

2019 Executive Farm Management Program

The Development and Evaluation of Distribution Packaging

Gregory Batt, Ph.D.

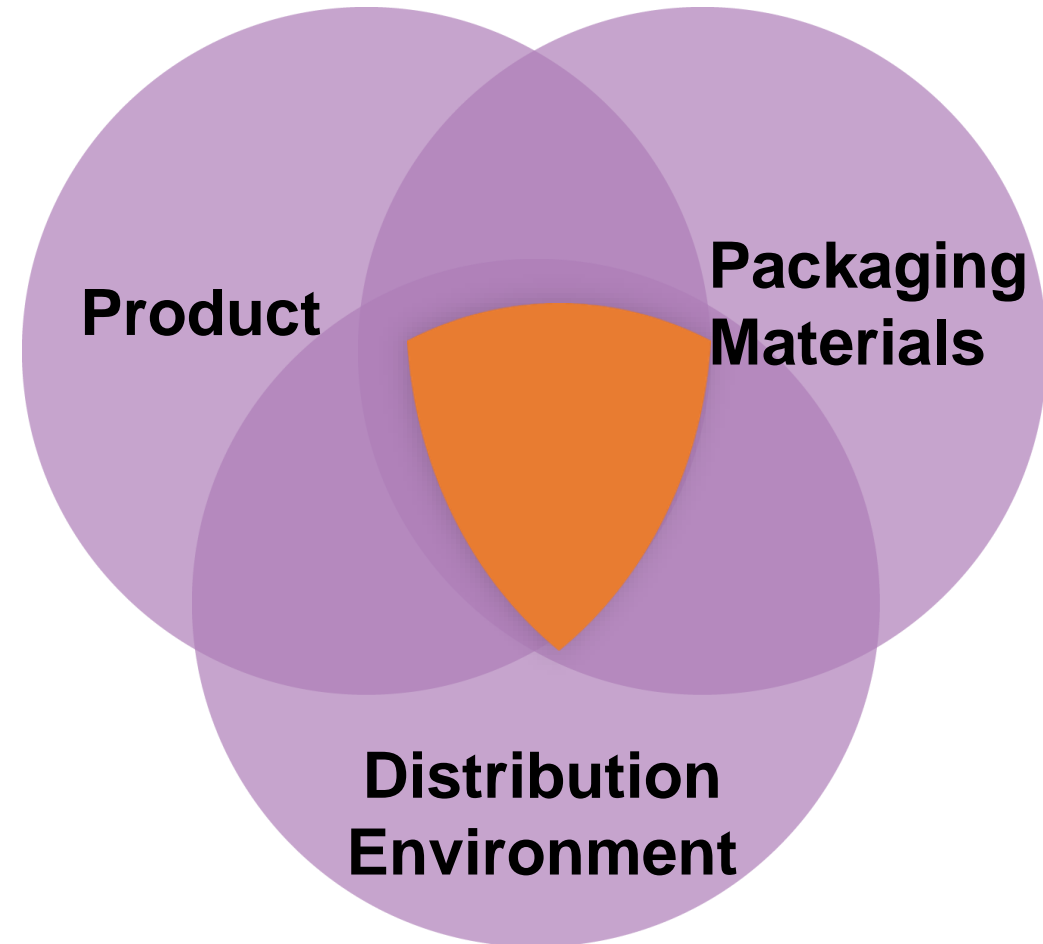
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Systems Approach Package Design

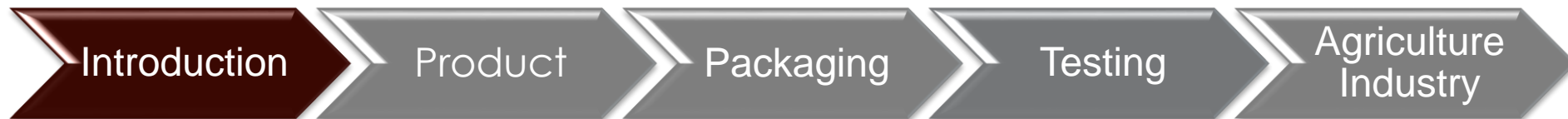
- Introduction
- Distribution Environment Characterization
 - Laboratory Testing
 - Levels of Testing
 - Standards Organizations
 - Current standards
- Product Fragility
- Packaging Material Performance
- Corrugated Boxes in the Agricultural Industry

Systems Approach



Distribution System Hazards

- Shock
 - Free fall drop, mechanical handling, road irregularities, etc...
- Vibration
 - Truck, plane, train
- Compression
 - Warehouse stacking, dynamic compression
- Environmental
 - Temperature, relative humidity, atmospheric pressure

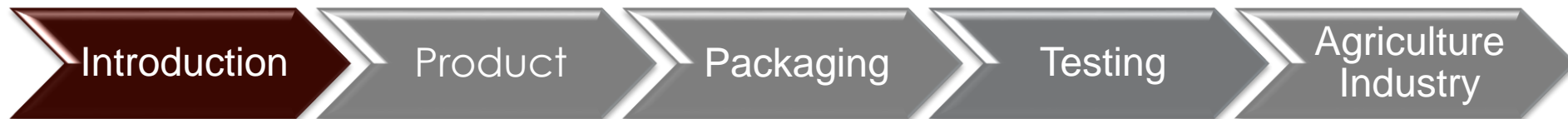


Fragile Product

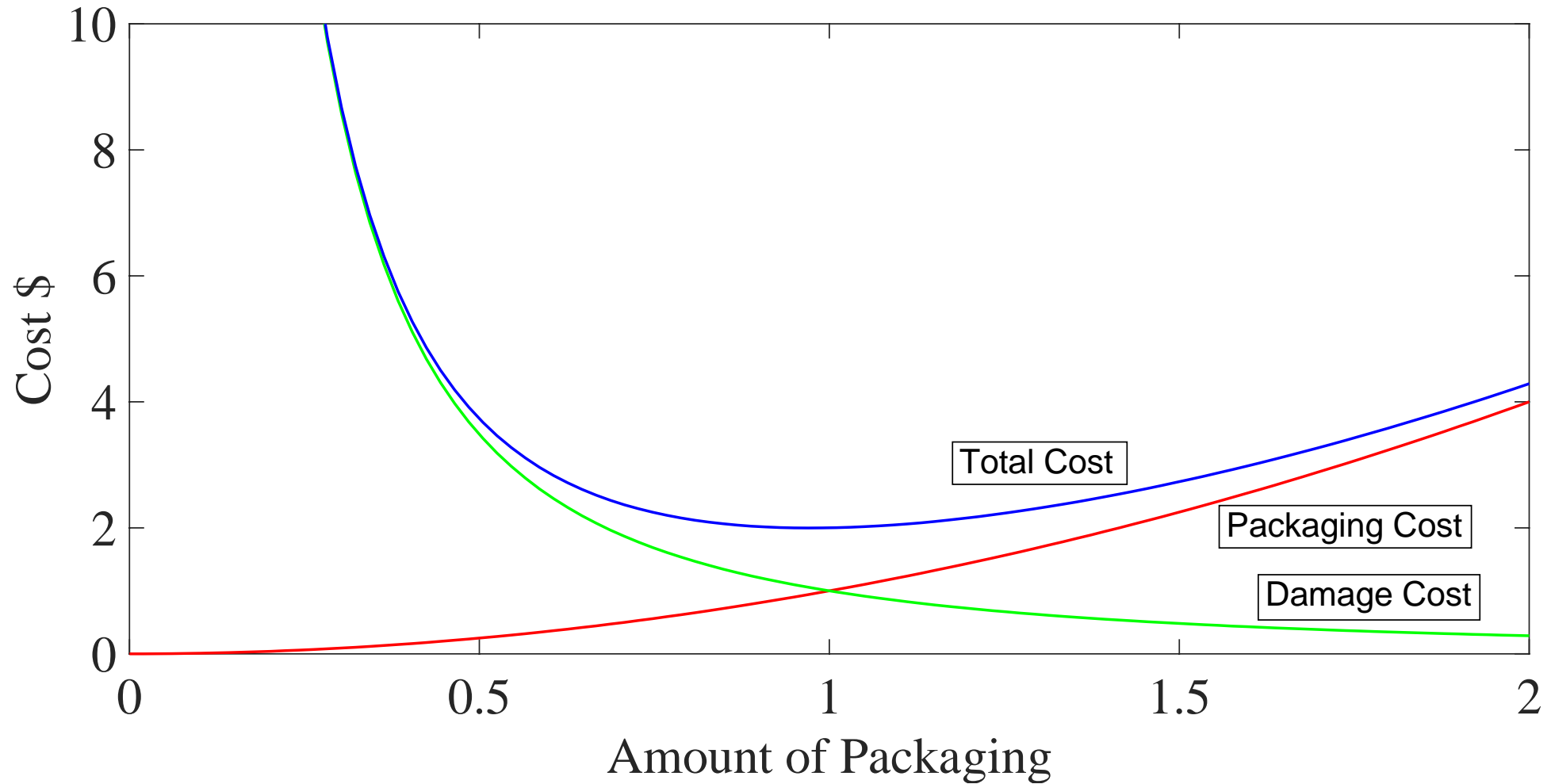
- What makes our product fragile?
 - Shock – What acceleration causes failure?
 - Vibration – What are the natural frequencies of components?
 - Compression – What force will it support?

Packaging Materials

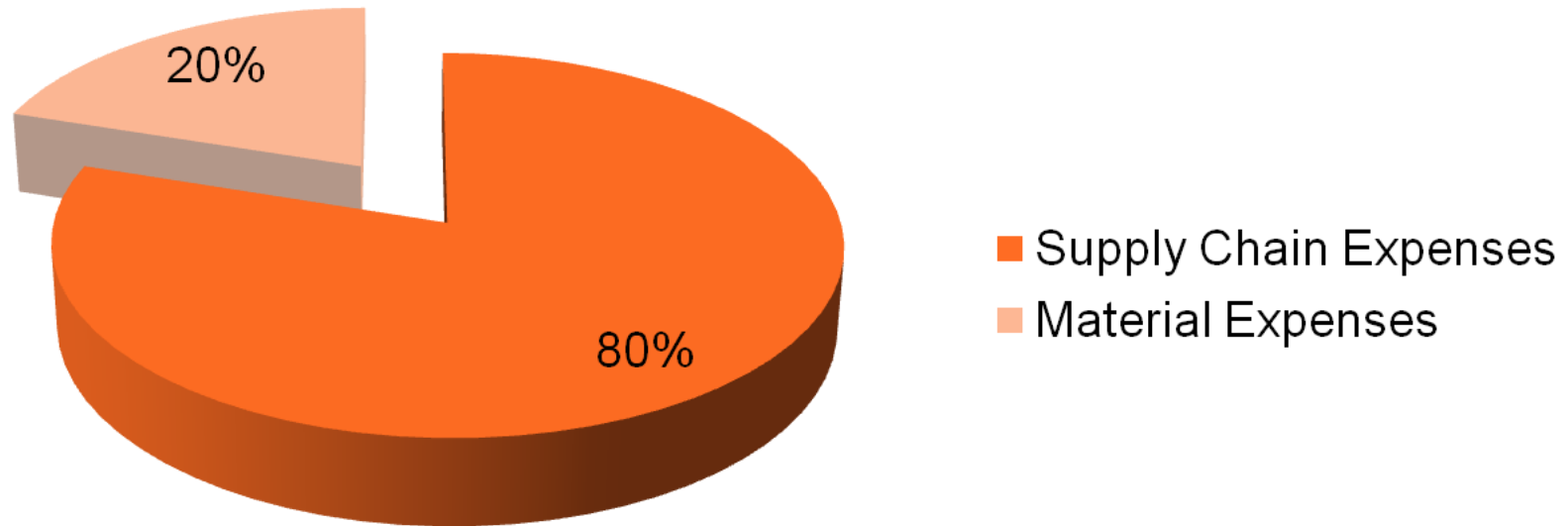
- Need to define the properties of the materials
- How do the materials respond to:
 - Shock
 - Vibration
 - Compression
 - Temperature / Humidity



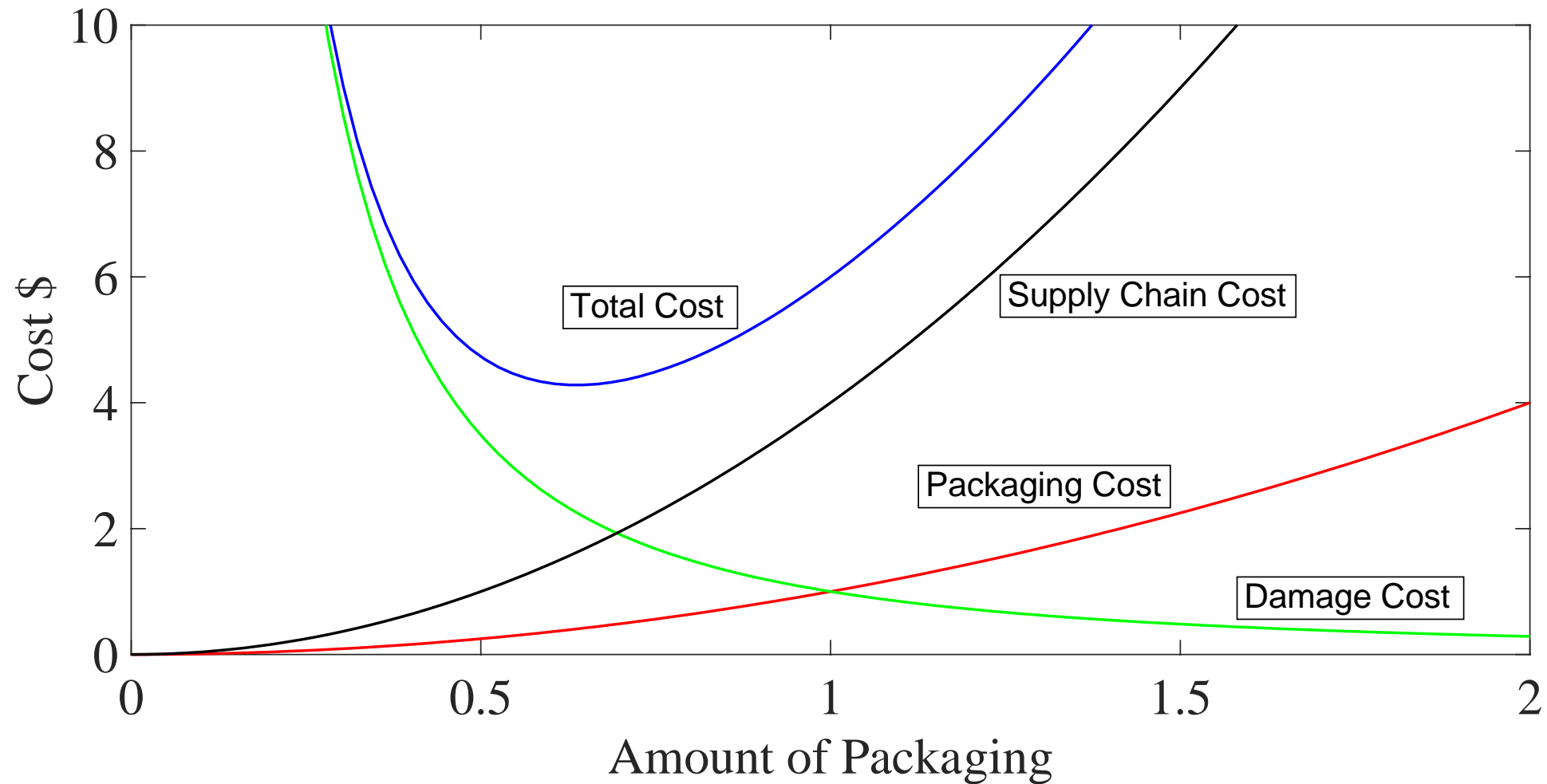
Optimum Protective Package



Point A to B Expenses



Optimum Protective Package with Supply Chain Cost



Define Distribution Environment

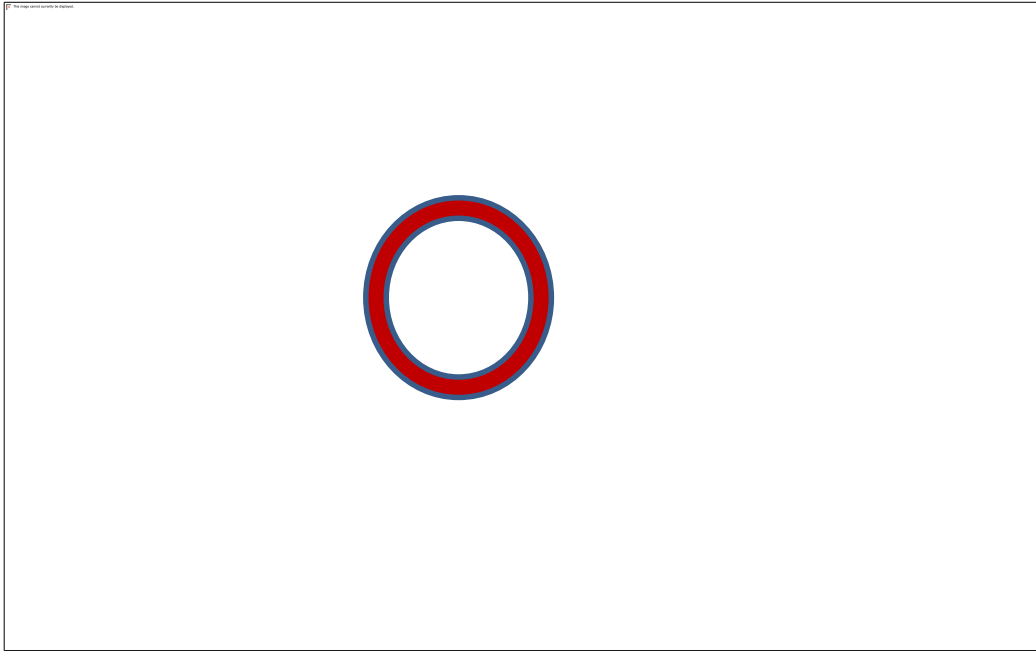


Distribution Environment

- Sources of information
 - Test specification organizations
 - ISTA, ASTM, ISO, MIL, DOT
 - Technical papers
 - Example: “An Assessment of the Common Carrier Shipping Environment” Forest Products Laboratory, FPL22
 - University or government institute research
 - Collect your own data



Distribution Environment Measurement

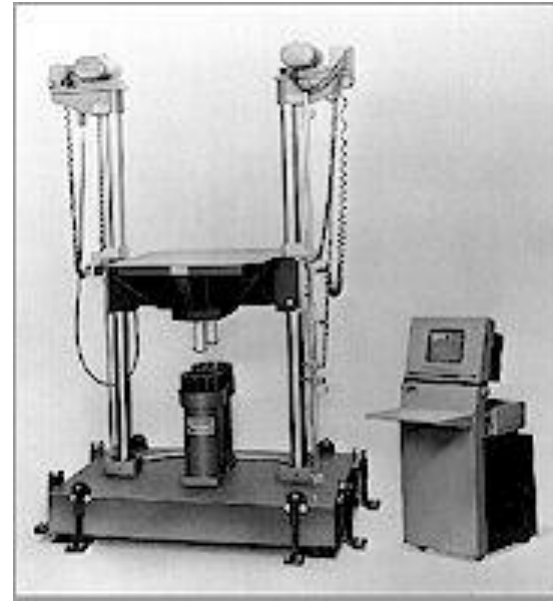


Determine Product Fragility



Product Fragility Mechanical Shocks

- Shock Machine
 - Use ASTM procedure D3332
 - Determine in 6 orientations:
 - Critical velocity change
 - Critical acceleration level



Introduction

Product

Packaging

Testing

Agriculture
Industry

Product Vibration Fragility

- ASTM standards
 - 0.5 g Sweep 3 – 100 Hz
- Resonance frequencies (Hz) of critical components in all three axis



Introduction

Product

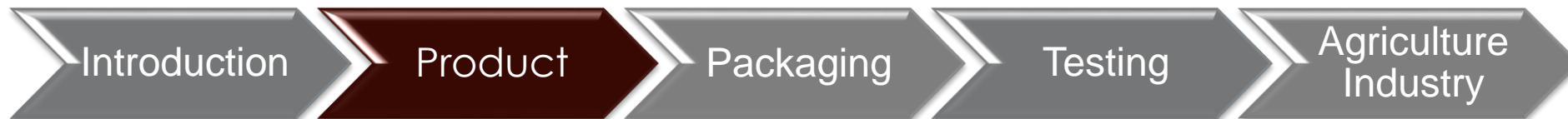
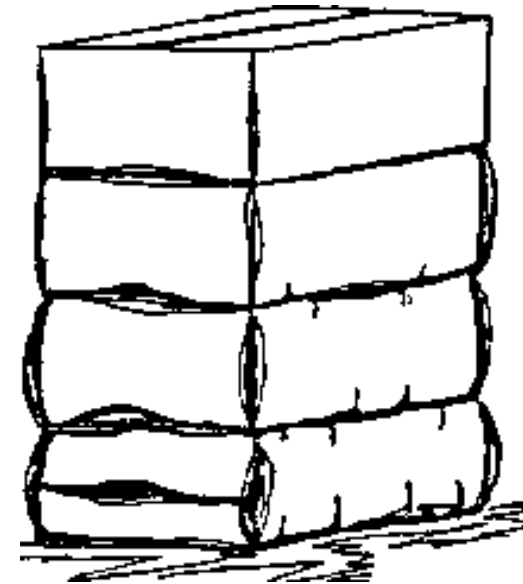
Packaging

Testing

Agriculture
Industry

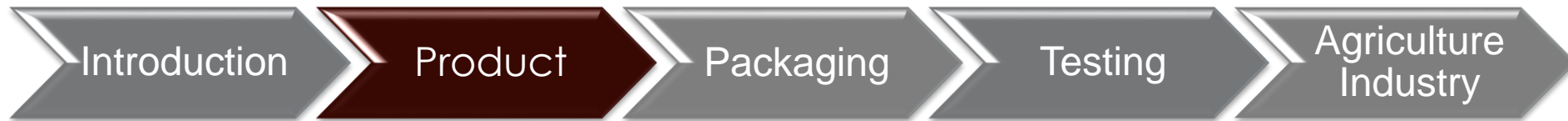
Product Fragility - Compression

- What force will cause product damage
 - *Package supports all* – Fruit, light bulbs
 - *Product supports all* – Bath tub, refrigerator
 - *Load sharing* – TV, computer



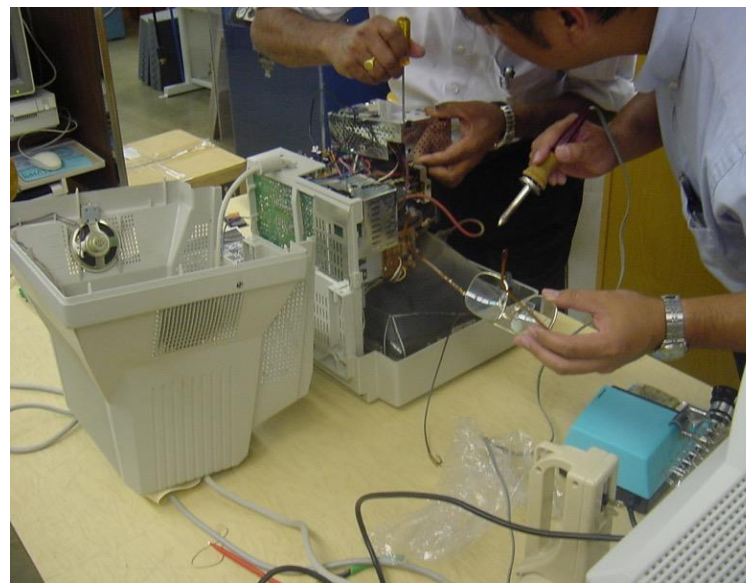
Product Fragility – Other

- Abrasion
- Corrosion
- UV
- Electro-static discharge
- Enclosed vessel expansion – low pressure
- Insect infestation
- Respiration rate



Product Improvement

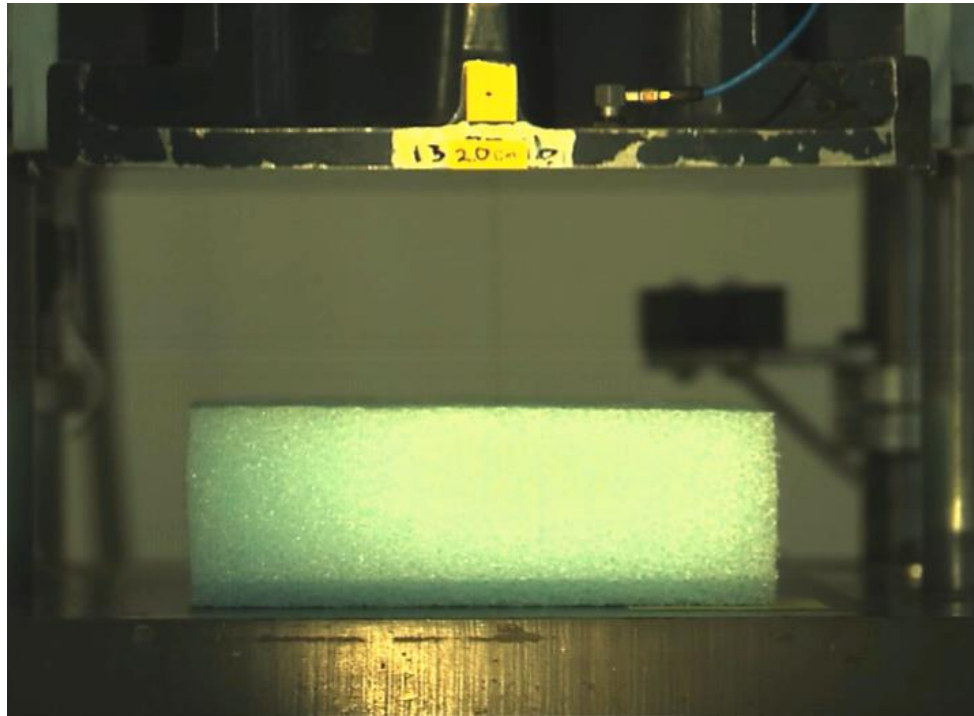
- After product fragility testing completed
- Suggest product ruggedness improvements
- Possible reduction in packaging requirements
- Requires concurrent package/product development



Packaging Material Properties



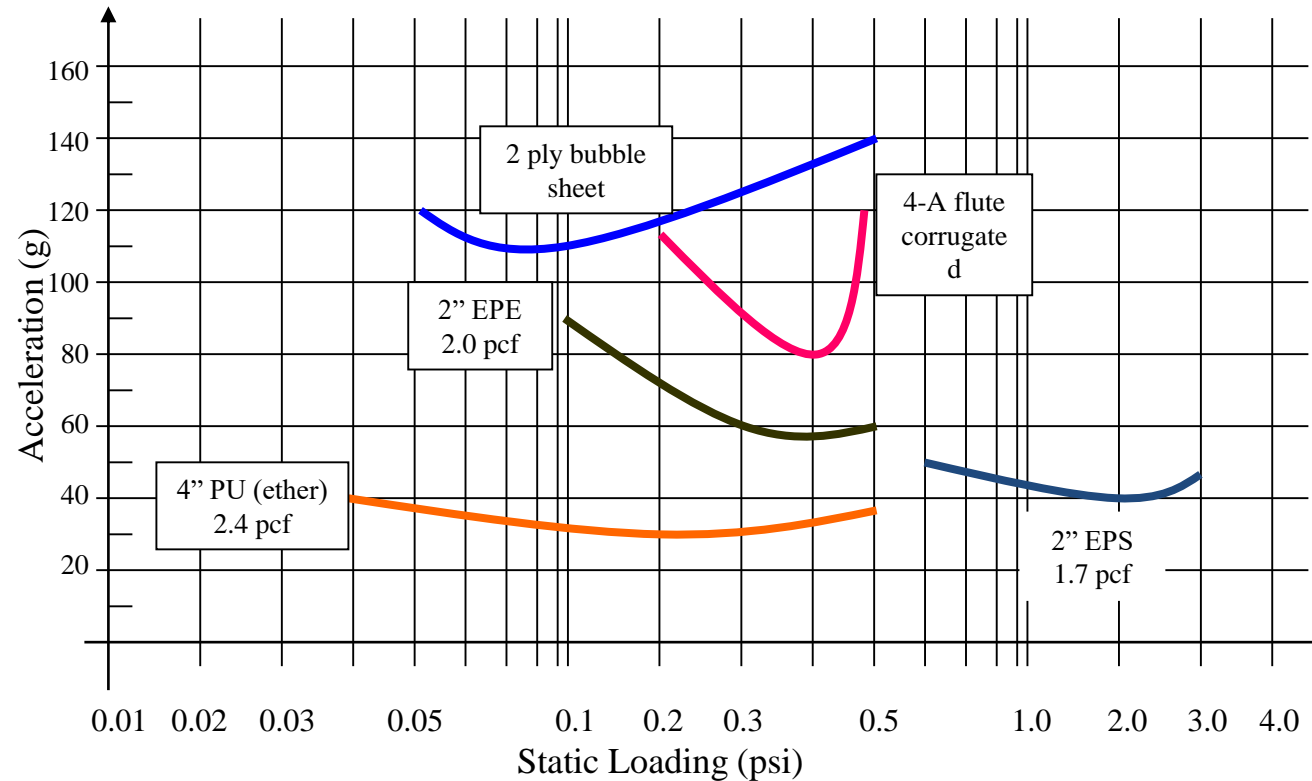
Cushion Testing



Shock Properties- Cushion Curves

30" drops, 70°F

Reference: Hanlon



Introduction

Product

Packaging

Testing

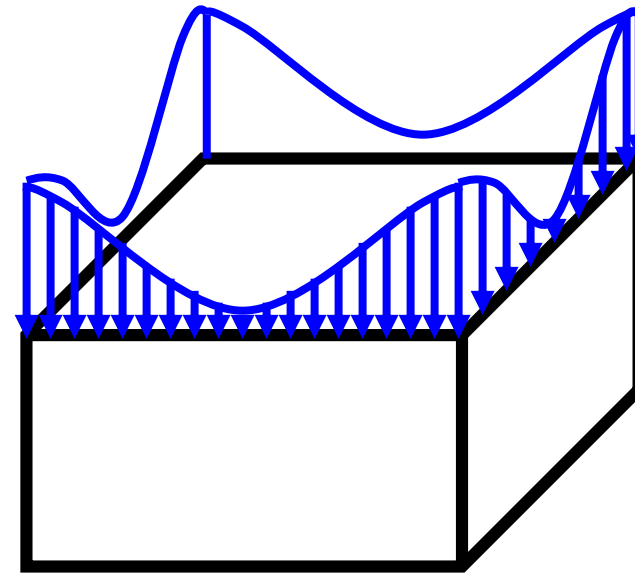
Agriculture
Industry

Box Strength – Material vs. Performance Spec.

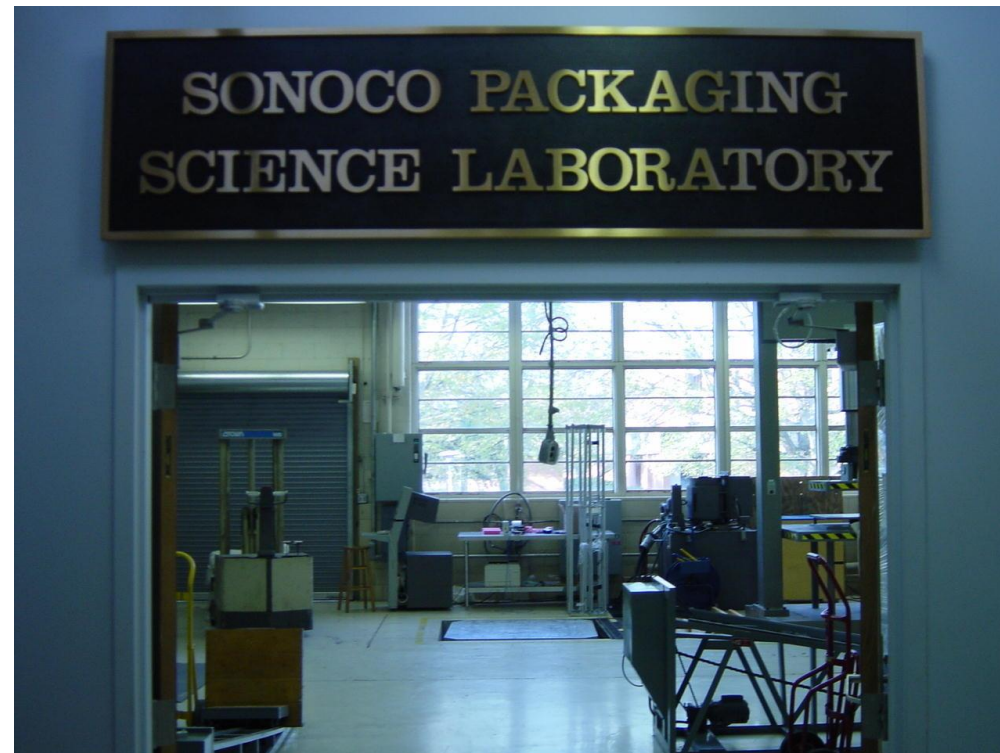
Material Specification

Mullen Burst Strength
Edge Crush Strength
Basis Weight
Coefficient of Friction
Adhesion Strength
Caliper

Performance Specification

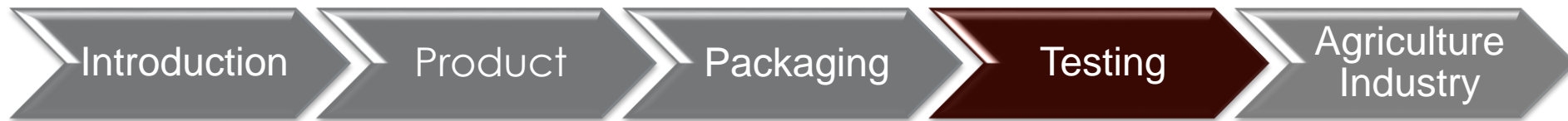


Laboratory Testing



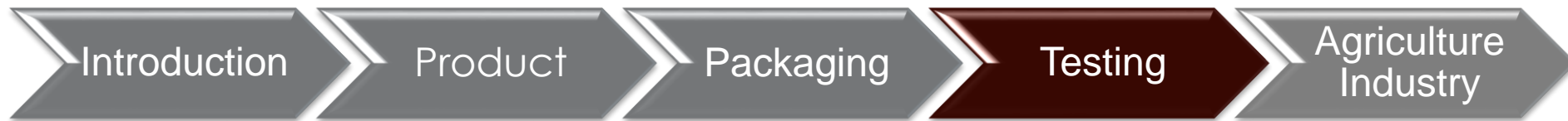
Justification

- Controlled environment
- Repeatable tests
- Watch product pass/fail
- Accelerated testing
- Immediate feedback



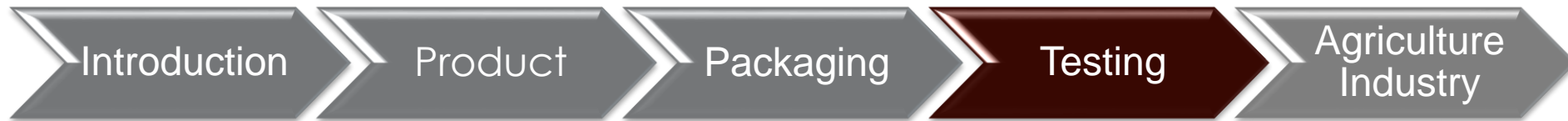
Performance Testing

- Laboratory testing
 - Integrity testing
 - Compare relative performance of package sample A to sample B
 - General simulation
 - Simulate general damage potential of a distribution cycle
 - Focused simulation
 - Simulate damage potential of specific system using field-measured hazards



Performance Testing

- Test specification organizations
 - International Safe Transit Association, *ISTA*
 - *ASTM International*
 - International Organization for Standardization, *ISO*
 - Military, *MIL*
 - Department of Transportation, *DOT*
 - National Motor Freight Traffic Association, *NMFTA*



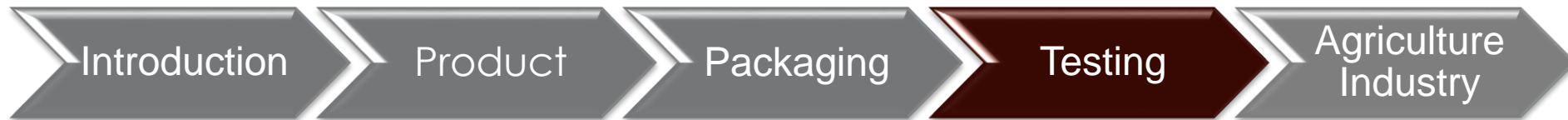
Performance Testing

- ISTA – www.ista.org
 - Publish simulation standards only
 - Reference ASTM procedures for test setup
 - Consensus standard writing body
- Certified Packaging
 - Required:
 - Shipper/manufacture must be members of ISTA
 - Test procedure must be a complete ISTA procedure
 - Lab must be certified by ISTA



Performance Testing

- ASTM – www.astm.org
 - Publish standards that specify test and machine setups
 - Publish two complete standards for simulation testing
 - ASTM D4169 and ASTM D7386



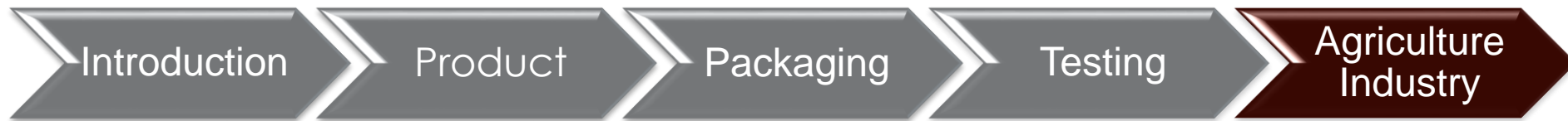
Typical Laboratory Testing



Research

Transportation, Handling, and Microbial Comparison of Molded Fiber and Expanded Polystyrene Apple Trays

- Clemson University M.S. Thesis
- Funded by tray manufacturer



Research

Funded by the United States
Department of Agriculture

- Evaluated packaged mangos from Mexico and Guatemala
- Proposed corrugated box design to reduce damage



New Standardized Package System for Imported Fresh Mangos to the United States from Mexico and Guatemala



Koushik Saha
Paul Singh
Vanee Chonhenchob
Jay Singh

iapri 19th IAPRI World Conference on Packaging
15-18 June, 2014

Thank you

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