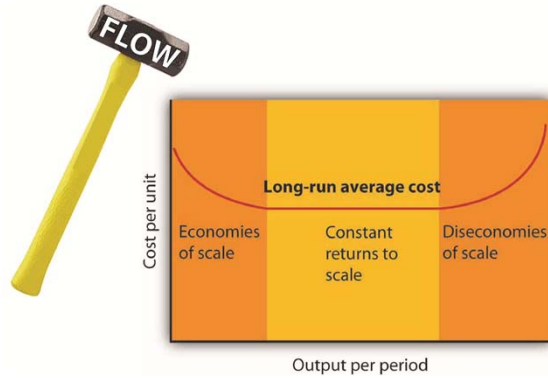


How Flow Destroys Economies of Scale

Creating a More Financially Stable Organization

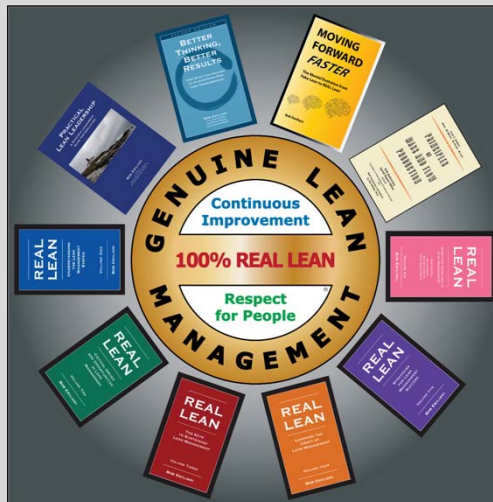


Professor Bob Emiliani
 Central Connecticut State University
 emilianibob@ccsu.edu

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Source: <http://www.flatworldknowledge.com/pub/1.2/principles-economics/31812web-31862>

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Today's Talk

Key Take-Aways

- **The Limitations of Economies of Scale**
- **How Economies of Scale is Inconsistent with Lean Thinking**
- **Why Flow Greatly Diminishes the Effect of Economies of Scale**
- **Specific Actions to Take to Reduce or Eliminate Reliance on Economies of Scale**

Ohno's Seven Wastes



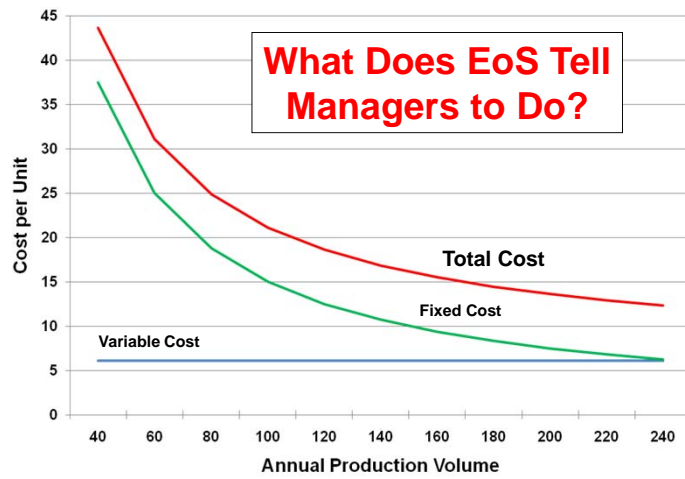
- **Overproduction**
- **Waiting**
- **Transportation**
- **Processing**
- **Inventory**
- **Movement**
- **Defects**

**Which is the
Greatest Waste?**

**“The greatest waste of all
is excess inventory.”**

T. Ohno, *Toyota Production System*, 1988, p. 54

Economies of Scale



**Thank You For Attending
My Talk Today!**



Going Back in Time

Adam Smith, Charles Babbage, Whatley Cook-Taylor

Production Costs Were Lowered by

- Division of Labor and Differential Pay
- Process Improvements
- New Machinery
- Free Trade & Law of Comparative Advantage

No Mention of “Economies of Scale.”

Going Back in Time

John Stuart Mill

“The larger the scale on which manufacturing operations are carried on, the more cheaply they can in general be performed. Mr. Senior [in 1836] has gone the length of enunciating as an inherent Law of manufacturing industry, that in it increased production takes place at a smaller cost, while in agricultural industry increased production takes place at a greater cost. I cannot think, however, that even in manufactures, increased cheapness follows increased production by anything amounting to a law. It is a probable and usual, but not a necessary, consequence.”

Calculations that Confirm Biases Become Law
e.g. Managers' Duty is To Reduce Costs, Increase Profits, Grow the Business, Increase Market Share, Increase Stock Price, etc.

Going Back in Time

Observations of Political Economists

Siloed B&Q Processing and Siloed Cost Accounting Gives Impression that Costs Always Decline as Volume Increases

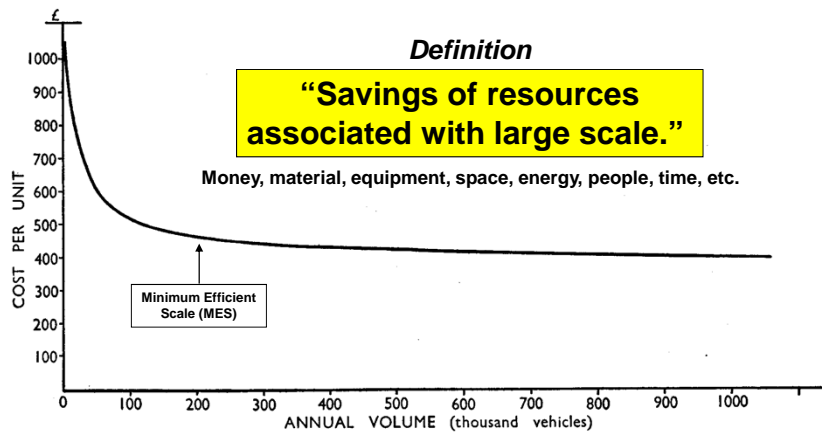
Political Economists Thought in Terms of Discrete Processing, Not Value Streams



Economies of Scale Becomes Prevalent in the Economics Literature Post-1900

What is “Economies of Scale?”

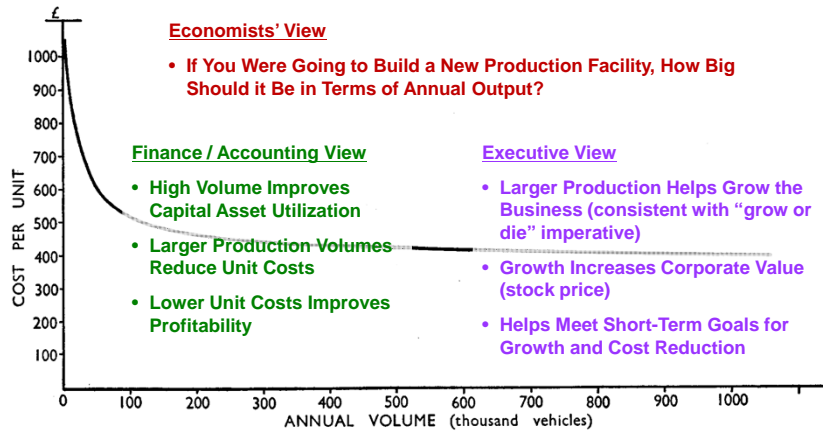
Technical Economies of Scale



G. Macey and A. Silberman, *The Motor Industry*, George Allen & Unwin Ltd, London, U.K., 1959, p. 94 (Figure 2).

Different Views

Economies of Scale



G. Macey and A. Silberman, *The Motor Industry*, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2).

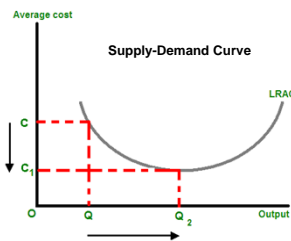
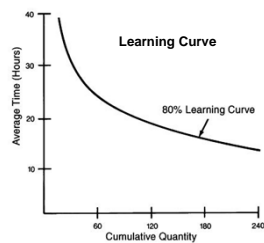
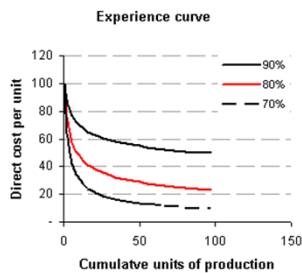
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Related Models



Running the Business Using 8th Grade Math

**Production is n -Dimensional...
How Can Unit Cost Depend Only on Volume?**

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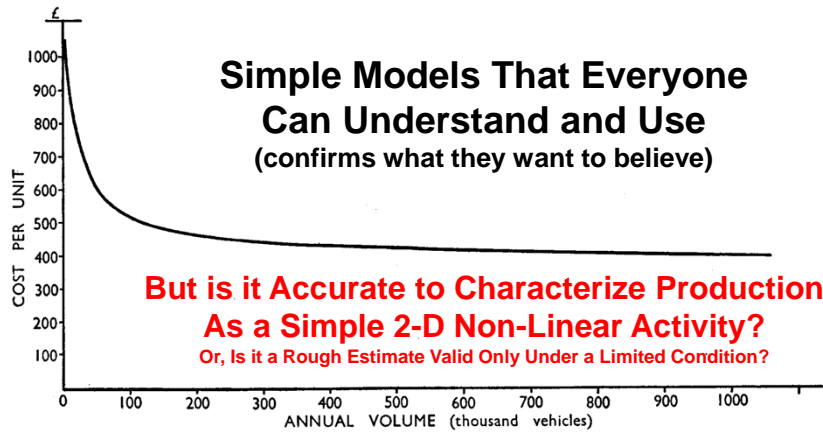
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Source: http://en.wikipedia.org/wiki/Experience_curve and <http://www.artisars.com/topic/experience-curve-effects>

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Managerial View



G. Macey and A. Silberman, The Motor Industry, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2).

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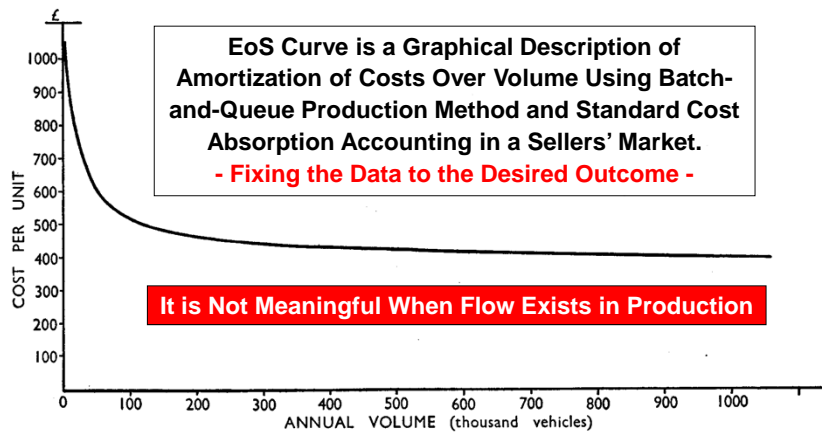
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Economies of Scale

The Wrong Way to Think



G. Macey and A. Silberman, The Motor Industry, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2).

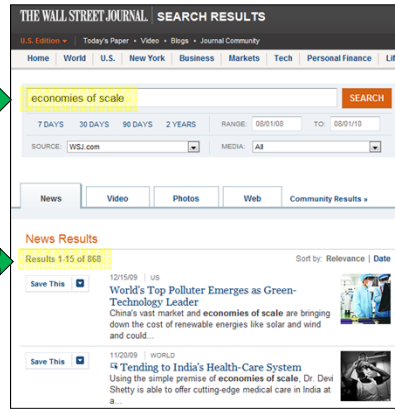
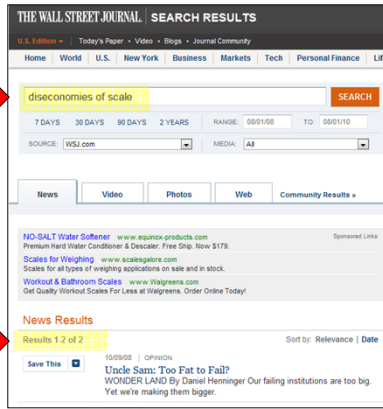
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Diseconomies of Scale

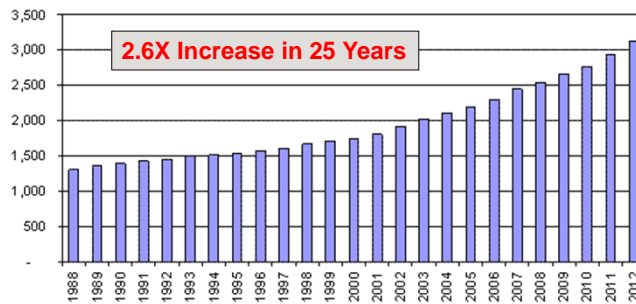


**Should be Very Suspicious of Something Presented as All Upside and Virtually No Downside
Ponzi Scheme, Reverse Auctions, Outsourcing/Offshoring, Financial Derivatives**

Economies of Scale

Example: Container Ship Capacity

Twenty Foot Equivalent Units Per Ship



Source: The Containership Market 2008
www.brs-paris.com
BRS - Alphaliner

Economies of Scale

Example: Container Ship Capacity



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Image source:
http://i0.godaddy.com/uk/photos/6525/652592_042a236.jpg
and
http://www.maerskline.com/ir/ir/?page=boats&cat=ships_norw/photo_archive/vesa11

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Economies of Scale

Supply Dyad



Example: Container Ship Capacity

“It’s Simple Economics...”

**Classic Example of Lowering Unit Cost
But Increasing Costs Elsewhere**

- Dock Expansion
 - Deeper Port Channels
 - Bigger Tug Boats
 - More Terminal Land for Containers
 - Expand Rail Infrastructure
-
- Expand Road Infrastructure
 - More Workers (current and future liabilities)
 - More Computing Capacity
 - More Capital Equipment
 - More Credit to Finance

“Simple Economics” Leads to Complex Costly Problems

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The Pioneers...

of Flow Production (to Meet Demands of **Buyers' Markets**)

Frank Woollard
Morris Motors



1883-1957

Taiichi Ohno
Toyota

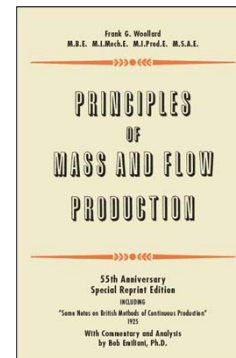


1912-1990

Woollard's Words

"The managers of concerns that have only short runs of work are usually under the impression that flow production can hold no interest for them and that batch production is the only method suited to their needs... Progressive firms are finding there are many useful lessons to be learned from flow production techniques which can be applied to small outputs and that when this is done a very near approach will be made towards achieving flow production costs." (p. 42)

"In general, the aim is to produce goods more economically and more quickly with less stress or strain on the producers than that which is inherent in the older methods." (p. 50)

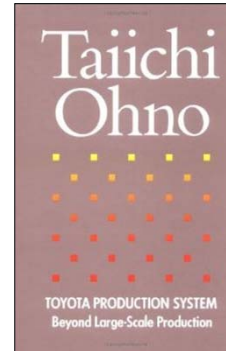


Ohno's Book

"The subtitle to Taiichi Ohno's book *Toyota Production System: Beyond Large-Scale Production* in Japanese is 脱規模の経営をめざして and would be better translated as:

'Aiming for Non-Scale Management' or
'An Escape From Scale-Based Management' or
'Towards Management Not Based on Scale.'

Ohno was clearly saying the Toyota Production System is a way out of scale or volume-based production." – Jon Miller, Gemba Kaizen

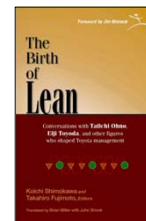


Ohno's Words

"In the automobile industry, the Maxcy-Silberston curve has been used frequently. According to this principle of mass production... the cost of an automobile decreases drastically in proportion to the increase in quantities produced. This was proved thoroughly in the era of high growth [sellers' market] and the principle has become embedded in the minds of people... In today's slow-growth era [buyers market], we must downplay the merits of mass production as soon as possible... such a [large lot size] production system is no longer appropriate for our needs." (p. 2)

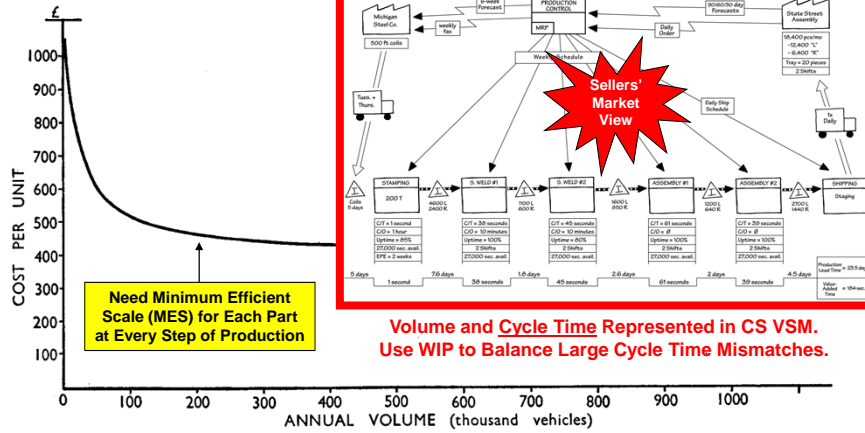


"An increase in production volume shouldn't necessarily mean a decline in unit costs any more than a decline in volume should mean an increase in unit costs. Those sorts of things happen as the result of arranging things poorly." (p. 53)



Economies of Scale

Reflect Batch-and-Queue Processing and Standard Cost Accounting



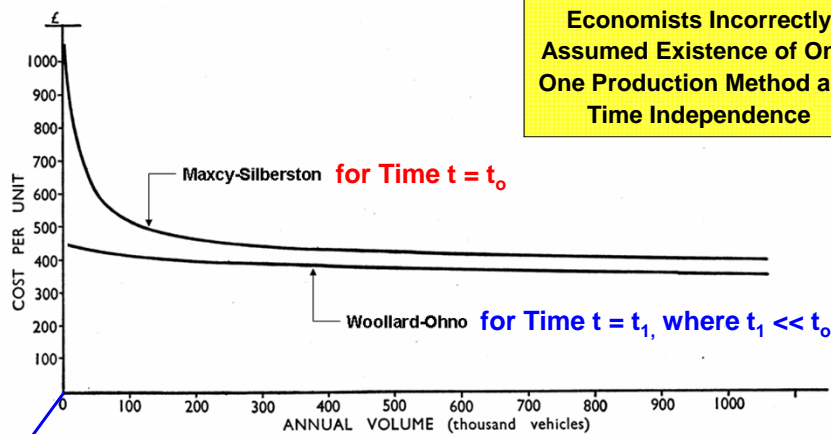
G. Maxcy and A. Silberston, *The Motor Industry*, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2).

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VSM Image Source: LEI
A. Silberston, "Economies of Scale in Theory and Practice,"
The Economic Journal, Vol. 62, No. 255, March 1952, pp. 368-391

Importance of Flow Production

Scale Cost Curve vs. Flow Cost Curve

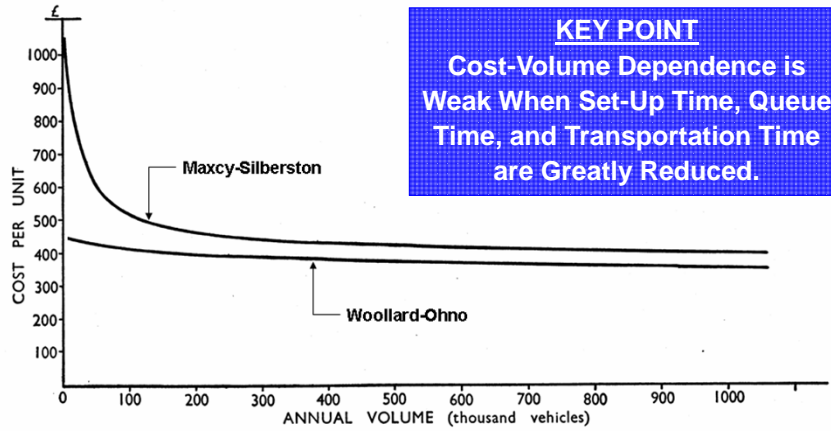


Adapted from G. Maxcy and A. Silberston, *The Motor Industry*, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2), by Bob Emiliani, www.theobtm.com, 2009

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Importance of Flow Production

Scale Cost Curve vs. Flow Cost Curve



Adapted from G. Maxcy and A. Silberston, *The Motor Industry*, George Allen & Unwin Ltd., London, U.K., 1959, p. 94 (Figure 2), by Bob Emiliani, www.theobm.com, 2009

EOS vs. Flow Production

Different Views

Neo-Classical Economist

- Standardization of Products, Parts, Processes, etc., Enables Economies of Scale (cost savings)
- Need High Volumes to Make Converting to Flow Worthwhile
- Specialized Machinery Results in Higher Volume
- Increased Productivity the Result of Increased Output
- Efficiency Not Worth Pursuing if Volumes are Small
- **Cost is Independent of Process**
- Economies of Scale Dictate Management's Actions (sellers' market view)
- Product Differentiation is Bad Because Volumes Remain Small Which Limits Economies of Scale
- Need High Sales to Mfg Efficiently

Progressive Operations Manager

- Standardization Enables Flow (faster throughput + lower costs)
- Flow Reduces Costs at Any Volume
- Machinery Can Assist Achieving Flow
- Increased Productivity the Result of Change in Method (what IEs do)
- Flow Improves Efficiency at Low Volumes
- **Cost is Strongly Dependent on Process**
- Customers Dictate Management's Actions (buyers' market view)
- Product Differentiation is Good; Reflects Customer Wants & Needs. Must periodically Reduce Variety.
- Mfg Efficiency Independent of Sales (aaaabbbc)

EOS vs. Flow Production

Economist's View vs. Operations View

**Managers Listen to Economists/Finance
Over (Lean) Operations People**

Economists Downplay and Ignore Diseconomies of Scale:

**Cost Curve is Not "Well-Behaved" if
Diseconomies of Scale are Considered.**

Managers Completely Ignore Diseconomies of Scale

Savings of Resources?

**Behavioral
Economics**

Results of Economies of Scale...

Production

- More Inventory Between Steps Number of Products Increases
- Bigger, More Expensive Equipment that Produces Faster than Can Be Subsequently Processed (overproduction)
- Play Earned Hours Metric Games
- Silos Created; Information Compartmentalized & Sits in Queue

Purchasing

- Over-Buy to Obtain Lower Unit Price
- Under-Buy to Save Money (perhaps losing sales)
- Pressure Suppliers to Reduce Unit Prices; Suppliers Retaliate with Higher Prices on New Items
- Play PPV Metric Games

Savings of Resources?

Results of Economies of Scale...

Finance

- Borrow Money at Lower Cost, But Pay Interest and Fees
- Debt Financed With Assets (increased risk)
- Low Unit Costs but Make Products Not Needed (Dollar Stores)
- Cut or Slow Down Growth of Wages and Benefits

Organizational Behavior

- Heroes & Favoritism
- Knowledge & Learning Among Workers Less Important
- Organizational Politics Becomes Dominant
- Slow to Recognize Problems and Make Decisions

Low Unit Costs But Higher Total Costs
In Part Due to Zero-Sum Behaviors by Managers

What Woollard-Ohno Learned

**Economies of Scale
Inconsistent with Lean**

**Yet Managers Love the Simple Concept and Simple
Curve, But are Unaware of the Many Qualifications
and of Diseconomies of Scale**

...And are Unaware of Flow

One More Thing...

Managers Say:

“Every cost element a company faces needs to be examined.”

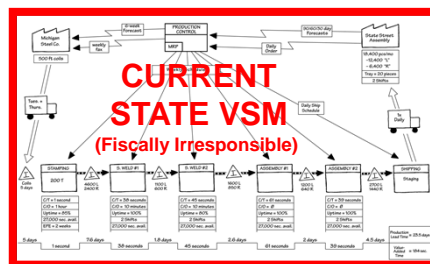
Managers Should Instead Say:

“Every process a company uses needs to be examined.”

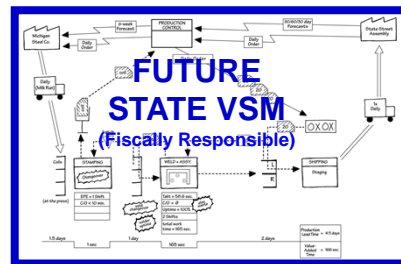
Costs are Subordinate to Processes

EoS is For Sellers' Market

Supply-Side Microeconomics (Neo-Classical Economics)



Demand-Side Microeconomics (Keynesian Economics)



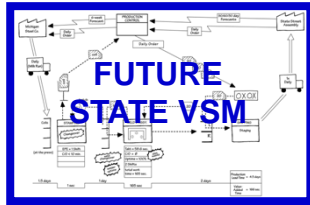
Is Supply Really the Key to Economic Prosperity?
Yes, According to (Sellers' Market) Absorption Accounting

Toyota is 90% Demand and 10% Supply-Side

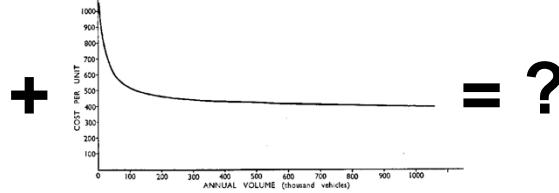
EoS Will Cause Confusion

...As You Strive to Become Lean

Demand-Driven Production
 "Make Only What We Can Sell"



Supply-Driven Production
 "Make More to Absorb Overheads
 and Lower Unit Costs"



**Creates Immense Confusion and
 Leads to Bad Decision-Making**

Economies of Scale



Example: Your Company

"It's Simple Economics..."

Lowling Unit Costs But Increasing Costs Elsewhere

- | | |
|--|---|
| <ul style="list-style-type: none"> • Expensive Capital Equipment • Service Contracts • Larger Inventories • Inventory Management • Find More Distributors (and offer deals) • Sales Incentives (sales force and customers) | <ul style="list-style-type: none"> • Supplier's Inventories • Obsolete Materials • Delays and Rework • More Training Expense • More Workers (current and future liabilities) • Top Tier Consultants and Attorneys |
|--|---|

"Simple Economics" Leads to Complex Costly Problems

Why is EoS Attractive to Mgrs?

What Drives Reliance on EoS Magic?

- **Over-Engineering Products and Services & Inability to Design to Market Price = High Unit Cost**
- **High Labor Costs Due to Over-Hiring (not due to high wages!)**
- **High Fixed Costs Due to Over-Specifying Capital Equipment**
- **Batch-and-Queue Processing**
- **Standard Cost Accounting (amortizations)**
- **Inability / Lack of Desire to Question Things... to Ask Why?**
(and punishment if you do)
- **Appeal of Simple “Lever” to Fix Business Problems (Cost, Growth)**
- **Discouraging Creativity and Innovation (Blame)**

How to Reduce Reliance on EoS

- **Design Products and Services to Market Price**
 - Use Target Costing Process
- **Flow Processing (reduce set-up, queue, & transportation time)**
- **Eliminate EoS, Learning Curves, Experience Curves, etc.**
From Your Thinking - Focus on Time, Not Quantity
- **Don't Over-Hire... But Do Increase Wages**
- **Right-Size Capital Equipment**
- **Lean Accounting**
- **Encourage Creativity and Innovation – Kaizen (No-Blame Environment)**
 - Question Things... Ask “Why?” Every Day

Summary

- **EoS is Widely Misunderstood** (by managers, economists, etc.)
- **Use is Limited to Sellers' Market, B&Q Processing, and Standard Cost Accounting (Unit Cost Focus)**
- **EoS Ignores Diseconomies of Scale**
- **EoS Inconsistent with Lean Thinking**
 - Take it from Woollard and Ohno (not economists or finance pros)
- **Flow Flattens EoS Curve, So Forget About EoS!**
- **Start Taking Actions to Eliminate EoS Thinking**
(reduced risk and debt increases financial stability)

EoS Concept Not Useful to Managers

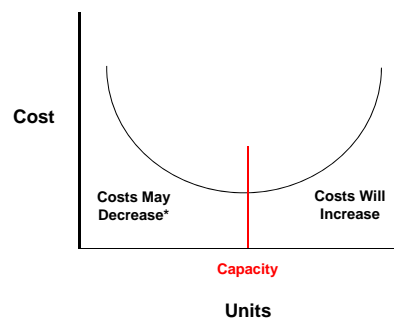
Please Remember This...

Ohno's Operations Perspective (*Workplace Management*, 1988)

“Because you have a warehouse now, you continue making things according to calculations that show it is cheap to produce unsalable products.” (p.35)

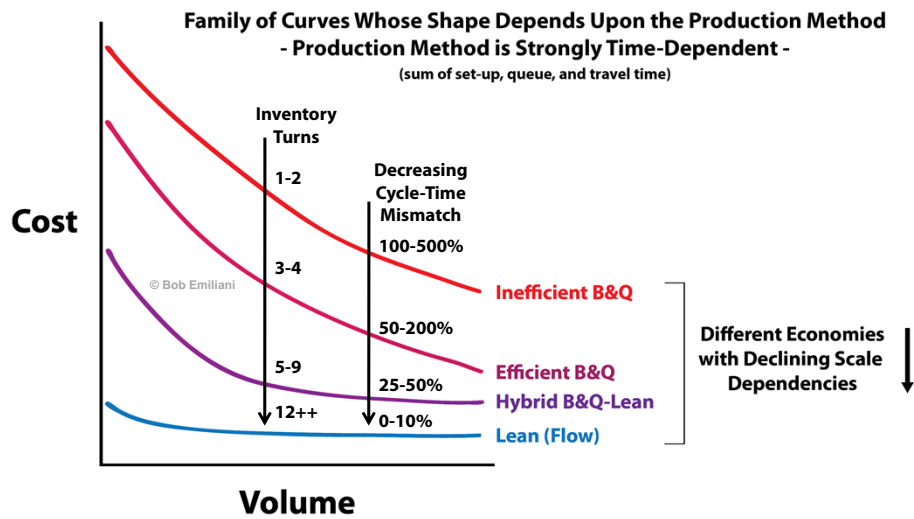
Read Chapter 10, pp. 38-40

Take “warehouse” to mean any place you can put material: warehouse, intra-company warehouses, JV partner, distributors, re-sellers, in-transit, auctioneers, liquidators, retailers, etc.



* Depends if products are salable and if things are arranged poorly.

Please Remember This...



Please Remember This...

B&Q and Lean are Different Economies Due to TIME!

Batch-and-Queue
 (Sellers' Market - Have Lots of Time)

- Standard Costs
- Earned Hours
- Purchase Price Variance
- Economies of Scale
- Machine Utilization
- Economic Order Quantities
- Labor Clocking
- Annual Budgeting

Lean
 (Buyers' Market - Have Little Time)

- Actual Cost
- Time (TT, CT, LT)
- Actual Price
- Flow
- Quantity / SWIP
- Units per Hour
- Value Streams
- Rolling Budgets

Don't Mix Up the Two!