

Reshoring U.S. Manufacturing

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Overview

1. Manufacturing is the foundation of national prosperity and also military power. **A decline in manufacturing capability is a universal leading indicator of a decline in national well-being and influence.**
2. Cheap labor is a dysfunctional and dangerous illusion. Eliminate the paradigm that cheap labor is really cheap, and we have a compelling argument for reshoring.
3. The good news is that proven, off-the-shelf solutions to the challenge of cheap offshore labor have been available for more than 100 years.

Manufacturing is All-Important (1)

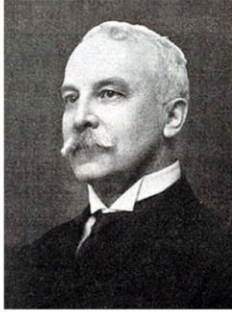
- Manufacturing is the backbone of national affluence and military power.
- Absence or decline in manufacturing capability has been a leading indicator of national decline. *There have been no exceptions.*
 - Polish-Lithuanian Commonwealth
 - Spanish and Portuguese Empires
 - War of Independence
 - American Civil War
 - First World War
 - Second World War

Manufacturing is All-Important (2)

- The rising importance of manufacturing was recognized as early as the mid-16th century.
 - The Polish-Lithuanian Commonwealth appeared to be reaching the height of its power at this time but it exported little other than commodities along with rudimentary finished goods such as cloth (presumably to be made into clothing elsewhere), beer, and rope. **"It was essentially the same kind of trading pattern that places third-world countries at the mercy of industrialized nations today."**
 - The problem was cited by the Polish economist Andrzej Glaber in 1543, at the time Spain and Portugal were importing vast quantities of treasure from the New World.

Zamoyski, Adam. 1987. *The Polish Way*, page 175

Manufacturing is All-Important (3)

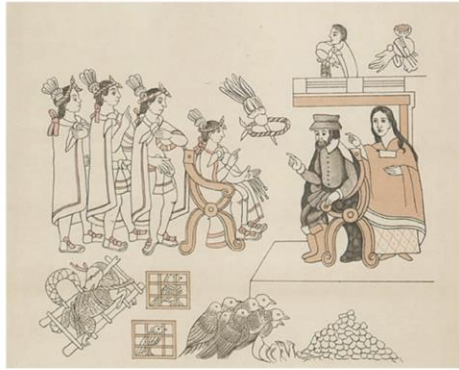


- Harrington Emerson wrote similarly in 1911 that the United States was essentially trading natural resources for manufactured goods. "...we childishly squander our national resources in exchange for perishable luxuries supplied us by older and wiser men, corporations, and nations, who, not having gifts and prodigal equipment, still use their brains and hands—men who trade us sunshine, water, and air for our mined wealth, for our soil's fertility."
- France and Germany, for example, transformed sunshine, water, and air into fermented beverages.

Harrington Emerson portrait from 1911, public domain due to age.

Emerson, Harrington. 1911. *The Twelve Principles of Efficiency*, public domain due to age/

Manufacturing is All-Important (4)



Hernán Cortés (1519) and other Spanish and Portuguese Conquistadors discovered huge quantities of gold and silver in Mexico and South America. Everybody thought this would make Spain and Portugal the most powerful and affluent nations on earth.

Cortés and La Malinche meet Moctezuma in Tenochtitlán. Public domain due to age.

Manufacturing is All-Important (5)

- Alfred Thayer Mahan's *The Influence of Sea Power Upon History* shows why this "wealth" was a total illusion.
- "When to these qualities are added the advantages of Spain's position and well-situated ports, **the fact that she was first to occupy large and rich portions of the new worlds and long remained without a competitor**, and that for a hundred years after the discovery of America she was the leading State in Europe, she might have been expected to take the foremost place among the sea powers. **Exactly the contrary was the result, as all know**. Since the battle of Lepanto in 1571, though engaged in many wars, **no sea victory of any consequence shines on the pages of Spanish history**; and the decay of her commerce sufficiently accounts for the painful and sometimes ludicrous inaptness shown on the decks of her ships of war."

Alfred Thayer Mahan, *The Influence of Sea Power Upon History*

<http://www.gutenberg.org/files/13529/13529-h/13529-h.htm> (public domain due to age)

Even Lepanto did not gain a lot of credit for Spain, as Venetian galleasses (built in the Venetian Arsenal, a de facto assembly line for ship construction) played a dominant role.

Manufacturing is All-Important (6)

- Mahan continues, "[Spain] herself produced little but wool, fruit, and iron; **her manufactures were naught; her industries suffered**; her population steadily decreased. **Both she and her colonies depended upon the Dutch for so many of the necessaries of life, that the products of their scanty industries could not suffice to pay for them.** "So that Holland merchants," writes a contemporary, "who carry money to most parts of the world to buy commodities, must out of this single country of Europe carry home money, which they receive in payment of their goods." **Thus their eagerly sought emblem of wealth passed quickly from their hands.** ...The fortunes of Portugal, united to Spain during a most critical period of her history, followed the same downward path: although foremost in the beginning of the race for development by sea, she fell utterly behind. **"The mines of Brazil were the ruin of Portugal, as those of Mexico and Peru had been of Spain; all manufactures fell into insane contempt; ere long the English supplied the Portuguese not only with clothes, but with all merchandise, all commodities, even to salt-fish and grain. After their gold, the Portuguese abandoned their very soil; the vineyards of Oporto were finally bought by the English with Brazilian gold, which had only passed through Portugal to be spread throughout England."**

Wool, fruit, and iron are all commodities. Wool must be made into wool cloth, and iron into manufactured goods, to be useful.

It is to be noted that almost all clothing sold in the United States is "imported," and the country of origin is usually not stated. If it was imported from a high-wage country such as France or Italy, the description would probably say so.

Manufacturing is All-Important (7)

- A major cause of the American Civil War; the South traded cotton to British textile mills in exchange for manufactured goods while the North's economy was based on manufacturing. Factory owners in the industrialized North agitated for protectionist tariffs against the British goods for which the Southern states traded cotton.
- Industrialization had meanwhile made slavery uneconomical in most of the North and would have almost certainly abolished it in the South had it been promoted there.
- Once the war began, the North's far superior manufacturing capability made the South's cause hopeless.

Manufacturing is All-Important (8)

How most of the world abolished slavery without fighting civil wars:



Aristotle (right) predicted that industrialization and automation would abolish slavery. "For if every instrument could accomplish its own work, obeying or anticipating the will of others, ...if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, **chief workmen would not want servants, nor masters slaves.**" Or, by implication, **low-wage labor.**

Picture from Raphael, "School of Athens," public domain due to age.

Aristotle (<http://classics.mit.edu/Aristotle/politics.1.one.html>) cites as examples the tripods of the god Hephaestus, and statues invented by the engineer Daedalus, that acted of their own accord. The Greeks also said that Hephaestus created two mechanical men, who were very similar to robots in 20th century science fiction movies. Greek myths (or science fiction stories) therefore featured what we would now call robots, or intelligent machines. While the Greeks' ability to build such machines was limited by the contemporary technology, those like Aristotle could foresee the socioeconomic implications of their future development.

Greek mythology also featured the world's first "battle mech," the bronze giant Talos whose most famous incarnation is probably Ray Harryhausen's model in *Jason and the Argonauts* (1963).

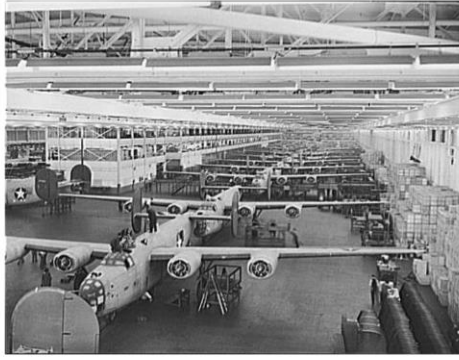
Manufacturing is All-Important (9)



The Ford Motor Company's Highland Park plant in 1922. Ford's industries made the United States the wealthiest and most powerful nation on earth, and created the American middle class with an unprecedented hourly wage of \$5 a day. Ford achieved this with **manufacturing methods that were cited explicitly as countermeasures against cheap offshore labor.**

Johnson, Bernard L. (February 1922), "Henry Ford and His Power Farm", in *Farm Mechanics*, photo from 1922 (public domain due to age).

Manufacturing is All-Important (10)



Admiral Yamamoto (paraphrased): "Don't start a war with people whose factories look like this." Ford's Willow Run bomber factory could make one B-24 per hour. It was more than clear by 1941 that factories, as opposed to agriculture, were the world's primary source of wealth—and military power.

Yamamoto portrait: "As an official portrait commissioned by the Imperial government of Japan, this portrait became public domain on 1973."

Willow Run bomber factory: public domain as a work by a U.S. Government employee

Manufacturing is All-Important (11)

- This section has shown how manufacturing overtook agriculture as the world's primary source of wealth, and military power, during the past few hundred years.
 - Mahan showed that this was evident more than 200 years prior to the Industrial Revolution, when Spain's and Portugal's dependence on manufactured goods from England and Holland relegated them to second-class status.
 - The same kind of manufacturing superiority the United States has conceded to other countries was responsible for U.S. victories in the First and Second World Wars. **There is clearly something wrong with this.**
- Next: Supply Chain Implications

Supply Chain Implications

- We have seen serious supply chain disruptions due to force majeure due to Covid-19 and natural disasters. Offshoring increases risks of supply chain interruptions.
- IATF 16949:2016 clause 6.1.2.3 (c), Contingency plans, requires planning for continuity of supply in the event of force majeure such as natural disasters or labor shortages.
 - "Japan Quake Knocked Out 25% Of Global Silicon Wafer Production"
 - "The global supply chain: So very fragile"
 - APICS (2011): **85% of companies reported supply chain disruption in a single year.**
 - Sumitomo: 1993 fire put more than half the world's supply of a critical epoxy resin for semiconductor encapsulation at risk.
- Next: the Answer to Cheap Labor

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Eric Savitz, "Japan Quake Knocked Out 25% Of Global Silicon Wafer Production" 3/21/11 Forbes <http://www.forbes.com/sites/ericsavitz/2011/03/21/japan-quake-knocked-out-25-of-global-silicon-wafer-production/>

Bill Powell, "The global supply chain: So very fragile" 12/12/11 Fortune <http://fortune.com/2011/12/12/the-global-supply-chain-so-very-fragile/> E.g. autoworkers in Ohio had their hours cut because Honda could not get parts from Thailand

"Majority of Businesses Experienced Supply Chain Failure" By APICS Staff December 06, 2011 <http://www.apics.org/news-landing-page/2012/01/20/majority-of-businesses-experienced-supply-chain-failure>

Sumitomo reference http://articles.latimes.com/1993-12-01/business/fi-62629_1_semiconductor-industry-assn

All of these examples are strong arguments for a voluntary "ISO 9001:2015 Plus" in which one's own procedures go beyond the standard's explicit requirements to consider risks of this nature.

The Answer to Cheap Labor (1)

- The first step to reshoring is to get rid of the dysfunctional paradigm that cheap labor, whether offshore or domestic, reduces costs.
- Cheap labor gives massive inefficiencies a place to hide because there is no real incentive to do anything about them.
- Cheap labor was obsolete more than 100 years ago for the same reason slavery was obsolete by the mid-nineteenth century. When a job becomes sufficiently efficient, the worker's pay is largely irrelevant.

The Answer to Cheap Labor (2)



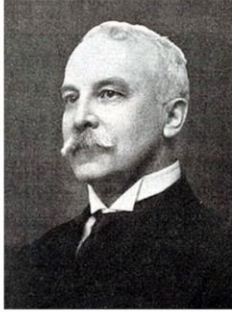
"...von Moltke's task was however far more difficult. **He could not count on having as many men, as much money, as abundant equipment, or as much material, as his opponents.** It was evident to him that invisible theories and principles, which his self-sufficient opponents did not recognize until too late, would have to make up for meagre material resources, human lethargy, and awkward equipment. **The struggle, before it began, even in its first planning, was to be one of efficiency against inefficiency...**"

Freyberg, Conrad. 1877. Generalfeldmarschall Helmuth Graf von Moltke, victor of the Franco-Prussian War

Emerson, Harrington. 1911. *The Twelve Principles of Efficiency*, public domain due to age. This book discusses the enormous wastes that are built into many if not most jobs.

France had a bigger army, a better rifle, and a bigger economy than Prussia in 1870 but Prussia used its resources more efficiently.

The Answer to Cheap Labor (3)



- "...we violently resist a demand for a 10 per cent increase in wages, but we tolerate a 50 per cent inefficiency in the worker."
- "The man whose manual labor it would take for over 500 years to spade up a section of unbroken prairie land, is quite inclined to think that he is using his time very efficiently if with team and plow he breaks up 640 acres in four years, when in reality with suitable equipment, mechanical tractors and gang plows, it could be done in 36 hours." This relates to **opportunity costs**, or results not achieved due to failure to use the best available method.

Harrington Emerson portrait from 1911, public domain due to age.

The Answer to Cheap Labor (4)

- The United States was not only afraid of cheap foreign labor in the early 20th century; **we were apparently terrified of efficient foreign labor in the early 20th century.**
 - "[The Japanese] conspicuously, consistently, and intelligently put [Helmuth] von Moltke's organization into effect in upbuilding their fatherland, and also applied all the twelve principles [of efficiency], which they had probably independently recognized and accepted before they began their quest. In thirty years, Japan with her 40,000,000 people was able to vanquish China with her 400,000,000. In another five years, Russia, the colossus of the North, that had shattered Napoleon I Russia, the dread of Great Britain, of France, of Germany for 90 years went down in defeat. American sympathies were with Japan, but scarcely was the war over before **the industrial organization of Japan, as much superior in principle to ours as were her army and navy to those of Russia, began to make us cry out in cowardly fear.**"

Emerson, Harrington. 1911. *The Twelve Principles of Efficiency*, public domain due to age. This book discusses the enormous wastes that are built into many if not most jobs.

Harrington Emerson portrait from 1911, public domain due to age.

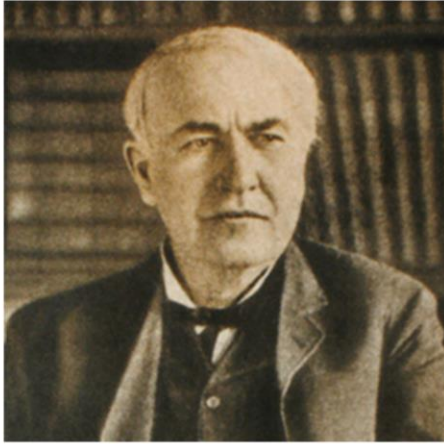
Emerson cites how Helmuth von Moltke recognized Prussia's inferiority to its rivals in terms of money, manpower, and even weaponry—the French Chassepot rifle was superior to the older von Dreyse needle gun—and therefore developed ways to use Prussia's army and resources more efficiently than France and Austria-Hungary used theirs. Emerson contends that Japan adapted these principles to industrial as well as military applications.

The Answer to Cheap Labor (5)

- Emerson added, "It is not the flesh and blood and brains of the Japanese that make them industrially dangerous ; it is not their money, for they are poor, not their equipment, for they have but little, not their material resources, because they are meagre. They are dangerous as industrial competitors because **we are dragging along under a type of organization that makes high efficiency [im]possible and they are not;** because we have not even awakened and they have to the fact that principles applied by mediocre men are more powerful for good than the spasmodic floundering of unusually great men."
- **Emerson and his contemporaries such as Henry Ford overcame this challenge, and we can use the same principles today.**

Emerson, Harrington. 1911. *The Twelve Principles of Efficiency*, public domain due to age. The context suggests that Emerson meant "impossible" rather than "possible."

The Answer to Cheap Labor (6)



Thomas Edison asked himself during an interview what workers would do once machines did everything—the same scenario once addressed by Aristotle.

"Manufacturers can then afford to pay any kind of wages."

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Benson, Allan L. 1923. *The New Henry Ford*. New York: Funk and Wagnalls p. 256

Photo of Thomas Edison from 1915, public domain due to age

The Answer to Cheap Labor (7)

- Cheap labor does not, contrary to popular belief, symbolize low prices and high profits. **Cheap labor is symptomatic of excessively high prices and also low profits.**
- Lean manufacturing practitioners know that inventory (one of the Toyota production system's Seven Wastes) conceals inefficiencies and poor quality.
- **Cheap labor similarly gives inefficiency a place to hide.**

The Answer to Cheap Labor (8)



Popular wisdom or "It is known..."
Management views the \$100 paid
by the customer as shown here.



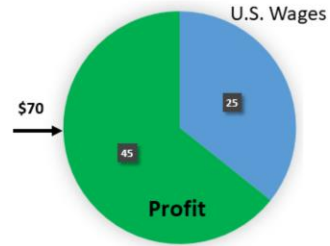
The obvious course of action is to cut
wages (e.g. by moving jobs offshore) to
increase profits and also lower the price.
This is why U.S. manufacturing capability
has been offshored to China and other
low-wage countries.

The Answer to Cheap Labor (9)

People such as Henry Ford, Frank Gilbreth, and Frederick Winslow Taylor realized, however, that the original model really looked like this:



Which means we can achieve something like this:



Cheap offshore labor conceals the inefficiency and waste.

That is, the workers were really getting \$10 rather than \$90 of the \$100 paid by the customer, while the rest was squandered on waste and inefficiency. The figure on the right shows exactly what Henry Ford achieved in the first part of the 20th century.

The Answer to Cheap Labor (10)



"Cutting wages is the easiest and most slovenly way to handle the situation, not to speak of its being an inhuman way. It is, in effect, throwing upon labour the incompetency of the managers of the business. If we only knew it, every depression is a challenge to every manufacturer to put more brains into his business--**to overcome by management what other people try to overcome by wage reduction.**"

Remember that Henry Ford didn't just say this, he made it work in all of his industries.

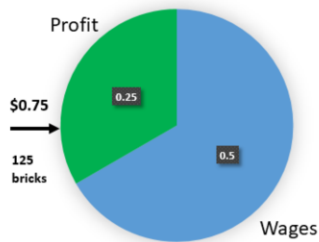
Henry Ford portrait, 1919 (public domain due to age)

Ford and Crowther, 1922. *My Life and Work*.

The Answer to Cheap Labor (11)

"Overcome by management what other people try to overcome by wage reduction."

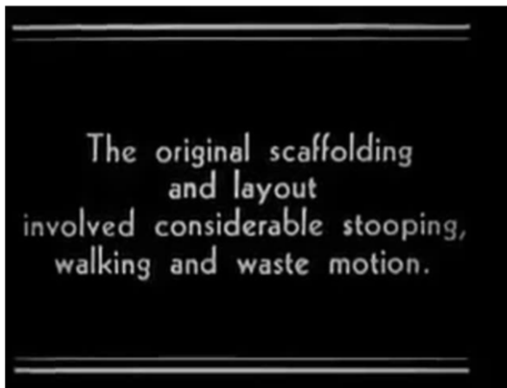
Suppose you run a construction firm in 1910 or so, and your customers complain that they have to pay \$0.75 for every 125 bricks (@0.6 cents) laid by your workers (plus the cost of the bricks and mortar). Your workers meanwhile get only 50 cents per hour (@0.4 cents per brick).



It is of course not possible to send construction work offshore, and a wage cut would probably cause your skilled brick layers to quit. You don't want to reduce profits either.

50 cents an hour was a very high wage by the standards of 1910, as the quarters and half-dollar pieces were made out of silver.

The Answer to Cheap Labor (12)



Brick layers
could lay 125
bricks per hour
under these
conditions.

Now we put brains into the business.

Movie by Frank Gilbreth, circa 1911. Public domain due to age.

The Answer to Cheap Labor (13)



Brick layers could lay 125 bricks per hour under these conditions.

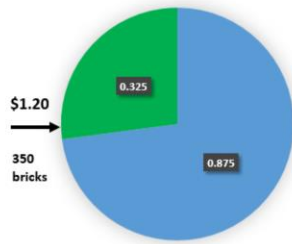
The money paid by the customer must carry the enormous waste involved with doing 125 toe touches or equivalent per minute.

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Movie by Frank Gilbreth, early 20th century, public domain due to age. Single image in case the movie in the previous slide doesn't work, and also for the pdf handout.

The Answer to Cheap Labor (14)

Gilbreth's non-stooping scaffold, which delivered the bricks at waist level, proved that the original job design wasted about 64% of the workers' labor. The non-stooping scaffold allowed them to lay 350 per hour, and with less effort.



Now suppose the workers get only 0.25 cents rather than 0.40 cents per brick, but lay 350 rather than 125 an hour. They can be paid 87.5 cents rather than 50 cents an hour (75% more), their employer gets 30% more profit, and the customer pays 0.343 rather than 0.40 cents per brick. Everybody is much happier.

The takeaway is that many if not most jobs contain enormous waste whose removal allows wage increases and price reductions.

The Answer to Cheap Labor (15)

- Taiichi Ohno, the father of the Toyota production system, noted in 1937 that one American worker was as productive as three Germans, and one German was as productive as three Japanese.
 - Germany and Japan were just as good as the United States at making high-quality civilian and military products. The United States won the Second World War because it could make them much more efficiently.
 - Note also that German and Japanese workers were emphatically not cheap labor. They had good job skills, but inefficient job design meant these skills were not used to their full capability.
 - Recall that, little more than 25 years previously, American industrialists had feared Japanese industrial organization.

Ohno, Taiichi. 1988. *Toyota Production System: Beyond Large-Scale Production*. Portland OR: Productivity Press, page 3

The Answer to Cheap Labor (16)



Frederick Winslow Taylor: "...the one element more than any other which differentiates civilized from uncivilized countries—prosperous from poverty—stricken peoples—is that **the average man in the one is five or six times as productive as the other.**"
Principles of Scientific Management (1911)

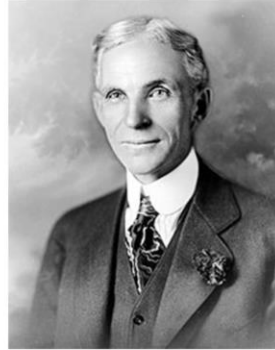
1. We have already seen that a badly designed job can waste 64% of a worker's labor.
2. Low-wage labor, whether domestic or offshore, gives the waste a place to hide.

Next: Opportunity costs can far exceed inefficiency

Opportunity Costs (1)

"If a device would save in time just 10 per cent. or increase results 10 per cent., then its absence is always a 10 per cent. tax."

Opportunity cost = unrealized revenue or savings from what we fail to do. In this case, the opportunity cost is 10 percent.



Ford, Henry, and Crowther, Samuel. 1922. *My Life and Work*. New York: Doubleday, Page & Company

Opportunity Costs (2)

- "44% of U.S. workers are employed in low-wage jobs that pay median annual wages of \$18,000," which comes to roughly \$9 an hour.
- The video that goes with the article shows a worker **using a mop** to clean the floor of a large warehouse or factory.
 - The worker gets poor wages, and the employer is meanwhile paying a lot more than it should to clean its floors. **Low wages often reflect low profits and high prices**, rather than high profits and low prices.

Picchi, Aimee. "Almost half of all Americans work in low-wage jobs." CBS News, December 2, 2019.

<https://www.cbsnews.com/news/minimum-wage-2019-almost-half-of-all-americans-work-in-low-wage-jobs/>

Opportunity Costs (3)

- A Google search on "automatic commercial floor cleaner" is highly instructive.
 - The Janitorial Store states that the average production rate for mopping is 5000 square feet per hour. Note that the worker must also use the mop to pick up the dirty water, and wring it out into a bucket.
 - A YouTube video by Global Industrial™ shows an Auto Ride On floor scrubber that can clean more than 60,000 square feet per hour. It costs about \$8999.
 - Robotic floor cleaners also are available.

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The Janitorial Store <https://www.thejanitorialstore.com/public/Cleaning-Production-Rates-for-Beginners-334-3.cfm>

<https://youtu.be/du2r5GuKjG0> Global Industrial Auto Ride On Floor Scrubber with a link to <https://www.globalindustrial.com/p/janitorial-maintenance/floor-care/scrubbers/global-153-auto-ride-on-floor-scrubber-32-cleaning-path-three-170-amp-batteries> (**Disclaimer**; products and manufacturer videos were found through Google keyword searches, and are cited solely to illustrate the learning objectives. I encourage anybody who wants to implement these specific ideas to do far more extensive research before making a purchase decision. The only exception is the Hoover Floormate which I can recommend based on personal experience.)

Smaller versions (e.g. push instead of ride) can even be purchased from Amazon.com. <https://janitorialassociation.org/janitorial-equipment/commercial-walk-behind-floor-scrubber-machines/> has models from five different manufacturers. <https://youtu.be/l7FpjYWr7Zw> shows the ClarkeMA50 15B Micro Scrubber in action while discussing the drawbacks of using a mop and a pail. I have a household automatic floor cleaner from Hoover that operates on a much smaller area, but automatically sucks the dirty water into a reservoir for disposal (thus eliminating the waste motion of doing it by hand, even with a squeegee mop while doing a better job in the bargain).

Opportunity Costs (4)

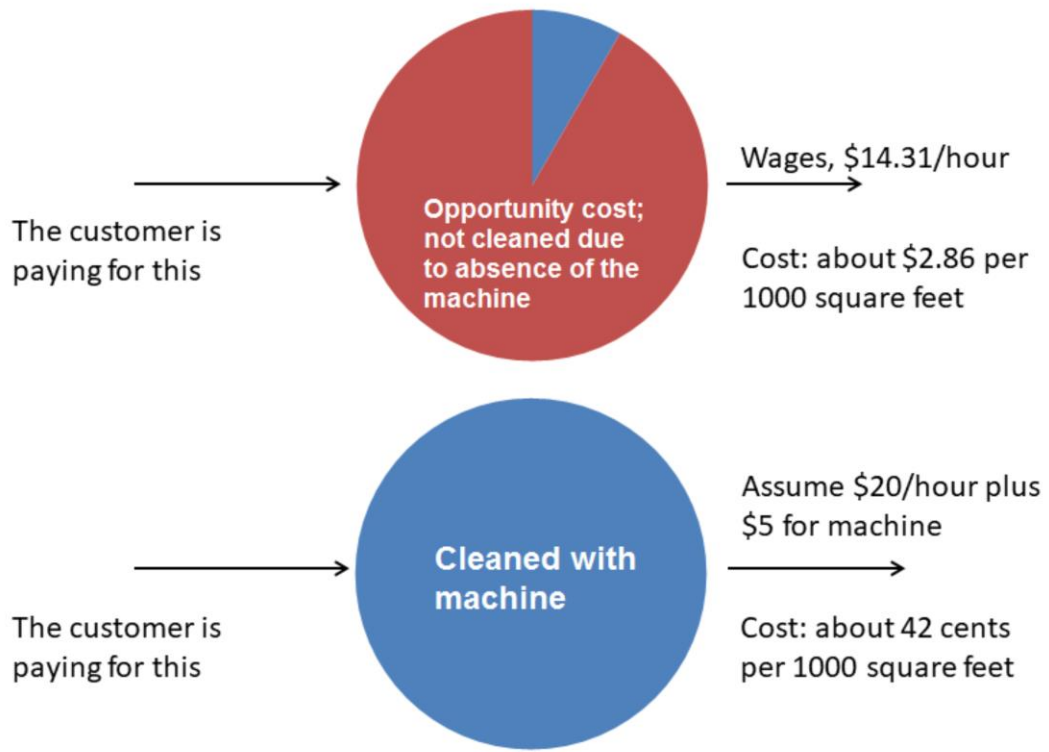
- The median hourly wage for janitors is \$14.31 per hour (2021, most recent information).
 - This is much better than minimum wage but it is not a middle class wage.
 - Option 1: pay 12 workers \$14.31 an hour to clean 60,000 square feet per hour. Hourly cost = \$171.72 per hour (plus benefits and employment taxes).
 - Option 2: pay one worker \$20 (or more) an hour to clean 60,000 square feet per hour, and spend \$5 an hour to pay for the \$8999 machine in less than one work year (2000 hours assuming one shift).

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<https://www.bls.gov/oes/current/oes372011.htm> Duties include "Perform heavy cleaning duties, such as cleaning floors, shampooing rugs, washing walls and glass, and removing rubbish." This does not sound like very interesting or fulfilling work.

If the factory or warehouse does not require 8 hours of cleaning at 60,000 square feet per hour, the worker can do something else with the remaining time. If the shop or store has only 10,000 square feet, a smaller machine could be used (requiring one worker instead of two) but the principle is still the same.

Opportunity Costs (5)



In practice, the machine would use electricity plus consumables such as cleaning solution, but the mop-and-bucket job also uses cleaning solution. The machine also pays for itself in less than a year.

Suppose for example that waste motion could be eliminated, as much as possible, from the mopping job so the worker can clean 6000 rather than 5000 square feet an hour. There is definitely an upper limit, though, on what can be done with a mop and it falls far short of what can be done with a machine. We can however, for practical analytical purposes, treat waste and opportunity costs similarly as the costs of *inaction* in terms of realizing an improvement—whether by removing the waste, or by introducing new equipment.

A Google search on warehouse, floor, and cleaning (and factory, floor, and cleaning) shows however machines being used in most—but apparently not all—cases.

Opportunity Costs (6)

- This example (and the subsequent ones) underscore the key takeaway that **an opportunity cost is not the cost of what we do wrong, but the cost of what we fail to do right.**
 - The cost of what we do wrong, such as rework or scrap due to poor quality, appears in the cost accounting system.
 - **Opportunity costs are invisible to the cost accounting system** because "money we didn't make" as opposed to "money we lost" is not deductible on an income statement or tax return.
 - **Cheap labor gives opportunity costs ample places to hide.** As an example, people still pick cotton by hand in Uzbekistan even though machinery has been available for decades.

Opportunity Costs (7)

- Student Action with Farmworkers (SAF): sweet potato harvesters get paid 40 cents per bucket, or \$25 per ton.
 - The site adds that 85% of our fruits and vegetables are picked by hand, and also that farm workers can be paid less than the minimum wage (e.g. \$5.50 an hour = \$11,000 a year).
 - A YouTube video of sweet potato harvesting shows men **bending over** to pick up the sweet potatoes, which they put into buckets they **carry** to a nearby farm vehicle.
 - Henry Ford wrote that no job should ever require anybody to bend over or take more than one step in any direction. People cannot be paid to do toe touches, or to walk.

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<https://saf-unite.org/content/facts-about-north-carolina-farmworkers>

"Harvesting Sweet Potatoes in Clayton, NC" <https://youtu.be/6XTtMc7i8r4> The narrator adds that it is "backbreaking, hard work." We already know from the Gilbreth brick laying example what is wrong with bending over.

Opportunity Costs (8)

- Various sweet potato harvesting machines are available.
 - Some are fully automated and can be operated by a single driver. The median wage for an agricultural equipment operator was \$17.48 an hour in 2021, versus sub-minimum wages for people doing the job by hand.
 - Others require manual labor and sorting but the workers ride on the machine rather than walking.
- The **opportunity cost** of not using a machine is reflected in low wages for the workers, high prices for the buyers, and mediocre profits for the employer.

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<https://youtu.be/MKsyJ0deXJ4> for a Lockwood sweet potato harvester in action

<https://www.bls.gov/oes/current/oes452091.htm>

Opportunity Costs (9)

- Strawberry picking requires (again) workers to bend over and walk. Workers may make \$10 to \$15 an hour in this manner.
 - California Rural Legal Assistance (CRLA) complains that the work is "grueling," requires "bending over," or working on hands and knees.
 - Henry Ford would agree: no job should require anybody to bend over or take more than one step in any direction.
 - Automatic strawberry picking machines are available, and less sophisticated machines pull trailers on which the workers ride face down to easily pick the strawberries without bending over. The **opportunity cost** of not using them is reflected in the form of expensive strawberries, low-paid workers, and poorly-compensated farm owners.

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<https://strawberryplants.org/get-a-job-picking-strawberries/> "strawberry picking will generate between ten and fifteen dollars per hour, depending on the skill of the strawberry picker"

CRLA "A Bitter Harvest: Strawberry Fields" Oct 15, 2010 shows workers bending over, walking, and even carrying boxes of strawberries on their shoulders (waste motion for which they cannot be paid, and which adds to the buyer's costs).

Florida Department of Agriculture and Consumer Services video of workers bending, walking, and carrying boxes of strawberries <https://youtu.be/-53fx7jdHU>
AGROBOT Robotic Strawberry Harvester at <https://youtu.be/M3SGScaShhw>

Nashville farmers invent strawberry picking machine <https://youtu.be/epGrJYDC9OU>
The workers lie face down on a moving platform, and a canopy can be put over the platform to keep out the sun. The narrator says it doubles the production rate.

Opportunity Costs (10)

- “Cotton Picking and Ginning” (1948) shows people bending over to pick cotton by hand while dragging a bag of cotton that can weigh up to 70 pounds. "It is hard, backbreaking work."
 - The movie then shows harvesting machines that can pick cotton 50 times as quickly, and do not of course require the operators to bend over or haul around a heavy bag of cotton.
- An Uzbek student died in 2013 while picking cotton, for which there is a mandatory 20 kg daily quota.
 - The reference does not go into detail but this could be a form of robot, a feudal tax paid in labor rather than with money.

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<https://youtu.be/G2zpgcm2Bxo>

Radio Free Europe/Radio Liberty, 2013. “Uzbek Cotton-Picking Claims Eighth Victim.” Oct. 2013. <https://www.rferl.org/a/25145827.html>

Opportunity Costs (11)

- An Indian-made handheld rechargeable battery-powered cotton picking machine is available for 5500 rupees (about \$71.50 USD) that will pick 125 kilograms of cotton per day (as much as six people doing it by hand).
 - **This reinforces the position that low wages are often symptomatic of low rather than high profits, and high rather than low prices.**
 - We want to look for, and eliminate, opportunity costs to help reshore American industries.

<https://www.indiamart.com/proddetail/cotton-picking-machine-5022844791.html>

This assumes that the Uzbeks can't afford the cotton harvesting machines that can do the work of fifty laborers.

Opportunity Costs (12)

- Japanese workers increased production of protective gowns 100-fold using primarily items purchased from a 100 yen (about 1 U.S. dollar) store.
- Poor countries are coming up with some extremely innovative (and cheap) ways to make individual workers more productive so they can be paid higher wages.
 - A woman walks in high-heeled shoes to make holes for seeds, thus showing what can be done when you can't afford a seed drill (invented in the 18th century by Jethro Tull).
 - A plastic bottle was cut to make a scoop which, when attached to a pole and equipped with a cloth chute, allows a worker to harvest fruits from trees which roll down the chute for easy collection.

"How it happened: Toyota Production System Leads to 100-fold Increase in Protective Gown Production" on YouTube https://youtu.be/knMN22_jQHl

The rock group led by Ian Anderson was named for the 18th century inventor.

<https://twitter.com/agbioworld/status/1125235612703973376> for use of high heels to make holes for peanuts

Opportunity Costs (13)

- Even unpaid labor is not however free. The workers must receive enough subsistence on which to live which suggests that six workers performing feudal "robot," or even six slaves, without the machine could easily be more expensive than one paid worker with the machine.
 - This brings us back to Aristotle's prediction that automation would make slavery, and by implication low-wage labor, obsolete.
 - **It also reinforces the position that elimination of waste and opportunity costs can render cheap offshore labor uncompetitive with high-wage U.S. labor.**

Opportunity Costs (14)

- Summary: opportunity costs are the invisible (to the cost accounting system) costs of what we don't do right, such as use machines to perform arduous labor.
 - Employers who have access to cheap labor have little incentive to look for superior ways to do the job. This reinforces the previous statement that **access to cheap labor, whether at home or abroad, gives enormous wastes and inefficiencies a place to hide.**
 - Henry Ford and other American industrialists proved repeatedly that cheap offshore labor cannot compete with high-wage U.S. labor if management and labor cooperate to "put brains into the business," as Ford put it.

We Can Do It (1)



This presentation has provided **actionable information** with which to rebuild American manufacturing and ensure we can safely ignore future Chinese (or OPEC, or other) threats to disrupt our supply chains.

None of this is theory. We did it before, and we can do it again.

- (1) We did it beginning in about 1908 (the introduction of Ford's Model T)
- (2) We did it again during the Second World War.

J. Howard Miller's "We Can Do It!", the inspiration for "Rosie the Riveter" Public domain as a publication of the U.S. Government

We Can Do It (2)

- Victor Davis Hanson, 2020. "Is America a Roaring Giant or a Crying Baby?" describes the United States' reaction to the Second World War.
 - The United States was still emerging from the Great Depression in the 1930s.
 - As of 1944, the United States' gross domestic product (GDP) **exceeded that of the Axis and the other Allies put together**. While American Soldiers and Sailors could not be replaced, any material the enemy destroyed could—and very quickly.
 - The United States began the war with seven large aircraft carriers and, despite the loss of several, ended the war with twenty-seven. **The US Navy's tonnage exceeded that of the rest of the world by 1945**. Most of the Axis' no longer counted due to being at the bottom of the ocean, but the Royal Navy's certainly did.

The Sherman Tank was, for example, no match for the German Tiger in a head-to-head confrontation but, if the Sherman's crew survived their tank's destruction, they were simply issued another. If the Tiger's crew survived their tank's destruction, they probably had to join the infantry because replacements were in short supply. The U.S. eventually deployed the mass-produced Pershing as an answer to the Tiger.

We Can Do It (3)

- Hanson adds that the United States has reserves of natural gas which means we will never again be dependent on self-serving and/or hostile foreign nations for energy.
- The United States developed substitutes (e.g. synthetic rubber) for raw materials whose supply was cut off by the Axis.
- The United States also has a history and legacy of innovation including the invention of lean manufacturing and what is now known as the Toyota production system.
 - It is actually Henry Ford's production system, which Taiichi Ohno introduced to Japan and then improved to some degree.

While China controls a disproportionate share of the world's rare earths, it does not control all of them and the United States has significant deposits.

We Can Do It (4)

American history is a legacy of industrial and manufacturing innovation.



Benjamin Franklin was not only an inventor, he was the real father of lean manufacturing.

- (1) "A penny saved is a penny earned" → money saved, e.g. through the avoidance of waste, flows directly to the bottom line while, in contrast, it may be necessary to increase sales by \$10 to get \$1 in profit.
- (2) Wasted time can never be recovered; the principle behind Goldratt's Theory of Constraints.
- (3) Henry Ford cited Franklin's influence explicitly.

Franklin's *The Way to Wealth* adds, "If you would be wealthy, **think of saving as well as of getting**. The Indies have not made Spain rich, because her outgoes are greater than her incomes." This reinforces the principle that elimination of a dollar in waste is as profitable as another ten or so dollars in sales.

Benjamin Franklin by Joseph Duplessis, public domain due to age.

We Can Do It (5)

- Franklin's *The Way to Wealth* adds, "Beware of little expenses; *A small leak will sink a great ship*, as Poor Richard says and again."
 - Franklin's principle, as applied more than 100 years later in Henry Ford's factories, is that seemingly minor annoyances and inefficiencies (such as having to walk or look for tools and parts) add up to a lot of waste. **Frontline workers are in the best position to notice these wastes.**
- "Buy what thou hast no need of, and ere long thou shalt sell thy necessaries."
 - Ford made it very clear that his purchasing department bought materials only as they were needed and not to get bargain discounts.

We Can Do It (6)

- Summary

1. The fundamental principles of what we now call lean manufacturing, and also the Toyota production system, **were developed in the United States and their foundation dates back to the 18th century.**
2. They were developed further in the early 20th century **as a specific response to not only cheap offshore labor, but also highly efficient offshore labor.**
3. These principles can be understood and applied by anybody with a basic education. Henry Ford wrote his books to his era's prevailing secondary school reading and comprehension levels.
4. While technology has certainly changed during the past 100 years, these principles have not. Nothing, other than the mistaken belief that "cheap labor equals low prices and high profits," prevents us from using them again.

Summary (1)

1. Manufacturing is the foundation of national prosperity, affluence, and military power. The absence or loss of manufacturing capability played a central role in:
 - The decline of the Polish-Lithuanian Commonwealth, which was once the most powerful nation in Europe
 - The decline of the Spanish and Portuguese Empires, which were the foremost nations in Europe at the beginning of the 16th century.
 - Secession of the Thirteen Colonies from the United Kingdom
 - Secession of the Confederacy from the Union
 - Defeat of the Central Powers in the First World War
 - Defeat of the Axis in the Second World War

Summary (2)

2. The United States has, during the past few decades, exhibited dangerous economic behavior very similar to that of Poland-Lithuania, Spain, and Portugal.
 - We have offshored substantial manufacturing capability, including capability related to semiconductors, desktop computers, large household appliances, and pharmaceutical products to other countries.
 - We are sending commodities offshore to be made into finished goods; the same economic pattern consistent with the relationship between colonies or Third World countries with industrialized nations.

Summary (3)

3. Cheap labor, whether domestic or foreign, is often symptomatic of overpriced goods and low profits.
 - Cheap labor, a substitute for what Henry Ford called "putting brains into the business," gives waste and inefficiency a place to hide. High wages mean management and labor must cooperate to make the jobs more productive.
 - Hand picking of crops is but one example of how enormous inefficiency can hide behind low-wage labor.
 - The made-in-the-USA techniques to remove the waste have been around for more than 100 years.

Summary (4)

5. The principle of opportunity costs cannot be overlooked.
 - These costs can be tenfold, twenty-fold, or even more but they cannot be reflected by the cost accounting system.
 - What is the opportunity cost of using manual labor to pick strawberries, or using a mop to clean a large commercial floor?
 - What is the opportunity cost of having six people (even unpaid) pick 120 kg of cotton per day when one person with a cheap handheld rechargeable electric tool can do the same job?
6. The United States gained manufacturing supremacy twice, and we can and must do it again.
 - Ford's industries gave us industrial supremacy by 1918.
 - American manufacturing pulled us out of the Great Depression and then defeated the Axis by 1945.
 - The same goal should be achievable by 2025 if not sooner.

Thank you for listening!

Questions and Discussion