

*Outsourcing to China*  
*A Case Study Revisited Seven Years Later*

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**David G. Meeker**

Consultant  
Neoteric Product Development  
87 Hammond Street  
Acton, MA 01720  
Meeker@mit.edu

**Jay P. Mortensen**

Consultant  
Procurement Engineering / Target Costing  
Seoul  
Republic of Korea  
jaypmortensen@gmail.com

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Dedicated to the Memory of

**Gordon M. Lewis**

September 9, 1940 - November 27, 2010



A wise friend and mentor whose counsel helped us all.  
His advance thinking and ideas expanded the product  
development envelope.

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### Abstract

In 2004, Dewhurst and Meeker wrote a paper entitled, *Improved Product Design Practices Would Make U.S. Manufacturing More Cost Effective: A Case to Consider Before Outsourcing to China*.

The premise of that case study was to answer the question:

*Is sending a product design off-shore for manufacture the cost-effective solution, or would U.S. companies benefit from taking the time to redesign products and keep manufacturing at home?*

This paper examines what has happened in the global market over the past seven years. We evaluate the current trends in outsourcing and those identified in the original paper, noting changes and developments. We then apply our analysis to highlight appropriate value-based manufacturing and outsourcing strategies.

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### Introduction

The changes in business operations we have experienced in the past seven years are the continuation of trends noted in 2004. Some of these changes are noted below:

- The United States has lost approximately [42,400 factories](#) since 2001.
- The United States has lost [nearly 32 percent](#) of its manufacturing jobs since 2000.
- In 2001, the United States ranked fourth in the world in per capita broadband Internet use. Today [it ranks 15th](#).
- As of the end of 2009, [less than 12 million Americans](#) worked in manufacturing. The last time less than 12 million Americans were employed in manufacturing was in 1941.
- Currently, Asia controls [84 percent](#) of the global production of printed circuit boards.<sup>1</sup>

The headline reads "Forrester Updates Offshore Job Numbers."<sup>2</sup> In its research report, Forrester finds that 3.3 million jobs will leave the U.S. by 2015 for foreign service companies. These jobs are in software development and business process outsourcing (BPO). Job losses, however, have been occurring for decades in the manufacturing sector. Manufacturing jobs tend to shift to the cheapest labor market. In the 1960s and 1970s cheap labor and automation in Japan displaced jobs. During the 1980s, manufacturing shifted to cheap labor in Mexico. Then during 1990s manufacturing shifted to China. Today, manufacturing jobs are shifting to growing economies like India and Vietnam, other Asia countries, South America, and back again to Mexico.

The tendency for companies to chase low cost labor markets to gain competitive advantages is well documented. Job migration is a complex issue with many facets. Unfortunately, some U.S. companies make outsourcing decisions based on simplistic models that lack (1) an understanding of total costs and (2) provisions for the risks. In this paper, we will:

1. Identify tangible and intangible costs of offshore manufacturing.
2. Identify the risks crucial to the decision to outsource.
3. Provide a "checklist" to help companies recognize potential costs and risks.
4. Evaluate the benefits of outsourcing.
5. Demonstrate how to turn outsourcing information into knowledge that adds visibility to value-based outsourcing decisions.

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<sup>1</sup> Tyler Durden, "Reminiscences of An American Industrial Nation – How in a Few Short Years America Lost its Manufacturing Sector", 6 January 2011, <[www.zerohedge.com](http://www.zerohedge.com)>

<sup>2</sup> Jim Ericson, "Forrester Updates Offshore Job Numbers," *Line 56 E-Business News*, 17 May 2004.

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### Information vs. Knowledge – Understand the Facts

#### **Why do we Outsource?**

Outsourcing is a complicated decision rooted in the strategic plans of a company. Some of the reasons that companies decide to outsource include:

- Mitigate risk
- Improve quality
- Faster time to market
- Obtain new ideas/thinking
- Rapid expansion of capacity
- Focus on core competencies
- Growth with less investment
- Infuse the company with new technology
- Leverage the company's assets and capabilities
- Improved return on investment
- Better cash flow
- Reduced cost

At this point, a reader's response might be, "Hey, I thought this paper is opposed to outsourcing. You just made a compelling case to move my factory offshore."

On the contrary, we are in favor of sustainable strategies that ensure the long-term viability of US companies, or any company, no matter its location. Economic stability in all countries promotes an environment in which peace is more likely to flourish. Our intention is to examine the rationale for outsourcing and to identify the real-world challenges in obtaining these benefits.

The authors have both been involved in successful outsourcing projects that have strengthened their respective companies. But we have also seen outsourcing decisions made that damaged the competitive ability of a company.<sup>3</sup> In all cases, better communication and transparency could have prevented erroneous decisions. Improving transparency without employing excessive time or cost is always the challenge.

We shall demonstrate that applying design-based analysis, like DFMA, to the decision to outsource a product provides timely, cost-effective information. A DFMA analysis points to the salient costs for manufacture and provides a launching point for effective discussions.

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<sup>3</sup> Michael Hiltzil, "787 Dreamliner Teaches Boeing Costly Lesson on Outsourcing," *Los Angeles Times*, 15 February 2011.

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### **Danger of Outsourcing**

Often, companies have an abundance of information but a lack of knowledge. Part of the process of converting information into knowledge is to assess risks. Unfortunately, many companies fail to fully recognize these risks. A summary of commonly underestimated dangers of outsourcing are noted.

- DANGER #1:** Overemphasis on low labor wages without proper visibility to other tangible and intangible costs. These costs are often missed because:
1. *They are not allocated to product costs:* Often costs are paid for by the corporation from various budgets. For example: quality inspection, supplier management, customs compliance, and others.
  2. *They are difficult to quantify:* Expedited shipments, supplier management (on-site and remote), supplier development and problem resolution.
  3. *They are not visible:* Local taxation, labor turnover, hidden compensation, compliance with human rights and ethical standards.
  4. *They are overlooked and/or underestimated:* Higher utility costs, cost for skilled maintenance, learning curve, training, higher quality control, and regulatory compliance such as customs compliance.

- DANGER #2:** Looking only to outsourcing for cost reduction while underestimating the value to be gained in product design. Focusing on the cost reduction of individual parts may obscure the cost reductions from the entire product design. Often, these savings require a structured discipline like DFMA to become visible because
1. The labor cost component may not be significant
  2. Logistics and customs costs may eliminate the labor cost savings
  3. Elimination of wasted material, requiring close control of the manufacturing process may prove elusive at off-shore facilities.

- DANGER #3:** Assuming the internal resources needed to manage the off-shore supplier exist:
1. Companies, like Apple, have found it necessary to devote significant resources to develop, train, control, and monitor off-shore suppliers.
  2. Poor communication and lack of proper governance are frequently cited reasons for outsourcing failures.
  3. Failing to understand the effort needed to understand local customs often results in frustrations and performance failures.

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**DANGER #4:** Forgetting that some products, whether or not they are redesigned, are not a good fit for offshore manufacturing. For example:

1. Products using a highly automated process may not show significant cost savings when produced off-shore.
2. Product weight and size can make shipping by either air or sea excessively expensive.
3. Products that require scheduling flexibility are poor candidates. Four to six weeks for sea shipments is not viable.
4. Products that undergo revisions increase the likelihood of quality failures. Often, inventory must be reworked when it arrives.
5. Products that require precision equipment may find depreciation cost is the same worldwide or the equipment used is inferior.

**DANGER #5:** Unaccounted for risk. While risk is not the reason to abandon a project, it should be well understood so that mitigation strategies can be put in place. Some of these risks include:

1. Complying with complicated and ever-changing customs regulations require specialists to avoid fines and penalties.
2. Geographic risk from natural disasters that require an expense contingency plan be maintained.
3. Logistical risk including fuel cost, availability of port facilities, port clearing time, losses in transportation.
4. Inadequate infrastructure leading to delays and quality issues.
5. Lack of skilled workers. Or, skilled works may be at a premium to U.S. costs. Cost of on-site support by U.S. staff.
6. Judicial, political and cultural instability.
7. Loss of intellectual property to competitors.
8. Use of physical assets to subsidize a competitors' products.

**DANGER #6:** Overlooking fundamental facts:

4. Through redesign, part count and material weight can be reduced to eliminate material, labor, and overhead costs.
5. Total cost of ownership associated with offshore manufacturing always contains obscured and hidden costs.
6. Low ethical standards at off-shore operations place consumers, employees, and ultimately, a company at risk of injury and financial loss.

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## A Closer Look

This paper is a call for a close look at the value to be achieved through product design practices as opposed to outsourcing. We acknowledge that valid cases for offshore outsourcing exist, but we have seen companies damage their competitive ability by outsourcing a product when redesign would achieve better results. The impact of a “make or buy” goes beyond costs as it can undermine the technological and economic viability of a company. A cross-functional effort by industry leaders, university research centers, and governmental agencies to understand the cost dynamics of product design and manufacture can revitalize companies and the national economy.

## Current State of Offshore Manufacturing

The U.S. Bureau of Labor Statistics publishes an international comparison of hourly compensation cost for production workers in manufacturing. The data is adjusted and mathematically modeled to give an apples-to-apples comparison between all the countries listed in the report. As can be seen, almost worldwide, the gap in U.S. and foreign labor wages has closed over time.

### International Comparisons of Hourly Wages in Manufacturing, 2009

	Hourly Compensation Costs					Hourly Compensation Costs			
	in U.S. dollars		U.S.=100			in U.S. dollars		U.S.=100	
	1997(1)	2009	1997 (1)	2009		1997(1)	2009	1997 (1)	2009
Norway	26.97	53.89	119	161	Israel	12.32	18.39	54	55
Denmark	24.64	49.56	109	148	Singapore	12.15	17.50	54	52
Belgium	28.23	49.40	125	147	New Zealand	12.37	17.44	55	52
Austria	27.38	48.04	121	143	Korea, Republic of	9.42	14.20	42	42
Germany	29.26	46.52	129	139	Portugal	6.38	11.95	28	36
Switzerland	28.33	44.29	125	132	Slovakia	2.86	11.24	13	34
Finland	22.17	43.77	98	131	Czech Republic	3.24	11.21	14	33
Netherlands	23.44	43.50	103	130	Argentina	7.43	10.14	33	30
France	24.99	40.08	110	120	Estonia	NA	9.83	NA	29
Sweden	25.11	39.87	111	119	Hungary	3.05	8.62	13	26
Ireland	17.15	39.02	76	116	Brazil	7.11	8.32	31	25
Italy	19.67	34.97	87	104	Taiwan	7.04	7.76	31	23
Australia	19.12	34.62	84	103	Poland	3.13	7.50	14	22
United States	22.67	33.53	100	100	Mexico	3.30	5.38	15	16
United Kingdom	18.24	30.78	80	92	Philippines	1.14	1.50	5	4
Japan	22.28	30.36	98	91					
Canada	18.89	29.60	83	88	NA=data not available.				
Spain	13.91	27.74	61	83					
Greece	NA	19.23	NA	57	(1) With the exception of Estonia and Greece, 1997 is the first year data are available for all countries.				

NA=data not available.

(1) With the exception of Estonia and Greece, 1997 is the first year data are available for all countries.

Actual labor rates for mainland China are not included above. These contain many hidden forms of compensation and benefits not typical in the West that are difficult to identify and vary from region to region. Rates may range from as little as 33 cents an hour to \$3 or \$4 an hour. This may still appear to be enticing, until the hidden costs of doing business in China are included.

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### Wages

With over 800 million people in the workforce, Chinese wages are arguably one of the most important manufacturing costs Western companies need to consider. China has a labor force twice as large as the U.S., European Union, and Japan combined.<sup>4</sup>

There are a number of factors driving the increase in labor cost.

1. Result of the One Child policy (1979)
2. Lewis turning point (shortage of workers pushing up wages)
3. Currency appreciation
4. Chinese government incentives for westward expansion
5. Rise of urban middle class demanding higher wages in response to higher food prices and general inflation

The graph below shows the results of the one child policy with work force increasing until 2015 and then rapidly decreasing after that.



<sup>4</sup> "Wage Increase and China Surplus Labor," *Economist Online* <<http://economistonline.munagao.com>>



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### **Working Conditions**

Improvements in worker safety and wages have increased the cost of manufacturing in America. In contrast, China possesses lower standards of safety and lower wages, resulting in seemingly low manufacturing costs. Too often companies ignore both the economic cost and ethical implication of these lower standards.

#### **Foxconn Shenzhen Experience <sup>5</sup>**

An explosion at Foxconn's newest plant killed three workers and injured 15. Only weeks earlier, a report by Hong Kong-based group, Students and Scholars Against Corporate Misbehavior (SACOM) exposed Foxconn's failure to improve working conditions despite a series of suicides by workers last year. Changes in wages and working conditions occurred only after the number of suicides at the Foxconn Shenzhen plant began to increase. The company ringed the building with nets and agreed to wage increases and working concessions. As a result of this event, workers at other companies held strikes (which is against the law in China) to receive comparable concessions.

#### **China High Court Action <sup>6</sup>**

In the wake of food safety violations, the China High Court called for harsher penalties. As reported by the United Press International, "The notice said lower courts should hand down the death sentences to those found guilty of food safety violations that result in loss of human lives."

#### **Apple's Annual Review of Labor Condition <sup>7</sup>**

In its annual review of labor conditions of all its global suppliers, Apple noted 137 workers had been seriously injured by a toxic chemical used in making glass screens. One supplier, Wintek, pressured injured and mistreated workers to resign and accept cash settlements to absolve the company, charges the company denied at the time. Apple, a responsible company, spends significant resources to ensure workers are treated fairly and penalizes suppliers that do not adopt their high standards.

#### **China Battery Factories <sup>8</sup>**

China closed several battery factories only after provincial officials came under pressure due to lead poisoning scandals. In Zhejiang province, a lead battery plant was closed after 300 people, including 99 children were found to have been poisoned by the plants' pollution. Lower environmental controls seem to be a contributing factor to lower costs at some plants.

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<sup>5</sup> Joel Johnson, "1 Million Workers. 90 Million iPhones. 17 Suicides. Who is to Blame?," *Wired*, 28 February 2011.

<sup>6</sup> "Death Penalty for Food Safety Violators?," *United Press International* 31 May 2011.

<sup>7</sup> David Barboza, "Workers Poisoned by Chemical at Apple Supplier in China," *New York Times Business Day Technology*, 22 February 2011.

<sup>8</sup> Dathin Hille, "China Acts over Lead Poison Scandals," *Financial Times*, 29 May 2011.

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### **Legal**

#### Industrial Espionage Laws

China's laws on industrial espionage provide authorities wide discretion in deciding who to charge with espionage. Often, economic and industrial data is considered to be state secrets. Without expert advice and close cooperation with the government, unwittingly violating these laws is possible.

In 2009, Executives of the Brazilian iron ore giant, Rio Tinto, were arrested by Chinese authorities during negotiations over iron ore sale contracts.<sup>9</sup> In addition to higher ore prices, the Chinese government had complained about Rio's decision to abandon a \$19.5 billion deal with Chinalco, the Chinese state-owned metals group, in favor of a deal with one of its long-time competitors.

#### Compliance with Labor Laws

China has many laws governing the treatment of workers, such as minimum-wage laws and laws governing overtime and overtime pay. As some companies have found, these laws are often ignored. U.S. manufacturers can be held legally responsible for these violations in their supply chain. The court of public opinion can also convict companies for these unethical working conditions.

#### Enforceability of Contracts

Many portions of US contracts are not enforceable outside the US. For example, a non-compete clause may do nothing to stop a supplier from using a company's tooling and equipment to develop competing products. In China, contracts should be written in Chinese, because the Chinese Contract Controls the relationship. It does not matter what the English version says.

One cannot stress enough the difficulty in translating contracts into Chinese. It requires recognized Chinese legal experts who speak and write Chinese at a native level to properly construct a viable contract with a Chinese supplier. Even then, enforcement may still be an issue.

#### Protection of Intellectual Property

Protection of intellectual property is weak to non-existent.<sup>10</sup> Even though China has joined the WTO and agrees to abide by all the legal world organizational rules, in reality, many laws are violated. Copyright laws, in particular, are not enforced, and

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<sup>9</sup> Anne Barrowclough, "China conforms Rio Tinto Executive was arrested for spying," *The Times/Sunday Times*, 9 July 2009. <[http://business.timesonline.co.uk/tol/business/industry\\_sectors/natural\\_resources/article6672023.ece](http://business.timesonline.co.uk/tol/business/industry_sectors/natural_resources/article6672023.ece)>

<sup>10</sup> David Leonhardt, "The Real Problem With China" *New York Times*, 11 January 2011.

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piracy of trademarked and copyrighted goods is ubiquitous. Many companies will not produce their product in Asia because they cannot protect the proprietary, patent, or intellectual properties of a product or its manufacturing process.

### Impact of Foreign Currency

China has pegged its Yuan at 8.28250 to \$1 U.S. since 1994. On October 30, 2003, the Bush administration claimed that China "is not violating the 1988 U.S. law against currency manipulation to gain unfair trade advantages."<sup>11</sup> This ruling came in spite of complaints that China's low wages played a major role in the loss of millions of U.S. manufacturing jobs. The U.S. Treasury ruled May 27, 2011 that China was not manipulating its currency to gain unfair trade advantage, but that the Yuan was undervalued and needed to be allowed to rise much faster.<sup>12</sup>

In 2011, the Chinese government came under renewed pressure to let the Yuan float. In spite of this pressure, China continues to manipulate its currency.



Regulators in China are grappling with long-run, unsustainable growth that is putting pressure on inflation, a problem endemic to developing nations. As countries grow, pressure on wages increase. China has experienced 20 years of growth exceeding 9% annually. Some of this growth resulted from an expansionary monetary policy that resulted in a number of risky loans. In 2011, Chinese regulators announced plans to restructure nearly one half trillion (yuan) in nonperforming loans. As it stands, the risk

<sup>11</sup> Martin Crutsinger, "U.S.: China Not Violating Currency Law," *AP News*, 30 October 2003.

<sup>12</sup> Doug Palmer, "U.S. Says China Yuan Undervalued But Not Manipulated," *Reuters*, 27 May 2011. <<http://www.reuters.com/article/2011/05/27/us-usa-china-currency-idUSTRE74Q6C620110527>>

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of higher manufacturing costs loom while the Policy Board of the Bank of China balances inflation with competing deficiencies in its economy.

### **Costs Associated with Outsourcing**

In the last decade, many U.S. manufacturing jobs have been outsourced to low-wage countries. Many companies lured by low labor costs discover later that the estimated savings were never realized due to unanticipated costs. Before deciding to source off-shore, a firm should analyze the total cost of offshore manufacturing. Factors that should be taken into consideration include:

#### **Ocean Shipping Cost**

Beyond the cost of production, shipping to and from Asia is one of the largest expenses. About 90% of world trade is moved by ship, usually packed into cargo containers. Container costs average about \$1,800 - \$1,900 for ocean shipping. Other shipping costs that should be considered include:

- Duty – based on the type of product and the related customs laws
- Cost of transport to the port in China
- Cost of transport to customers or distributors within the U.S.
- Cost of warehousing while in transit
- Customs compliance costs
- Inventory carrying cost while in transit. Delivery of a product from China to the U.S. can take 4 to 6 weeks.
- Unfavorable payment terms. Some Asian companies demand payment when the door on the container closes.
- Potential cost of unforeseen delays, such as the West Coast dock strike of 2002
- Homeland Security issues affect shipping schedules
- Financing cost on the value of the shipment
- Insurance for lost containers – each year, approximately 10,000 containers fall overboard. Some famous spills include:
  - 80,000 Nike tennis shoes into the north Pacific Ocean
  - 414 drums of arsenic near New York City (recovered)
  - 29,000 bath toys
  - 34,000 hockey gloves
  - 500,000 cans of beer into the Pacific Ocean

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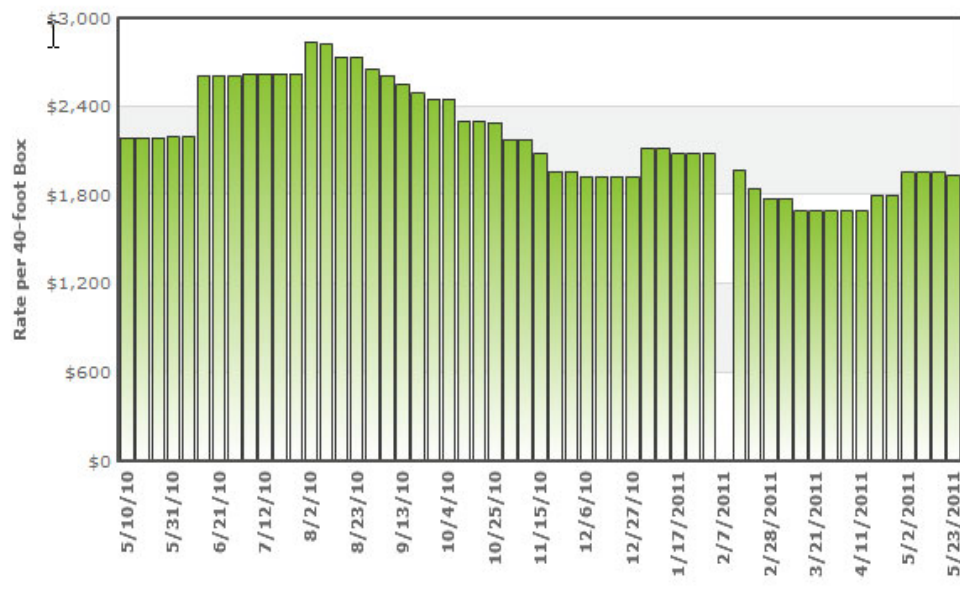
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- 5 million Lego plastic pieces

As a rule of thumb, we estimate that ocean freight and logistics costs add about 17% to the product cost. These costs cover transporting the product to the port of shipment, loading a 40 foot container, processing paperwork, ocean voyage, customs clearance together with off loading and domestic transportation.

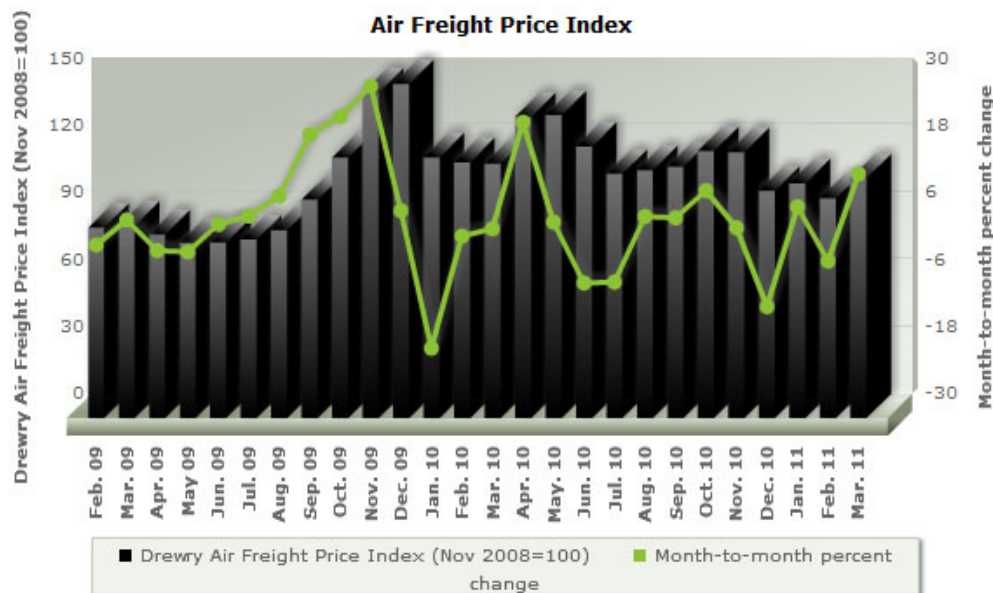
The Journal of Commerce publishes each month a comprehensive set of data and charts related to shipping and shipping cost drivers. They also have data broken down by shipping and destination points both east and west bound. Listed below are two of the charts Container Rate benchmark and the Air Freight Price index.



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### **Air Shipping Cost**

Naturally, firms that ship by air face higher transportation costs but benefit from faster delivery. Products with small footprints that are lightweight are the typical candidates for air shipment. While constantly changing, costs range from \$2.00 to \$2.50 per pound. Products packaged in large corrugated boxes carry a much higher cost to ship by air.

### **Material Costs**

In general, when compared to other costs associated with outsourcing, off-shore material costs are not significantly different than here in the U.S. However, certain types of materials, for example U.S. grades plastic, are not available in the off-shore markets and must be exported from the U.S. to the off-shore supplier. Material specifications may also be different or measured in a different manner. It is often necessary to perform engineering and quality evaluation to confirm a material is satisfactory, not a cost added to the product. In addition the difficulty in maintaining quality control of raw materials is exacerbated when the source of the material is not clear or when it changes without the required notice.

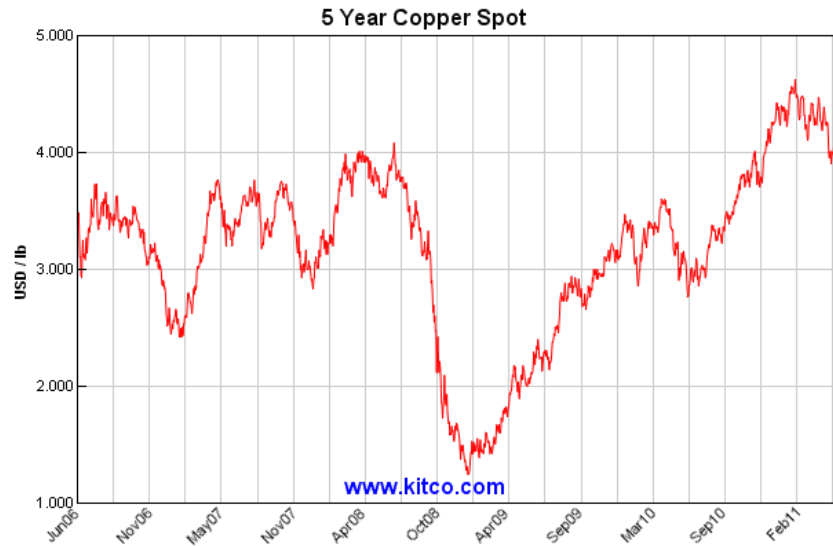
Today, China is the world's largest consumer of raw materials used to manufacture products for export and internal consumption. The rate at which China is importing and using material has caused the price of these materials to dramatically increase in the last couple of years. Five year graphs of copper, aluminum, neodymium, and

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dysprosium showed how demand by china has increased cost of raw materials. The charts also show the effects of the global recession of 2008. The one certainty in regards to raw material cost is they will only be increasing over time.



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Rare Earth data from <<https://www.metal-pages.com>>



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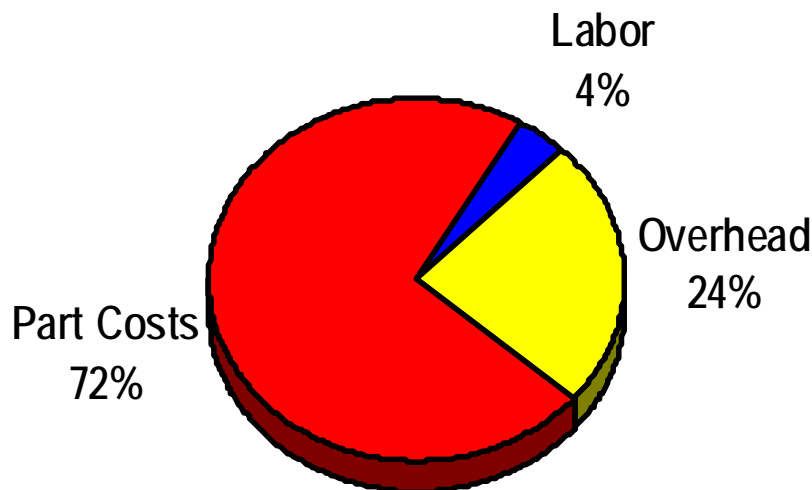
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### **Labor – How much labor does the product contain?**

Too often, the cost of a product is associated exclusively with its labor costs. The significant portion of a product's cost is not necessarily labor however. While some products and assemblies contain significant portions of labor, most do not.

The chart below has been created from data gathered by Boothroyd Dewhurst, Inc., over the last few years and is based on costs from U.S. manufacturers.<sup>13</sup> The chart shows that labor is often the least significant contributor to cost. Instead, raw materials and parts produce the lion's share of cost. This is significant because it indicates that redesigning a product may provide much greater cost savings than manufacturing overseas.



### **Travel / Time Zones**

Travel to Asia is expensive both in terms of time and money. Typically, U.S. company travelers stay an average of one week to ten days. Typical plane fare to Far East average \$10,000.00 - \$12,000 dollars. Starting up a relationship with a vendor and

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<sup>13</sup> A typical product cost breakdown, Boothroyd Dewhurst, Inc., DFMA Training Guide, 2003.

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launching a product can consume three or more trips to Asia. Maintaining the relationship requires in-person contact.

The time zone difference requires early morning or late night calls. Replies to e-mail messages become delayed until China or America has woken up inflicting additional costs because of delays.

We estimate that as much as 1% is added to product cost as a result of travel, communication issues (including translation), and lost time.

### **Quality Issues**

The manufacturing quality of a product is an issue that requires constant vigilance. China's low labor rates exist because a plentiful supply of unskilled workers exists in rural areas who are trying to make a better life for themselves. Since payment is often based on the number of units completed, any unit finished is a "good unit." Many companies are surprised when the container is unloaded and a product sample is pulled to find a variety of quality issues.

In general, having on-site personal or qualified third-party inspectors/auditors to control quality is crucial. Over time, controlling quality may become an arduous task. A supplier's business may serve an increased number of customers, making it more difficult to monitor quality. In addition, suppliers may also change without any notice the process by which they produce, affecting quality. Inspecting all products before shipment is crucial. Our experience is that these quality defects can run between 1 and 8 percent of product cost.

### **Vendor Selection**

There are several ways to get started manufacturing in China that include:

- Working with a U.S. third party to operate a factory
- Entering a joint relationship with a supplier
- Selecting a supplier simply to manufacture your product.

Selecting the partner is the most critical step in an outsourcing plan. It consumes significant time of qualified people to have a successful outcome. Due diligence is required to ensure the supplier can meet your requirements. Important considerations when selecting a supplier in China include:

- Do they have a US based office?
- Do they speak and understand English sufficiently well to avoid confusion?
- Have you explained your expectations and can the supplier explain them to you?
- Is it likely that the joint interests with the supplier will become misaligned in the future as business conditions change?

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- Does an adequate governance structure exist or will you need to build one?
- Are you able to efficiently operate within the Chinese business culture?
- Do you understand the cost of sending and evaluating RFQ's? These costs can run from 0.2 to 2% of product cost<sup>14</sup>
- Regardless of what the contract says, visibility into the 2<sup>nd</sup> and 3<sup>rd</sup> tier suppliers is difficult to obtain and these suppliers are frequently changed without notice. Ensuring quality and performance of an unseen supply chain is difficult.

### **Other Issues and Costs to Recognize**

A full NPV analysis measures opportunity costs including unintended side effects from a proposed project. In addition to the costs identified in the previous sections, a number of others exist. Naturally, costs depend upon the product and industry structure. The list below details a few but is not all-inclusive:

- |   |  |
|---|--|
| • Legal Issues                                  | • Underestimation of startup costs                                 |
| • Theft/Piracy                                  | • Increasing labor costs once a vendor relationship is established |
| • Shipping losses                               | • Cost of transition   |
| • Cost of additional paperwork                  | • Cost of layoffs and severance                                    |
| • Cost of employee morale                       | • Cost of inventory carry due to shipping                          |
| • Cultural/Communication difficulties           | • Cost of managing offshore  |
| • Loss of manufacturing control and flexibility | • Cost of bringing a project back to the U.S.                      |
| • Training costs                                |  |

Manufacturing in China prohibits the use of just-in-time inventory methods and runs counter to lean manufacturing. Because of the long shipping times, schedules are rigid and companies are less able to respond to changes in market demand.

Upper and lower bounds should be placed upon any cost estimates for producing in Asia. These should include some allowance for catastrophic events such as shipping accidents. In addition, the health environment of China, in particular, has economic costs. The first outbreak of SARS occurred in China, and its impact on southern China's economy was significant. The more recent outbreak of the bird flu has also had some impact, although not to the extent of SARS. Currently companies are beginning to quantify the cost of employees quarantined after trips to Asia.

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<sup>14</sup> Stephanie Overby, "The Hidden Costs of Offshore Outsourcing," *CIO Magazine*, 1 September 2003.

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If outsourcing to China should fail, and this has happened, the cost associated with bringing a project back to the U.S. is high. Typically products that are outsourced do not have best-in-class design. Cheaper manufacturing rates make it possible to take a poor design and make it economically manufacturable. However, how can such a product now be brought back to the U.S. and be produced competitively? The design must be reworked from scratch, reducing parts and materials in order to compensate for higher labor rates.

We have conservatively estimated that this final category of miscellaneous costs of outsourcing to Asia adds only 1% to the product cost. We believe the actual figure would be much higher given that every product has a unique set of external costs. We underestimate the costs involved for the purpose of presenting our argument. The likelihood that the real costs will be higher makes the argument more compelling.

### Conclusions About Off-shore Manufacturing Costs

The aforementioned costs, both tangible and intangible, sum to 24% of total product cost. While actual experience varies, this estimate is based on our experiences with various suppliers and products. This estimate does not include provisions for many of the risks and intangible costs that relate to specific products. Your analysis should quantify all of the relevant intangible costs for your product.

#### Representative Cost of Logistics for Landing a China Built Product in the U.S.

Baseline adder for shipping and logistics	17%
Finding a vendor	1%
Quality issues	4%
Travel and communications	1%
All others	1%
Total adder	<u><u>24%</u></u>

This estimate is comparable to numbers quoted by Gary Larson, vice president of sales and business development for Electronics Systems Inc., who estimates 15 to 20 percent for added costs of freight, customs, homeland security, logistics, inventory carrying costs and reduction in cash flow.<sup>15</sup> Not fully taken into account are quality, culture, travel, and other costs that have been raised in this paper.

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<sup>15</sup>Susan Mucha, "Calculating the Total Costs of Offshore Outsourcing," *Circuits Assembly*, June 2003, pp. 28-30.

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A West Coast producer of industrial products that does manufacturing in China disclosed to us that a cost adder of 16 percent covers only the costs of shipping and logistics.

A producer of commercial goods experienced the following results when evaluating design as part of an outsourcing event. (The numbers were modified to maintain confidentiality. The ratios among the numbers are consistent with the original calculation.) This analysis is for transferring production to a mature plant with which the producer already had a relationship. The effect of start up costs in China and the costs related to shutting down a plant in the U.S. thus were not included in this analysis. Also, shipping costs from China were optimized by assuming that a product could be shipped alongside others purchased from suppliers.

The analysis indicates that the benefit of outsourcing significantly decreased with product redesign. Although labor was a significant portion of the manufacturing cost, the redesign was able to reduce both overall labor and part cost. Optimizing the design and manufacture of the product reduce the product cost significantly. The argument for domestic production is strong when this analysis is coupled with the risks of producing overseas.

	Current Design				Re-design			
			USA Better/Worse				USA Better/Worse	
	USA	China	than China		USA	China	than China	
	Build	Built	\$	%	Build	Built	\$	%
Raw Material	6.58	6.52	(0.06)	(1%)	3.35	3.38	0.03	1%
Purchased Parts	5.38	3.85	(1.53)	(28%)	3.85	3.05	(0.80)	(21%)
Direct labor	0.19	0.04	(0.15)	(79%)	0.16	0.03	(0.13)	(81%)
Indirect Labor & Salary	0.61	0.24	(0.37)	(61%)	0.38	0.24	(0.14)	(37%)
Benefits	0.24	0.06	(0.18)	(75%)	0.15	0.06	(0.09)	(60%)
Overhead	1.56	0.94	(0.62)	(40%)	1.15	0.87	(0.28)	(24%)
SG&A	0.37	0.33	(0.04)	(11%)	0.37	0.33	(0.04)	(11%)
Profit		0.37	0.37	100%		0.37	0.37	100%
	14.93	12.35	(2.58)	(17%)	9.41	8.33	(1.08)	(11%)
Quality Inspection		0.04	0.04	100%		0.04	0.04	100%
Supplier Management		0.05	0.05	100%		0.05	0.05	100%
Logistics Costs	0.06	1.41	1.35	100% <sup>+</sup>	0.06	1.37	1.31	100% <sup>+</sup>
	14.99	13.85	(1.14)	(8%)	9.47	9.79	0.32	3%

### Other Outsourcing Experiences

**Boeing Commercial Airplanes** chief Jim Albaugh talked about the lessons learned from the disastrous three years of delays on the 787 Dreamliner delay. One lesson that he was unusually candid about was the 787's global outsourcing strategy intended to slash cost which backfired.<sup>16</sup> Wall Street estimated the additional cost of this failure at \$18 billion. Ironically, an internal company conference paper warned Boeing of the outcome that occurred. Dr. L.J. Hart-Smith, a world-renowned airplane structures engineer, correctly critiqued excessive use of outsourcing.<sup>17</sup>

**Accenture** a business consulting firm surveyed 287 manufacturing companies on the topic of outsourcing. 61% of the respondents said they were considering moving their manufacturing home. The reasons cited included input price increases, logistical costs, exchange rate issues, and quality costs. Specifically:

- 73 % of the companies have seen significant increases in supplier material costs and component prices.
- 57 % have experienced cost increases associated with logistics and transportation; 36% have seen price increases for overhead and administrative functions;
- 31% have been impacted by exchange rate differentials;
- 26 % have had to increase their inventories as a means to buffer supply chain disruptions; and
- 25 % have seen increases in the cost of quality.
- Other increasing costs included material handling and warehousing; packaging; VAT, customs and duties; product qualifications; customer service costs; procurement staff costs such as broker fees; and increased tooling costs.

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<sup>16</sup> "A "prescient" warning to Boeing on 787 trouble," *The Seattle Times*, 9 February 2011.  
<[http://seattletimes.nwsources.com/html/sundaybuzz/2014125414\\_sundaybuzz06.html](http://seattletimes.nwsources.com/html/sundaybuzz/2014125414_sundaybuzz06.html)>

<sup>17</sup> L.J. Hart-Smith, "Out-Sourcing Profits - The Cornerstone of Successful Subcontracting," Boeing Third Annual Technical Excellence Symposium, February 2001.

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The study concluded that “the overreliance on direct costs to the exclusion of other legitimate cost factors distorts the business case for offshoring ....”<sup>18</sup>

**Beijer Electronics** used DFMA to reduce cost while designing mobile data terminals. Beijer designers were able to reduce part count by 50%, fasteners by 61%, and assembly time by 70%. All these savings allowed Beijer to keep product manufacturing in the U.S.<sup>19</sup>

### Conclusion and Further Reading

Seven years after our original report on the hidden costs of offshoring product manufacture, it is clear that the practice that companies have of not properly accounting for costs continues to be a problem. Aside from unexpected events, hidden costs exist because complete costs are rarely allocated to the product and reside instead in corporate overhead budgets. This distorts fair comparison of domestic and offshore manufacturing, leaving labor rates as a common, central metric.

Essential to any decision about whether to relocate manufacturing to another country is the requirement for better overall accounting practices and a deeper reliance on risk management or FMEA (failure mode and effects analysis). In addition, there needs to be an effort first to benchmark designs with DFMA and apply these methods to improve product performance and reach established target costs.

One question we asked in our 2004 study was, why not send the DFMA redesign to China and have it manufactured there? This is an option, of course, but only after reviewing all of the factors listed earlier (pages 5-6) as dangers. Is it more viable to go overseas than invest in the country that is still the number one consumer market in the world? In the U.S. there are potentially stronger supply chain partnerships, better logistics, good rule of law, and a smart development-based community for creating cost-effective, quality products.

As we acknowledged in our first paper, more study and discussion is needed to determine the comparative benefits of outsourcing the manufacture of products to China versus redesigning products and manufacturing them here. Again, good thinking

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<sup>18</sup> Richard McCormack, “Accenture: Offshore Outsourcing Has Not Worked,” *Manufacturing & Technology News*, Vol. 18, No.7, April 2011. <http://www.manufacturingnews.com/news/11/0415/Fellowes.html>

<sup>19</sup> “Keeping Manufacturing Onshore By Design”, *Design 2 Part*, February 2011:62-68

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on this topic will cross over and integrate disciplines such as product design, industrial and manufacturing engineering, procurement, operations management, product costing, and corporate finance and accounting.

For those who wish to investigate the subject further, the offshoring debate is now regularly reported in the trade and business press and in major television news media. We recommend following business analysts such as Boston Consulting Group and Aberdeen Group for in-depth reports, as well as supply chain expert Dr. J. Paul Dittmann of the University of Tennessee.

In addition, significant work on this subject is being done by Harry Moser of the Reshoring Initiative, whose Total Cost of Ownership Estimator software is complementary with DFMA ([www.reshorennow.org](http://www.reshorennow.org) or [harry.moser@comcast.net](mailto:harry.moser@comcast.net)).

### **Appendix: Design for Manufacture and Assembly**

#### **Design for Assembly – Simplicity Pays Off**

Design for Assembly (DFA) is a methodology for evaluating part designs and the overall design of an assembly. It is a quantifiable way to identify unnecessary parts in an assembly and to determine assembly times and costs. Using DFA software, product engineers assess the cost contribution of each part and then simplify the product concept through part reduction strategies. These strategies involve incorporating as many features into one part as is economically feasible. The outcome of a DFA-based design is a more elegant product with fewer parts that is both functionally efficient and easy to assemble. The larger benefits of a DFA-based design are reduced part costs, improved quality and reliability, and shorter development cycles.

<http://www.dfma.com/software/dfa.htm>

#### **Design for Manufacture – Vital to Competitiveness**

Design for Manufacture (DFM) is a systematic approach that allows engineers to anticipate manufacturing costs early in the design process, even when only rough geometries are available on the product being developed. Given the large number of process technologies and materials available, few design engineers have detailed knowledge of all the major shape-forming processes. Consequently, engineers tend to design for manufacturing processes with which they are familiar. DFM methodology encourages individual engineers and concurrent development teams to investigate



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additional processes and materials and to develop designs that may be more economical to produce. With more information about viable processes and materials, users can quantify manufacturing costs for competing design alternatives and decide which design is best. <http://www.dfma.com/software/dfm.htm>

### The Relationship between DFA and DFM

DFM complements DFA. Engineers use DFA software to reduce the assembly cost of a product by consolidating parts into elegant and multifunctional designs. DFM software then allows the design engineer quickly to judge the cost of producing the new design and to compare it with the cost of producing the original assembly. Used together, DFM and DFA software give engineers an early cost profile of product designs, providing a basis for planning and decision making. Such analyses, when performed at the earliest stages of concept design, have the potential to greatly influence manufacturing and other life cycle costs before they are locked in. <http://www.dfma.com/software/index.html>

Complete information about DFMA methodology is available at: [www.dfma.com](http://www.dfma.com).

## About the Authors

**David G. Meeker** is an authority on the application of Design for Manufacture and Assembly and its role in new product development. His areas of expertise also include benchmarking, cost estimating, and design for disassembly and recyclability.

David has more than 29 years of industry experience working as an engineer for companies in both the commercial and defense industries, including Digital Equipment Corp., Compaq Computer Corp, and Hewlett-Packard Company. He is credited with saving hundreds of millions of dollars through improved product design strategies. He is currently a private consultant applying new product development techniques to improve quality and time to market and to reduce cost. David also teaches product design in the Department of Mechanical Engineering at Massachusetts Institute of Technology.

David has published papers in the journals of professional organizations such as the American Society of Mechanical Engineering and the International Conference on Engineering Education. He holds a B.S and M.S. Degrees Carnegie Mellon University.

**Jay P. Mortensen** is an authority on Procurement Engineering and Target Costing. He has applied Design for Manufacture and Assembly processes in new product development, redesign, competitive analysis, and General Procurement. His areas of expertise include process simplification, supply chain development, benchmarking and should cost analysis, financial and operational due diligence, financial management, and compliance.

Jay has more than 25 years of industry experience working in procurement, finance, and operations for companies that include Toyota, LG Electronics, KPMG, and Maytag. He has supported the development of value through process and produce simplification using DFMA principles. He has spent about five years of his adult living in Asia. Jay has been a speaker on product and supply chain optimization for the Society of Manufacturing Engineers, CAM-I/AICPA Conference, and International Forum on DFMA for Target Costing, DFMA, and Should Cost Modeling processes