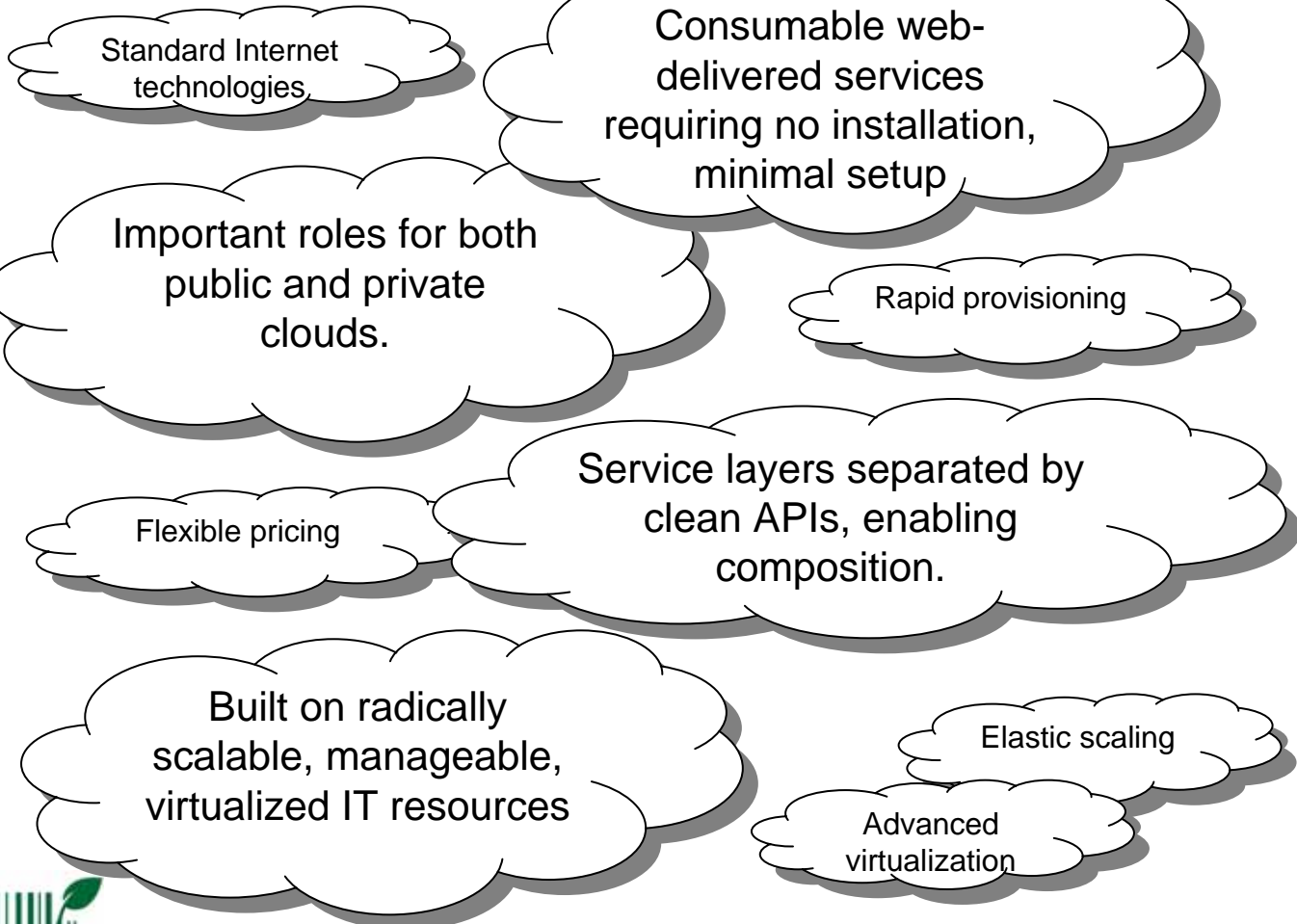
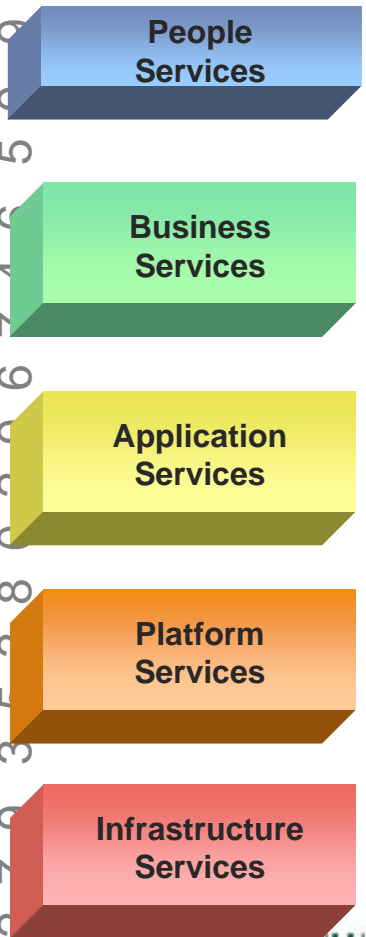
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Cloud

Cloud Computing is a model of shared network-delivered services, both public and private, in which the user sees only the service, and need not worry about the implementation or infrastructure

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Digital Collaboration

- How information is shared, and decisions are made, across a complex network of trading partners will evolve with advances in ...
 - Collaborative Software
 - Visualization
 - Social Computing and Social Network Software



Summary

- Future technology for traceability
 - Will involve more information, from disparate sources, unhindered by data collection
 - Includes advanced analytical methods, and incorporates uncertainty within decision support systems
 - Will be scalable and agile (e.g. cloud, collaborative software), by necessity
 - Will move traceability from a REACTIVE to a PROACTIVE measure for helping to insure food safety

