

# Lean Thinking Applied

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QUARRY  
ACADEMY

Improving Processes. Instilling Expertise.

DYNO  
Dyno Nobel





# Southwest Research Institute

- ◆ Over 3,200 employees
- ◆ Revenue in 2011 exceeded \$581 million
- ◆ Over 4,300 projects conducted in 2011

*Benefiting government, industry and the public through innovative science and technology*

# 11 Technical Divisions

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## **SwRI**<sup>®</sup> *TECHNICAL* Divisions

Aerospace Electronics & Information Technology

Applied Physics

Automation & Data Systems

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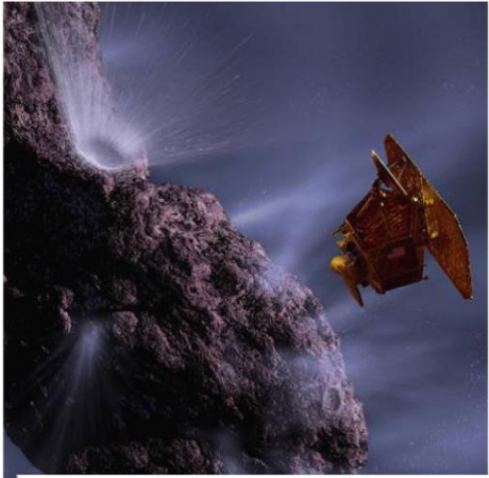
Signal Exploitation & Geolocation

Space Science & Engineering

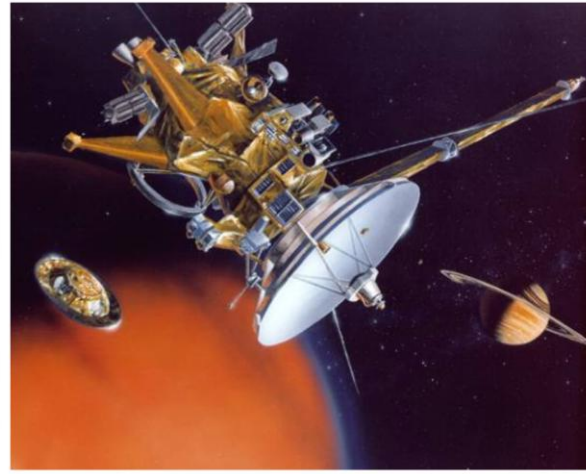
Training, Simulation & Performance Improvement

# Space Missions

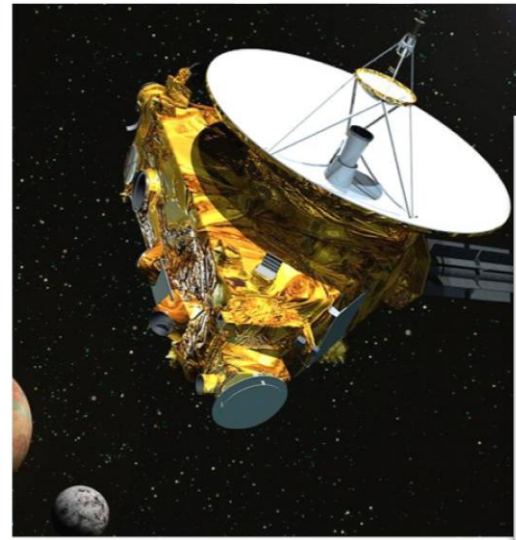
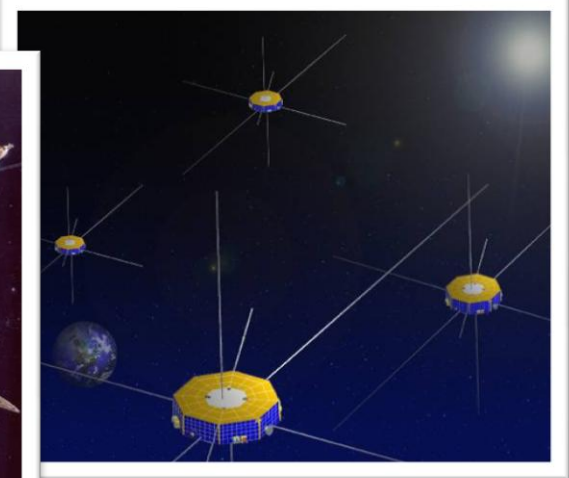
Deep Impact



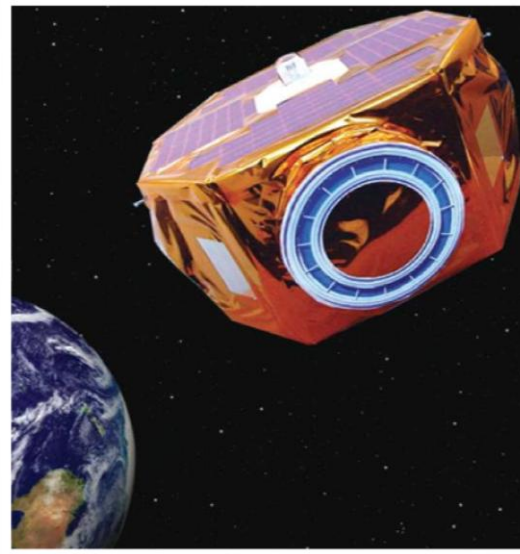
Cassini-Huygens



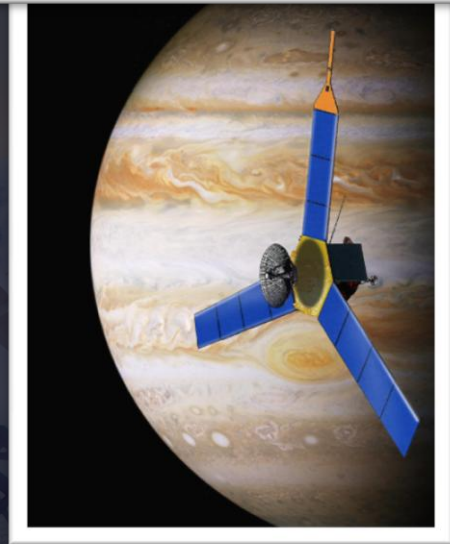
Magnetospheric  
Multiscale (MMS)



New Horizons



Interstellar Boundary  
Explorer (IBEX)

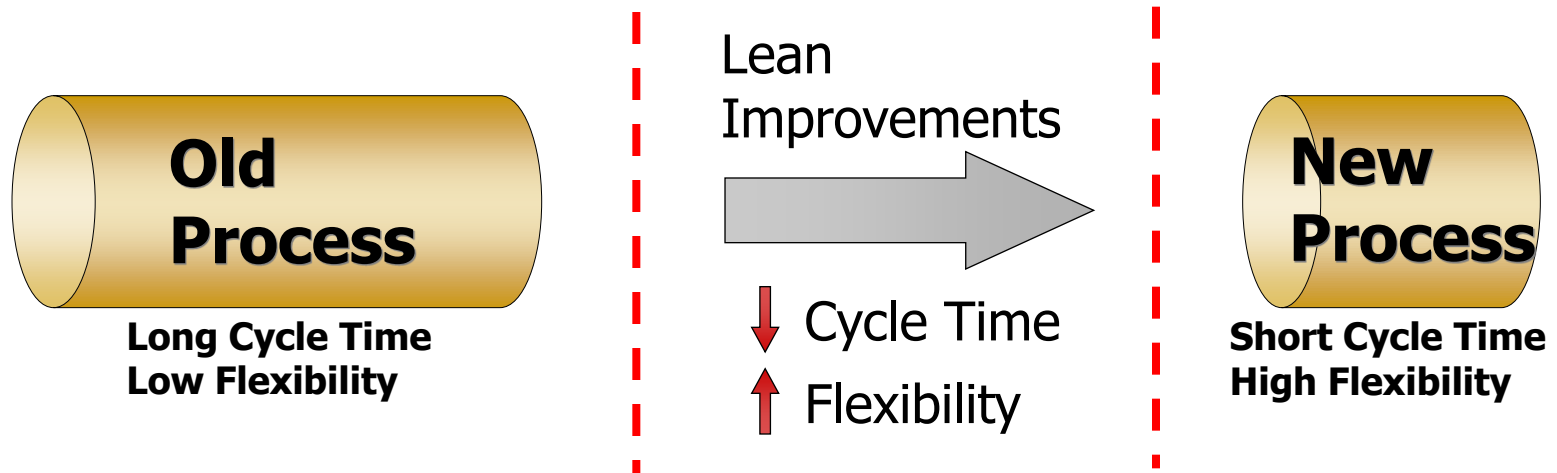


Juno

# Course Agenda

- **Lean Process Improvement**
  - ✓ Why Lean
  - ✓ What is Not Lean / What is Lean
  - ✓ What is Value
- **Measuring the Process**
- **Applying to Quarrying – A Rock Factory**
- **Paradigm Shift**
- **Conclusions / Take-Aways**
- **Questions and Answers**

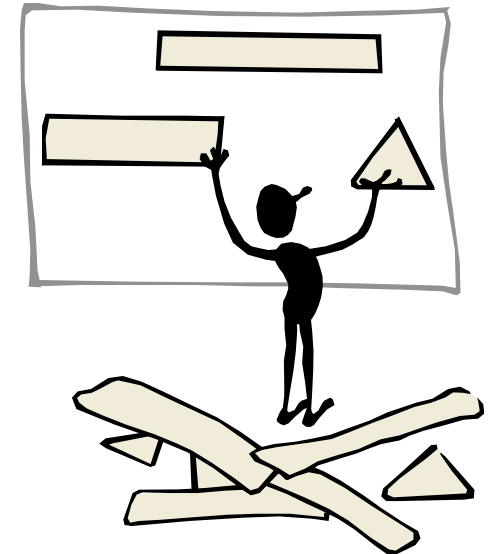
# Why Lean as an Improvement Strategy



- **Faster feedback on process performance (increased learning cycles)**
- **Improved first pass yield (results in improved productivity)**
- **Improved process stability (results in improved throughput)**
- **Uncovers process deficiencies (forces problem resolution)**
- **Less work-in-process (reduced risk)**
- **Improved customer satisfaction (flexibility and responsiveness)**

# Embracing Lean Means Embracing Change

- How we approach challenges
- How we solve problems
- How we involve others
- How we communicate
- How we think



# Why Change Our Thinking

**Einstein said:**

**“We can’t solve problems  
by using the same kind of thinking  
we used to when we created them.”**

**We need to challenge and break our  
paradigms!**



***“I think there is a world market for maybe five computers.”***

**Thomas J. Watson,  
Chairman of IBM, 1943**



***“Computers in the future  
may weigh no more than  
1.5 tons.”***

**Popular Mechanics,  
Forecasting the  
relentless march of  
science, 1949**



**Popular  
Mechanics**

Collaboration with Roger Black and Christian Schwartz

***“I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won’t last out the year.”***

**Prentice Hall**

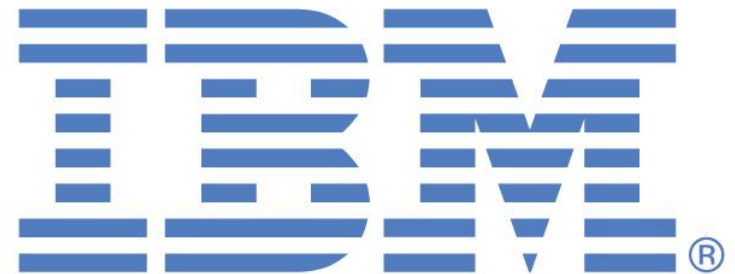
**Editor Business Books, 1957**



**Prentice  
Hall**

***“But what ... is it good  
for?”***

**Engineer,  
Advanced Computing Systems  
Division of IBM,  
Commenting on the microchip,  
1968**



***“There is no reason for any individual to have a computer in their home.”***

**Ken Olson, President, Chairman, and founder of Digital Equipment Corporation, at the Convention of the World Future Society in Boston 1977**

**d i g i t a l**

***“640K ought to be  
enough for anybody.”***

**Bill Gates,  
Microsoft Chairman, 1981**

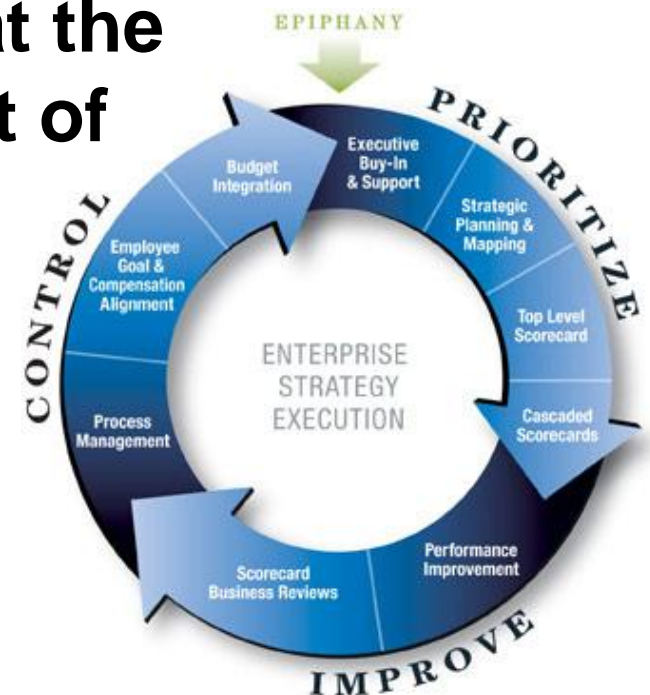


***Microsoft***<sup>®</sup>

# Defining Lean

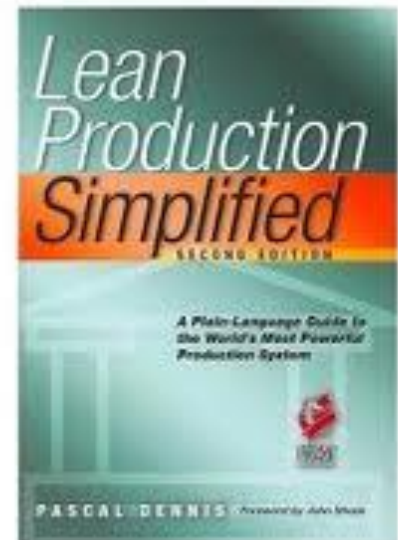
**“Systematic approach to identifying and eliminating waste (non-value-added activities) through continuous improvement by flowing the product/process at the pull of the customer in pursuit of perfection.”**

The MEP Lean Network



# What is Lean Simplified?

- ✓ **Customer Focused**
- ✓ **Process Focused**
- ✓ **Culture Driven**
- ✓ **Stresses Creativity**
- ✓ **Value Driven**





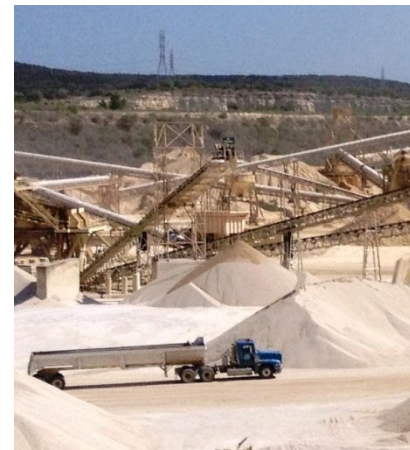
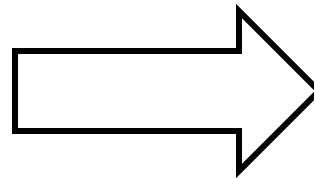
# What is NOT... Lean?

- ❌ 5S
- ❌ Setup Reduction
- ❌ One Piece Flow
- ❌ Poke Yoke (mistake proofing)
- ❌ Kanban
- ❌ Batch Size Reduction
- ❌ Just In Time
- ❌ Kaizen



# What is value?

Value = Transformation

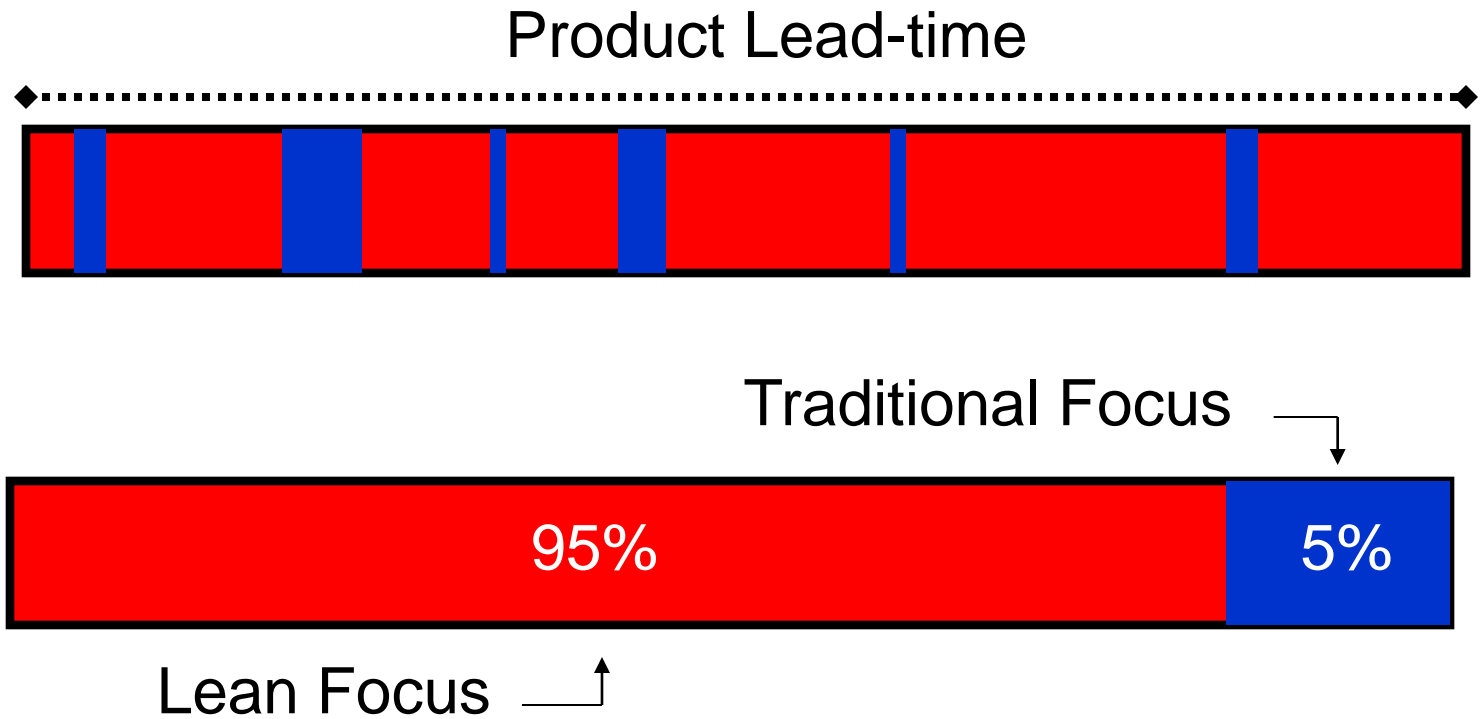


# Assessing Types of Activities

- **Value Added – Steps essential to deliver product or service according to customer requirements**
  - ✓ Transforms the item or service toward completion
  - ✓ Customer cares (what the customer is willing to pay for)
- **Non-Value Added – Steps that generate a negative return on the investment of resources and usually can be eliminated without impairing a process**
- **Non-Value Added But Necessary – Steps that would otherwise be non-value add, but are required for regulatory, safety, or other reasons**

**In general, assume a step is Non-Value Added unless a strong case can be made to show that it is Value Added**

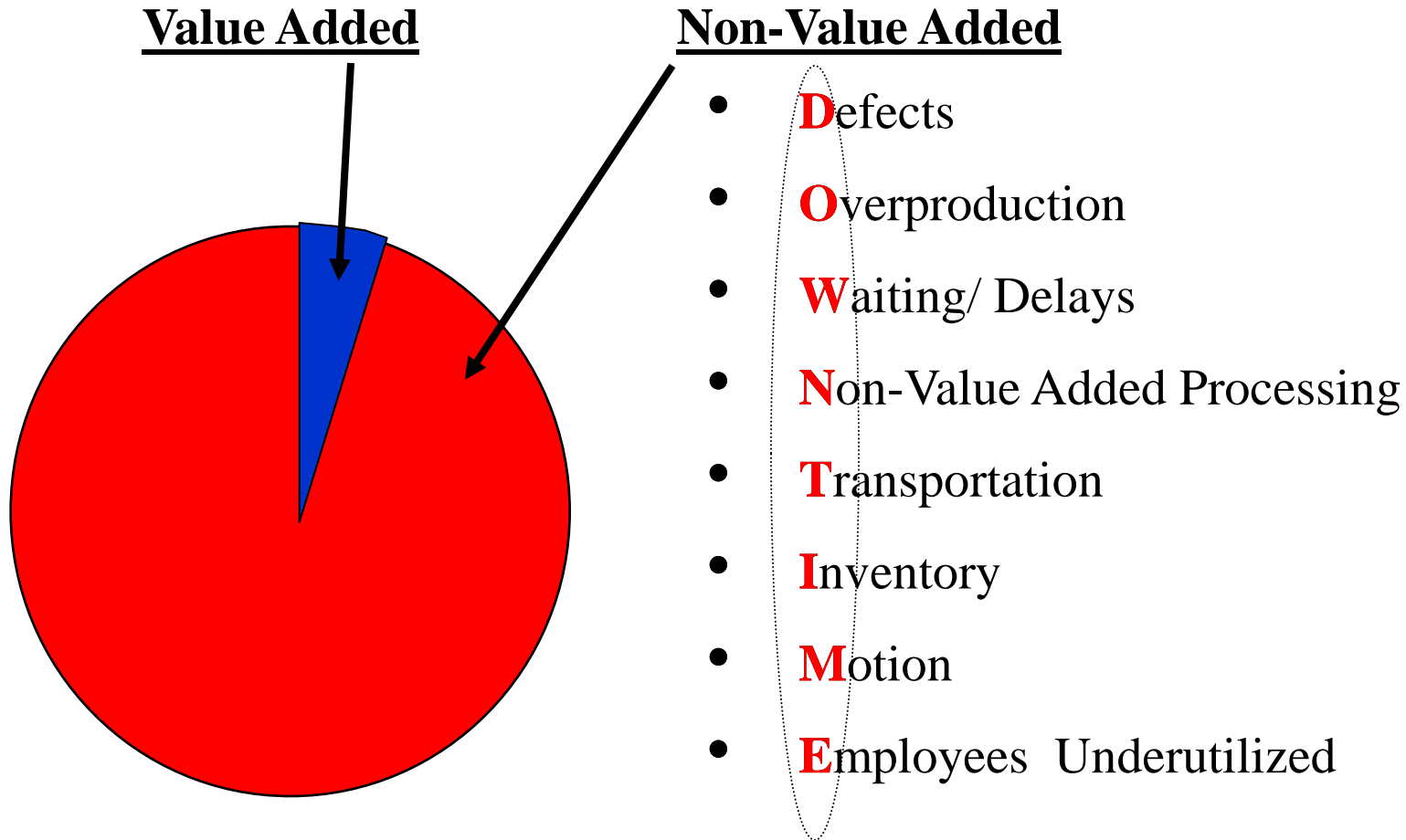
# Waste in a Typical Process



Non-Value Adding activities

Value Adding activities

# Lean = Eliminating the Wastes



# Defects

- **Definition: Anything that does not meet customer specifications or requirements**
  - ✓ **Form, fit or function**
  - ✓ **Timing/delivery**
- **Examples**
  - ✓ **Product out of specifications**
    - Oversized vs. Fines
  - ✓ **Late Deliveries**
- **Causes**
  - ✓ **Variance! Variance! Variance! In:**
    - Processing methods
    - Equipment maintenance/set-up
    - Associate training/experience
    - Customer communication



Anything beginning with “Re”  
(redesign, reissue, reprint) is  
a hint that you have defects!

# Overproduction

- **Definition: Batch size more than 1 piece**
  - ✓ Making more than is required by the next process
  - ✓ Making it earlier...
  - ✓ Making it faster...
- **Examples**
  - ✓ Work in process
- **Causes**
  - ✓ Long setup time
  - ✓ Unbalanced workloads
  - ✓ “Keep busy” attitude!



# Waiting/Delay Waste

- **Definition: To be stopped, detained, or hindered for a time**
- **Examples**
  - ✓ Waiting for machines
  - ✓ Waiting for parts, tools, supplies, etc.
  - ✓ Waiting for upstream operations
  - ✓ Waiting for clarification of instructions
  - ✓ Waiting on employees to show up
- **Causes**
  - ✓ Unbalanced work load and schedules
  - ✓ Unplanned set-up, maintenance and quality events





# Non-Value Added Processing

- **Definition: Effort that adds no value to the product or service from the customers' viewpoint**
- **Examples**
  - ✓ **Engineering tolerances/specs beyond customer needs**
  - ✓ **Unused records (collecting data that no one reads)**
  - ✓ **Multiple data entry on separate computer systems**
  - ✓ **Redundant approvals**
  - ✓ **“Extra” of anything – painting thickness, etc.**
- **Causes**
  - ✓ **Change review looks at only one aspect – not the whole system**
  - ✓ **“Just-in-case” attitude**

# Transportation Waste

- **Definition:** An act, process, or instance of transferring or conveying from one place to another
- **Examples**
  - ✓ **Transporting raw materials, work-in-process and finished inventory around the plant**
- **Causes**
  - ✓ **Layout of the operation**
  - ✓ **Flow not planned**
  - ✓ **Large batch sizes, long lead times, and large storage areas**



# Inventory Waste

- **Definition: Any supply in excess of a one-piece**
- **Examples**
  - ✓ Spare parts
  - ✓ Raw materials
  - ✓ Finished Goods
- **Causes**
  - ✓ Quality or yield problems
  - ✓ Long supply lead times
  - ✓ Poor forecasts
  - ✓ “Bulk quantity” pricing



# Motion Waste

- **Definition: Any movement of people or machines that does not add value to the product or service**
- **Examples**
  - ✓ Walking to job sites
  - ✓ Looking for lost orders
  - ✓ Walking to get supplies or raw materials
- **Causes**
  - ✓ Inconsistent work methods
  - ✓ Poor workplace organization and housekeeping



# Employees Underutilized

- **Definition: The waste of not using people's mental, creative, and physical abilities**
- **Examples**
  - ✓ **Micromanaged employee**
  - ✓ **Untrained/ unskilled employee**
- **Causes**
  - ✓ **Low or no investment in training**
  - ✓ **Low pay, high turn-over strategy**
  - ✓ **Negative business culture**



# Waste

- **Waste are the elements of production that add no value to the product**
- **Waste only adds cost and time**
- **Waste is really a symptom rather than a root cause of the problem**
- **Waste points to problems within the system**



# What is Waste

Waste is “anything other than the minimum amount of equipment, materials, parts, space, and worker’s time which are absolutely necessary to add value to the product. – ADD WASTE”

- Shoichiro Toyoda, President, Toyota

Waiting

Overproduction

Transportation

Inventory

Underutilized People

Motion

Defects

Non-Value Added Processing

# Foundation of Lean

“One of the most noteworthy accomplishments in keeping the price of Ford products low is the gradual shortening of the production cycle. The longer an article is in the process of manufacture and the more it is moved about, the greater is its ultimate cost.”

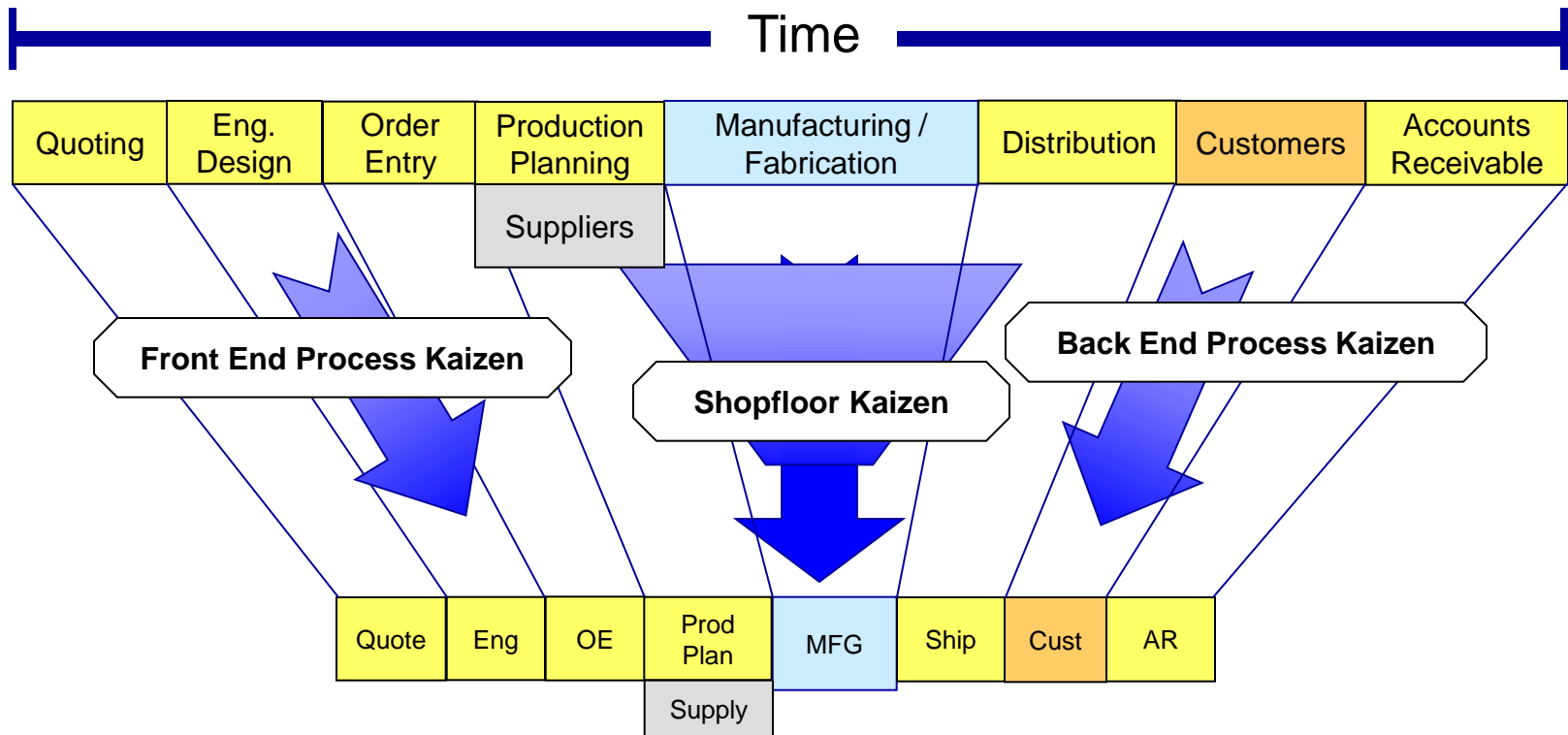


Henry Ford, 1926



# Measuring a Process

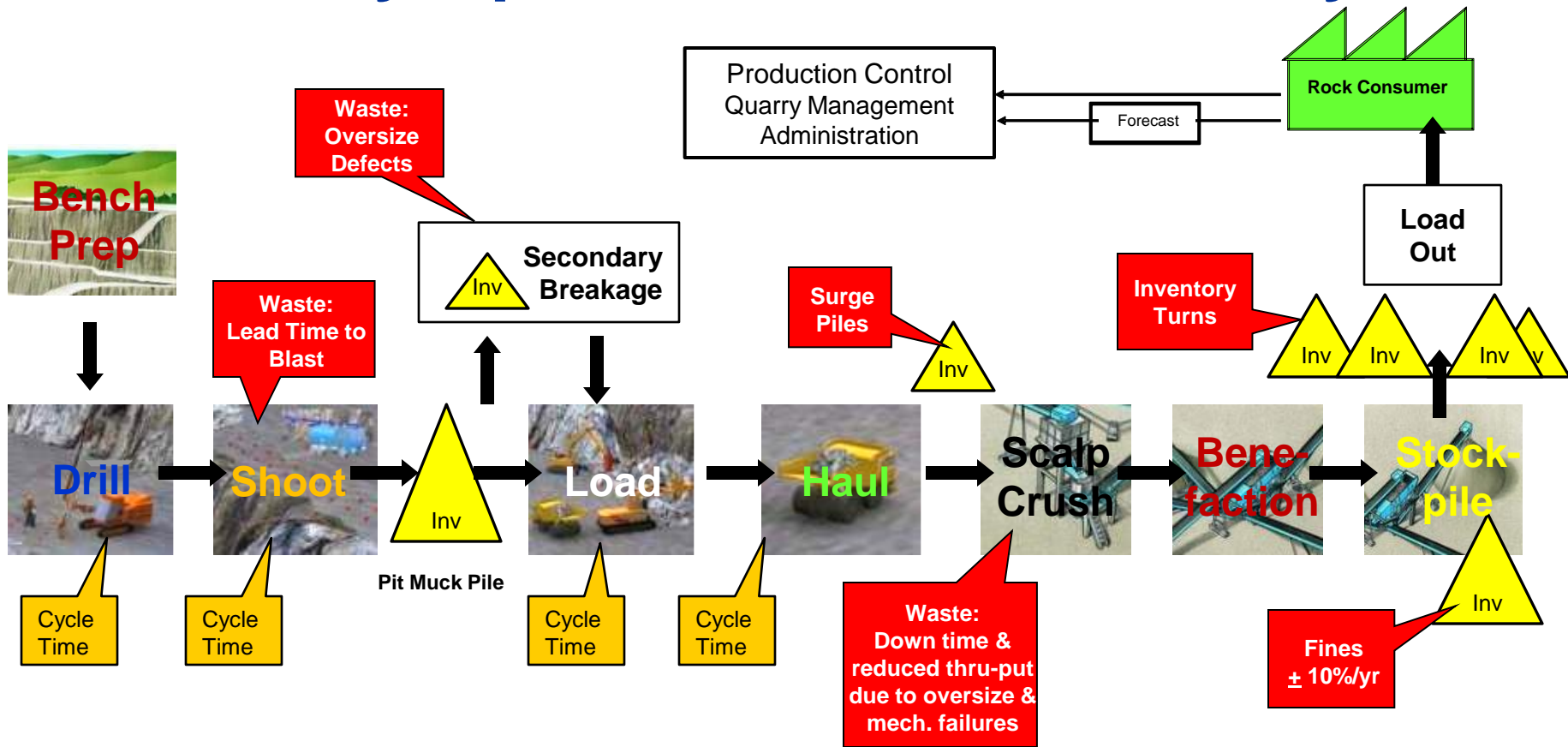
**Efficiency** -- Reducing Lead time across entire Value Stream



# The Value Stream – Lean Thinking



# Quarry Operations – Rock Factory



\$ per Ton

Drilling

Blasting

Secondary  
Breakage

Loading

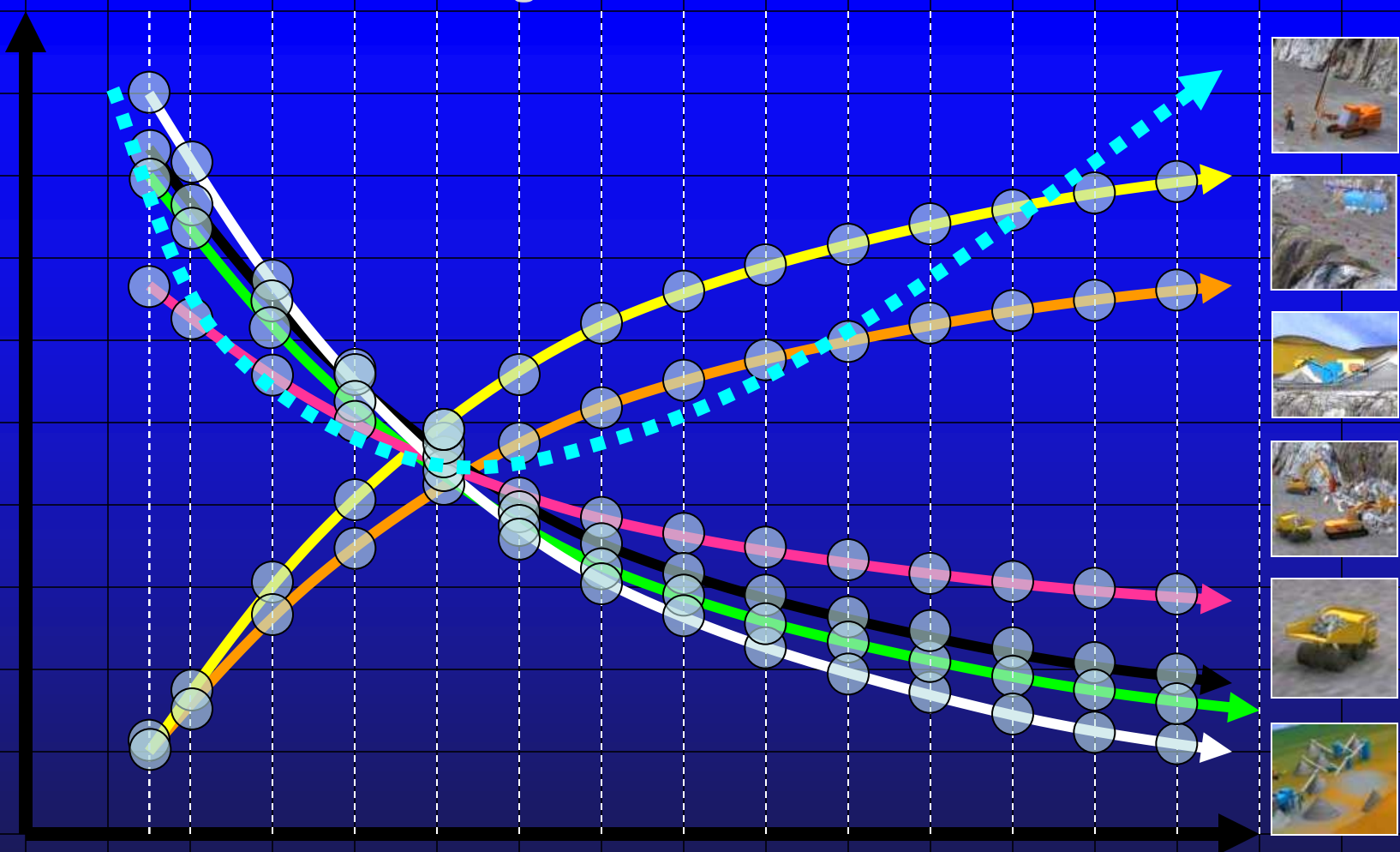
Hauling

Crushing

Poor

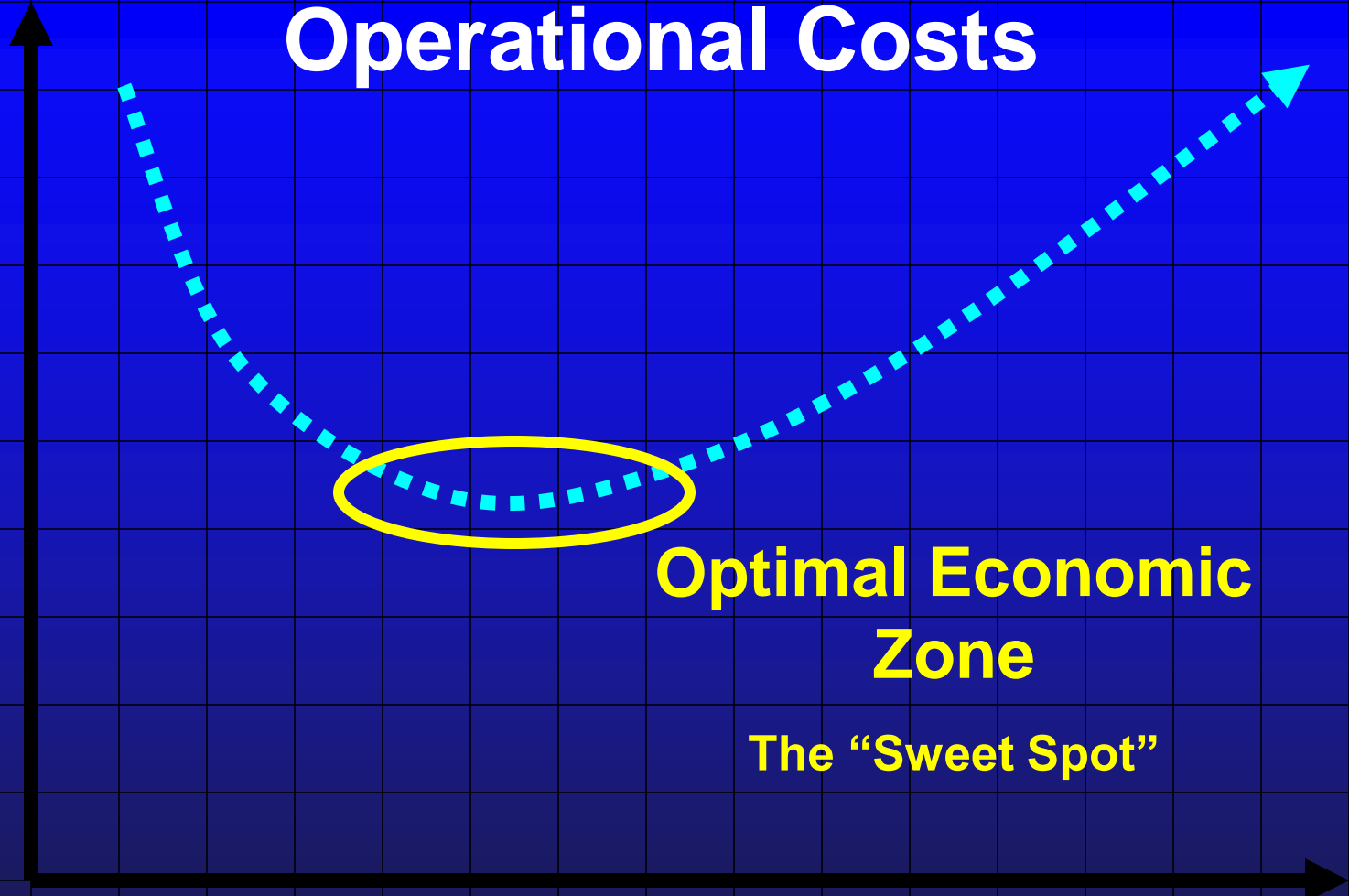
Excellent

Degree of Fragmentation



# Combined Unit Operational Costs

\$ per Ton



Optimal Economic Zone

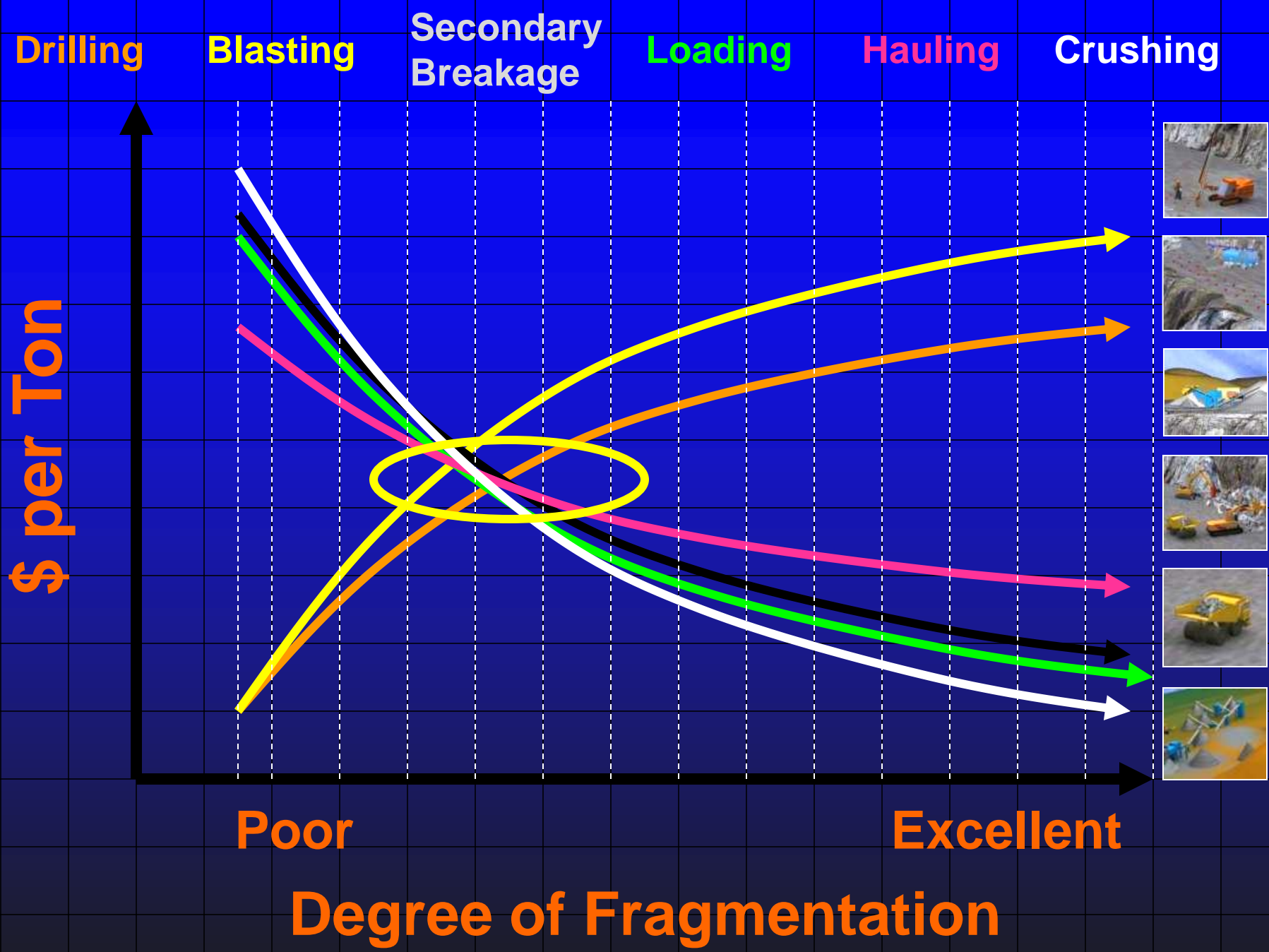
The "Sweet Spot"

Poor

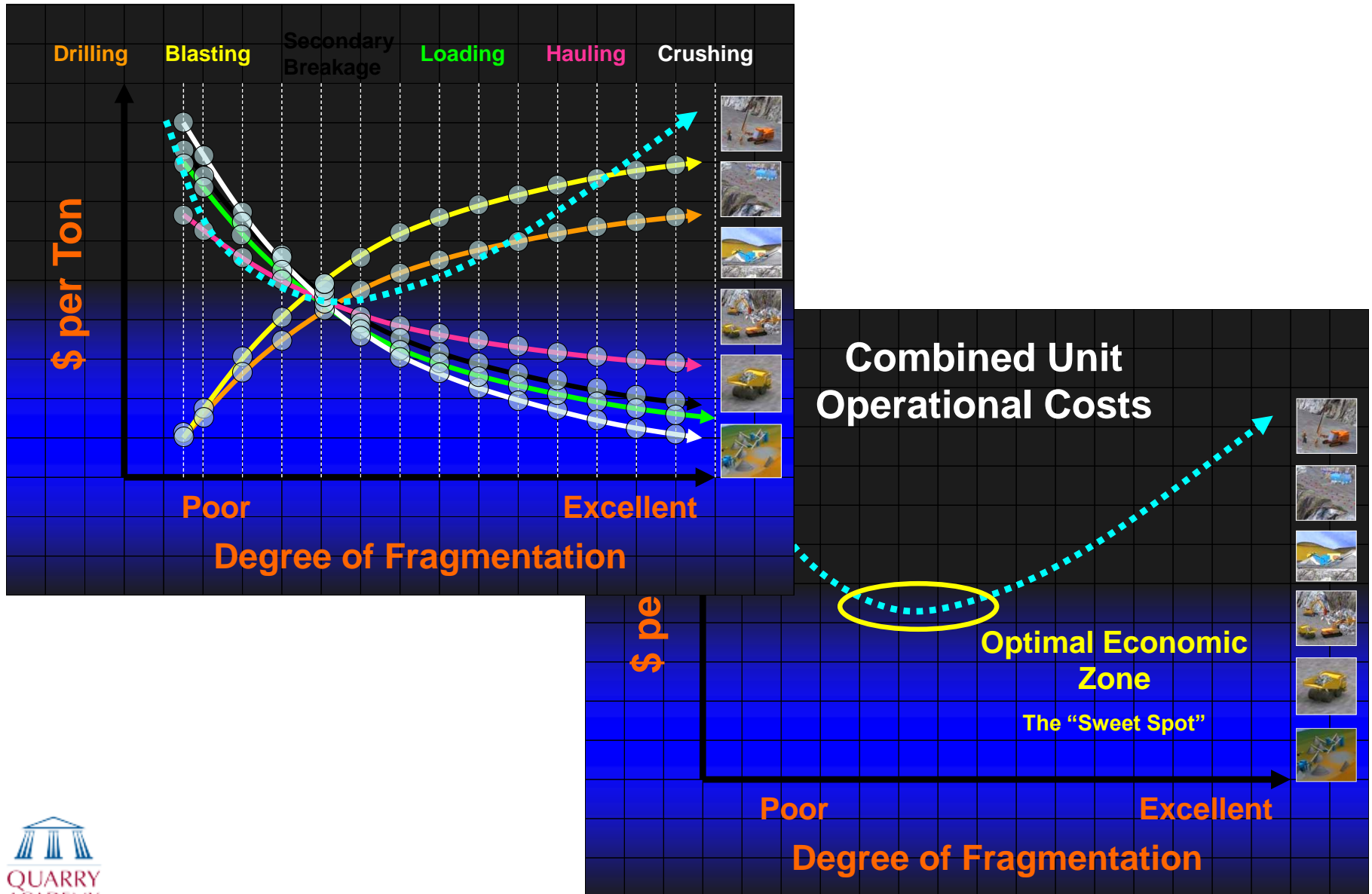
Excellent

Degree of Fragmentation

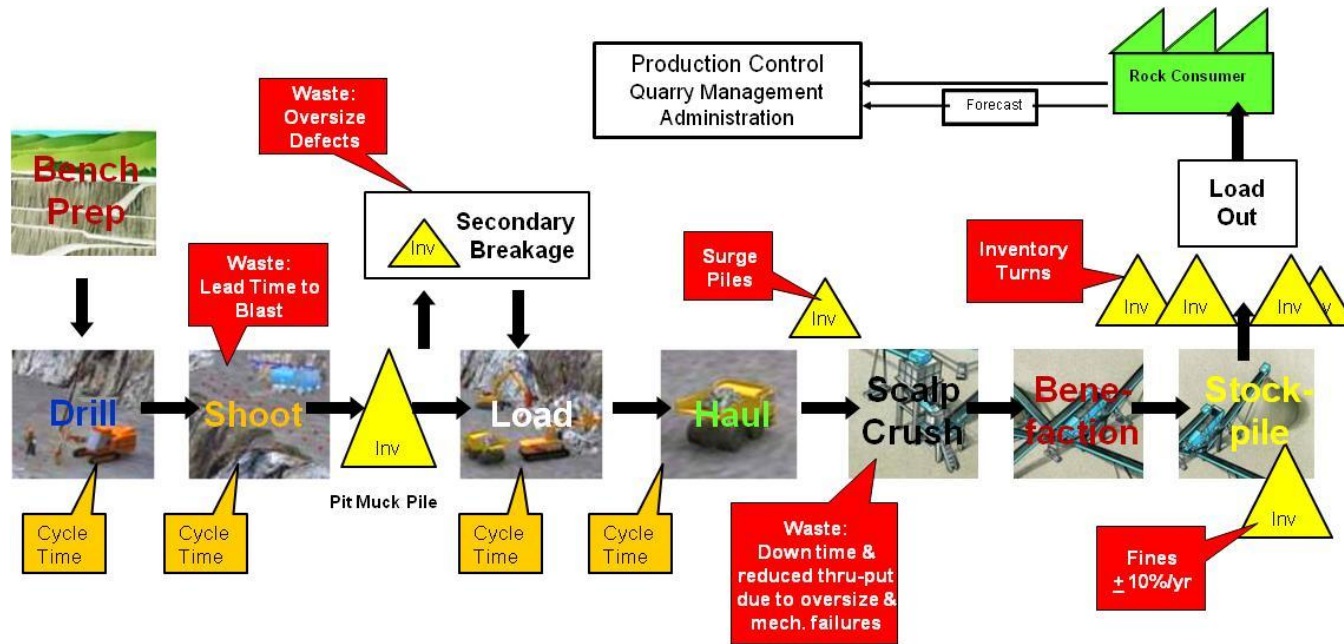




# The Goal... Improve Competitiveness



# The Value Stream / Rock Factory



**PROCESS FLOW**



**COMMUNICATION**



# Get the Waste Out of the Process...

- ✓ Time
- ✓ Movement / Motion
- ✓ Inventory
- ✓ Over-Production
- ✓ Out of Spec Product
- ✓ Under-Production



# Cultural Characteristics

- **Holistic Approach to Process Improvement**
- **Kaizen – Continuously Driven**
- **Employee Based**
  - ✓ **Top Down**
  - ✓ **Bottom Up**
- **Environment of Empowerment but Driven by Process**

# What Kills Lean!

- **Command and Control Management**
- **Environment of Micromanagement**
- **Used for Workforce Reduction**

# Keys to Success

- **Unyielding leadership**
- **Strategic vision, based on Lean Enterprise as part of company strategy**
- **Involve employees**
- **Share information and manage expectations**
- **Identify and empower champions, particularly operations managers**
- **Execute pilot projects prior to rolling out culture across organization**
- **Foster an atmosphere of experimentation**
- **Install realistic performance measurement, evaluation, and reward systems**
- **Deep commitment to excellence**



# Questions?

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Resources / Materials: <http://www.nist.gov/mep/>

***Lean Thinking***

***Learning to See***

***Andy and Me***

Authors: Womack and Jones

Authors: Rother and Shook

Author: Dennis

[www.quarryacademy.com](http://www.quarryacademy.com)



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