

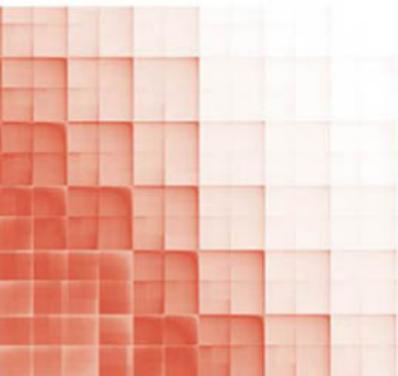
# **Toyota China: Matching Supply with Demand**

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**Xiaoying Liang, City University of Hong Kong;  
Lijun Ma, Shenzhen University;  
Houmin Yan, City University of Hong Kong**

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**PEARSON CASES IN SUPPLY CHAIN MANAGEMENT AND ANALYTICS**



The case is reprinted from *The Supply Chain Management Casebook* by Chuck Munson

# Toyota China

Matching Supply with Demand

Chuck Munson  
with Xiaoying Liang, Lijun Ma, and Houmin Yan

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# Toyota China: Matching Supply with Demand<sup>1</sup>

**Xiaoying Liang<sup>†</sup>, Lijun Ma<sup>‡</sup>, and Houmin Yan<sup>°</sup>**

*“For years, operations managers have recognized that the matching of supply and demand is one of their most challenging problems.”<sup>2</sup>*

—Gabriel Bitran, MIT Sloan School of Management

Five eager faces looked up at Mr. Johnson Zhang, regional sales manager for Central China of GAC Toyota Motor Co., Ltd. (GAC-Toyota), as he entered the conference room. It was May 2009, and the meeting had been scheduled to discuss the quota allocation of a newly released Toyota SUV model, the Highlander, which had been in great demand since its launch. The five attendees were major sales

<sup>1</sup> Dr. Xiaoying Liang, Dr. Lijun Ma and Dr. Houmin Yan prepared this case for class discussions. It is not intended to serve as endorsement, sources of primary data or illustrations of effective or ineffective management. Preparation of this case was supported in part by RGC Competitive Earmarked Research Grants 4187/09 and 4183/11, and by NSFC grants 71001073 and 71271182. The authors would like to thank Mr. Johnson Qiang, Toyota’s regional manager for central China, for his detailed introduction to the Chinese automobile market and permission to access data from dealerships.

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<sup>2</sup> “Matching Supply with Demand: An Introduction to Operations Management,” 3rd ed., Gerard Cachon and Christian Terwiesch, McGraw-Hill/Irwin, 2012.

representatives of GAC-Toyota in Central China, all with huge bookings from their dealers to fulfill. They each had the sole objective of getting the largest quota possible from the headquarters. However, as the huge popularity of the Highlander far exceeded the prelaunch forecast, some dealers would inevitably be disappointed due to the production capacity constraint. What could Mr. Zhang do to ensure that as many dealers and their customers as possible were satisfied? Would the supply shortage and long delivery time mean the loss of customers to competitors? Well aware of the increasingly intensive competition in China's automobile market, Zhang knew he did not have much time left to figure out the solution to the problem.

## The Automobile Industry in China

### *Global Overview*

The automobile industry is one of the most important economic sectors in the world. In 2010, over 77 million vehicles were produced worldwide.<sup>3</sup> China, Japan, and the United States are the top three producing countries, accounting for 46% of total production. Based on the total number of vehicles produced in 2005, then 66 million, it was estimated that the global turnover of the automobile industry was equivalent to €1.9 trillion. The industry also created over 8 million jobs directly, representing more than 5% of the world's total manufacturing employment, and about five times more indirectly. According to a study of 26 countries conducted by the International Organization of Motor Vehicle Manufacturers (OICA), vehicle manufacturing and usage contributed more than €433 billion to government revenues.<sup>4</sup>

<sup>3</sup> "World motor vehicle production by country and type," OICA correspondents survey, <http://oica.net/wp-content/uploads/all-vehicles-2010.pdf>, 2011

<sup>4</sup> "The world's automotive industry," OICA, <http://oica.net/wp-content/uploads/2007/06/oica-depliant-final.pdf>, 2006.

Historically, the automobile industry has accounted for about 3% of the gross domestic product (GDP) in the United States,<sup>5</sup> while in China its contribution has increased from 1.50% of GDP in 2005 to 2.61% in 2010.<sup>6</sup>

The top-10 manufacturers accounted for more than 66% of the total motor vehicle production of 77.8 million units in 2010. The Japan-based Toyota Motor Corporation was the leader in global motor vehicle production, with a total of 8,557,351 vehicles, followed by the U.S.-based General Motors Company (GM) at 8,476,192.<sup>7</sup>

### ***History of the Automobile Industry in China***

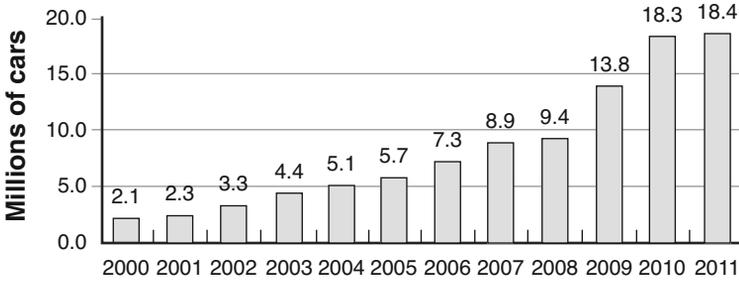
The automobile industry in China has a history dating back to the first Five-Year Plan (1953–1957). In 1953, First Automobile Works (FAW) was founded in Changchun, the capital of Jilin province. In 1956, it produced its first product, a 4-ton commercial truck under the brand name “*Jie Fang*,” which means “liberalization.” In the more than five decades since then, and especially since 1978 when China began its economic reform (also known as “reform and opening up”), China’s automobile industry has gradually grown into a pillar of the economy and has become one of the most important in the world (see Figure 1). Between 2000 and 2011, it recorded an average annual growth rate of 22%, much higher than the average global growth rate during the same period. Only in 2008 did China post a single-digit growth rate, due to the global financial crisis. In 2009, China surpassed Japan to become the No.1 automobile producing country and also topped the United States to become the largest automobile market in the world. Nonetheless, the car penetration rate (CPR, measured as

<sup>5</sup> “Contribution of the automotive industry to the economics of all 50 states and the United States,” Center for Automotive Research, Ann Arbor, MI., 2010.

<sup>6</sup> “The Overall Development Situation and Trend of the Automotive Industry in China,” Yang Dong, Shanghai Auto, Vol. 6, 2011.

<sup>7</sup> “World ranking of manufacturers 2010,” OICA, <http://oica.net/wp-content/uploads/ranking-2010.pdf>, 2011.

cars per thousand people) is still low compared with developed countries (see Table 1), which shows huge potential in this market.



**Figure 1** China's vehicle production from 2000–2011.

Source: Printed with permission of the China Association of Automobile Manufacturers (CAAM).

**Table 1** List of Major Countries by Number of Vehicles per Thousand People

No.	Country	CPR	Data Year
1	China	83	2011
2	Japan	589	2009
3	U.S.	812	2010
4	Germany	634	2008
5	South Korea	379	2011
6	Brazil	259	2011
7	France	575	2007
8	Spain	608	2008
9	India	18	2009
10	Mexico	276	2009

Source: World Bank

Originally, China's automobile manufacturers were all state-owned, either by the central government, such as FAW and Second Automobile Works (Dongfeng Motors), or by local governments, such as the Beijing Automotive Industry Corporation (BAIC), Chang'an Auto, Guangzhou Auto, and Fujian Auto. With the beginning of the

economic reform in 1978, the government started to allow the operation of private automakers and joint ventures with foreign automakers. The first joint venture was the Shanghai Volkswagen Automotive Co., Ltd. (SVW), established between Volkswagen (VW) and the Shanghai Automotive Industry Corporation (now SAIC Motor) in 1984.<sup>8</sup> Although there were some conflicts in the process of collaboration, this form of joint venture was widely considered a “win-win” for both sides: foreign automakers can gain entry into the promising Chinese market, lower their production costs through localization of production, and enjoy some policy benefits; on the other side, local manufacturers could gain access to the advanced technology, management and marketing expertise of the foreign partner and capitalize on established foreign brands. In 2011, the top-10 manufacturers sold 6,472,200 cars, accounting for 64% of total car sales (see Table 2). Eight of them were joint ventures.

**Table 2** Top 10 Manufacturers by Sales in 2011

Rank	Manufacturer	Volume (10,000)
1	SAIC-GM	111.87
2	SAIC-VW	100.54
3	FAW-VW	97.63
4	Dongfeng-Nissan	66.54
5	BAIC-Hyundai	58.56
6	Chery	46.88
7	Geely	43.28
8	Changan-Ford	41.54
9	Dongfeng-Peagot	40.41
10	FAW-Toyota	39.97
<b>Total</b>		<b>647.22</b>

Source: Printed with permission of the China Association of Automobile Manufacturers (CAAM).

<sup>8</sup> “Volkswagen Group China,” Wikipedia, [http://en.wikipedia.org/wiki/Volkswagen\\_Group\\_China](http://en.wikipedia.org/wiki/Volkswagen_Group_China).

## *Toyota in China*

Established by Kiichiro Toyoda in 1937 as a spinoff from his father's company, Toyota Industries, Toyota Motor Corporation has grown into one of the world's leading automobile manufacturers. In 2010, Toyota produced 8,557,351 vehicles and achieved worldwide consolidated sales of 8.4 million vehicles under the Toyota, Lexus, Daihatsu, and Hino brands, ranking first in the world according to both measures.<sup>9</sup>

In 1959, Toyota opened its first plant outside Japan in Brazil, and it has maintained a philosophy of localizing both the production and the design of its products ever since.<sup>10</sup> It soon became a leader in customer satisfaction and embodied the success of Japanese automobile manufacturers in the global market. The Toyota Production System (TPS), built on the two pillars of "Just-In-Time" production and "Jidoka,"<sup>11</sup> is well known for its ability to reduce production costs and lead time, eliminate defects, and improve the overall quality of its products.

Although Toyota began exporting cars (starting with the Crown sedan) to China in early 1964, localization of production got off to a late start compared with Toyota's rivals. For each model, Toyota's usual strategy is to import first and then to decide whether to localize production depending on the model's popularity. Its first joint venture, the Tianjin Toyota Motor Engine Co., Ltd., only started operating in 1988. In the same year, Sichuan FAW Toyota Motor Co., Ltd. was founded, and it produced the first locally produced Toyota vehicle, the Coaster bus, 14 years later than its main competitor, the

<sup>9</sup> "World ranking of manufacturers 2010," OICA, <http://oica.net/wp-content/uploads/ranking-2010.pdf>, 2011.

<sup>10</sup> "Toyota history: Corporate and automotive," Toyoland.com, <http://www.toyoland.com/history.html>.

<sup>11</sup> "Toyota Production System Terms," Toyota Georgetown, <http://toyotageorgetown.com/terms.asp>.

VW group. Since then, Toyota has sped up its expansion. In 2003, the Sichuan plant began to produce the Land Cruiser Prado.<sup>12</sup> In 2004, Toyota established a joint venture, GAC Toyota Motor Co., Ltd., with the Guangzhou Automobile (GAC) Group to produce the Camry in Guangzhou, the capital of Guangdong province and the largest regional automobile market in China. In 2009, Toyota decided to localize the production of its popular SUV model, the Highlander, in GAC-Toyota. By 2011, Toyota had localized the production of 19 sub-brands in China. Its market share in China was 5%, compared with 18% in the United States and more than 40% in Japan.<sup>13</sup> Despite the low market share, the Toyota Camry, RAV4, and Highlander are among China's top sellers in the higher price ranges, generating higher profits.

#### *4S Stores*

Like other foreign automakers, the majority of Toyota's marketing, distribution, and sales operations in China are conducted by its joint venture dealerships. The dealerships are called 4S stores: Sales, Spare parts, Service and Surveys. They are designed to provide integrated services to customers. According to the statistics of the Ministry of Commerce and China Automobile Dealers Association (CADA), in 2010 there were 15,000 4S stores in China, of which 1,700 had been newly added in that year alone, and the number is expected to reach 30,000 by 2015.

Although the spike in the number of 4S stores represents the fast expansion of sales networks, profits are shrinking. When 4S stores first arrived in China around a decade ago, they had a very high rate of return on investment. Although a 4S store required an initial investment of around 20 million RMB to launch, it was fairly common for

<sup>12</sup> "FAW Toyota history," FAW, [http://www.faw.com/international/toyota\\_history.jsp?TM=FAW-Toyota](http://www.faw.com/international/toyota_history.jsp?TM=FAW-Toyota).

<sup>13</sup> "Sorry, Toyota: GM is winning China", Michael Brush, MSN Money, 2011.

this investment to be made back within two years or even within three months.<sup>14</sup> The profit mainly came from new-vehicle sales. However, as competition intensified and the profit became slimmer, 4S stores began to struggle to make a profit. J.D. Power and Associates recently conducted a survey of 1,605 4S dealerships in China, comprising 38 brands in 59 cities, which indicated that the percentage of dealers reporting a profit in 2011 fell to 63 percent, compared with 81 percent a year ago, and 20 percent of dealers reported that they had lost money on their operations—up from 9 percent in the previous year. On average, dealerships in China currently derive 40 percent of their profits from new-vehicle sales, a significantly higher proportion than in mature markets. It is expected that dealerships will gain greater profits from vehicle financing, used-vehicle sales and servicing and parts as the market continues to evolve.<sup>15</sup>

## **Toyota China's Production Planning and Demand Management**

### ***Demand Forecasting and Production Planning***

To make the best use of Toyota's highly efficient TPS production system, the real challenge is in accurately forecasting demand and planning production accordingly. This is extremely difficult in a fast-growing market, such as China, particularly for newly introduced models with no historical sales data. Toyota China holds a sales convention at the end of each fiscal year, which gathers the major sales representatives from all over China. One important mission of this convention is to collect the dealers' replenishment plans for the coming year, which should include both the total quantity and the

<sup>14</sup> "China's 4S car dealerships hit the skids," CKGSB Knowledge, Sep 11, 2011.

<sup>15</sup> "J.D. Power and Associates reports: Amidst Beijing auto show product celebration, the industry is experiencing declining dealership profits," PRNewswire, Apr 22, 2012.

detailed numbers for specific models and configurations for each month. Toyota then determines the yearly quota for each dealer based on the numbers submitted and the consolidated sales for the past year. The general production plan for the coming year is arranged correspondingly. In implementation, Toyota China can make adjustments to the general plan according to the realized sales.

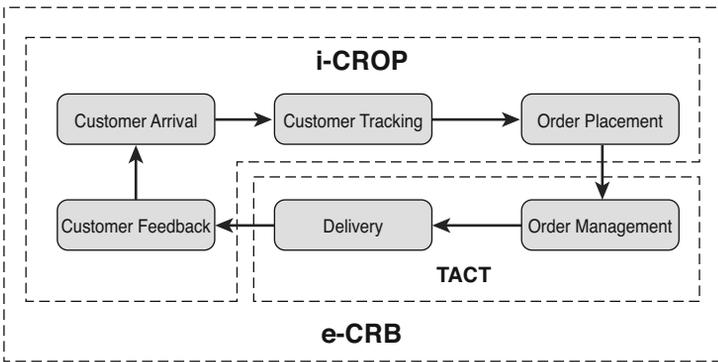
Toyota China has adopted a multi-level management structure. Regional sales managers are responsible for all of the sub-regions within their regions. They determine an overall quota and then allocate the quota among the sub-region dealers. When the demand is realized, they can also arrange transshipments between sub-regions if necessary. This centralized management helps to achieve coordination among dealers. Dealers also enjoy a certain amount of flexibility in demand realization. They must inform Toyota China of their replenishment quantities three months in advance, and they can then adjust the quantity by up to 10% until two months before the delivery. They can specify the colors up to one month before the delivery.

However, although adjustable production and replenishment can help to alleviate the risks of overstock and shortage, the effect is still limited. For instance, the Highlander, a popular SUV model, began local production in China in early 2009. During our field study of GAC-Toyota, we found that in the first half of 2009, the number of Highlanders ordered by dealerships was 60% higher and the actual realized demand was 90% higher than Toyota China's projected demand. Because some core parts were imported and the capacity was constrained, Toyota China was unable to increase its production in time to fully satisfy the surging demand. Toyota China responded to the supply shortage by expanding production of the Highlander in September 2009, although there was already a long lag. The inevitable result was a prolonged delay in the delivery time to customers, up to three to six months compared with the usual one month or less.

### Customer Management at 4S Stores

According to Toyota, by the end of 2009, it had around 650 4S stores in China, which form the distribution network for its vehicles. Currently, 4S stores generate most of their profits from new-vehicle sales.

Figure 2 illustrates the normal operation of a 4S store. The evolutionary Customer Relationship Building (e-CRB) system is an in-house customer relationship management system used by Toyota China’s dealerships. Its two key components are the intelligent Customer Relationship Optimization Program (i-CROP) and the Total Arranging and Cultivating (TACT) system. The i-CROP is responsible for the management of customer information, and the TACT is the interface between dealerships and Toyota China. The customer tracking block classifies customers into four classes (A, B, C, and D) according to their intended purchasing times. This classification is usually based on a subjective estimation by 4S store clerks. A detailed description of the classification system is provided in Table 3. Once orders are placed, dealerships use the TACT system to track them until final delivery. According to the 2-month data that we collected from a typical 4S store, about 20% of the in-store customers who purchased the Highlander belonged to Classes A and B, and the rest were split evenly between Classes C and D.



**Figure 2** Business process at a 4S store

Source: Field study at GAC-Toyota.

**Table 3** Customer Categories

Class	Predicted Purchasing Time
A	1 week
B	Between 1 week and 1 month
C	Between 1 month and 3 months
D	> 3 months

Source: Field study at GAC-Toyota

The interests of Toyota China and its 4S stores are not always perfectly aligned. For example, Toyota China would like to maintain central control over decisions such as pricing, bundling sales, and cross-regional transshipments to avoid image damage and malicious competition, whereas 4S stores would like to enjoy more flexibility. This interest misalignment is particularly prominent when a supply-demand imbalance emerges. As Toyota China cannot fully address the supply shortage by increasing its production, the dealerships need to make best use of their limited inventories to retain customers. In the case of a supply-demand imbalance, dealerships switch to a market segmentation strategy characterized by price and delivery-time differentiation. Two purchasing options are offered to customers: spot and consignment. By choosing the spot option, customers get their desired cars immediately from the on-hand inventory, but either need to pay a higher price, buy a bundled insurance product or upgrade the configuration. By choosing the consignment option, customers pay the manufacturer's suggested retail price (MSRP) and are put on a waiting list, with delivery usually taking two-three months. However, because the "mark-up" associated with the spot option is often determined by dealerships themselves according to the prevailing supply-demand condition, it varies from time to time and from place to place. This has caused a lot of controversy among customers, with some of them even blaming Toyota China for intentionally creating a shortage to rip off customers.

As the regional manager, Mr. Zhang needs to coordinate the actions of his dealers. However, he first needs to answer the following questions. Will the coordination of individual dealers be beneficial, for example, in terms of demand and inventory management? If so, how should Toyota China take advantage of the coordination? Regarding the customer segmentation strategy adopted by dealers, what dimensions, other than price, does the strategy explore? In addition to the profit improvement from refined customer segmentation, what other benefits can dealers and Toyota China obtain by utilizing the customer information collected using the strategy?