Building a competitive manufacturing sector: How MEP could help

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National Academy of Sciences

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Agenda

- The competitiveness of small manufacturers
  - Why should we care?
  - Two futures: low road and high road
- Why it's hard for small manufacturers to improve
  - Complementarities and externalities
- What MEP could do

Why should we care?

- Because of outsourcing, many large manufacturers depend on SME's
  - 1/3 of US auto supply employment is in firms <500 employees
    - ~ 1 million of 12 million *total* US mfg jobs
    - Ag equipment, aerospace, other supply chains also have significant SME participation

Case Western Auto Supply Chain Study

- Interviews with 30 firms (summer/fall 2010)
  - Tier: First and second
  - Employment: 50 to 50,000
  - Customers: Detroit 3, Honda, Nissan, Toyota, BMW
- Confidential survey of suppliers in US
  - Includes all tiers, foreign-owned
  - Endorsed by PMA, OESA; Funded by Dept. of Labor
  - 1400 responses (about 25%; 30% for firms < 500 emp)

This talk: small, lower-tier suppliers

- Key for viability of auto supply chain
  - firms <500 employees account for > 1/3 of employment in the auto supply chain

Two Futures for US manufacturing

- High-road
- Low-road
- We see evidence of both

“High-road” mfg can be win/win/win

- In “high-road” production, well-paid workers make cost-effective, sustainable products for consumers, and profits for owners
  - *How?*
    - High road techniques harness everyone’s knowledge—not just top executives’ -- to achieve innovation, quality, and variety
    - Example: “agile production”
      - Firms design, set up, produce a variety of products quickly
      - Because product mix changes constantly, a fixed division of labor not practical

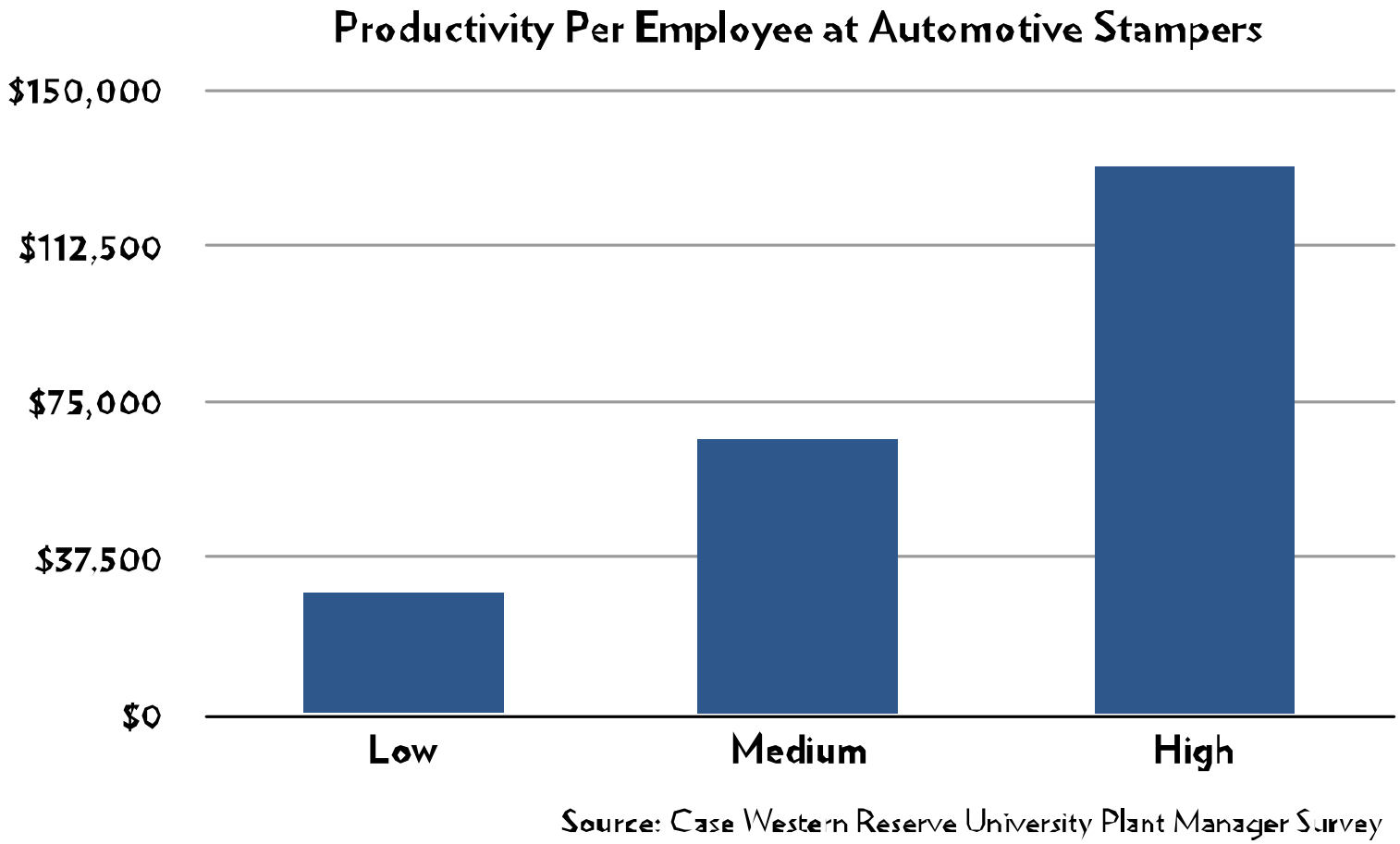
Low-road

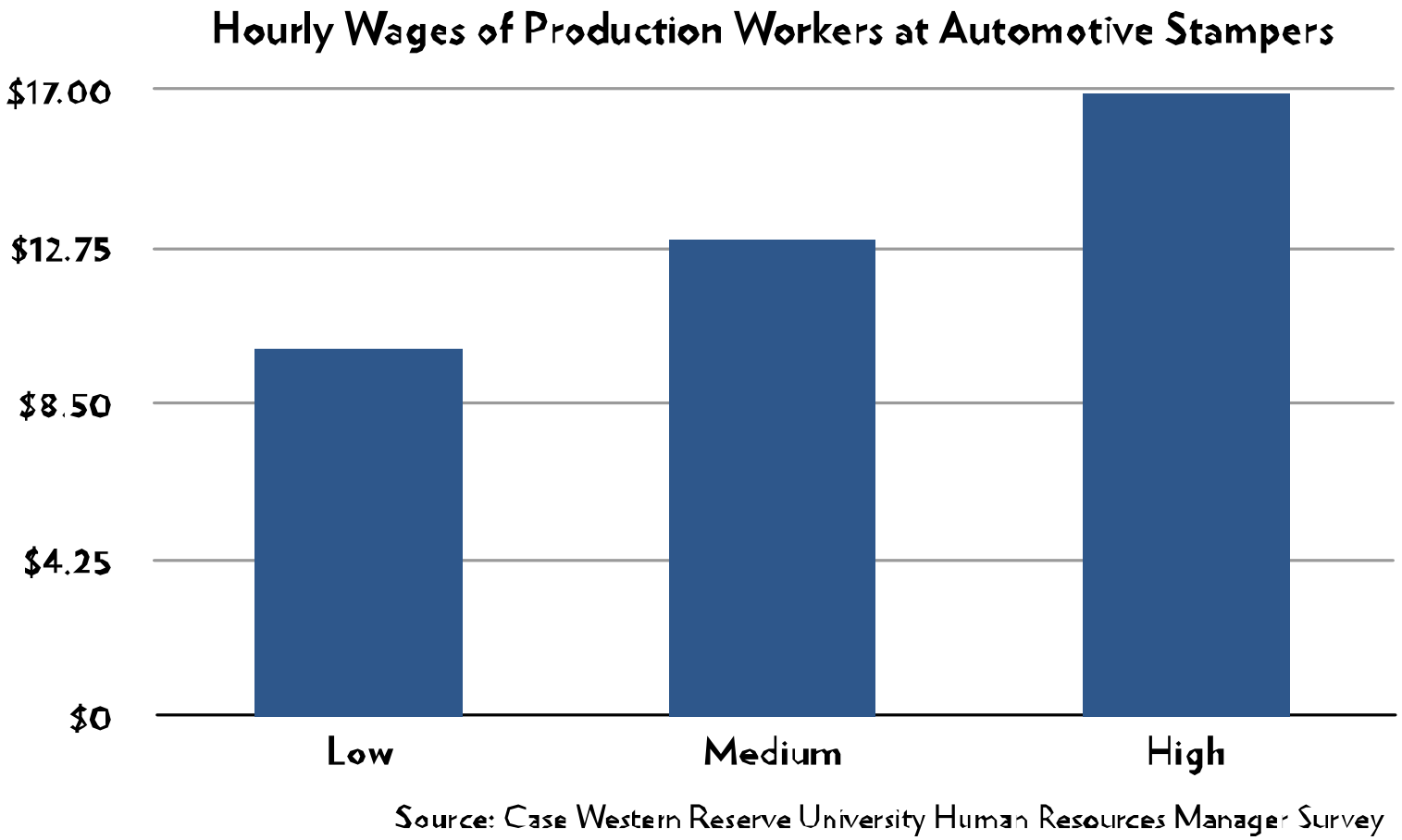
- Each company in the chain tries to profit by squeezing those below them
  - Cost-shifting rather than value-maximizing
  - ‘our hands are tied’

Variability within industries

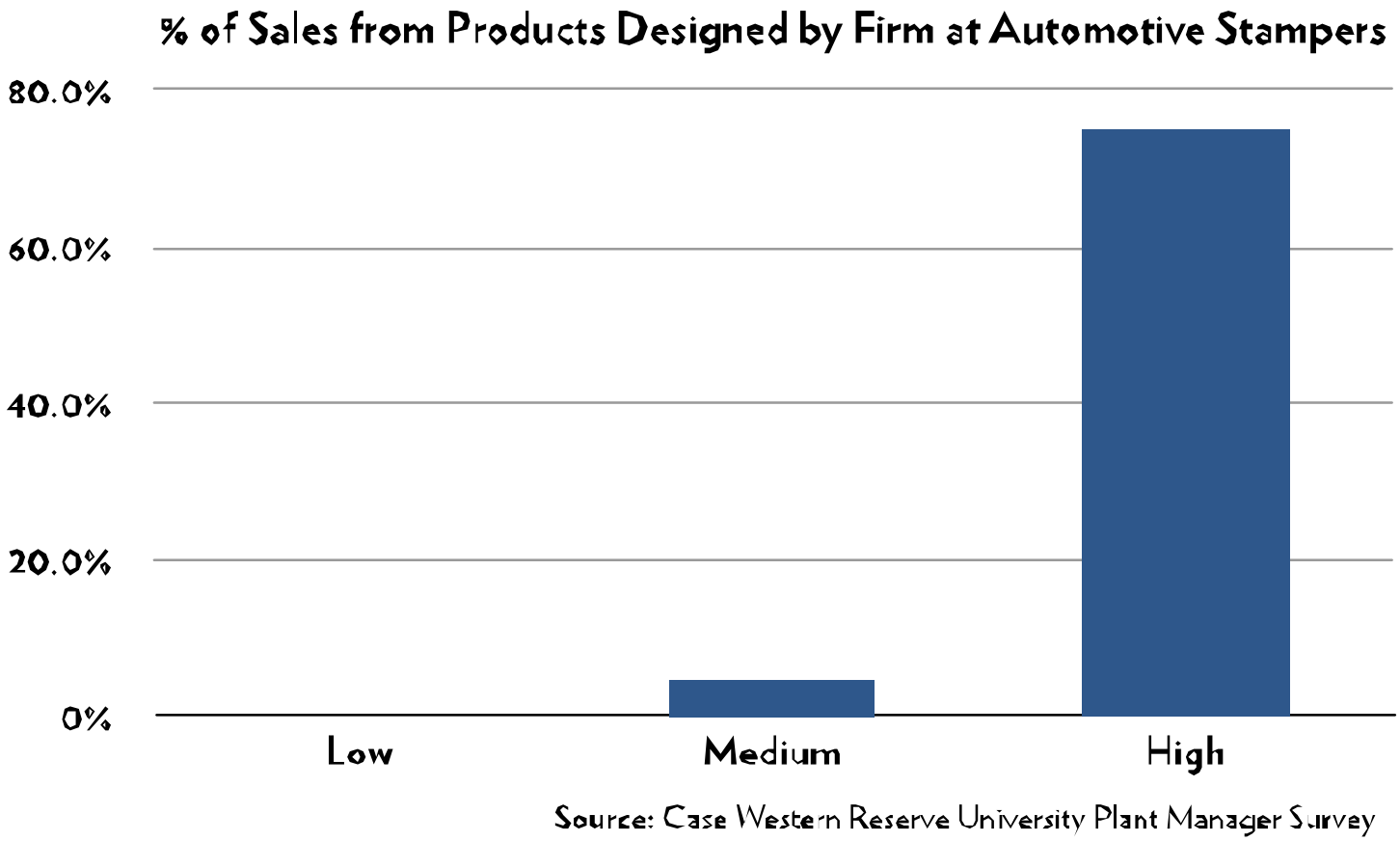
- Even within narrow industries, firms compete using different production recipes
  - With different implications for innovation and standard of living

» See also Luria and Wiarda


Productivity Per Employee at Automotive Stampers
$150,000
$112,500
$75,000
$37,500
$0
Low
Medium
High
Source: Case Western Reserve University Plant Manager Survey



Source: Case Western Reserve University Human Resources Manager Survey


% of Sales from Products Designed by Firm at Automotive Stampers
80.0%
60.0%
40.0%
20.0%
0%
Low
Medium
High
Source: Case Western Reserve University Plant Manager Survey

Quality,stabililty ➡ productivity

Sectoral variation: auto suppliers

		Percentile cutpoint				
Sector	Metric	25th	Median	75th	90th	90th vs. median
Stamping	VA/FTE*	$54,687	$74,249	$89,316	$125,177	1.7
	Good 1st time	97.00%	98.85%	99.64%	99.97%	47.3
	Employee turnover	31.6%	17.1%	8.3%	0%	infinite
Molding	VA/FTE	$36,199	$53,331	$72,492	$112,053	2.1
	Good 1st time	93.19%	96.66%	99.10%	99.46%	6.2
	Employee turnover	37.4%	31.9%	10.4%	5.5%	5.8
Machined parts	VA/FTE	$54,034	$64,012	$84,529	$112,439	1.8
	Good 1st time	94.19%	97.00%	98.80%	99.85%	20.0
	Employee turnover	46.3%	23.3%	11.7%	0.0%	infinite
Dies, molds, prototypes	VA/FTE	$59,235	$67,625	$82,117	$105,566	1.6
	Good 1st time	90.00%	95.50%	98.50%	99.40%	7.5
	Employee turnover	27.0%	17.9%	9.7%	0.0%	infinite
Machine tools	VA/FTE	$66,621	$90,271	$141,286	$226,168	2.5
	Good 1st time	88.57%	96.17%	98.80%	99.90%	38.3
	Employee turnover	37.3%	16.3%	9.1%	5.3%	3.1
Electricals/ electronics	VA/FTE	$30,567	$43,007	$69,929	$91,577	2.1
	Good 1st time	92.25%	95.41%	98.08%	99.44%	8.2
	Employee turnover	47.1%	28.3%	11.7%	5.6%	5.1

Note: Variance within sector swamps variance between sectors.
* VA/FTE = Value-added/ full-time eqivalent

SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.

Innovation benefits from shop-floor skills

- Two aspects of “lean”:
  - Resource reduction (eg JIT):
    - frees up capacity for new products
  - Continuous improvement (“kaizen”)
    - Provides distributed knowledge to speed de-bugging
    - Firms with quality circles, suggestion systems, preventive maintenance:
      - Design a greater % of their products
      - Do more R&D
      - Have faster rates of process improvement

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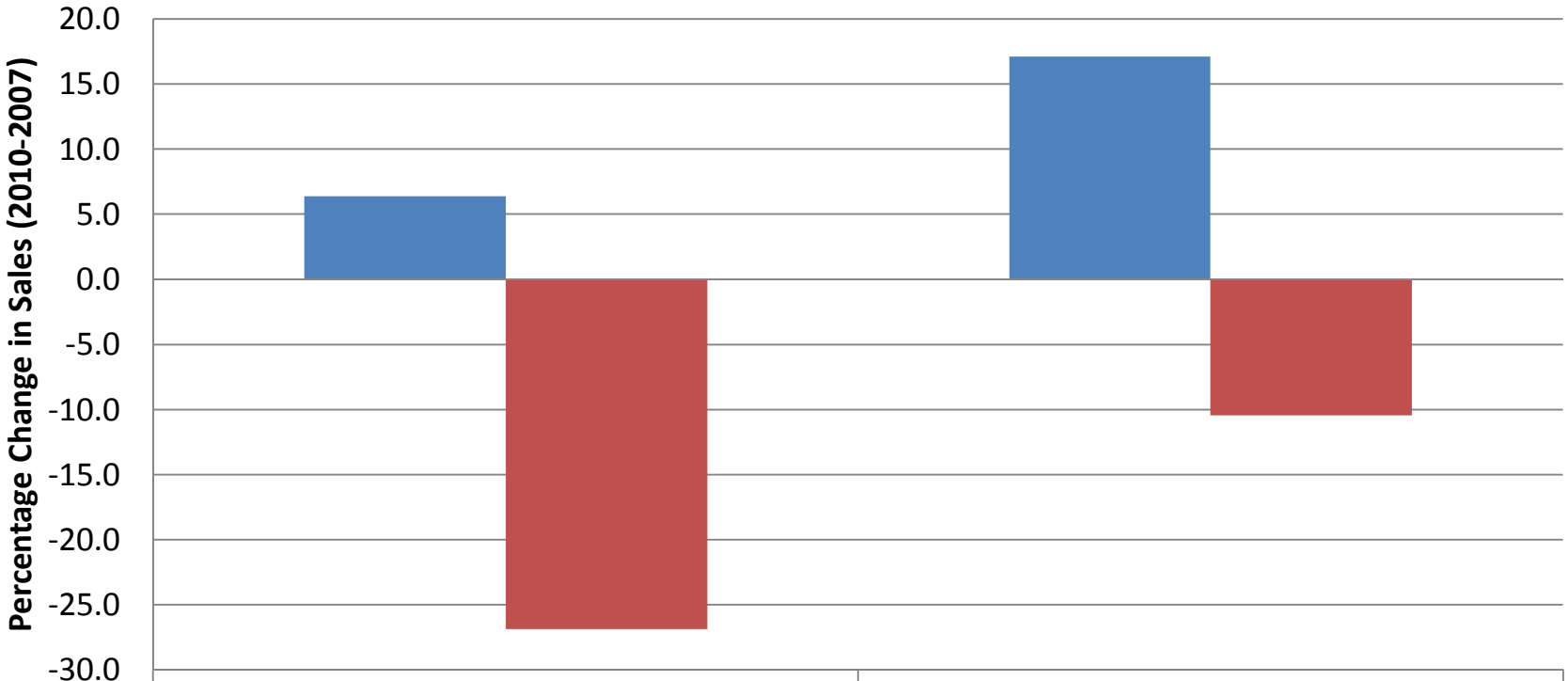
Role of “kaizen” practices

(stampers only)



	Firms where employees attend quality circle meetings	Firms that perform preventive maintenance
Yes	6.4	17.1
No	-26.9	-10.4

How do firms achieve high productivity, wages?

- Direct labor is usually only 5-15% of cost
- Higher-wage workers can reduce cost, increase revenue
  - Higher wages **à** more investment in skills
    - Allows knowledge overlap and flexibility
    - Avoids costly mistakes
      - Shut down assembly line costs $10,000 per minute
- *Despite their advantages, firms don't adopt high-road policies (by self report)*
  - *< 50% have quality circles or consistent PM*

Barriers to adoption of 'high road'

- Complementarities
  - One investment doesn't pay off without other investments—hard for a small firm to pull off
    - Agile production requires near-simultaneous investment in equipment, marketing, IT, HR
- Externalities
  - Firms don't capture benefit to customers, workers and communities of investment in high-quality products, high-wage jobs

Externalities

- Re-structuring of US manufacturing has weakened institutions for skill development
  - Outsourcing creates shared supply chains
    - Each supplier provides to several automakers
      - So automakers are tempted to "free-ride" on their rivals' investments in suppliers
    - Large companies can seek the best suppliers anywhere
  - Decline of mfg employment, unions reduces apprenticeships
- US has much to learn from other countries in governing shared supply chains
  - Germany >> Fraunhofer

MEP helps mfg w/ high road

- Helps firms with complementarities
  - one of the few sources of comprehensive diagnosis
- Helps solve problems it diagnoses
  - directly provides "lean" training
    - Should emphasize continuous improvement more
  - brokers some solutions
    - Link to information about what works
      - Help translate new technology, new management practice from universities to make usable by SME's
      - Info-sharing within clusters
    - Helps with funding to adopt

"Continuous Improvement" at MEP

- MEP can't solve all these problems by itself
- Decentralization hinders MEP efforts to serve company supply chains
  - Customer provides incentive for SME's to focus on important but not urgent task of upgrading
- MEP could learn better what works
  - Increase incentive for clients to accurately estimate impacts
  - MEP could more systematically use longitudinal data on what practices work; build support with evaluation methods like randomized treatment and control groups.

Continuous improvemet (II)

- MEP could deepen relationships with universities
  - New technologies
  - Training for field agents
  - New management techniques
    - Risk analysis
    - Total cost of ownership
    - Leadership development

backup

Two Customer Strategies

- Collaborative
  - If problem arises between customer and supplier, communicate to resolve it
    - Goal: maximize total value of supply chain, and take a share of the resulting profit
  - Result: suppliers invest
    - 2x more likely to have preventive maintenance
    - Significantly more process improvement
  - Only 11% of suppliers have such relationships with largest customer

- Cost-shifting
  - Goal: make profit by shifting costs to others, even if total value of supply chain is reduced
    - Threaten to exit from the relationship if supplier doesn't agree
  - Result: large companies push risk onto SME's
    - 80% of suppliers who design are not paid for design service
    - Suppliers hold 5x more inventory as % of sales

For SME's in supply chains

- Larger customers could help them upgrade—but often they don't.
  - Each supplier provides to several automakers
    - So automakers are tempted to "free-ride" on their rivals' investments in suppliers
  - Large companies can seek the best suppliers anywhere in the world

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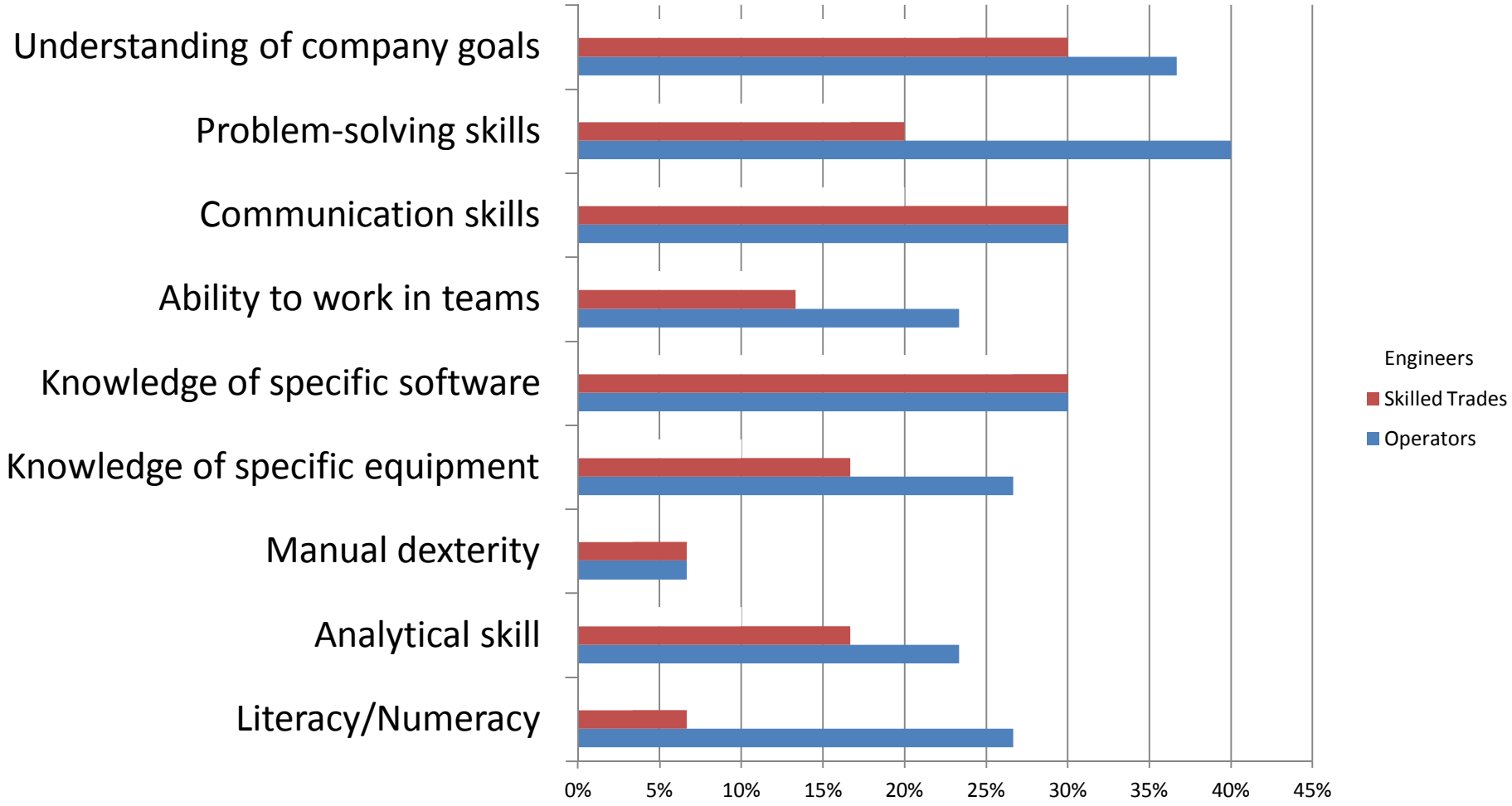
Measuring voice

- Firms that:
  - practice VA/VE with customers
  - Have contract > 1 year
  - Would receive help from customer if rival offered same product at lower price

  - 11% of firms have such relationships now
  - 29% of firms had them in 1993

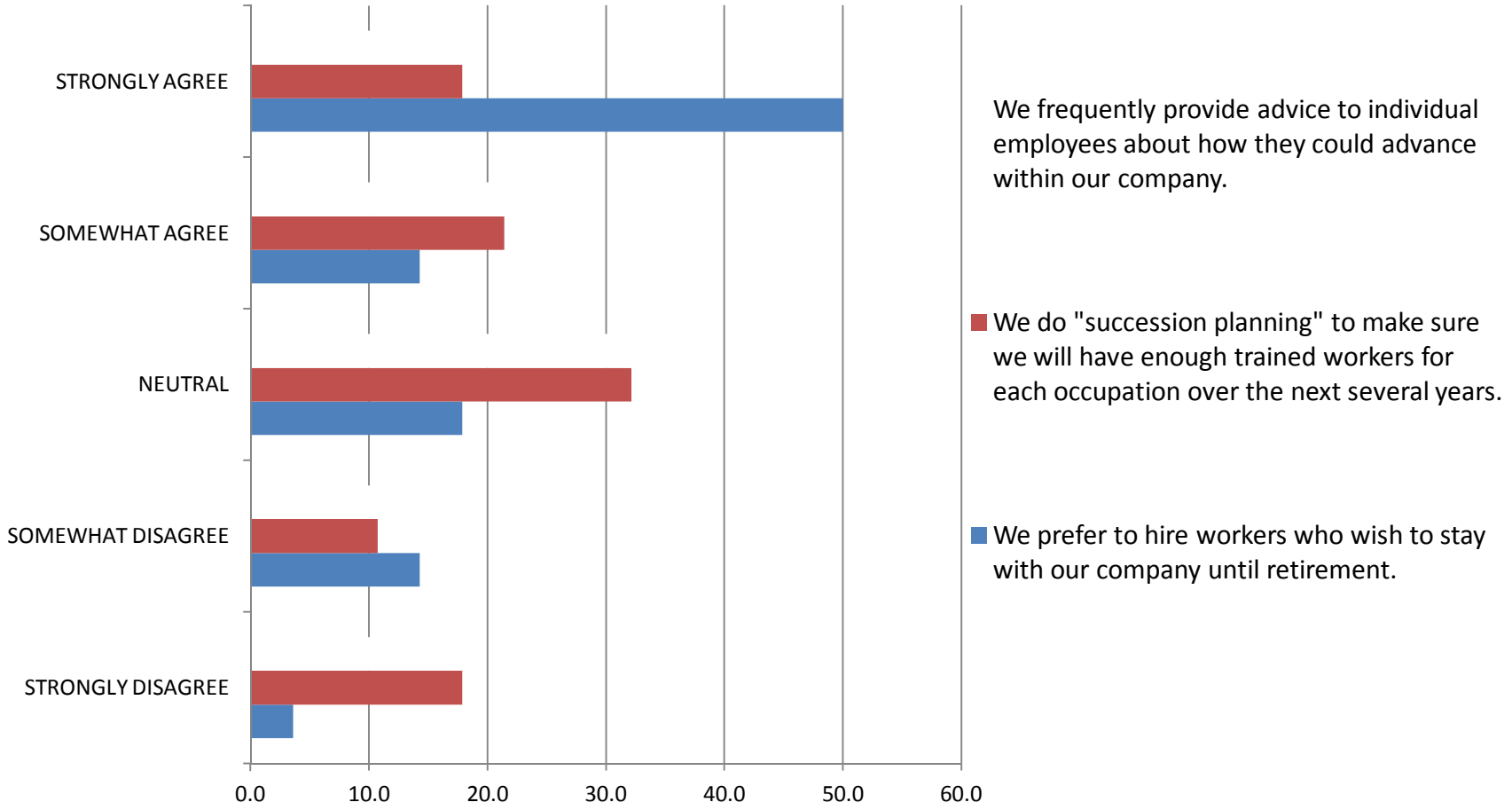
Current Skill Deficiencies in Employees (Stampers Only)



Note: firms that pay higher wages report fewer problems

HR policy not internally consistent

(stampers only)



avoid hidden costs of off-shoring

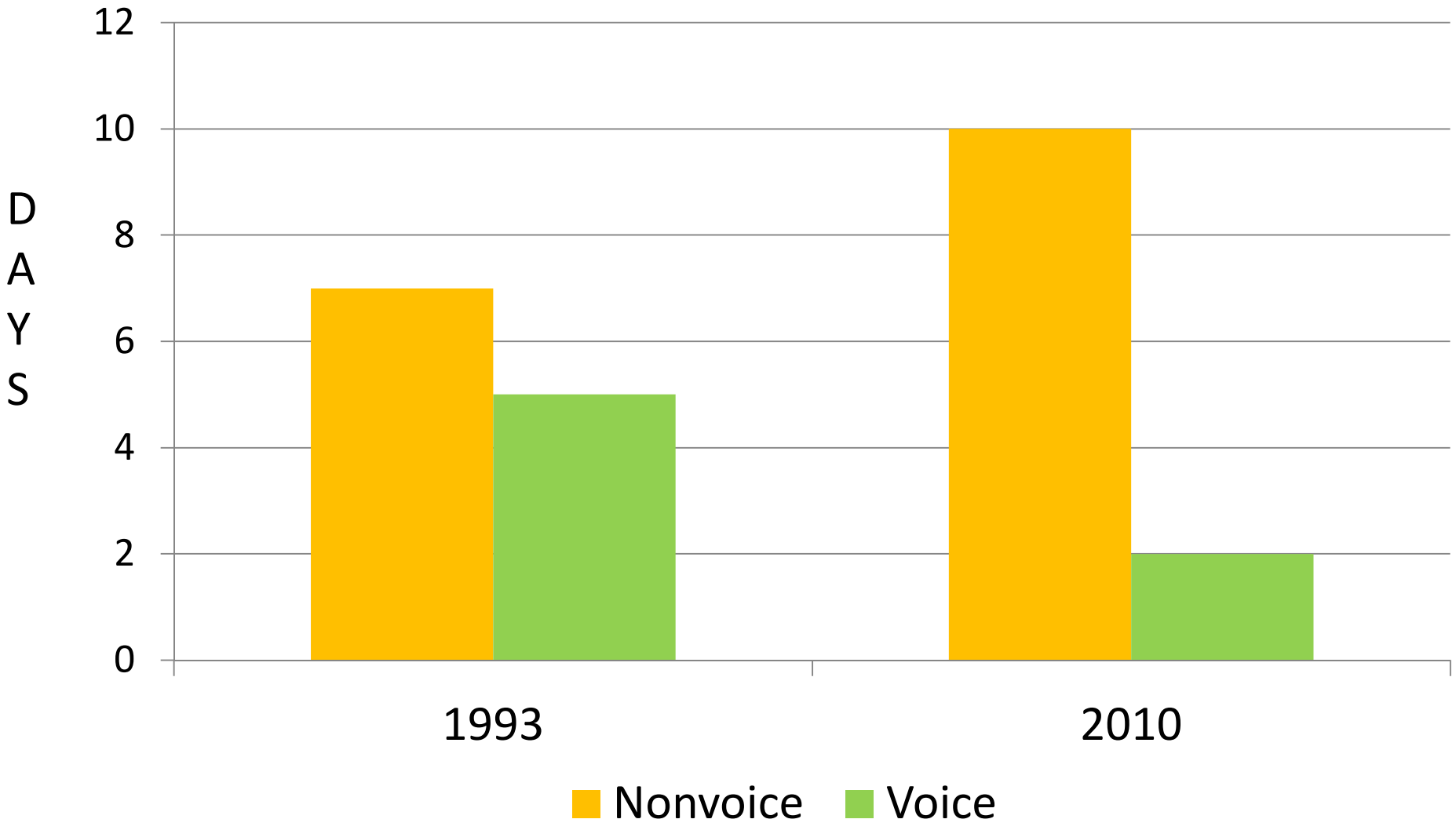
- Management loses focus on innovation at home
- Increased risk from long supply chain
- More difficult communication among design, engineering, and production means quality problems may fester
- Eventually, design as well as production may move

Conclusions

- Skills can be productively added to every job
  - Workers, firms, and society benefit
- But adoption of high-road strategy is not inevitable
  - Managers often lack incentives or vision
- Programs that train both workers and management can address this problem.
  - Manufacturing Extension Partnership (MEP)
  - Program pays for itself in increased tax revenue
- Coordinated efforts by governments and firms in supply chain would result in more firms adopting strategies geared toward long-term success

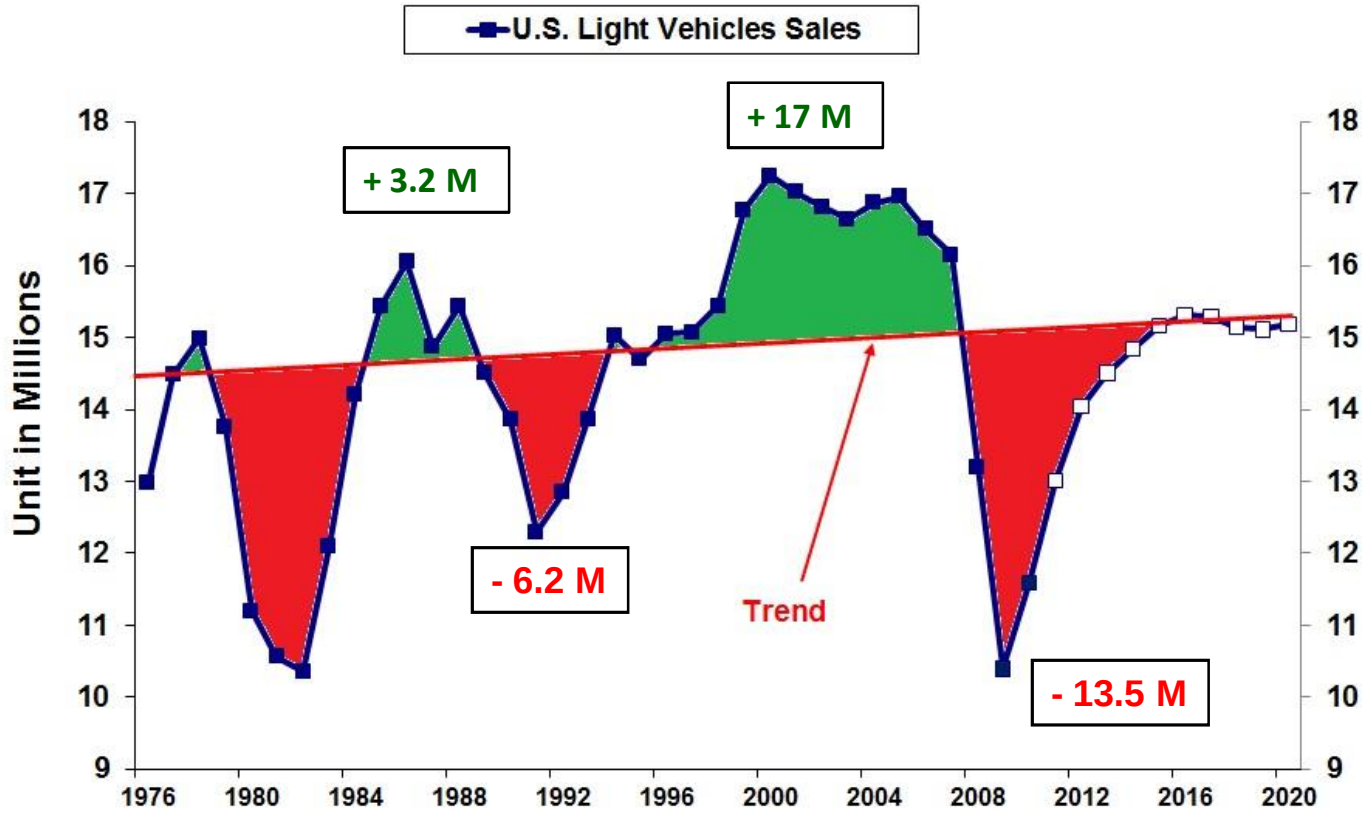
Size of the Just-in-Case Inventory:

the difference between production lot sizes & delivery lot sizes



The big crash

CAR Long-Term U.S. Light Vehicle Sales Forecast as of December 2010

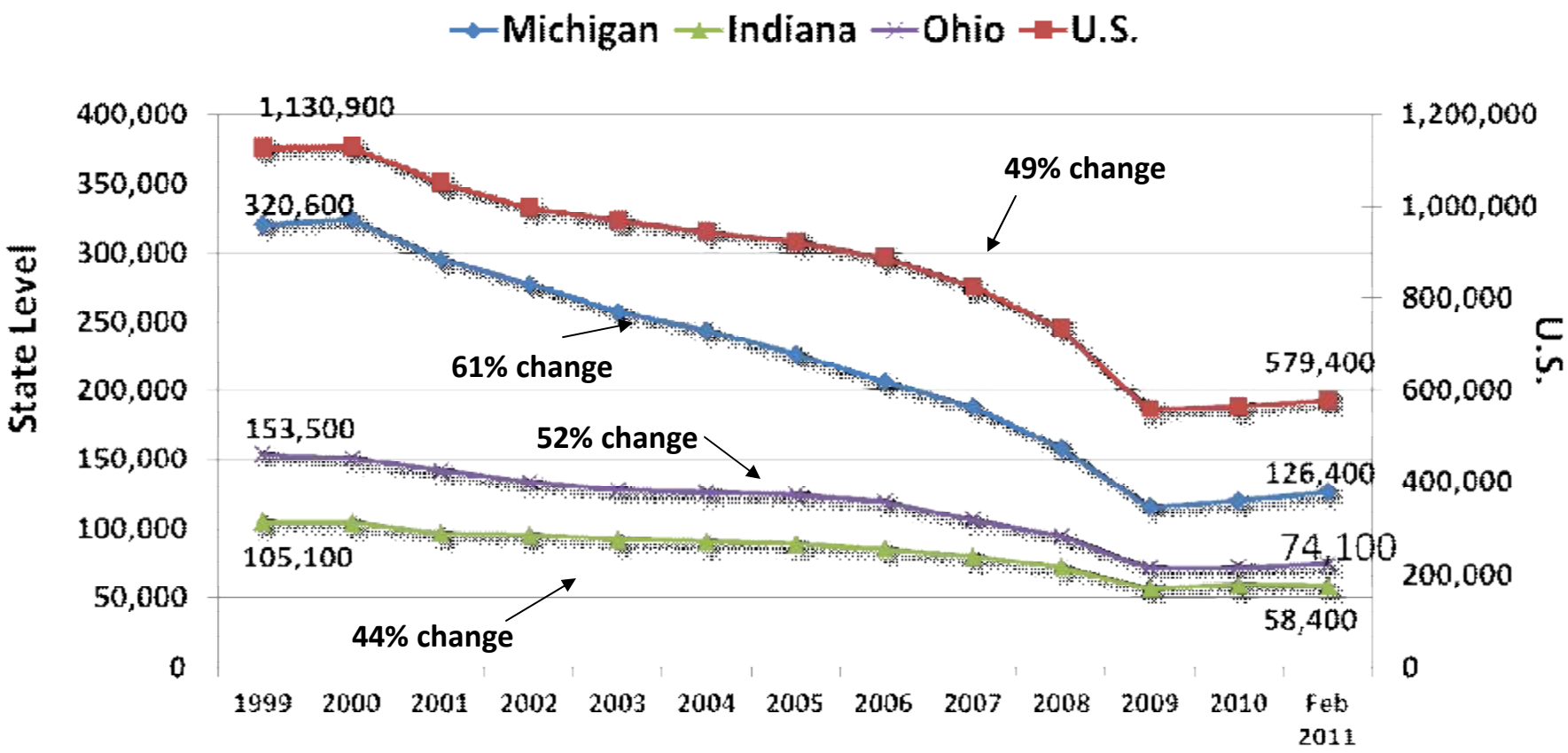


Dec 2010 Forecast										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
(Millions)	13.0	14.0	14.5	14.8	15.2	15.3	15.3	15.1	15.1	15.2

Emerging from the Darkest Part of the Tunnel…

Motor Vehicle & Parts Manufacturing Employment

1999 – Feb 2011



Source: BLS, U.S. DOL, April 2010

The long-simmering crisis

The "Detroit Three" have a *price* problem more than a cost problem

- Detroit 3 cars do not command the same price as same-size cars from Toyota or Honda (price gap of > $2,000 per car)
- Suppliers have played a key role in this problem
  - Capability problem
    - Each automaker wants to free-ride on others' investment
    - Result: Underinvestment in design, quality, delivery, innovation capabilities
  - Collaboration problem
    - US automakers incentivized purchasing agents to minimize piece prices
      - but this often increased system costs, reduced performance (eg, poor ride quality)
        - » due to poor mgt of interactions across parts, frequent engineering changes

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Shared supply chains can be productive

- If governed well
  - German, Japanese, Italian approaches

What are customers doing?

How are suppliers responding?

Small, 2nd-tier Suppliers: 3 responses

- Clever cost cutter (45%)
- Lean investor (15%)
- Craft skill (unsystematic) (40%)

- I will illustrate each type by a firm we interviewed

Results: 3 strategies

	% trades	% engineer	wage	% prod'n in quality circle	turnover	HR plan (1-5)
Cost cutter (45%)	6	8	12	10	8	2.6
Craft (40%)	22	7	18	20	7	3.6
Kaizen (15%)	4	22	27	40	1	3.5

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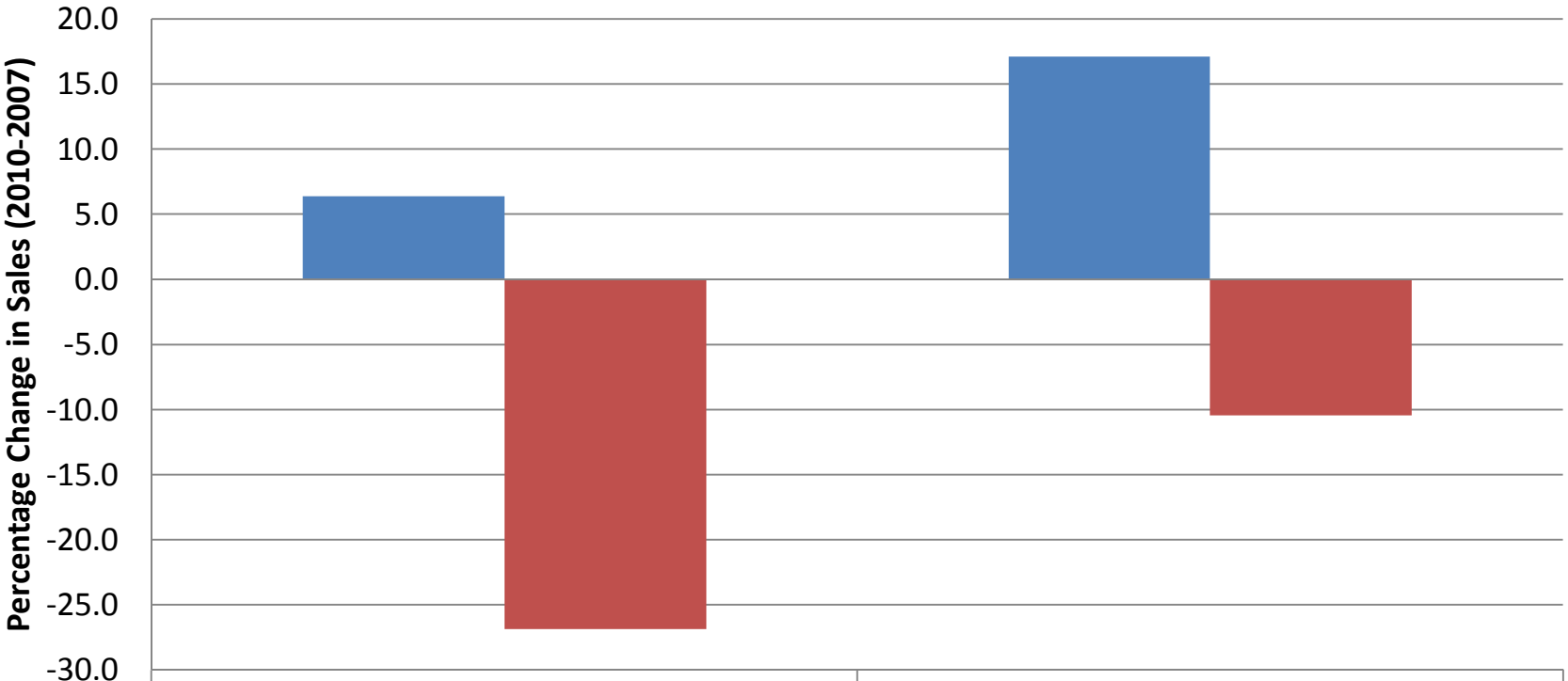
What internal strategies work?

- Which stampers recovered best from crisis?

Role of "kaizen" practices

(stampers only)



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Principles underlying results (I)

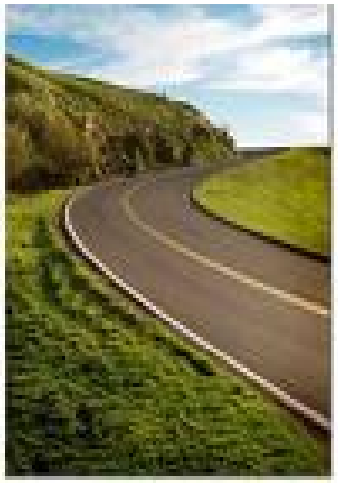
- Policies internal to a firm
  - Choose a good customer
    - One that practices voice rather than cost-shifting
  - Combine "kaizen" and distinctiveness
    - Firms that integrate HR policy and overall firm strategy perform best

“High-road” mfg can be win/win/win

- In “high-road” production, well-paid workers make cost-effective, sustainable products for consumers, and profits for owners
  - *How?*
    - High road techniques harness everyone’s knowledge—not just top executives’ -- to achieve innovation, quality, and variety
- Combines elements from lean and craft clusters

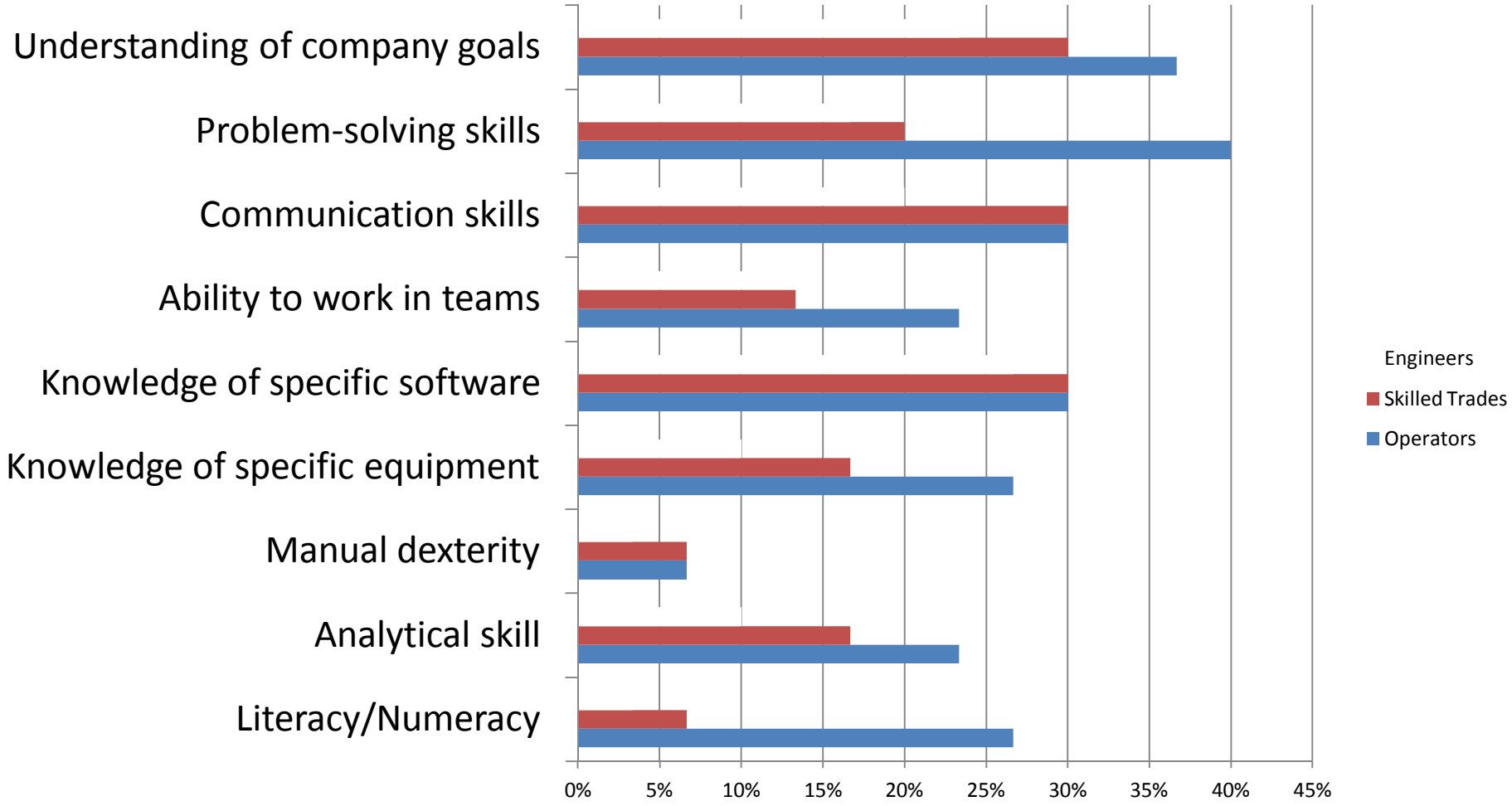
US firms can compete with China

- By *increasing* skill – not by imitating China
- But, many firms do not use this strategy, because the market often fails to incentivize it.
  - Spillovers to workers and suppliers
    - Firm management doesn't capture all the gains from high-road production, so they invest too little in it.
  - Complementarities



  - Kaizen firm needed to invest in information technology, training, process redesign, and marketing
  - No one of these investments would pay off without the others. The need for multiple investments seems too daunting for many firms.

Current Skill Deficiencies in Employees (Stampers Only)



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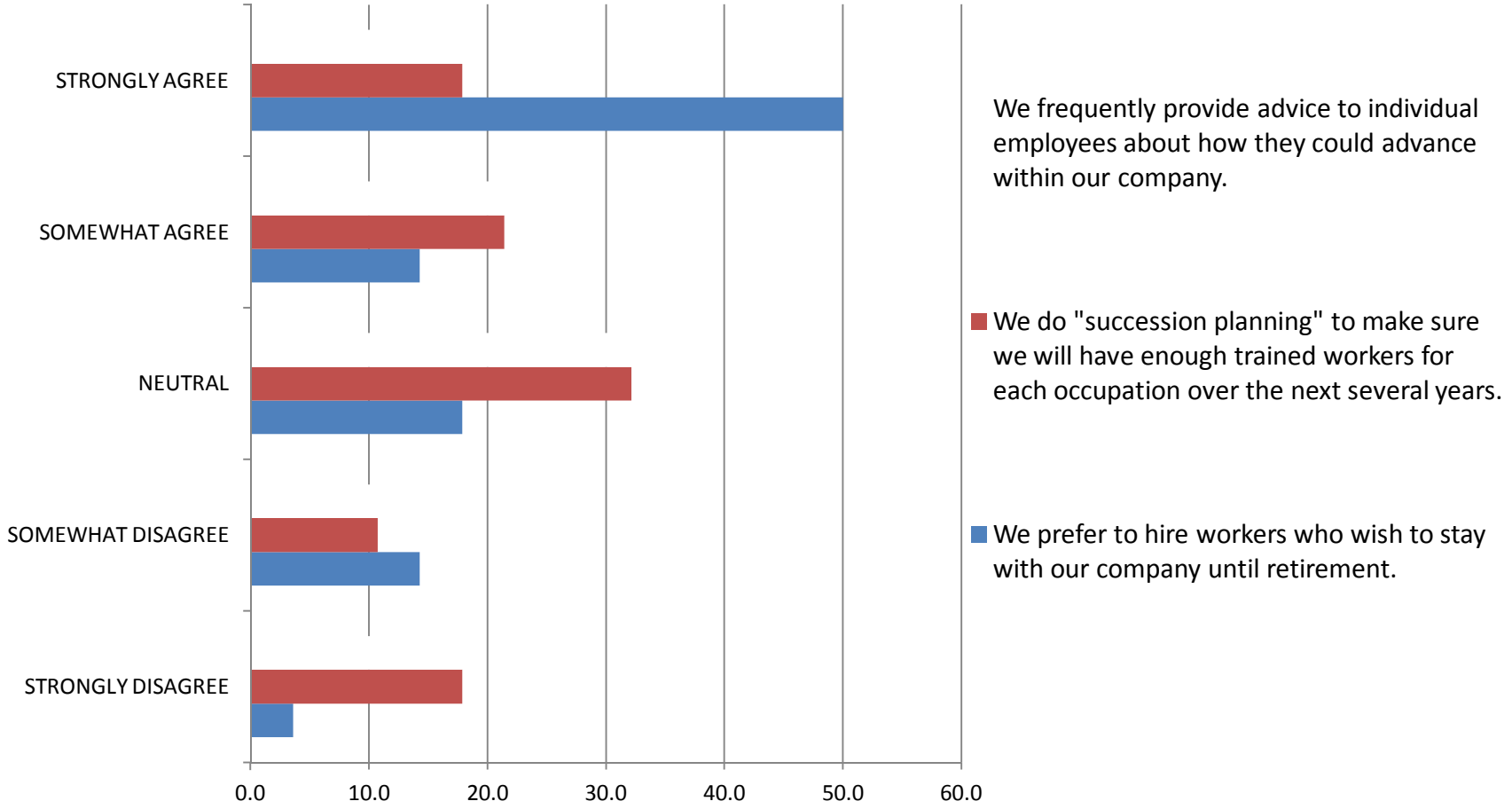

Principles underlying results (II)

- Policies External to a firm
  - Work to improve “eco-system”
    - create more good customers
      - Trade association effort to create “model contracts”, buy based on “total cost of ownership”
    - create more trained workers, agile firms
      - Partner with others to alleviate skill shortages
      - Take advantage of programs that help with complementary investments
        - » Manufacturing Extension Program
    - create more learning opportunities
      - This conference!

Conclusions

- Crisis creates opportunity
  - Automakers and first-tiers realize (for the moment) interdependence of supply chain
    - Unresolved: who will pay for investments in capability in shared supply chains
- PMA members can recover (and thrive) by:
  - Internally
    - Adopting policies to promote kaizen and distinctiveness
    - Seeking customers that use voice
  - Externally
    - Partner with others to improve governance of shared supply chains

Performance of these strategies

- Which does best for productivity, profits, wages? (to be determined)
- Performance of (rare) strategy that combines investment in workers +Toyota Production system + distinctive competence (eg product development or unusual process skills) + diverse markets ('agile' version of high road)
- Hoped-for conclusion: firms that integrate HR policy and overall firm strategy perform best