Changing Our Work…

The Value of PLM/SLM
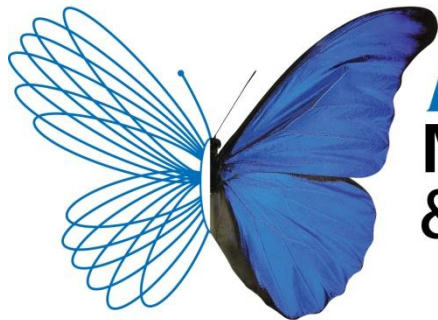
Introduction

Laura Michalske
The Procter & Gamble Company
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Current Responsibilities:
- Oral Care, Global Health, Snacks, and Pet Care Modeling & Simulation (M&S)
- Engineering Section Head
- Manage the full range of M&S approaches as it applies to R&D, Engineering & Manufacturing,
- Engineering PDM/PLM
- M&S SLM Sponsor
- Chair for the NAFEMS Simulation Data Management Working Group

P&G
Modeling & Simulation

The power to transform.

Investors Know P&G By…

- ## Sales: $79 Billion FY June 30th, 2010

- ## Net Earnings: $12.6 Billion

William Procter

- **The Worlds Largest Consumer Goods Company**
  - Market Cap ~ 173.56 billion COB 3/30/2011.
  - 61% of global households have at least 1 P&G product
  - 4.2 billion times a day, P&G brands touch the lives of people around the world

- **P&G Builds Lasting Shareholder Value**
  - P&G has paid Dividends (without interruption) since 1890
  - 54 consecutive years of *increasing* dividend payments.
  - Last 54 years, compound annual dividend growth = 9.5%
  - One of the 10 most valuable companies in the U.S.
  - Invest over $2 Billion/yr in R&D

James Gamble

P&G Modeling & Simulation

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Consumers Know Us By…

Innovation…
One of Our Core Strengths

- **Consumer Understanding**
- **Brand Building**
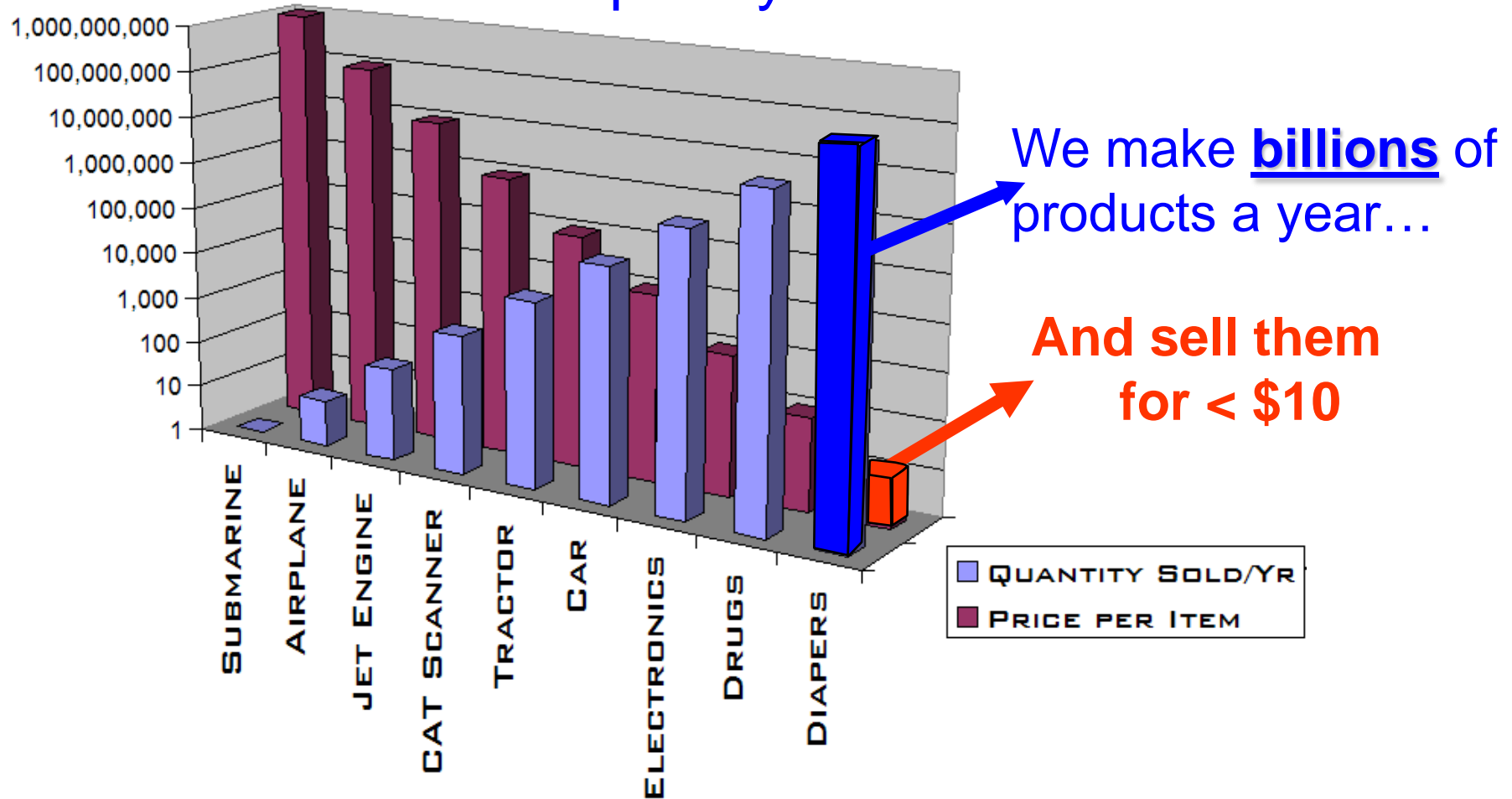- **Global Scale**
- **Innovation**
- **Go-to-Market Capability**

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Innovation Challenges
Complexity

We make **billions** of products a year…

And sell them for < $10

We ship more "Boxes" than any manufacturing Company in the World!

Why Rocket Science?

The power to transform.
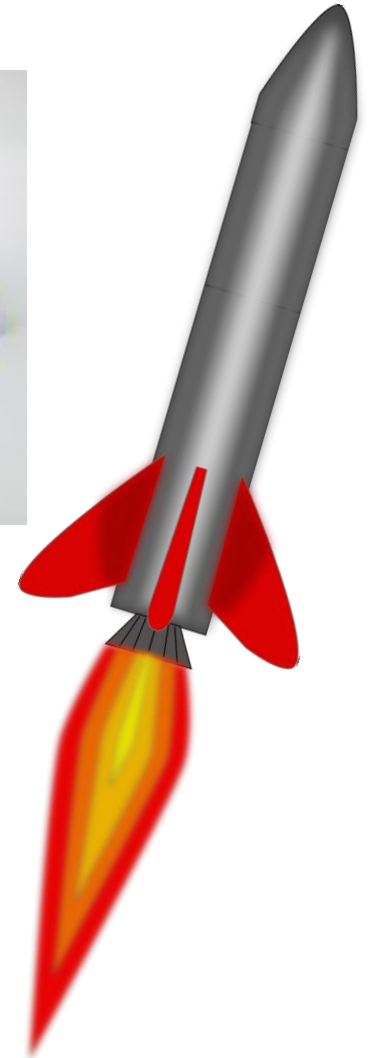
P&G's M&S Approach…

We build and test the *FIRST* prototypes…

'VIRTUAL' ones that…

Package Design Examples

Downy Bottle Design

Technology: ABAQUS, SGI Origin
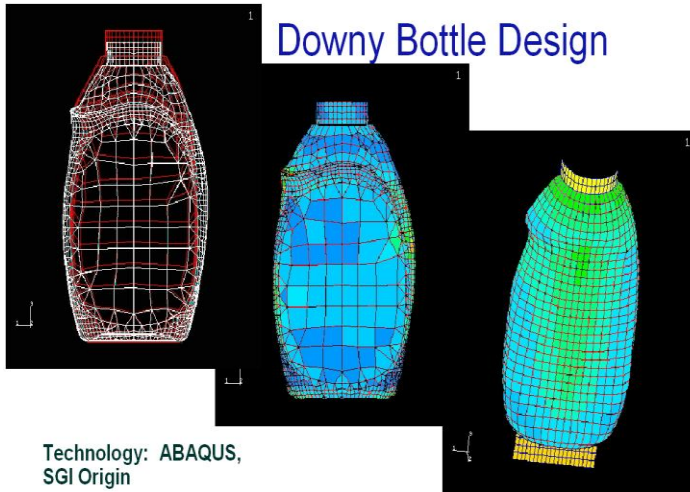
- **Fit**

- **Work**

- **Make Financial Sense**

…**BEFORE** they exist in the real world.

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…Atoms to the Enterprise
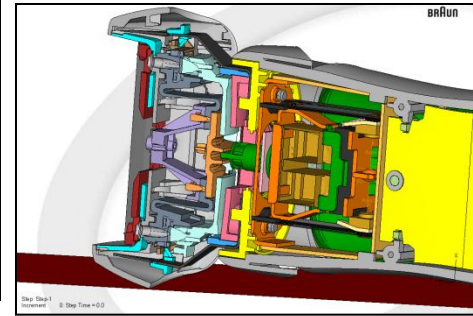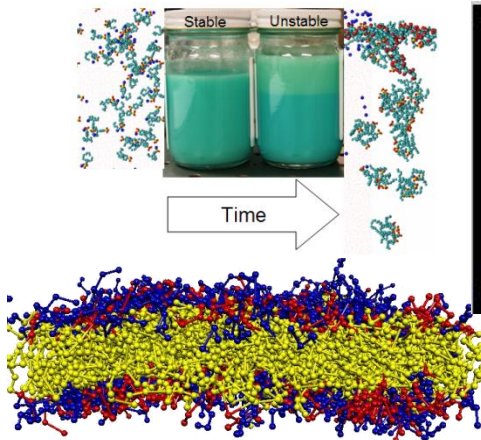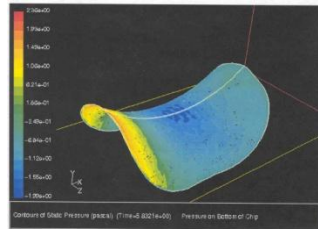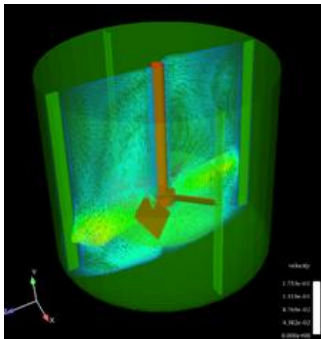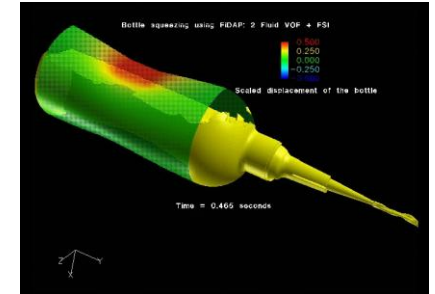
Product/ Device/ Package
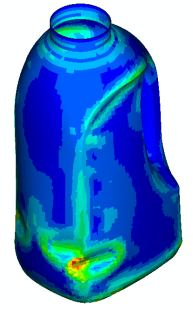
Process
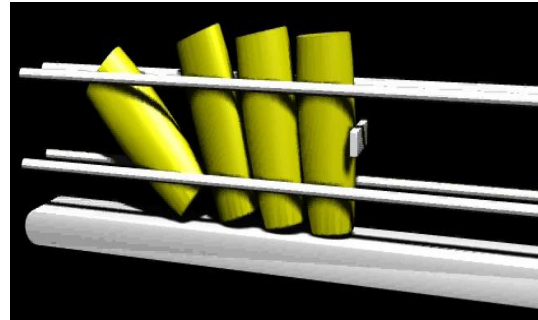
Mechanical & Converting
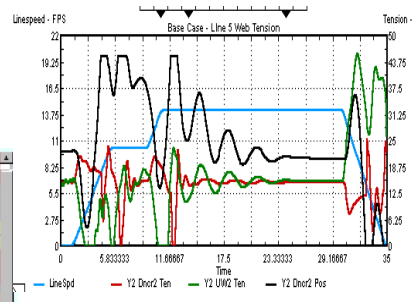
Supply Chain, Through- put, & Reliability
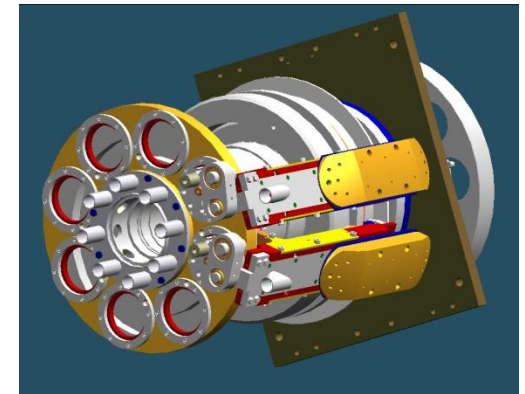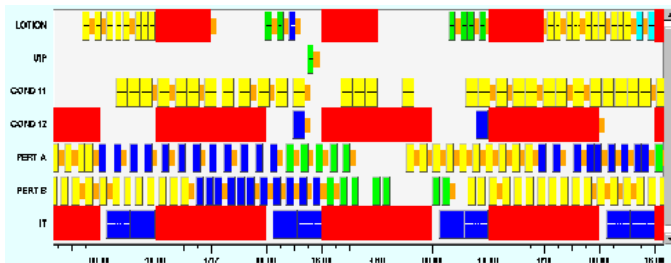
Make a Billion Diapers…

How long does it take to make a billion Pampers?

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Modeling
& Simulation

The power to transform.

Some Examples

The power to transform.

Splicing Webs…

FEA
Explicit
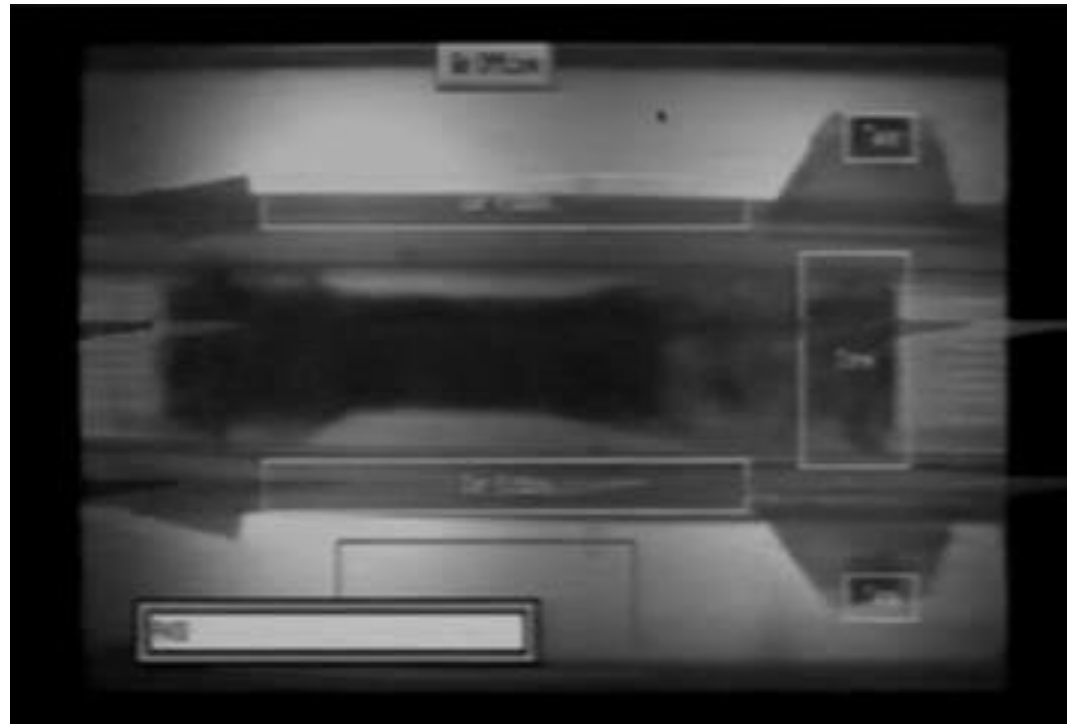
What Happens…
When you miss!

Registered Splicer Model
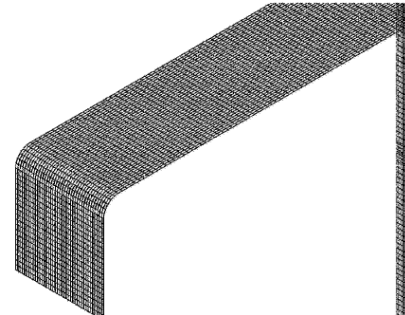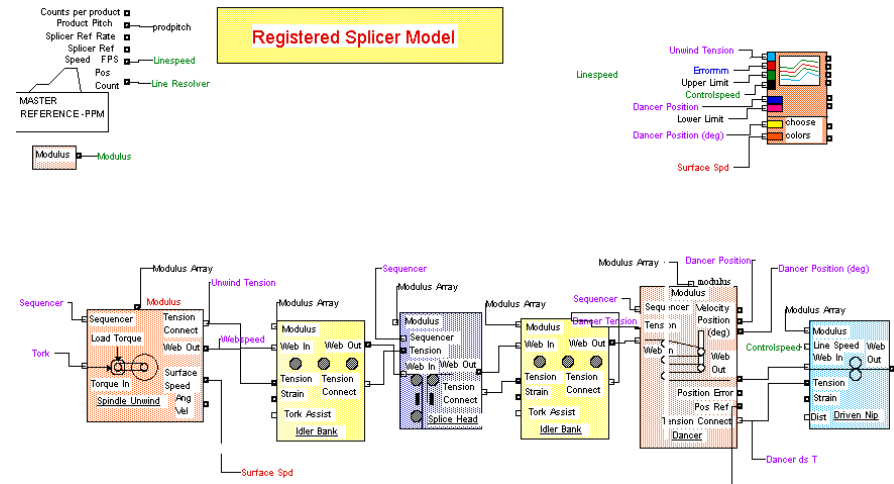
Control Dynamics

The power to transform.

Behind Every Great Package…
…Is more than meets the eye!

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Can We Pack It?

Bottle Race Track
'Circa 2000'
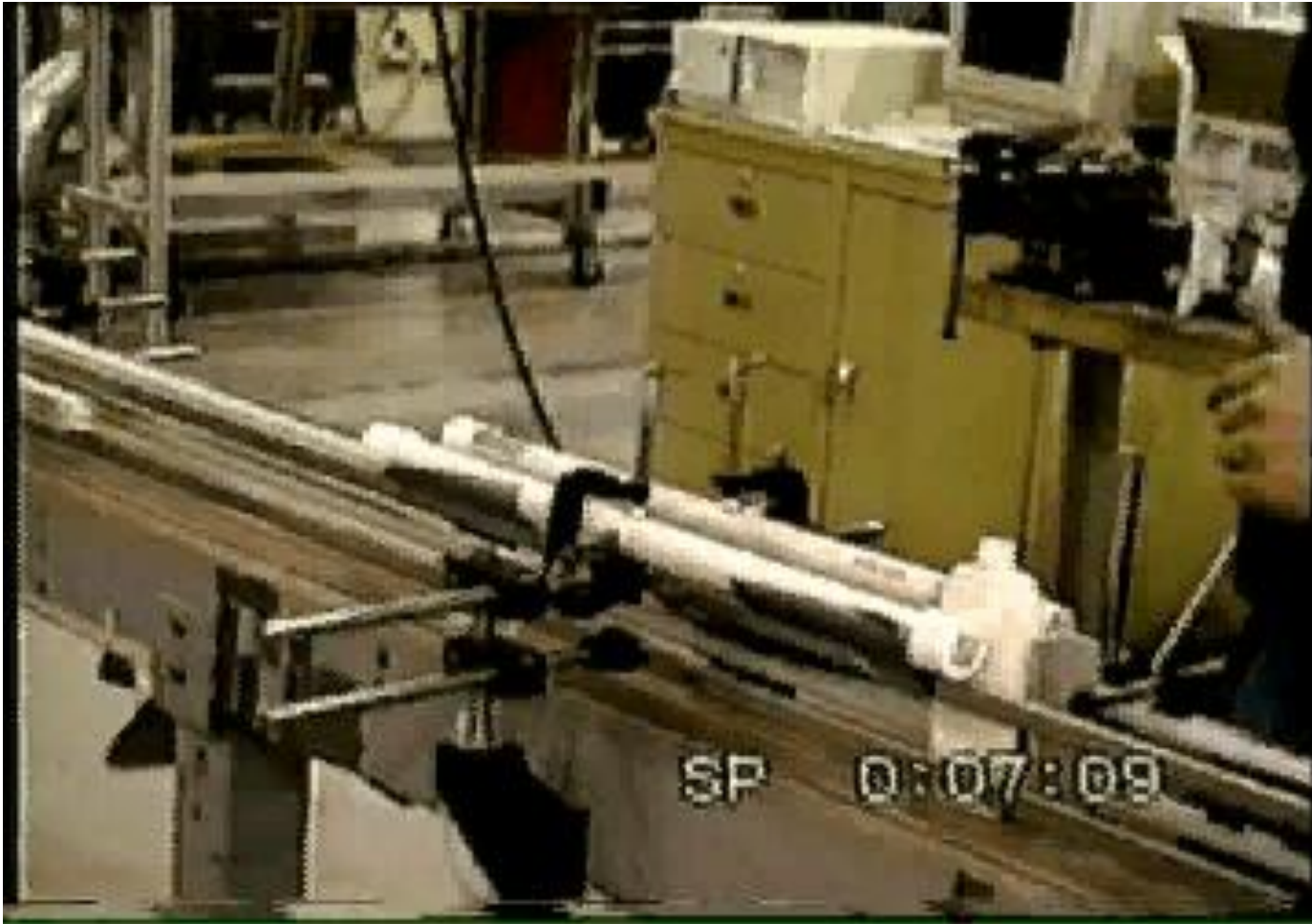
Virtual Race Track

LS-DYNA KEYWORD DECK BY LS-PRE
Time =   0
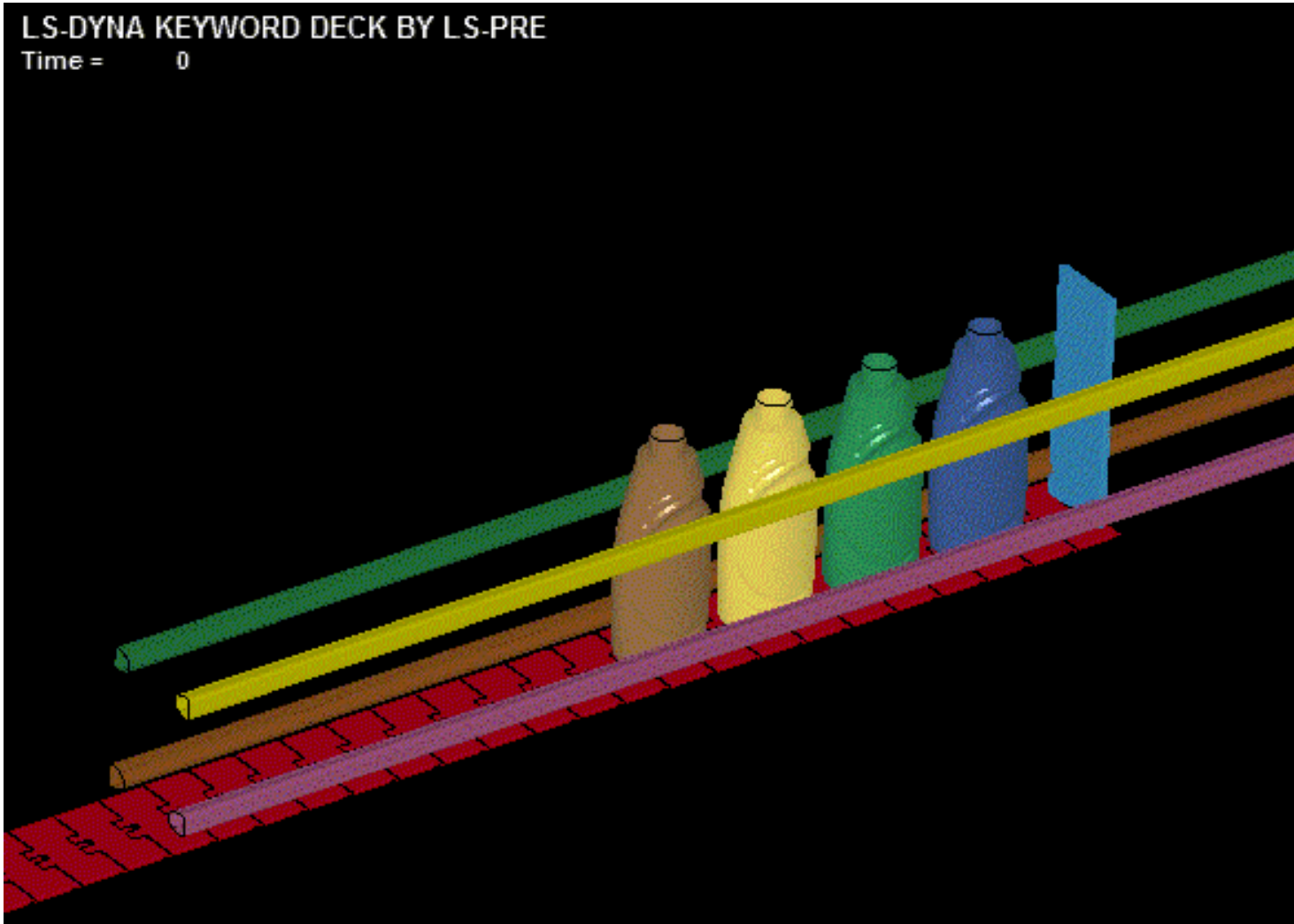
Can 'test' bottles you never want to make!

Explicit FEA

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Mixing Liquids:

Mixing Dense Viscous Fluids
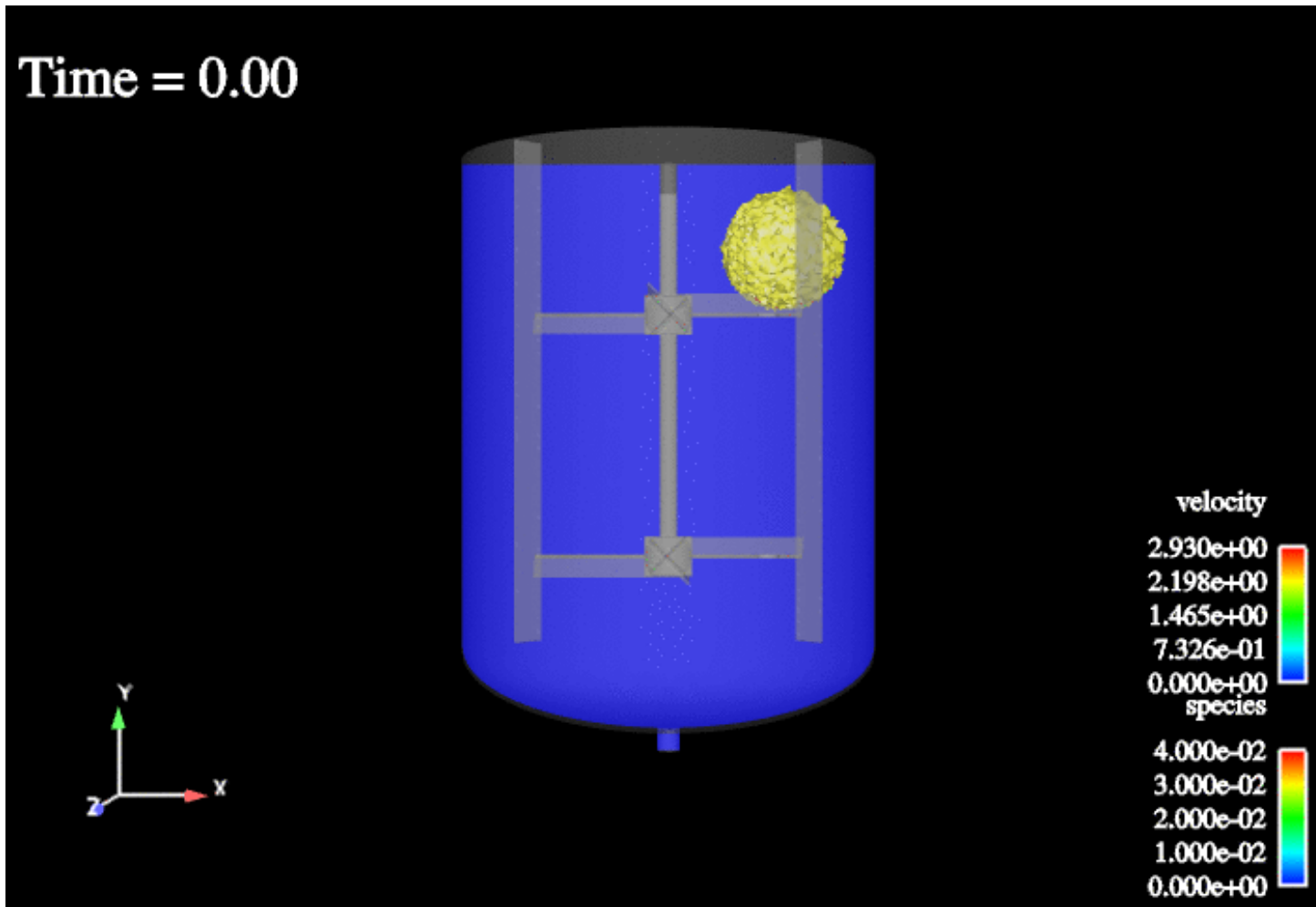
A test you never want to run in a plant!

Static Mixer

Time = 0.0000
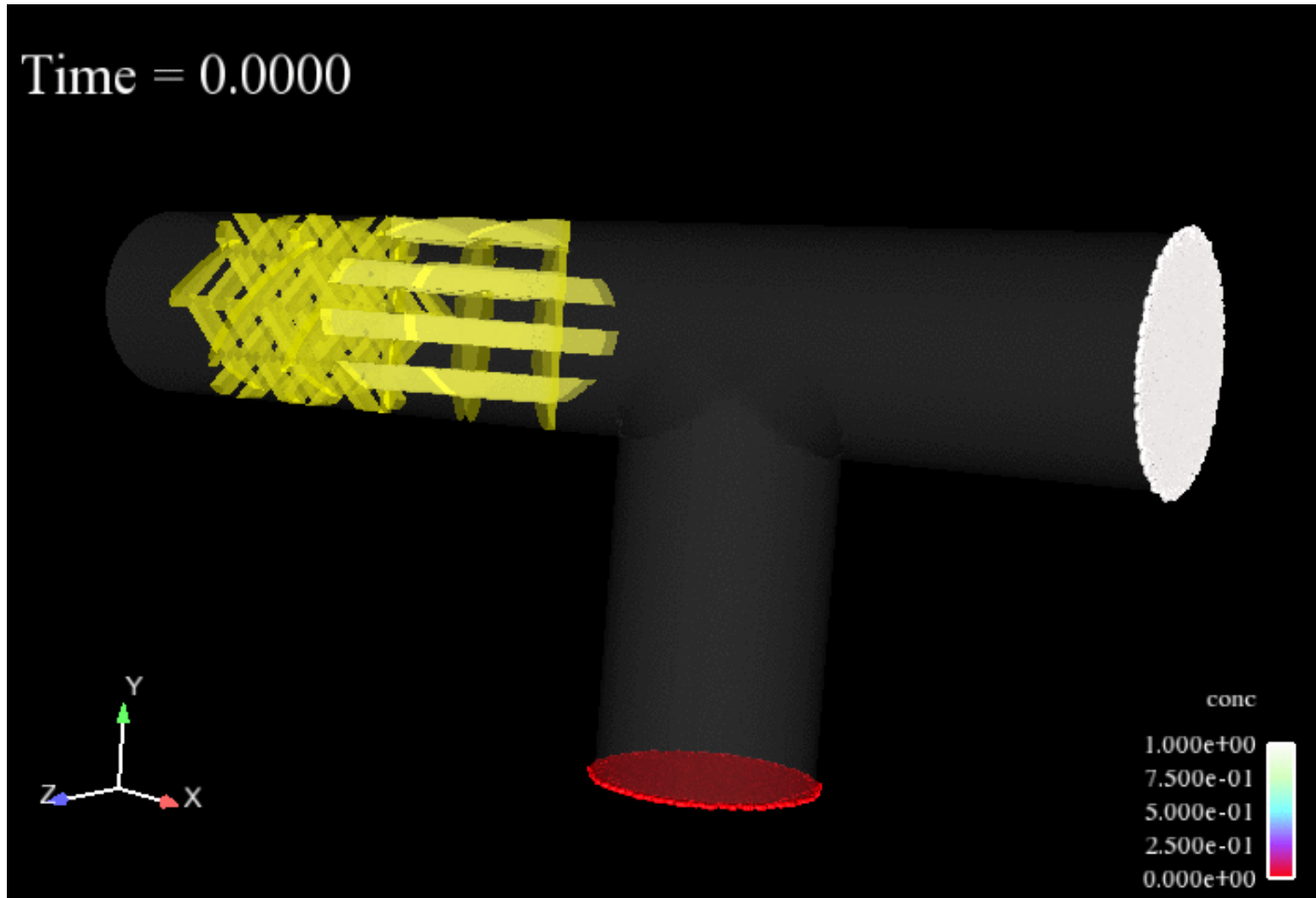
Make a 10⁹ Pringles?

FORTUNE

August 20, 2007

High-powered computing simulation of a Pringle potato chip.

WHY HPC MATTERS

How long does it
Take to make a
Billion Pringles?
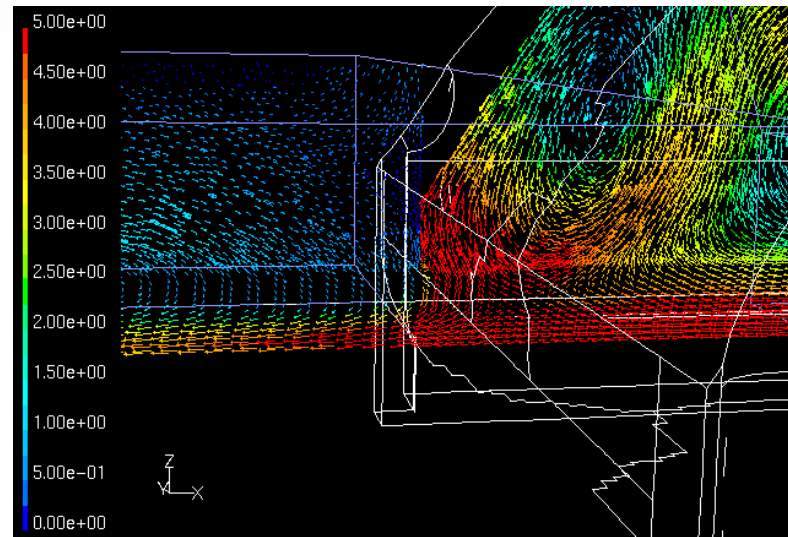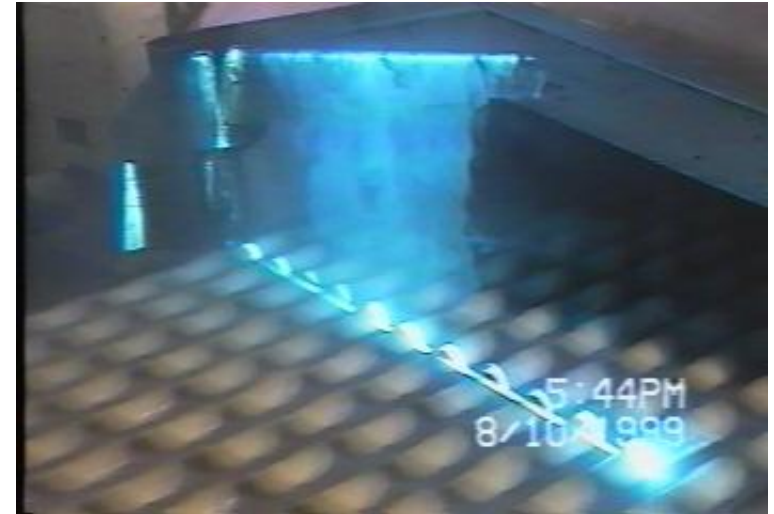
Velocity Vectors Colored By Velocity Magnitude (m/s) (Time=1.8410e+01)   Mar 16, 2000
FLUENT 5.3 (3d, segregated, rngke, unsteady)

Make a Billion Pringles…

…Aerodynamics are Relevant

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Modeling & Simulation
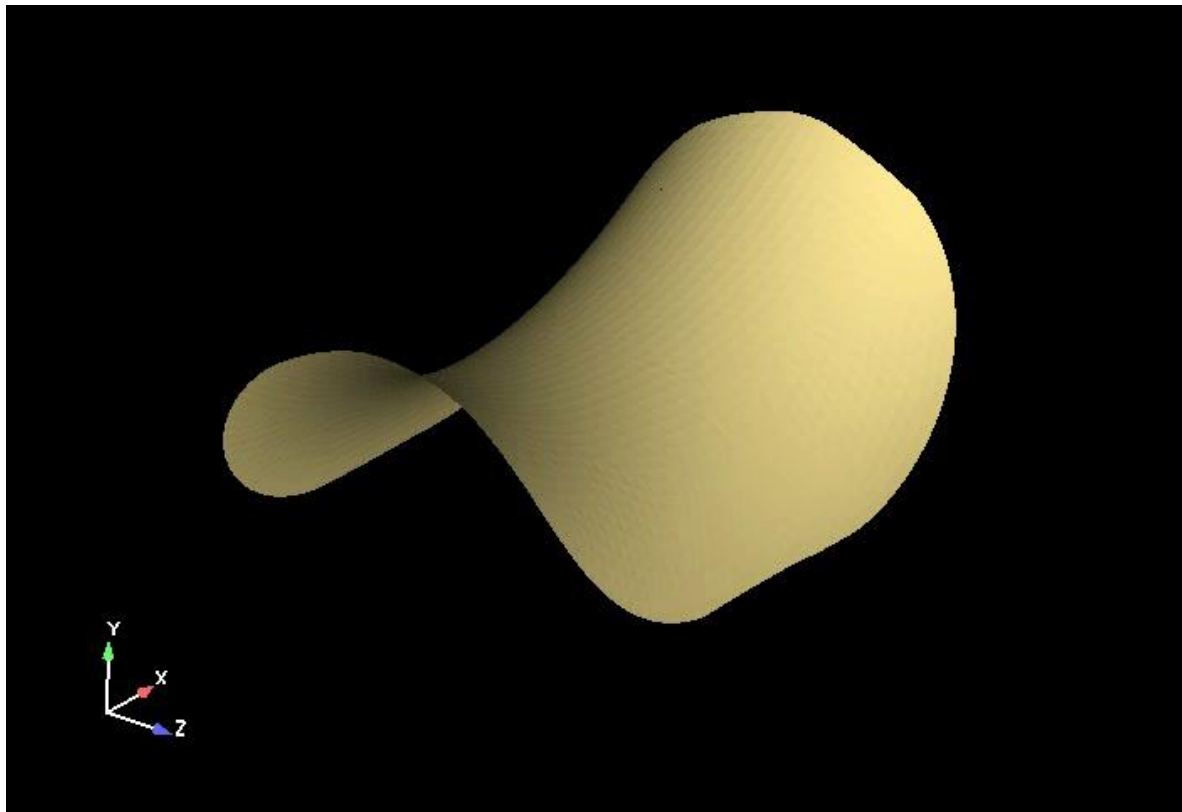
High Speed Film Removal
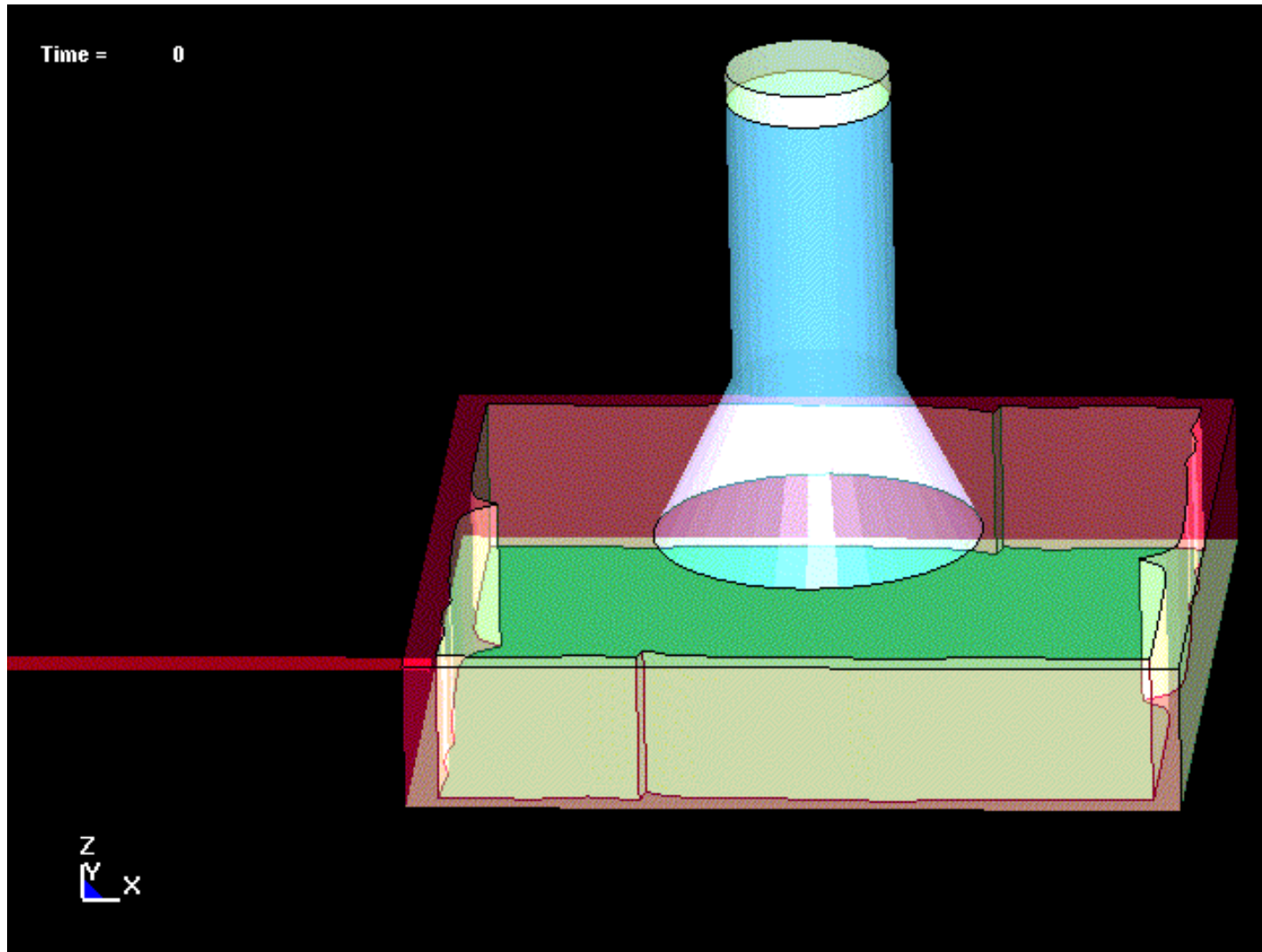
A hard to design process!

FSI: Fluid Structure Interaction

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So Why Is P&G Investing in PLM/SLM?

The power to transform.

Why Is PLM a Priority For Us?

- Platform for Driving Innovation Productivity
    - "Innovate how we innovate"

- Deliberate, Systematic Approach To Simplification
    - "Let's us fully leverage our scale"

- Platform to Embed Modeling & Visualization Into The Work
    - "Explore virtually – Confirm physically"

- PLM is Our Strategy To Digitally Transform Innovation & New Product Development

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Going Digital – Outcomes

We want to be a $100B Company that acts like a $10B one. We need to operate better inside & outside to become flatter, faster, simpler. Digitizing the company entirely from molecule to selling/shipping products is what will help us operate as a small company. We want to be demand-driven, operate real-time and be future-focused. We want to be the first company in the world to digitize our processes end to end."

– Bob McDonald
P&G CEO
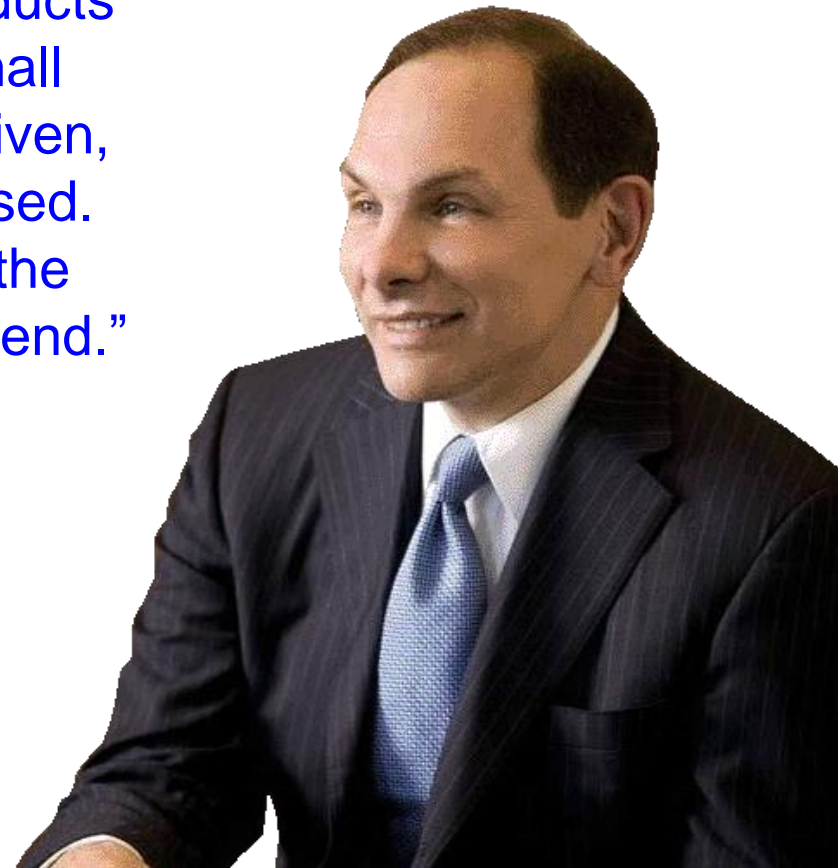
P&G PLM Journey

- Started in the late 1990's

- Created several very successful but non-integrated PLM based capabilities:
  - Specifications & Standards
  - Paper Products Manufacturing Equipment Design
  - Packaging Art & Label
  - Gillette Product & Manufacturing Process development systems

- PLM intervention in 2007: Why weren't we seeing the full transformational benefit of the "PLM Promise"?

- PLM Strategy Reinvented in 2008

- Next Generation PLM Implementation: 2009 → 2014

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P&G Work Processes
as enabled by PLM

Product Development

Consumer Need Identification · Claims Development · Materials Development · Formula & Assembly Development

Consumer Testing · Regulatory Clearance · Analytical & Performance Testing · Process Development

Common Capabilities
Modeling & Simulation
Initiative Management
IP Management
Knowledge

Transformation Analysis · Process Study · Site Selection · Equipment & Facility Design · HS&E · Cost & Reliability Engineering

Manufacturing Process Development

Maintenance · CQV · Construction · Procurement · Controls Engineering

Shape Sketch · Concept CAD · 3D Tech Design · M&S Mesh · Mold Design · Graphic Design

Package Development

Customization & Promo Packs · In-Store Materials · Pallet Design · Primary & Secondary Packs · Structured Artwork

supplies timely, accurate data for...

- Production
- Purchasing
- Master Data
- Quality Assurance
- Compliance Reporting
- Customer Reporting
- Legal Discovery

P&G

'Moore's Law'
Computing Hardware Performance

LANL 'Road Runner'

U.S. DOE 'Leadership' Class Machines

Petaflops

10^{15}

SNL 'Red Storm'

LLNL ASCI 'White'

LANL "Blue Mountain"

Teraflops

10^{12}

Gigaflops

10^9

Cray-1

CDC 7600

CDC 6600

Megaflops

10^6

IBM 7030

IBM 704

Maniac

Operations/sec

10^3

Seac

Kilaflops

P&G's 1st, 2nd, & 3rd Generations

accounting machines

10^0

1940 1950 1960 1970 1980 1990 2000 2010

Year

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Pursuing Realism …

– Solve 'Bigger' more complex Problems (Billion Elements, Billion Atoms/Molecules...etc.)

– Do parametric studies vs. point estimates (Stochastic)

– Reach more analysts ... Automate what it takes an expert to do today

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SLM *is* PLM for Modeling & Simulation

- Managing/guiding M&S workflows
  - "More analyses in less [people] time"

- Capturing data for reuse and traceability
  - "Reapply, don't reinvent"

- Embed M&S in to core work processes
  - "More scientists/engineers exploring virtually"

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SLM Benefits to P&G

Physical Product Design / Product Design via Modeling & Simulation

Easily Reproduce Analyses

Connect Business Decisions

Extend Reach of M&S

M&S Analyst Productivity

P&G Modeling & Simulation

The power to transform.
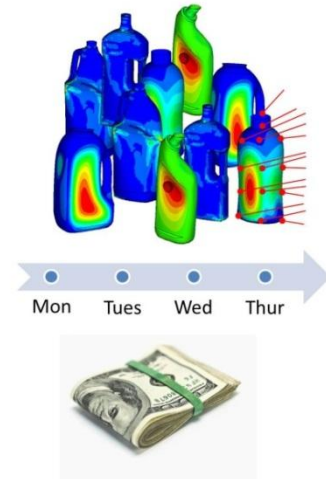
Our Approach

1 Replace existing M&S automation frameworks

"Pay the bills" and deliver analyst benefits

2 PLM integrations

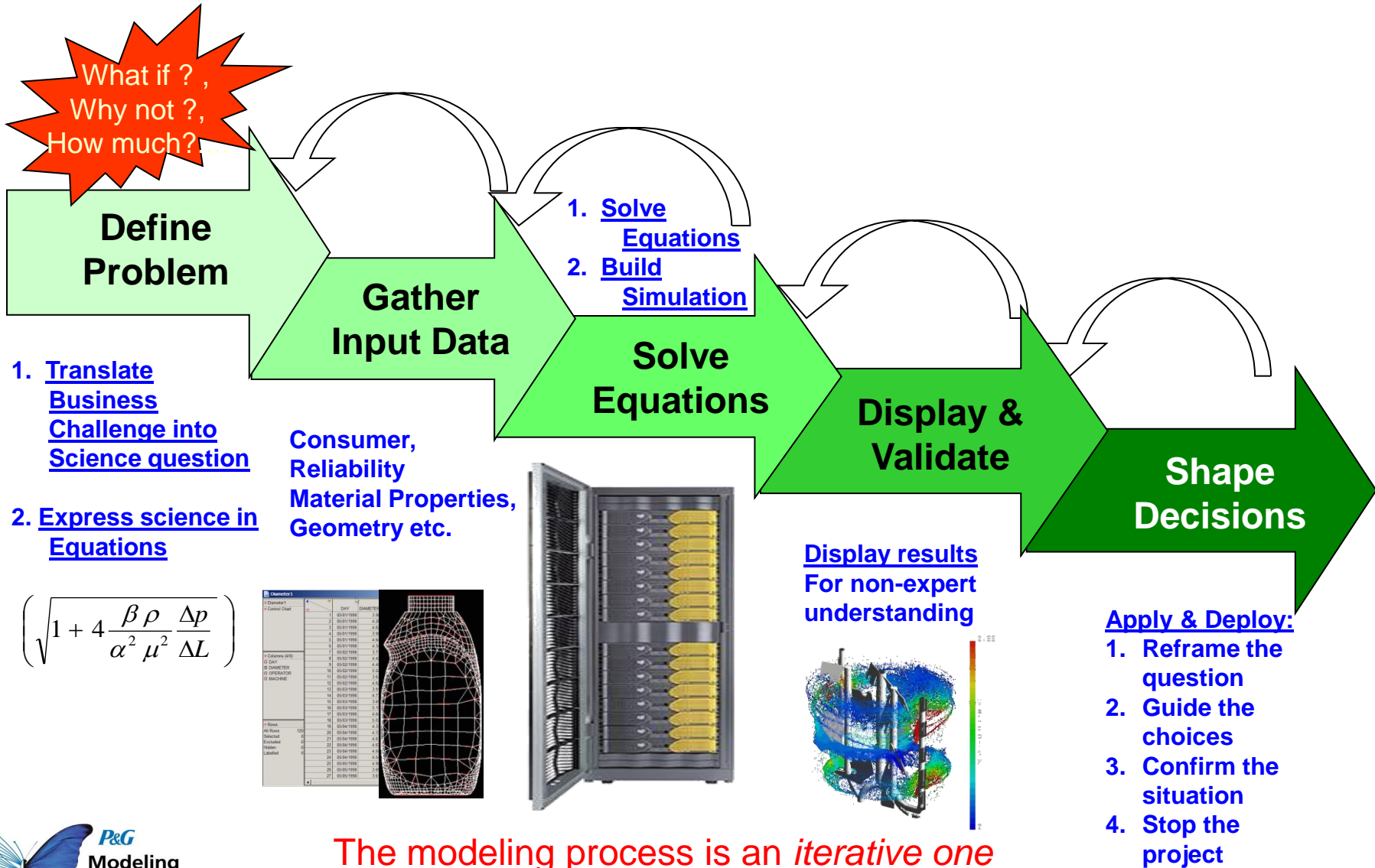Decision traceability and practitioner expansion

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M&S Work Process

What if ?,
Why not ?,
How much?

Define Problem

Gather Input Data

1. **Solve Equations**
2. **Build Simulation**

Solve Equations

Display & Validate

Shape Decisions

1. **Translate Business Challenge into Science question**

2. **Express science in Equations**

$$\left(\sqrt{1 + 4\frac{\beta\,\rho}{\alpha^2\,\mu^2}\frac{\Delta p}{\Delta L}} \right)$$

Consumer, Reliability Material Properties, Geometry etc.

Display results For non-expert understanding

Apply & Deploy:
1. **Reframe the question**
2. **Guide the choices**
3. **Confirm the situation**
4. **Stop the project**

P&G Modeling & Simulation

The modeling process is an *iterative one*

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Key "Learnings"

Challenges:

- Analyst productivity alone is likely insufficient to justify large SLM/SDM investment

- SLM/SDM GUIs aren't initially intuitive for most analysts

Opportunities:

- SLM/SDM is "worth it" provided you have a holistic understanding of "why?"

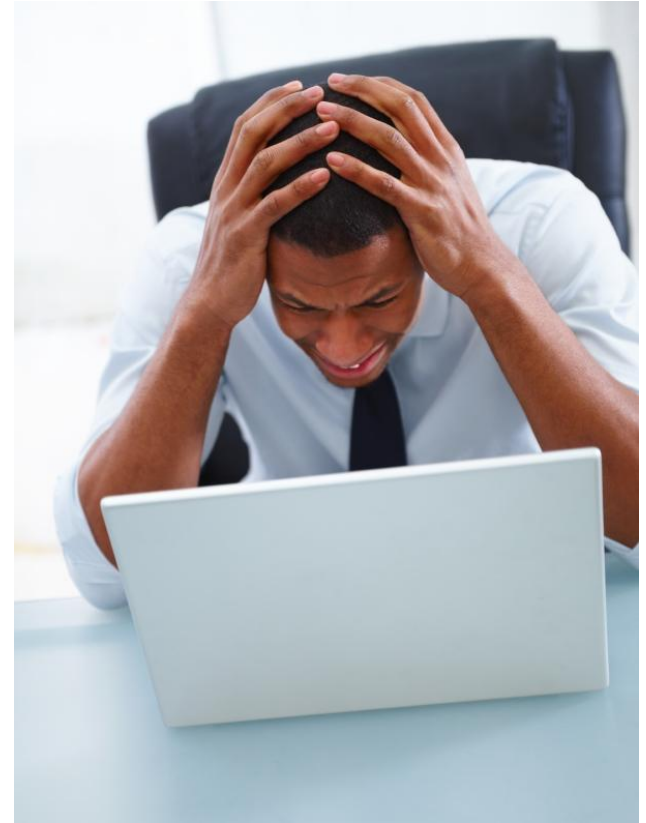- Patience and perseverance are essential to success

P&G

Finally Where To Learn More About How to Change Your Work…

- **SDMWG Sessions**
  - SDMWG Intro
  - SDM 101
  - Survey Report
  - SDM Frankfurt
  - Summary/White Paper Update
  - Vendor Forum (Panel)
- Thursday May 26th
- Session 9F (10:55) & 10F (13:15)

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Close & Questions

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& Simulation**

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