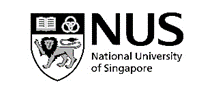
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Caterpillar Inc.: Aftermarket PartS Freight Optimization[[1]](#footnote-1)

Ramya Subramanian and Professor Singfat Chu wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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Sam Tan thanked the driver of the bus as he got off opposite the Asia Distribution Centre of Caterpillar Inc. (Caterpillar) in Singapore. It was 8:00 a.m. on Monday July 10, 2017, and Tan was looking forward to starting his final internship prior to graduating with an honours bachelor’s degree in analytics and operations. Caterpillar was on his short list of potential employers.

At 8:30 a.m., he was greeted by the head of the operations team:

Tan, welcome to Caterpillar. We are glad to have you with us until you head back to university next month. We have been thinking of how to make your stay here a productive one. A problem that we have identified for you pertains to how we split the daily shipments of spare parts among our three strategic freight forwarders. Essentially, they compete on prices, estimated delivery time, and on-time performance (that is, actual delivery within the estimated time). We use an experience-based heuristic to achieve low cost, short estimated delivery time, and high on-time performance as much as possible. We hope you can help us develop an alternative methodology [that] is more rigorous and analytical.

How Caterpillar started

Before applying for the internship position, Tan had researched the history of the company. The name “Caterpillar” was registered as a trademark in 1910 by the Holt Manufacturing Company in Stockton, California. Led by innovator Benjamin Holt since 1886, the company had been developing steam engines to replace the horses that pulled its combine harvesters. Between 1904 and 1905, the company developed a steam traction engine that moved on revolving tracks instead of wheels. Revolving tracks provided higher operational stability than wheels, as their larger surface area allowed for better traction, especially when the ground was soft, uneven, or hilly. A photographer who saw “the motion of the track undulating between the drive sprocket and the front idler wheel . . . exclaimed that the machine crawled like a caterpillar. Holt adopted that name for his crawler tractors.”[[2]](#footnote-2) In 1906, Holt introduced the precursor of the modern crawler tractor, which was powered not by steam but rather by the less problematic and more efficient gasoline.

When World War I broke out in 1914, the Holt Manufacturing Company expanded production to supply its tractors to the allied forces and eventually to the U.S. military, when it joined the fray in 1917. When the war ended abruptly in 1918, the company faced a deluge of cancelled procurement contracts, production overcapacity, and stockpiles of military equipment; sales of this war surplus depressed the new tractor market. When Holt passed away in 1920, the company’s finances spiralled deeply into debt.

A solution surfaced in May 1925, thanks to bond broker Harry H. Fair, who arranged the merger of the Holt Manufacturing Company with its long-time competitor, the C. L. Best Tractor Company. The merger was deemed to be in the best interests of both companies, which could otherwise have gone under. The merged entity was named Caterpillar Tractor Company, to take advantage of the reputation of the Caterpillar trademark. With about 2,500 employees and 80 independent dealers, Caterpillar at that time mainly served the agricultural industry in the United States with a product line consisting of five tractor models. Net sales in 1925[[3]](#footnote-3) amounted to about US$14 million.[[4]](#footnote-4)

Caterpillar today

By 2017, Caterpillar had blossomed into a globally known brand with over 20,000 patents[[5]](#footnote-5) to its name and some three million pieces of equipment, including its characteristic bulldozers, excavators, backhoes, loaders, locomotives, and engines,[[6]](#footnote-6) deployed worldwide. It had a regular presence on corporate rankings pertaining to finance, reputation, branding, supply chain excellence, employee diversity, and corporate social responsibility.[[7]](#footnote-7) Its iconic yellow and black logos appeared across all of its products, including licensed merchandise such as clothing, footwear, and scale models. Caterpillar had become a world giant in the provision of equipment and engines in three broadly-defined industries: construction (including infrastructure, forestry, and building construction); resources (including mining, quarry, waste, and materials handling); and energy and transportation (including engines, turbines, diesel-electric locomotives, and related parts for industry, power generation, and the transportation of oil and gas over water and land). Caterpillar also offered financial products, including leases, instalment sales contracts, working capital loans, and wholesale financing plans.

These four segments (construction, resources, energy and transportation, and financial products) contributed 40 per cent, 15 per cent, 37 per cent, and 8 per cent, respectively, of the company’s 2016 net sales of $38 billion. Net sales had fluctuated between a low of $32 billion in 2009 (due to the subprime mortgage crisis) and an all-time high of $66 billion in 2012. Since then, falling oil and commodity prices had adversely affected Caterpillar’s sales as investments linked to those industries declined. In the era of Industry 4.0,[[8]](#footnote-8) Caterpillar’s management was looking into new revenue generation through predictive analytics, which would use data-gathering and diagnostic technologies to optimize operations and asset maintenance for its customers, some 470,000 of whom were connected online in 2016.

Caterpillar had been doing business outside the United States since the days of Benjamin Holt. In 2016, it had manufacturing and remanufacturing facilities in 21 countries. The geographical regions of North America; Asia Pacific; Europe, Africa, and the Middle East; and Latin America accounted for about 47 per cent, 21 per cent, 23 per cent, and 9 per cent of its net sales, respectively. It had a full-time global workforce in 2016 of 95,000 people.

Caterpillar was run from the U.S. corporate headquarters in Illinois. Six other marketing and operations offices were located in San Diego, Piracicaba (Brazil), Geneva, Beijing, Tokyo, and Singapore. Its clients across 190 countries were served via a network of 172 independent dealers, who interacted with 25 parts distribution centres across the globe to provide prompt aftermarket service.[[9]](#footnote-9)

asia distribution centre

The objective of each parts distribution centre was to fulfil 98 per cent of orders within 24 hours of receiving them. Caterpillar had started operations in Singapore in 1967, two years after Singapore gained its independence, and had designated Singapore as the location for its Asia Distribution Centre (ADC). The 700,000-square-foot facility, which stocked some 180,000 line items, was located on Tractor Road—a name that reflected the significance of the facility to Singapore.

Caterpillar decided on the locations of parts distribution centres on the basis of their potential business volumes and their connectivity to the company’s customers. Singapore was an attractive location for the ADC as it offered the best connections by air, sea, and land to Caterpillar’s Asian customers, who were scattered across Asia, from Mongolia in the north to India in the west, Indonesia to the south, and China to the east.

Singapore’s strategic location at the southeastern tip of continental Asia was recognized in 1819 by Sir Thomas Stamford Raffles, who set up a free port there to compete with Dutch-controlled ports in the region for the booming trade between China and India. Over the years, Singapore grew in importance as rubber and tin were shipped from nearby Malaya. The introduction of steamships increased the volume and speed of trading, and the opening of the Suez Canal cut the travel time between Asia and Europe.[[10]](#footnote-10)

After Singapore gained independence in 1965, it developed into one of the four “Asian Tiger” economies—along with Hong Kong, South Korea, and Taiwan—which enjoyed high growth rates by producing textiles and electronics for world markets. Blessed with good connectivity for import and export activities via the sea, these economies grew further in importance when air traffic grew.

Until 2017, Singapore had anchored itself as a prime logistical hub. The Port of Singapore had become the busiest transshipment port, and it was among the top ports in the world in terms of tonnage. In 2016, it handled 31 million 20-foot-equivalent containers and serviced 139,000 vessels.[[11]](#footnote-11) Singapore’s Changi Airport, which opened in 1981, recorded almost 59 million passenger movements in 2016. It served as a port of call for over 100 airlines serving some 380 cities in 90 countries. Beyond serving civilian travel, Changi Airport was also among the busiest worldwide for air cargo, handling almost two million tons in 2016.[[12]](#footnote-12) In 2016, The World Bank ranked Singapore fourth on its Logistics Performance Index, which benchmarked 160 countries based on the efficiency of their international supply chains.[[13]](#footnote-13) Given these accomplishments, it was clear why Caterpillar selected Singapore for its ADC.

daily freight forwarding decision

The ADC operations team was responsible for meeting the key performance indicator of shipping spare parts ordered by dealers. Urgent orders of spare parts flowed through Caterpillar dealers’ order system. For destinations without contracted rates, such as for the 10 countries in the Southeast Asia region, the operations team would consolidate all shipments daily by country. By late afternoon, it would then raise a freight spot quote inquiry to the procurement team and request that it appoint a freight forwarder (FF) for each country. Caterpillar had discovered through experience that it could gain from spot as opposed to contracted rates, as many FFs often had excess capacity to these 10 countries.

The procurement team would forward information on the weight, volume, and delivery locations of each spare-parts shipment to three strategic FFs (FF1, FF2, and FF3) appointed for the Southeast Asia region. The FFs would submit a quotation indicating the cost and the number of transit days they would require to make all the deliveries in each country. The procurement team would then evaluate the submissions and proceed to select an FF for each country based on the data for the shipments required that day (see Exhibit 1). Finally, the consolidated shipment for each country would be picked up by the selected FF before the end of the business day.

On July 5, 2017, for deliveries to Brunei, FF1 quoted S$7,511[[14]](#footnote-14) and estimated that it would require two transit days to get all the spare parts delivered, while FF2 quoted S$8,328 for one transit day and FF3 quoted S$7,600 for two transit days. Caterpillar privileged prompt aftermarket service to its customers. Accordingly, it tracked the delivery performance of each shipment as it had a “committed delivery lead time” in servicing its dealers. If an FF quoted to deliver all the shipments in a country within two days but failed to do so, it would have negative implications for all parties. Caterpillar only worked with FFs that had on-time-performance (OTP) statistics near the top in the industry. For the Brunei market, FF1 had historically delivered 95 per cent of shipments on time when it had quoted two day deliveries, while FF2 and FF3 had achieved historical OTP rates of 89 per cent and 92 per cent, respectively, when they had quoted one and two day deliveries in the past.

Caterpillar had many customers in Brunei, Indonesia, Malaysia, and Thailand (see Exhibit 1). There were not many shipments to be made within Singapore, as most dealers there came directly to the ADC to pick up the required parts. For those who did not, the three FFs delivered all shipments to them by the next business day. New markets were also opening up in Cambodia and Laos. The current low volumes of orders coming from these countries had not yet enticed all three FFs to serve them. Thus, FF1 did not provide service to either Cambodia or Laos; FF2 was not servicing Laos; and FF3 was the only FF serving both countries.

Caterpillar believed in dividing business among the three FFs rather than relying too much on any one FF, and this helped the company to mitigate risk. To that end, it was decided that no FF would get more than 60 per cent of Caterpillar’s total shipping expenditures on any given day. This meant, for example, that if Caterpillar were to spend S$40,000 for shipments on a given day, no FF would receive more than S$24,000. While there was a maximum on the amount to be paid to an FF, there was no minimum, for obvious competitive reasons.

The procurement team used an experience-based heuristic for selecting an FF for each country, while taking into account the costs, the number of transit days, the OTP statistics, and the 60 per cent expenditure ceiling. As it was being pressed by the internal audit team, which was promoting continuous process improvements, the procurement team wondered if Tan, during his month-long internship, could develop a more rigorous, analytical method for making the FF selection for each country.

Exhibit 1: Cost, Transit Days, and historical on-time performance

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Cost (S$)** | | | **Transit Days** | | | **OTP (%)** | | |
| **Country** | FF1 | FF2 | FF3 | FF1 | FF2 | FF3 | FF1 | FF2 | FF3 |
| Brunei | 7,511 | 8,328 | 7,600 | 2 | 1 | 2 | 95 | 89 | 92 |
| Cambodia | – | – | 675 | – | – | 4 | – | – | 67 |
| Indonesia | 9,174 | 9,239 | 8,636 | 3 | 4 | 5 | 88 | 96 | 95 |
| Laos | – | 990 | 1,115 | – | 5 | 5 | – | 77 | 85 |
| Malaysia | 6,577 | 6,978 | 6,830 | 2 | 2 | 2 | 93 | 95 | 97 |
| Myanmar | 1,490 | 1,920 | 1,355 | 4 | 3 | 4 | 70 | 86 | 74 |
| Philippines | 2,349 | 2,179 | 2,108 | 2 | 3 | 3 | 90 | 87 | 82 |
| Singapore | 338 | 356 | 362 | 1 | 1 | 1 | 100 | 100 | 100 |
| Thailand | 5,618 | 5,999 | 5,175 | 3 | 2 | 4 | 95 | 91 | 97 |
| Vietnam | 3,560 | 3,975 | 4,100 | 5 | 3 | 4 | 98 | 83 | 94 |

Note: OTP = on-time performance; FF = freight forwarder.

Source: Created by authors based on company documents.

1. This case has been written on the basis of published sources only. Consequently, the interpretation and perspectives presented in this case are not necessarily those of Caterpillar Inc. or any of its employees. [↑](#footnote-ref-1)
2. “Caterpillar History,” Antique Caterpillar Machinery Owners Club, May 12, 2012, accessed December 14, 2017, <https://web.archive.org/web/20120512021747/http://www.acmoc.org/about-caterpillar>. [↑](#footnote-ref-2)
3. “90 Years of History,” Caterpillar, accessed December 14, 2017, www.caterpillar.com/en/company/history/archive/90-years-of-caterpillar.html. [↑](#footnote-ref-3)
4. All currency amounts are in U.S. dollars unless otherwise specified. [↑](#footnote-ref-4)
5. Caterpillar Inc., *Q4 2016: Caterpillar Fact Sheet*, 2016, accessed December 14, 2017, http://s7d2.scene7.com/is/content/Caterpillar/CM20170313-42240-25187. [↑](#footnote-ref-5)
6. Lauren Zanolli, “Caterpillar’s Next Dig: Big Data,” Field Service Digital, June 18, 2015, accessed December 14, 2017, http://fsd.servicemax.com/2015/06/18/caterpillars-next-dig-big-data/. [↑](#footnote-ref-6)
7. “Caterpillar,” Ranking The Brands, accessed December 14, 2017, https://www.rankingthebrands.com/Brand-detail.aspx?brandID=365. [↑](#footnote-ref-7)
8. Bernard Marr, “What Everyone Must Know about Industry 4.0,” *Forbes*, June 20, 2016, accessed December 14, 2017, https://www.forbes.com/sites/bernardmarr/2016/06/20/what-everyone-must-know-about-industry-4-0/#8e3e154795f7. [↑](#footnote-ref-8)
9. Caterpillar Inc., *2016 Annual Report*, April 1, 2017, accessed December 14, 2017, http://reports.caterpillar.com/ar/\_pdf/2016\_cat\_ar.pdf. [↑](#footnote-ref-9)
10. Heirwin Mohd Nasir, “Stamford Raffles’s Career and Contributions to Singapore,” National Library Board, Singapore, accessed December 14, 2017, http://eresources.nlb.gov.sg/infopedia/articles/SIP\_715\_2004-12-15.html. [↑](#footnote-ref-10)
11. “Port Statistics,” Maritime and Port Authority of Singapore, accessed December 14, 2017, https://www.mpa.gov.sg/web/portal/home/maritime-singapore/port-statistics. [↑](#footnote-ref-11)
12. “Traffic Statistics,” Changi Airport Group, November 23, 2017, accessed December 14, 2017, www.changiairport.com/corporate/about-us/traffic-statistics.html. [↑](#footnote-ref-12)
13. “Logistics Performance Index,” The World Bank, accessed December 14, 2017, https://lpi.worldbank.org/. [↑](#footnote-ref-13)
14. S$ = Singapore dollar; S$1.00 = US$0.73 on July 1, 2017. [↑](#footnote-ref-14)