LAI Lean Academy™

The Start of Your Lean Journey

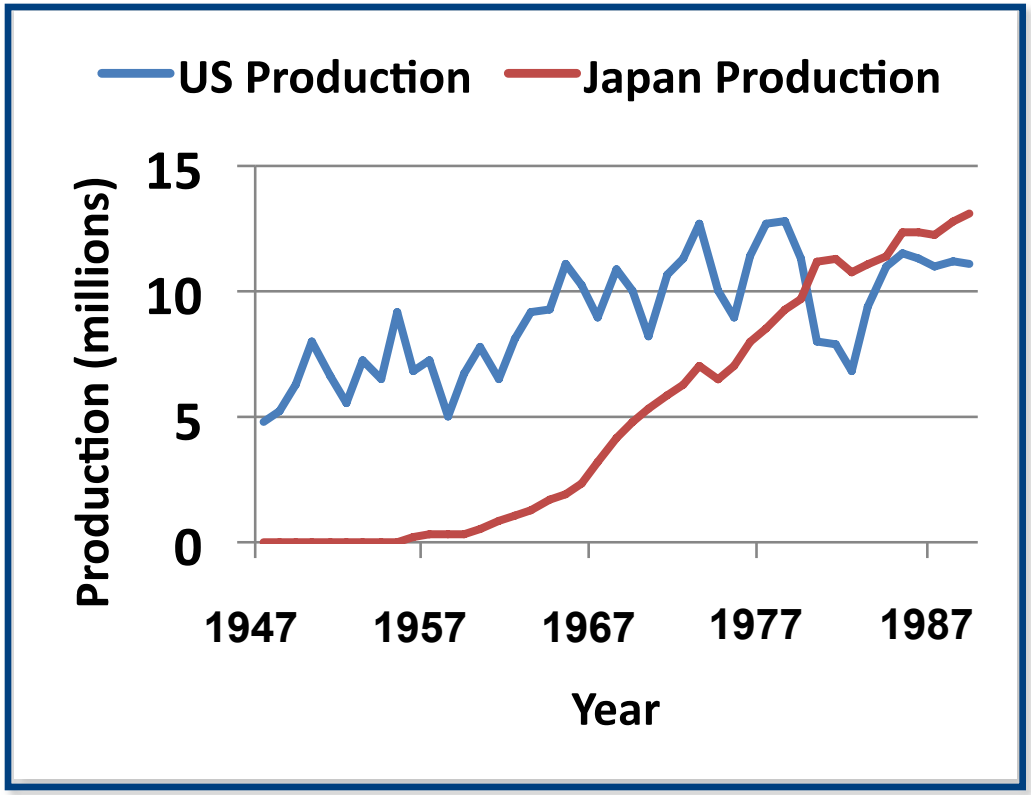
Learning Objectives

At the end of this module, you will be able to:

- Explain the origins of Lean and Six Sigma
- Explain the “6S” lean tool
- Define Lean, lean enterprise, stakeholders
- Recognize why lean six sigma principles are being implemented in aerospace, healthcare and other sectors
- Express that lean is a “journey” not a “state”

Lean Arises From Japanese Auto Industry

Selected Metrics for US & Japan Automobile Manufacturers		
Product Development (mid 1980s)		
	Japanese Producers	American Producers
Avg. Engineering Hrs per New Car (millions)	1.7	3.1
Avg. Development Time per New Car (months)	46.2	60.4
Employees in Project Team	485	903
Supplier Share of Engineering	51%	14%
Ratio of Delayed Projects	1 in 6	1 in 2
Summary of Assembly Plant Characteristics for Volume Producers, 1989		
	Japanese in Japan	American in N Am
Productivity (hrs/veh)	16.8	25.1
Quality (defects/100 veh)	60	82.3
Inventory (days for 8 sample parts)	0.2	2.9
Work Force on Teams	69.3%	17.3%
Suggestions per employee	61.6	0.4
Number of Job Classifications	11.9	67.1
Training Hrs of New Production Workers	380.3	46.4



Trends have continued since this 1989 data reported in *The Machine That Changed The World*

Lean Thinking Introduced

Lean **emerged from post-WWII Japanese automobile industry as a fundamentally more efficient system than *mass* production.**

	Craft	*Mass Production*	*Lean Thinking*
Focus	**Task**	**Product**	**Customer**
Operation	**Single items**	**Batch and queue**	**Synchronized flow and pull**
Overall Aim	**Mastery of craft**	**Reduce cost and increase efficiency**	**Eliminate waste and add value**
Quality	**Integration (part of the craft)**	**Inspection (a second stage after production)**	**Inclusion (built in by design and methods)**
Business Strategy	**Customization**	**Economies of scale and automation**	**Flexibility and adaptability**
Improvement	**Master-driven continuous improvement**	**Expert-driven periodic improvement**	**Worker-driven continuous improvement**

Lean thinking **is the dynamic, knowledge-driven, and customer-focused process through which all people in a defined enterprise continuously eliminate waste and create value.**

Adapted from Murman, et. al, *Lean Enterprise Value*,, Palgrave, 2002.

Comparison of Lean & Six Sigma

Six Sigma was developed by Motorola in the 1980s to systematically improve quality by elimination of defects.

	Six Sigma	Lean
Objective	**Deliver value to customer**	**Deliver value to customer**
Theory	**Reduce variation**	**Remove waste**
Focus	**Problem focused**	**Flow focused**
Assumptions	• **A problem exists** • **Figures and numbers are valued** • **System output improves if variation in all processes inputs is reduced**	• **Waste removal will improve business performance** • **Many small improvements are better than system analysis**

Six Sigma is *a data driven philosophy and process* resulting in dramatic improvement in products/service quality and customer satisfaction.

Adapted from Nave, Dave. "How to Compare Six Sigma, Lean, and the Theory of Constraints." Quality Progress. March 2002

Lean and Six Sigma

- Lean and Six Sigma are synergistic
  - Lean optimizes flow and strives to eliminate waste
  - Six Sigma stresses quality through the elimination of variation in all enterprise processes
- A unified framework called *Lean Six Sigma* has emerged
- Enterprises usually adopt their own name. Some examples:
  - Textron – *Textron Six Sigma*
  - Pratt & Whitney – *ACE*
  - US Air Force – *AFSO21*
  - Boeing – *Lean+*
  - New York City Health & Hospitals Corp – *Breakthrough*
  - Virginia Mason Medical Center – *Virginia Mason Production System*

The LAI Lean Academy® curriculum focuses on the fundamental concepts which underpin these and other transformation initiatives.

Two major pillars of lean thinking:

1. Continuous Improvement
2. Respect for People

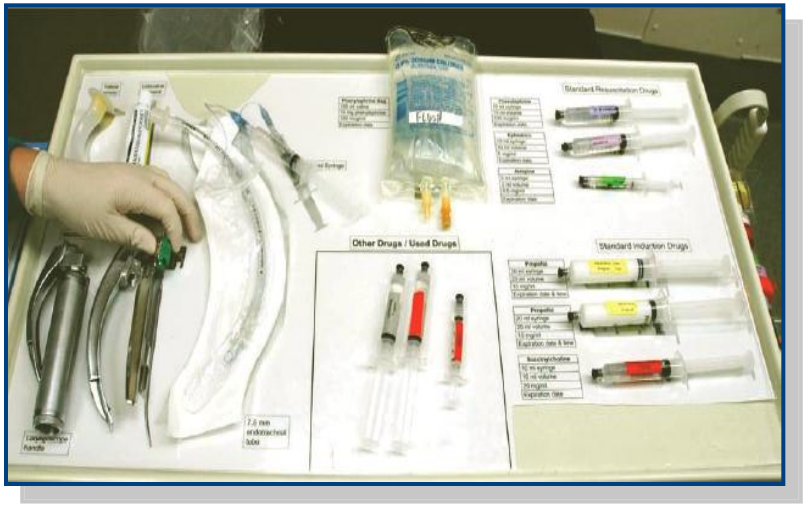
Workers are encouraged to use their full capability to improve their own work environment

6S
~~5S~~ - A simple "lean tool"

- Sort
- Safe
- Straighten
- Scrub
- Standardize
- Sustain

Before

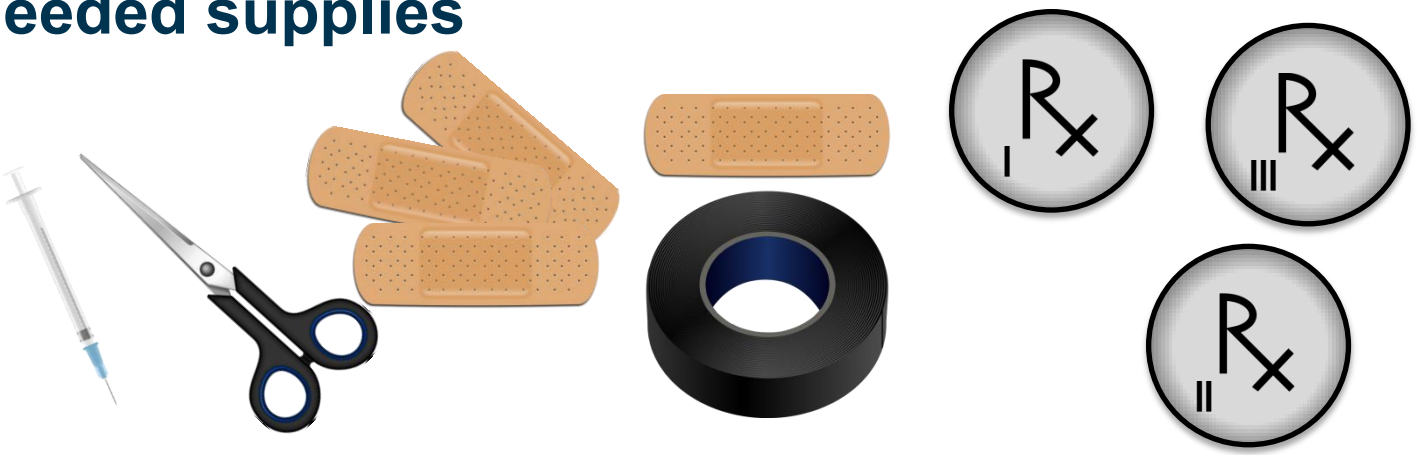
After



Courtesy of University of Michigan Health System, Ann Arbor, MI. Used with permission.

6S Exercise - 1

- We will apply 6S to a workplace and measure the improvement in executing our job
- During each 20 second round, your job is to gather needed supplies



- The first page of your exercise represents our current workplace (don't turn the page over yet)
- The next slide is what you have to fetch
- Mark an X on each item you locate

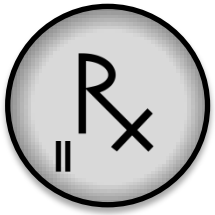
Round I Needs

- 5 syringes

- 5 band aids

- 5 scissors

- 5 medication II



- Ready….Set…..

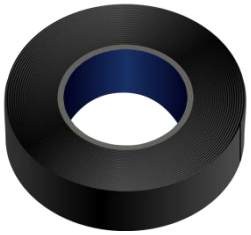
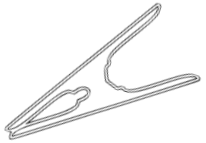
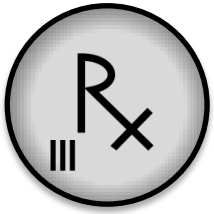
6S Exercise - 2

- **Sort**
- Safe
- Straighten
- Scrub
- Standardize
- Sustain

- **The first "S" is *Sort***
  - **We have removed from the storage area unneeded items**

Courtesy of Jefferson Healthcare, Port Townsend, WA. Used with Permission.

Round 2 Needs

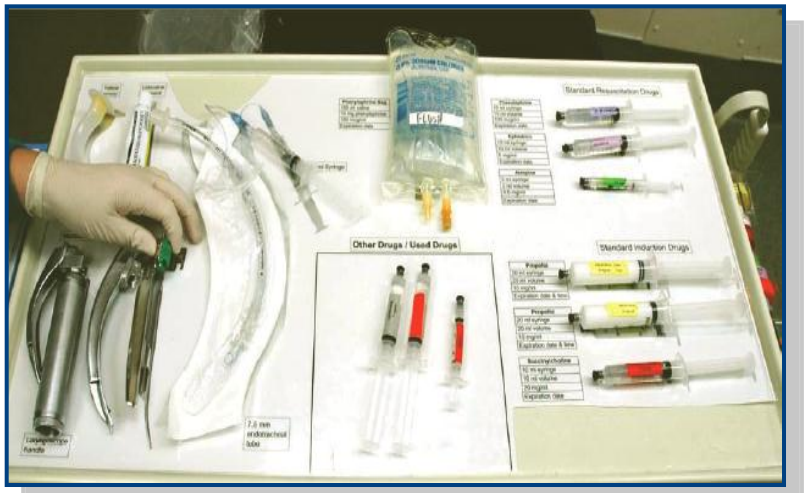
- 5 tape rolls 
- 5 band aids 
- 5 tweezers 
- 5 medication III 

- Ready… Set…

6S Exercise - 3

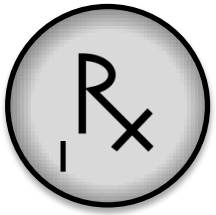
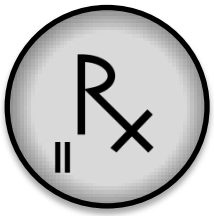
- Sort
- **Safe**
- Straighten
- Scrub
- Standardize
- Sustain

- **The second "S" is *Safe***
  - **Making the workplace safe for employees and patients**



Courtesy of University of Michigan Health System, Ann Arbor, MI. Used with permission.

Round 3 Needs

- 5 Syringes 
- 5 medication I 
- 5 scissors 
- 5 medication II 
- Ready… Set…

6S Exercise - 4

- Sort
- Safe
- **Straighten**
- Scrub
- Standardize
- Sustain

- **The third "S" is *Straighten* or *Set in Order* or *Store***
  - **We have installed a rack system to help locate similar items**

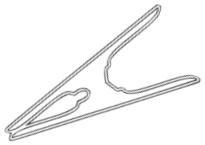
Courtesy of University of Iowa Hospitals and Clinics. Used with permission.

Round 4 Needs

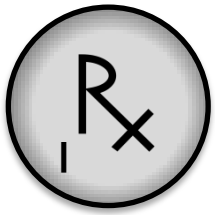
- 5 syringes

- 5 rolls tape

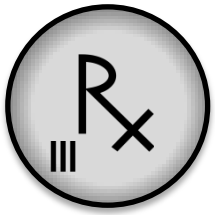
- 5 tweezers



- 5 medication I



- 5 medication III



- Ready… Set…

6S Exercise - 5

- Sort
- Safe
- Straighten
- **Scrub**
- Standardize
- Sustain

- **The fourth "S" is *Scrub* or *Shine or Sweep***
  - **Cleanliness is important in healthcare workplaces**
- **It's tough to scrub a piece of paper, so we'll skip this S**

Courtesy of University of Michigan Health System, Ann Arbor, MI. Used with permission.

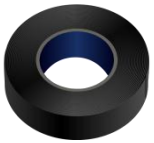
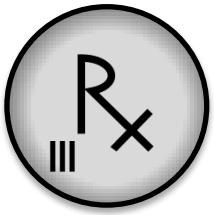
6S Exercise - 6

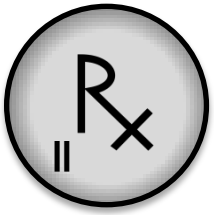
- Sort
- Safe
- Straighten
- Scrub
- **Standardize**
- Sustain

- **The fifth "S" is *Standardize***
  - **We have developed a standard way of storing things to make them easy to find.**

Courtesy of Jefferson Healthcare, Port Townsend, WA.
Used with Permission.

Round 6 Needs

- 5 Syringes 
- 5 band aids 
- 5 tweezers 
- 5 rolls of tape 
- 5 medication III 

- 5 medication II 

- Ready… Set…

6S Exercise - 7

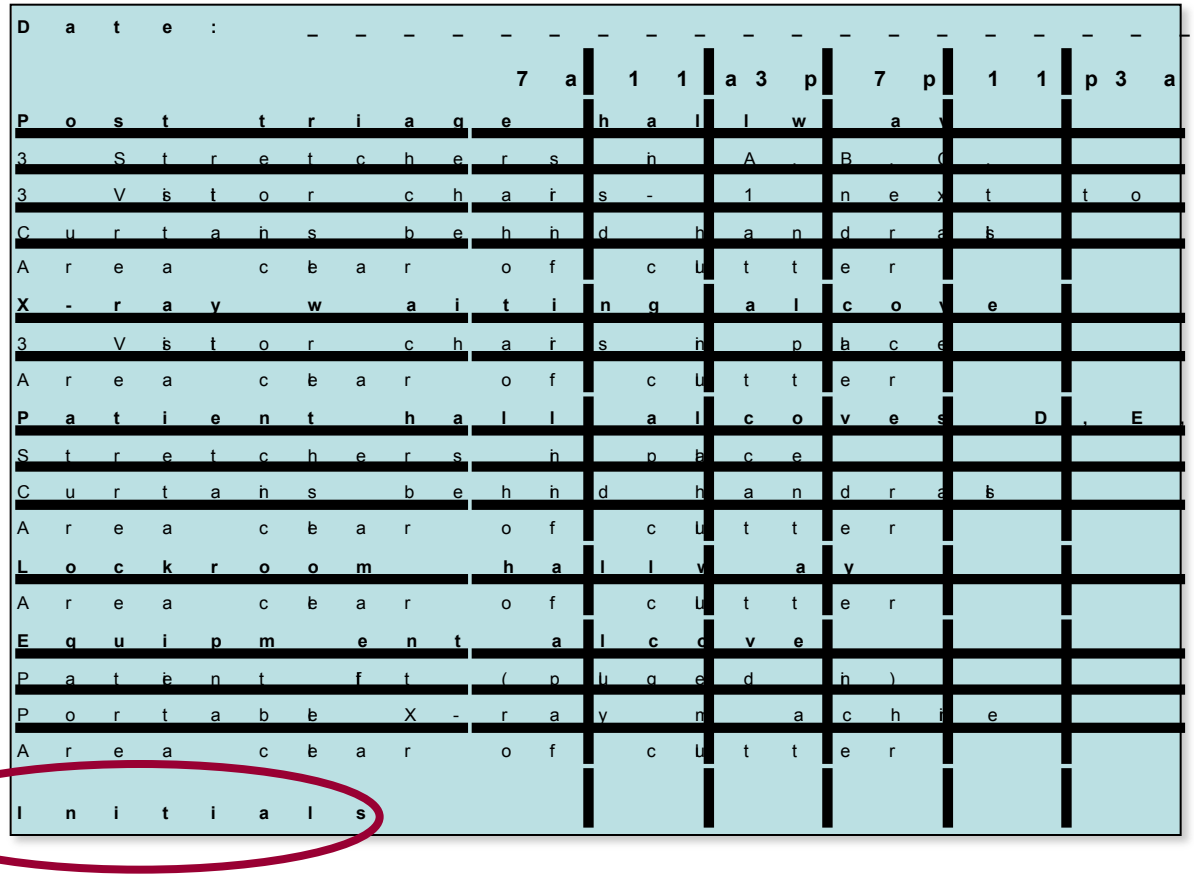
- Sort
- Safe
- Straighten
- Scrub
- Standardize
- **Sustain**

- **The sixth "S" is *Sustain* or *Self-Discipline***
- **This is your challenge: Sustain your lean activities**
- **Often the hardest to achieve**

Sustain

6S Standard Sheet

- Example of part of a daily ED outside hallway checklist
- Initials at bottom



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Aerospace - A Flagship Industry…

Enabling the global movements of people and goods

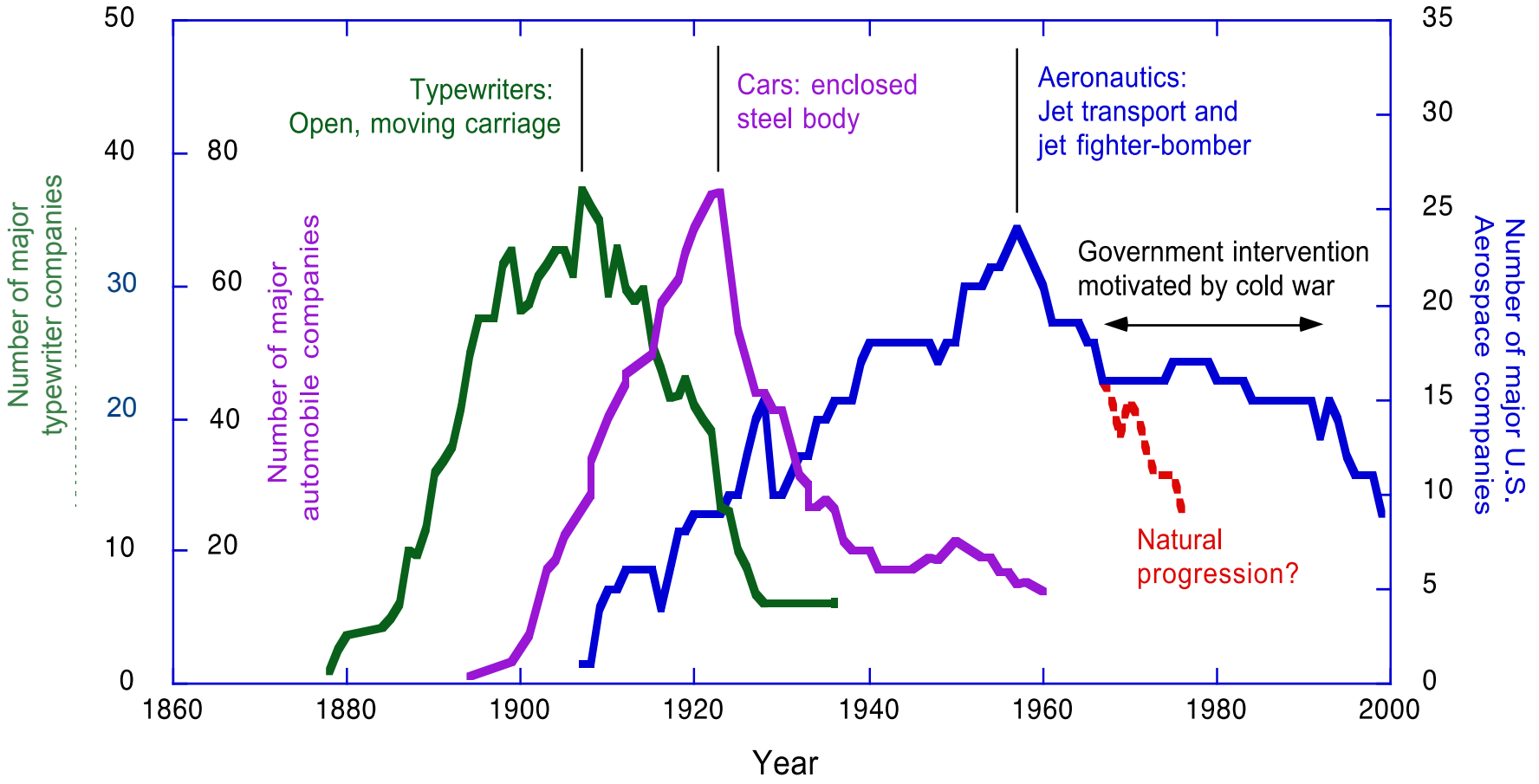
Enabling the global acquisition and dissemination of information and data

Advancing national security interests

Providing a source of inspiration by pushing the boundaries of exploration and innovation

Reference: Murman, et. al., *Lean Enterprise Value*, Palgrave 2002

Industry Innovation Linked to Product Evolution



Companies with "mature" products cannot survive with an obsolete business strategy

References: For typewriters, George Nichols Engler; for cars, Entry and Exit of Firms in the U.S. Auto Industry: 1894-1992, National Academy of Science; for aerospace, S. Weiss and A. Amir, "The Aerospace Industry", in Encyclopedia Britannica.

Cost-Price Relationship

The fundamental cost –price relationship changes as industries mature

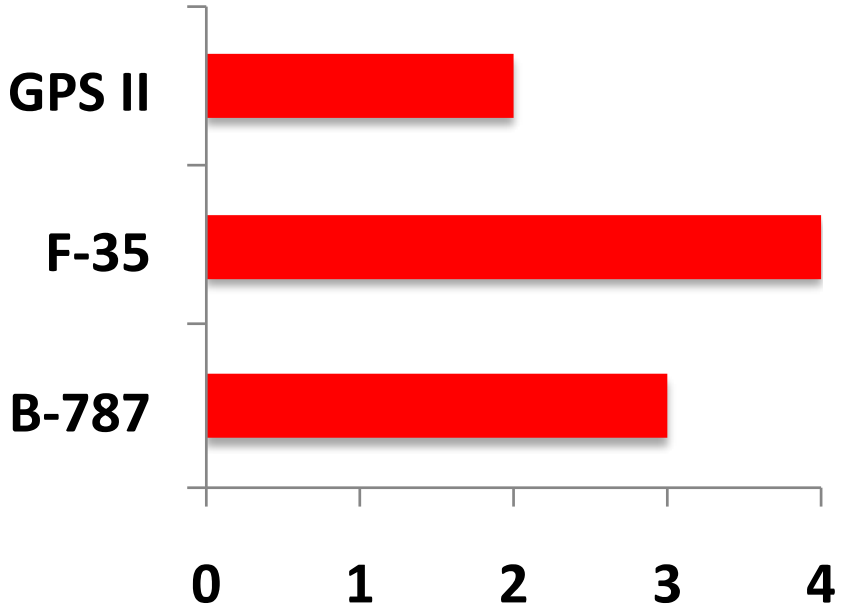
Emerging Industry: cost plus profit equals price

Mature Industry: customers and competition determined price

Mature industries must lower costs and/or increase perceived value to achieve profit!

Recent Aerospace Programs

Years Behind Schedule



Cost Growth

About $1B over run in 2008 GAO

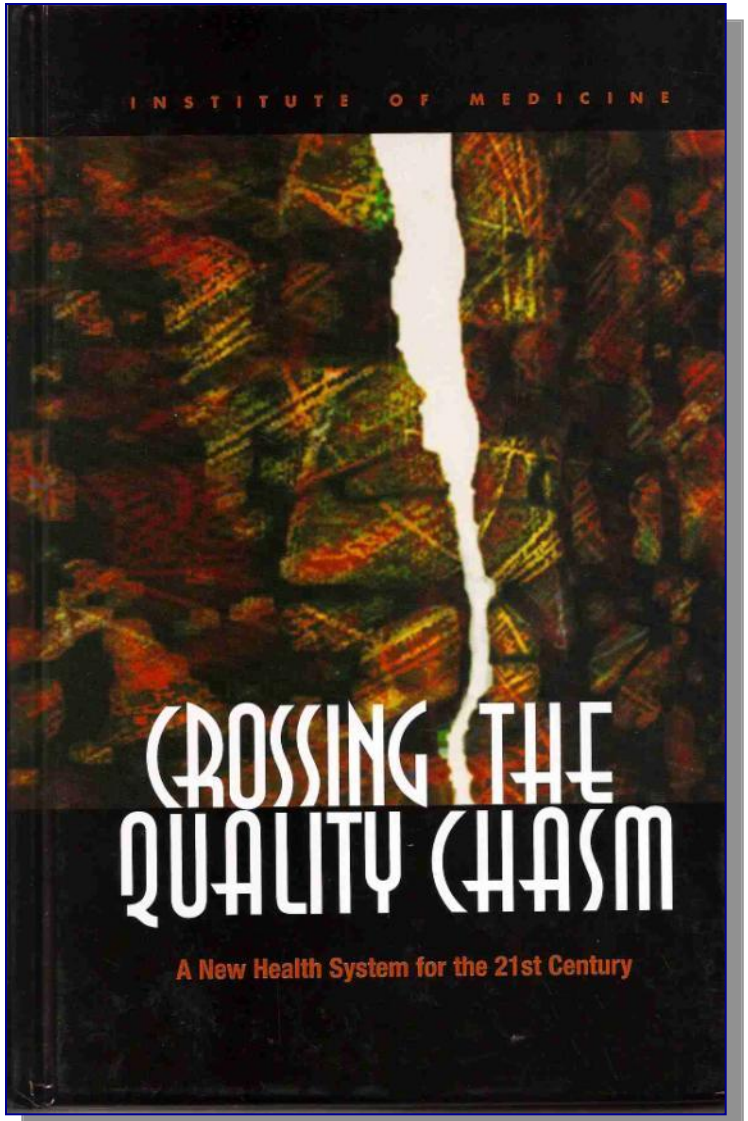
Unit cost increased from $50 to $92 million in 2002 dollars.
Bloomberg December 14, 2010

$12B or more over run in development costs.
Seattle Times, December 19, 2010

Other programs with cost and schedule growth: F-22, A-380, B747-8, A400M, SBIRS, EELV ….

Source: Flickr. Ben Gertzfield. CC BY-NC

Six Aims for Healthcare Improvement



"Health care should be:

- Safe
- Effective
- Patient -centered
- Timely
- Efficient
- Equitable

These aims are not new….
Yet American health care fails far too often with respect to these aims, despite enormous cost and dedication and good efforts of millions of American healthcare workers"

Courtesy of the National Academy Press. Used with Permission.

US Healthcare Warning Signs

Cost

- Over 16% of GDP spent in healthcare expenses (2007)
- 117% increase in worker insurance premiums, (1999-2008)
- 119% increase in employer insurance premiums, (1999-2008)
- US spends 75% more on healthcare than G-5 countries (2006)

Quality

- 44,000 - 98,000 deaths attributed to medical errors (1999)
- 32% of patients report medical mistake, medication error or lab error in past two years (2007)
- 12-79% gap between delivered vs recommended care (2003)

Access

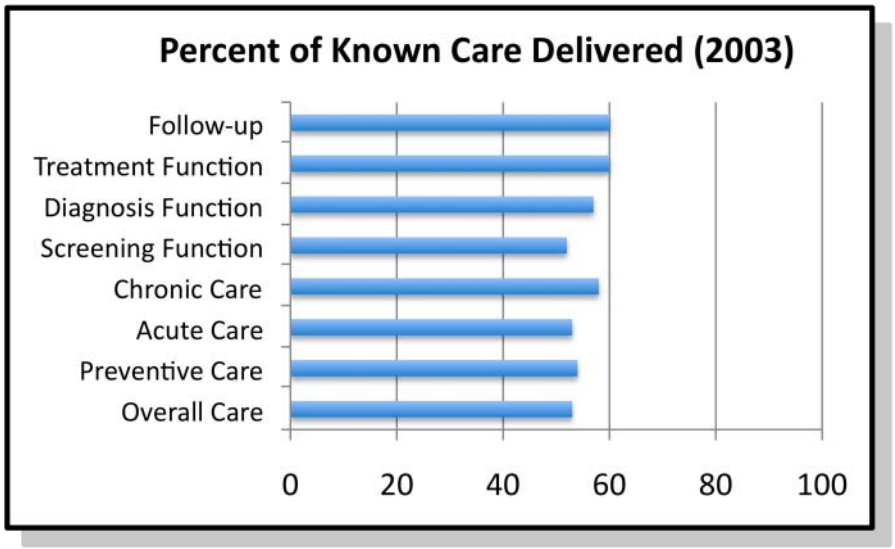
- 45 million Americans are uninsured
- Individuals over 65 expected to increase over 50% by 2020
- Fragmented provider network, IT systems, insurance, etc.
- 40% of patients not treated or medicated due to cost (2004)

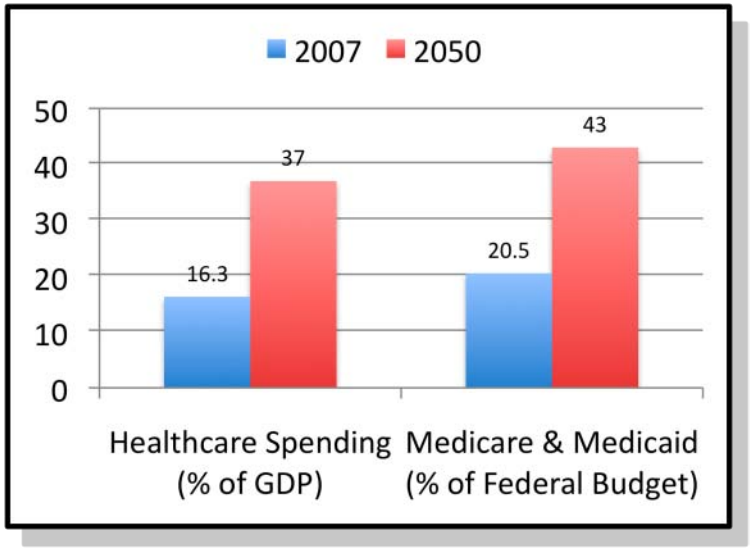
Trouble

- 60% of doctors would not recommend career to young people
- 50% of ED caregiver time spent on paperwork (2001)
- 315,250 shortage of RNs predicted for 2015

US Healthcare - A Value Crisis

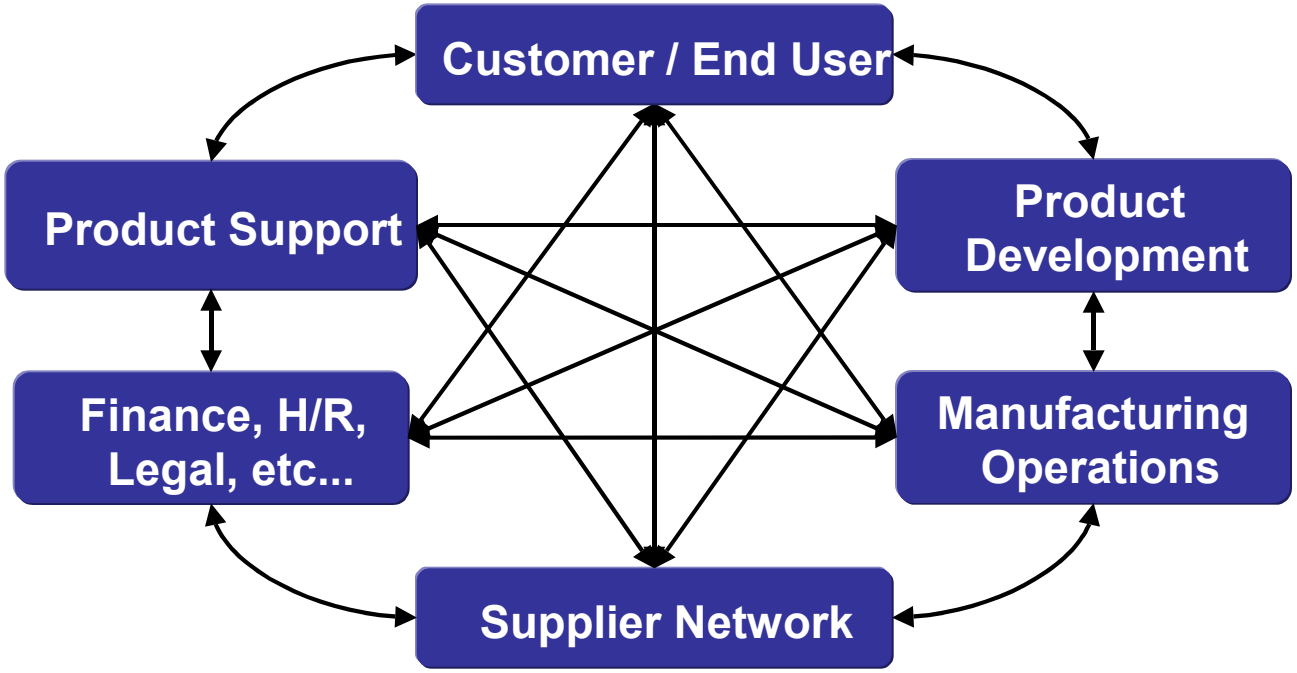
$$\text{Value} \approx \frac{\text{Delivered Care}}{\text{Cost}}$$





- Lean Six Sigma can increase healthcare value delivery by:
  - Improving healthcare quality
  - Decreasing healthcare costs
- It is one piece of a puzzle to solve the US healthcare crisis

What is an Enterprise?



"One or more organizations having related activities, unified operation, and a common business purpose"

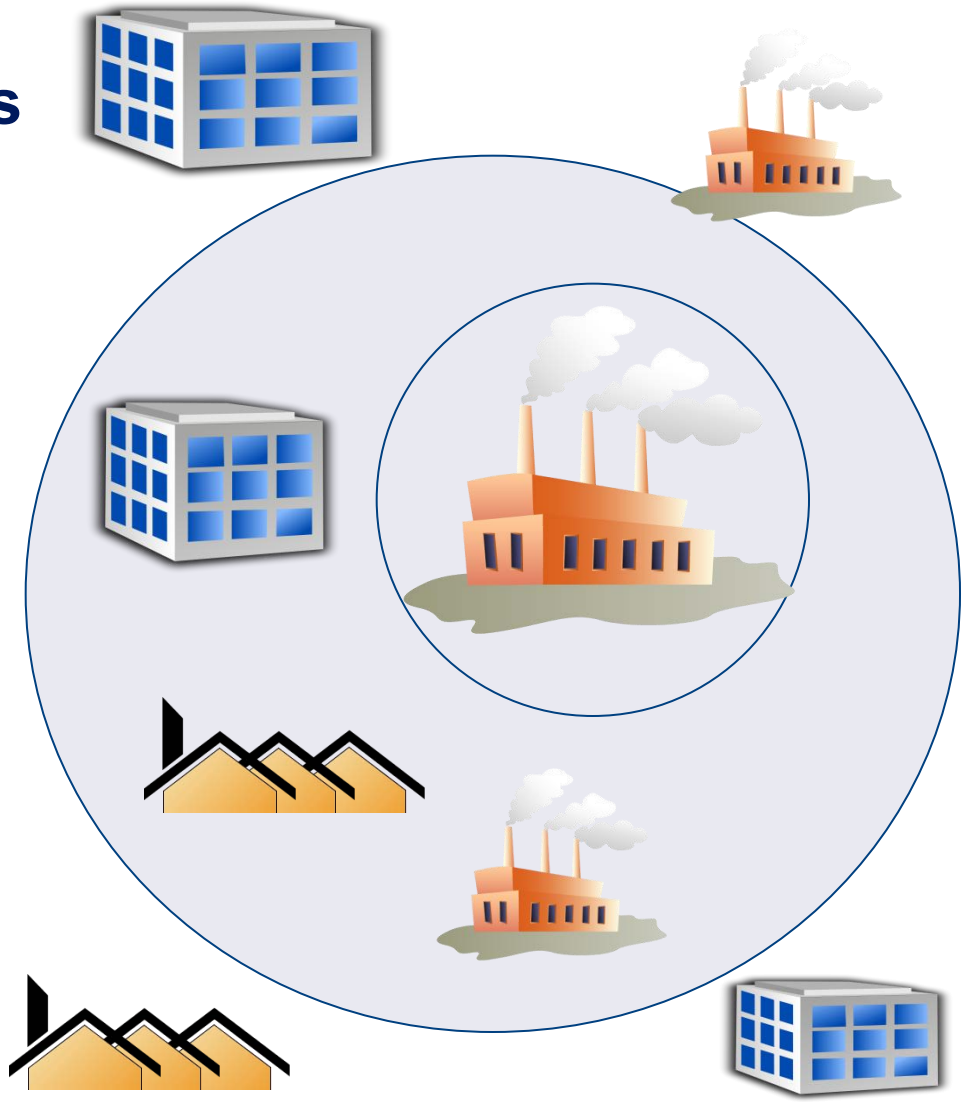
Black's Law Dictionary, 1999

The global economy is a complex web of enterprises of many kinds.

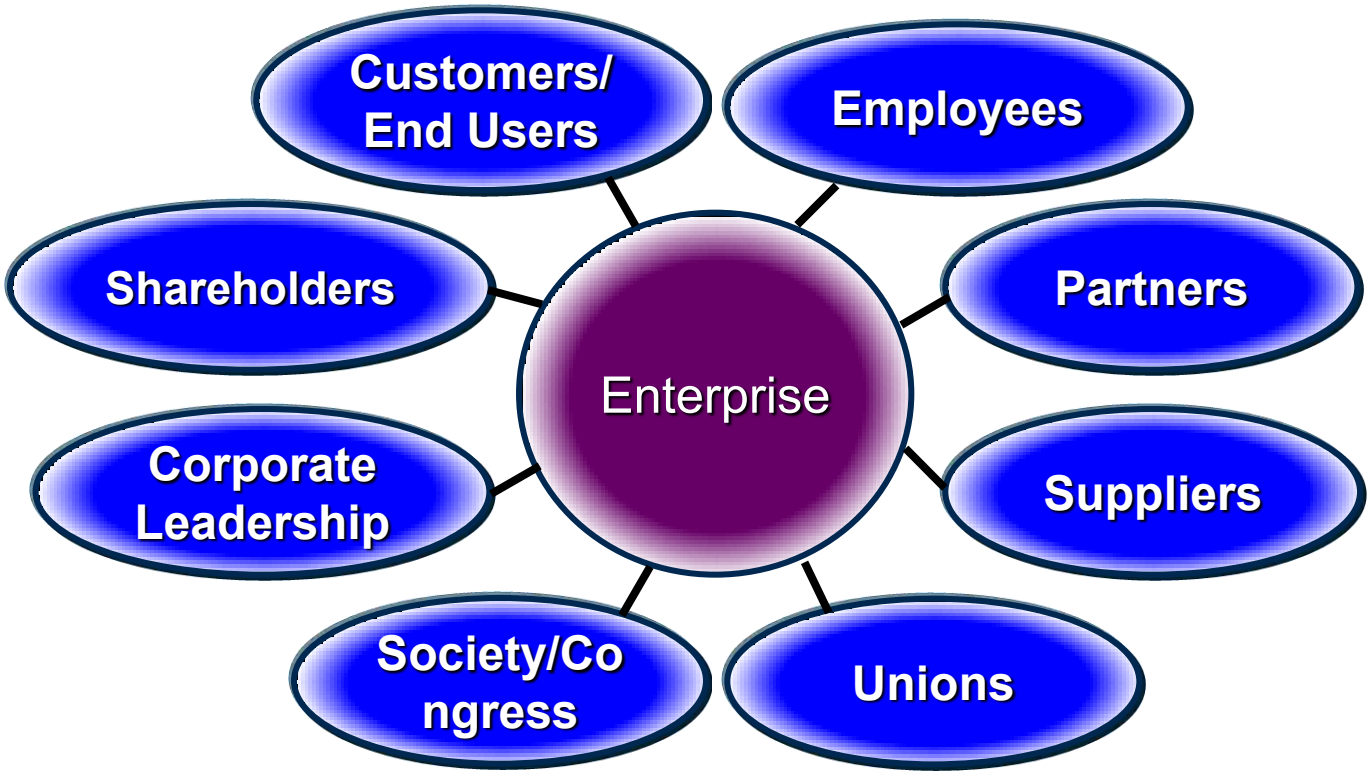
You need to understand YOUR enterprise in order to improve it.

What are the Boundaries of an Enterprise?

- The enterprise boundaries need to be identified: Definition is contextual
- Core enterprise: Entities tightly integrated through direct or partnering agreements.
- Extended enterprise: From customer's customer to supplier's supplier.



Who Are The Enterprise Stakeholders?



"Any group or individual who can affect or is affected by the achievements of the organization's objective"

Freeman, *Strategic Management: A Stakeholder Perspective*, Pittman, 1984

Stakeholder Value

"Value - how various stakeholders find particular worth, utility, benefit, or reward in exchange for their respective contributions to the enterprise."

Murman et al., *Lean Enterprise Value*, Palgrave, 2002

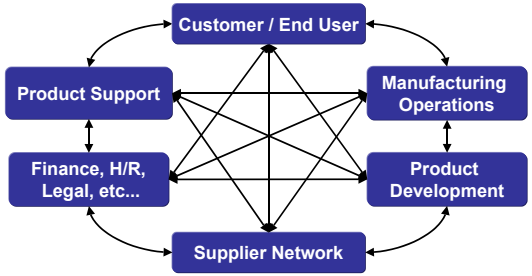
Value Expected from the Enterprise

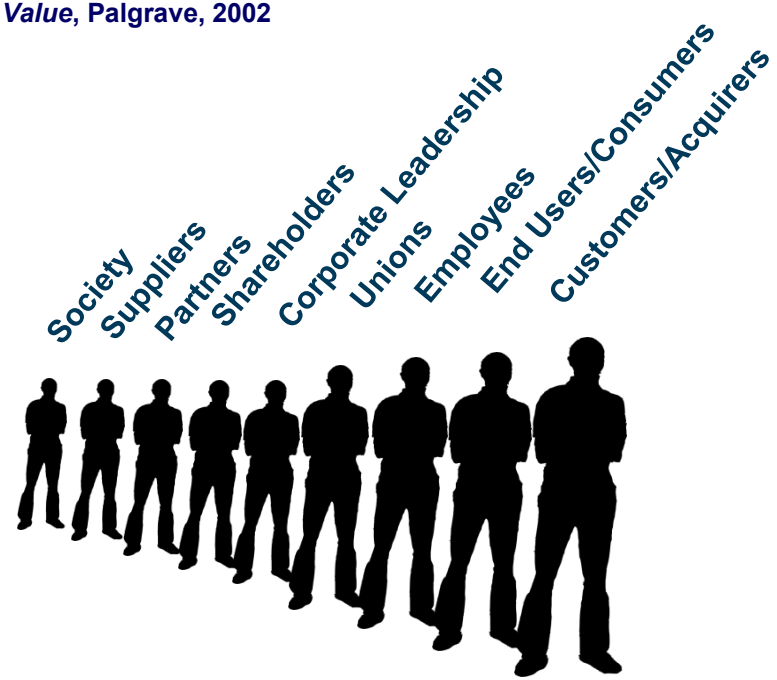
Value Contributed to the Enterprise

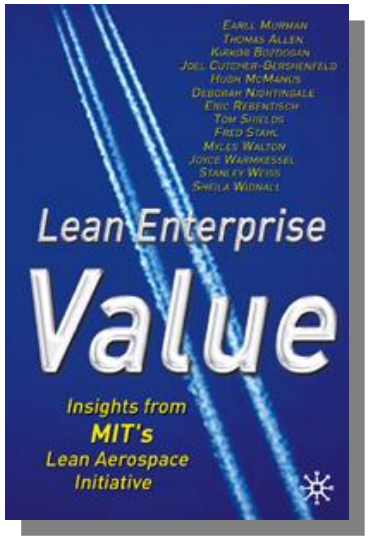
What is A Lean Enterprise?

"A lean enterprise is an integrated entity that efficiently creates value for its multiple stakeholders by employing lean principles and practices."

Murman et al., *Lean Enterprise Value*, Palgrave, 2002

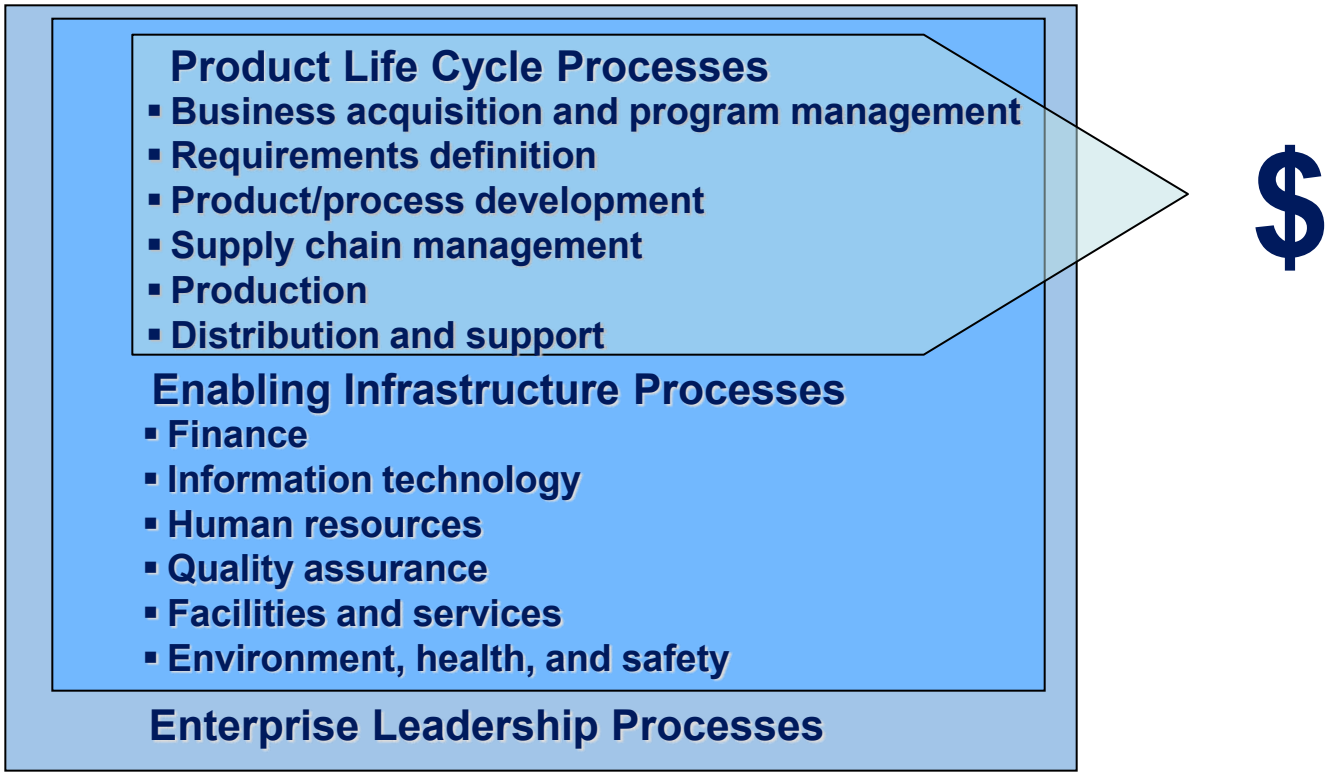






Courtesy of Earll Murman and Palgrave Macmillian, http://www.palgrave.com/

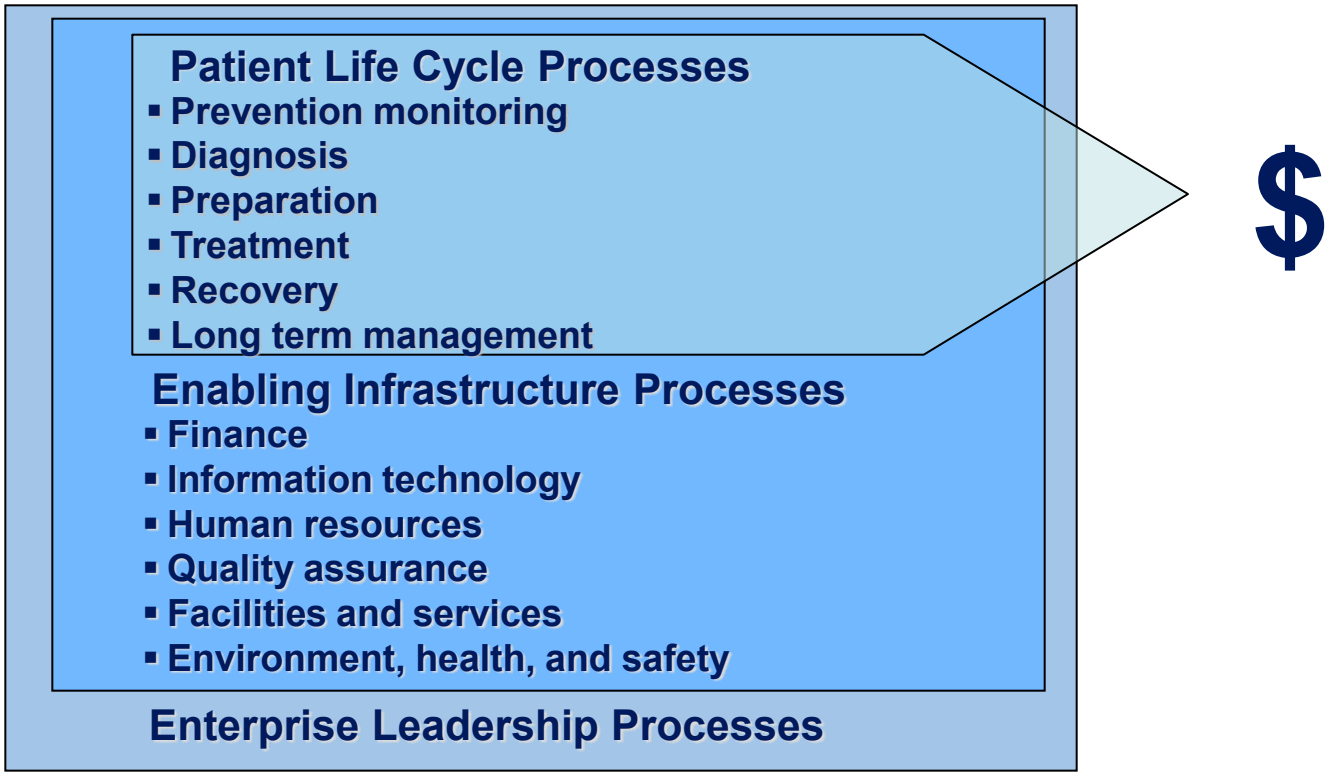
Lean Applies to All Product Enterprise Processes



Lean applies to production and all other life cycle processes that deliver value to the customer and revenue to the enterprise

Lean also applies to enabling infrastructure and enterprise leadership processes required to deliver program value

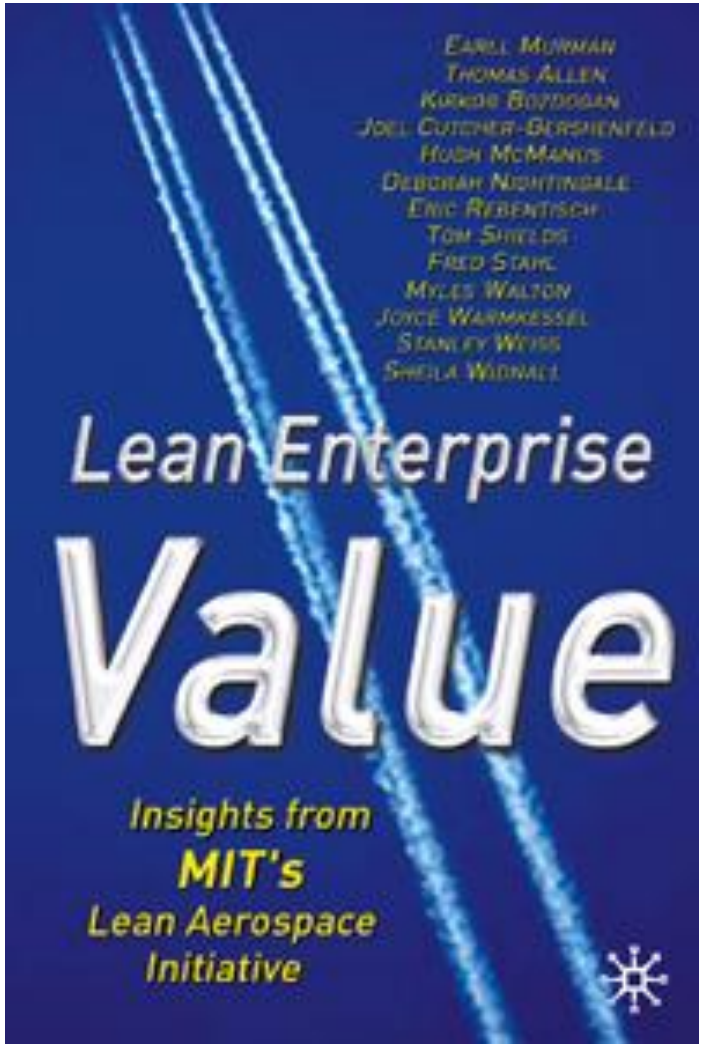
Lean Applies to All Healthcare Enterprise Processes



Lean applies to treatment and all other life cycle processes that deliver value to the customer and revenue to the enterprise

Lean also applies to enabling infrastructure and enterprise leadership processes required to deliver program value

Lean Produces Results in Aerospace



Courtesy of Earll Murman and Palgrave Macmillian, http://www.palgrave.com/.

In 1992 US Air Force asked:

Can the concepts, principles, and practices of the Toyota Production System be applied to the military aircraft industry?

Today we can say:

Yes…

…if Lean is focused on *enterprise value* creation

F/A-18E/F Super Hornet
"An Evolving Lean Enterprise"

Requirements

- 25% greater *payload*
- 3 times greater ordnance *bringback*
- 40% increase in unrefueled *range*
- 5 times more *survivable*
- Designed for future *growth*
- Replace the A-6, F-14, F/A-18 A/B/C/D
- Reduced support costs
- Strike fighter for multi-mission effectiveness

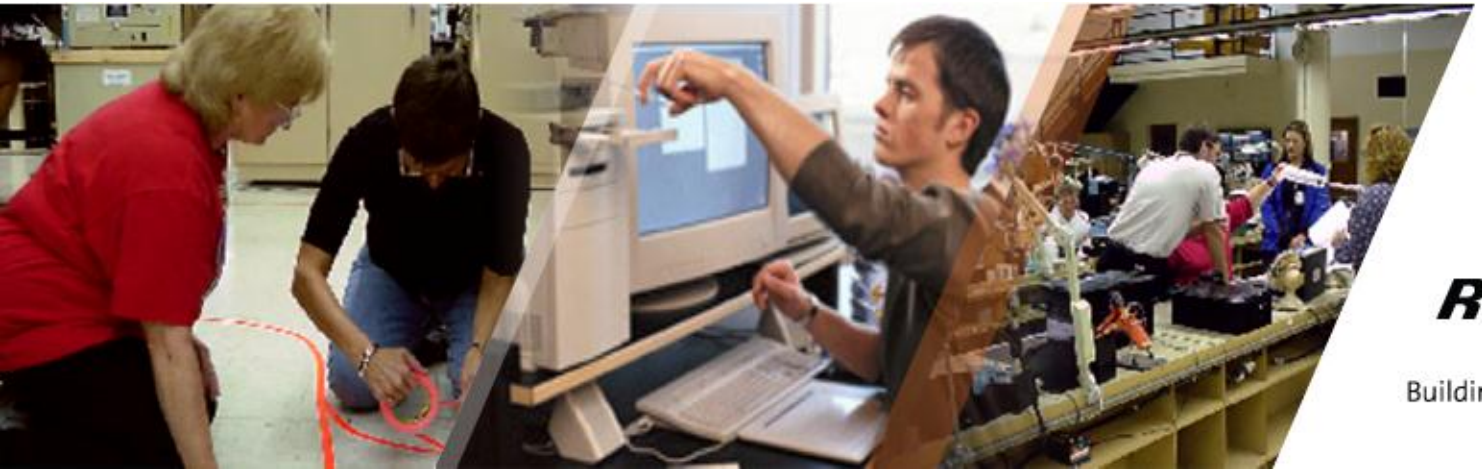
Program Execution

- Development budget capped at $4.88B
- Completed on schedule - 8.5 years from "go-ahead" to IOC
- Program was never re-baselined
- *High correlation of program management practices and LAI's Lean Enterprise Model*

Highly capable across the full mission spectrum

Adapted from 2000 slide provided by F/A-18E/F Program .

Lean Electronics: Our Operating Philosophy



Rockwell Collins
Building trust every day

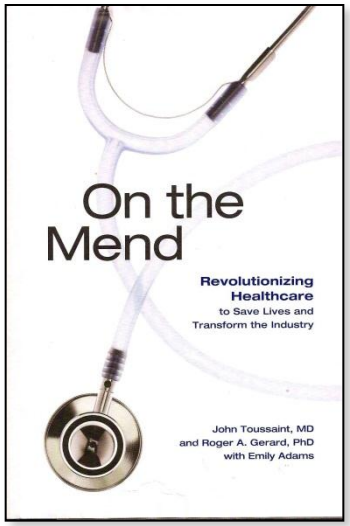
Results In the Office:

- Reduced Publishing Cycle Time 72%
- 70% Work In-Process Reduction
- 38% Productivity Improvement
- 77% Manuals Inventory Reduction

Results In the Factory:

- 25% Improvement in Productivity
- 46% Reduction in Inventory
- Cycle Time Reductions of up to 75%

Lean Produces Results in Healthcare



Courtesy of Lean Enterprise Institute.
Used with Permission.

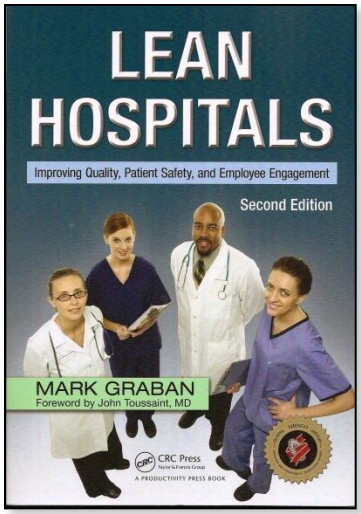
A few of many examples

Waiting time for orthopedic surgery reduced from 14 weeks to 31 hours (from first call to surgery) – *ThedaCare, WI*

48% readmission rate reduction for COPD patients - *UPMC St. Margaret Hospital, PA*

$180M capital spending cost avoidance from lean improvements – *Children's Hospital, WA*

72% reduction in lab results turnaround time from 2004-2010 without addition of head count or instrumentation – *Alegent Health, NE*



Courtesy of Mark Graban.
Used with Permission.

Lean Produces Results in Other Sectors

new balance

Metric	Pre Lean	Lean	Change
Work in Process Time	8 days	3 hours	- 98%
Value Added Time	0.2 %	12.8%	+ 6400%
Inventory Turns	3.5	13	+ 371%
Order to Ship time		1-3 days	
Floor space	2 floors	1 floor	- 30%
Annual Production	105K	155K	+ 48%

Sources: LAI EdNet New Balance Plant Tour Video, 2008. LEI "For Athletic Shoe Company the Soul of Lean Management is Problem Solving", Chet Marchwinski 2008

Photos by Earll Murman

Kanban - A Lean Tool

- Kan(card) + ban(signal)
- Visual cuing system to indicate material, parts, and/or information is/are authorized to move downstream
- Examples

www.glovia.com/pdf/datasheets/GloviaKanban.pdf

Other Examples

- Empty parts bin with spaces for predetermined parts
- Marked open space on production floor
- Marked line on storage rack
- Empty inbox in engineering

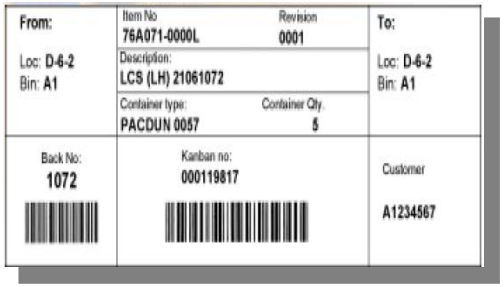
A card signaling replenishments of material are needed.

Courtesy of Glovia. Used with permission.

Adapted from: Hovav, M, Khattar, S, Katzen, J, "Kanban/Supply Chain Sequencing", Presentation to MIT ESD.60 Lean/Six Sigma Systems. Summer 2004

Lean is a "Journey" Not a "State"

- It took close to 30 years for Toyota to develop all of the aspects of the Toyota Production System (TPS), including the lean thinking that goes with that system.
- Consider the kanban
  - 1950s – First kanban experiments
  - 1960s – Kanban introduced company-wide
  - 1970s – Kanban distributed across suppliers
- And Toyota continues to develop and perfect the TPS, and to share their knowledge with others



www.glovia.com/pdf/datasheets/GloviaKanban.pdf
Courtesy of Glovia. Used with permission.

Adapted from: Hovav, M, Khattar, S, Katzen, J, "Kanban/Supply Chain Sequencing", Presentation to MIT ESD.60 Lean/Six Sigma Systems. Summer 2004

Question

How long do you think it might take your company to to implement lean thinking across their enterprise, starting with the knowledge now available from Toyota and others?

- 20 years
- 10 years
- 5 years
- 1 year

Hold up the colored 3 x 5 card of your choice

WELCOME
to
The Start of
Your Lean Journey!

Take Aways

- Lean six sigma practices emerged from the Japanese auto & US electronics industries
- 6S is a simple and effective lean tool
- Lean thinking applies across an enterprise
- An enterprise has a core and extended boundaries, and many stakeholders.
- Lean has been successfully demonstrated in aerospace, healthcare, and other enterprises
- Lean is a “journey” not a “state”

Lean Academy

What is the most important thing you learned from this module?

Write a short answer on a 3 x 5 card

Reading List

Dertouzous, M.L., Lester, R.K. and Solow, R.M., *Made in America: Regaining The Productive Edge,* MIT Press, Cambridge 1989

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Acknowledgements

Contributors

- Hugh McManus – Metis Design
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