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**Komatsu's business model  
through the product lifecycle\***

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## Komatsu's business model through the product lifecycle

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### 1. Introduction

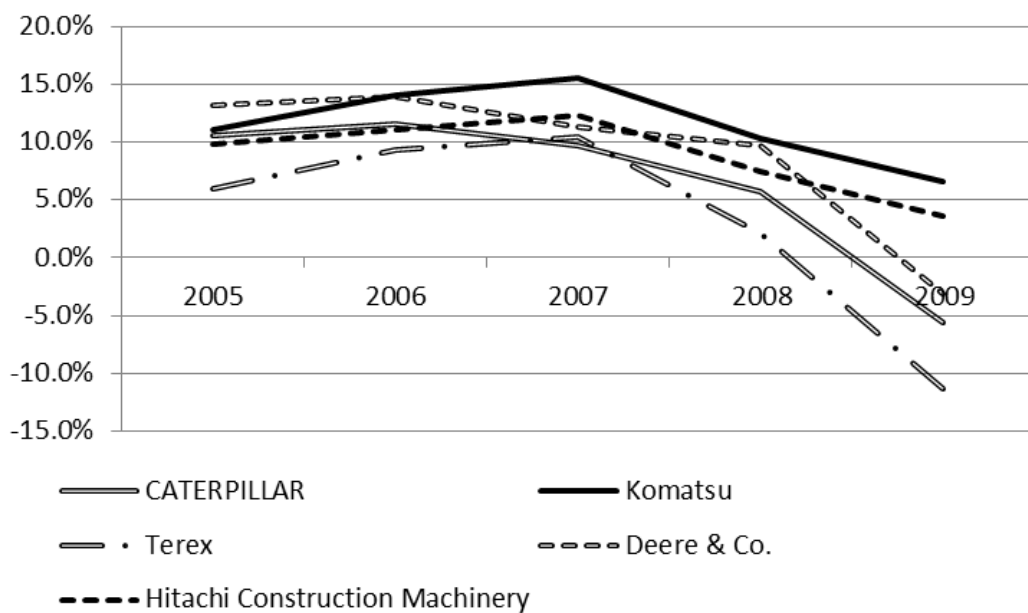
Komatsu Limited (hereinafter referred as Komatsu) is a major construction equipment manufacturer founded in 1921. Komatsu Iron Works, which manufactured mining machinery and machine tools for its parent company, Takeuchi Mining Industry, which was engaged in coal-mining and mining, spun off as Komatsu Limited in 1921. Before the World War II, Komatsu built the first tractor in Japan and was also engaged in the development of bulldozers at the request of the military authorities. When Caterpillar Inc. of the United States made inroads into the Japanese market in the 1960s, Komatsu intensively worked on quality improvement and received the Deming Prize in 1964. This is renowned as a successful example of Japanese manufacturers in the postwar period in Japan. Komatsu is one of the distinctive manufacturers in Japan.

Caterpillar Inc. of the United States is the world's leading construction equipment manufacturer. Its sales revenue for 2009 for construction equipment was about 18.148 billion dollars. Komatsu was the second behind Caterpillar Inc. and its sales revenue for 2009 (fiscal year ended March 2010) for construction equipment and vehicles was about 13.64 billion dollars. The other major manufacturers include Terex Corporation, Deere & Company, and CNH Global N.V. of the United States; Hitachi Construction Machinery Co., Ltd. of Japan; The Liebherr Group of Germany; and VOLVO of Sweden. While many of these construction equipment manufacturers source engines from other truck manufacturers, only Caterpillar Inc. and Komatsu produce them in-house and are able to manufacture construction equipment from cast metals. Therefore, not only the size of sales revenue but also the diversity of their accumulated technology makes Caterpillar Inc. and Komatsu prominent among construction equipment manufacturers.

Komatsu's profitability of construction equipment hovers steadily at a comparatively high level (Figure 1). Figure 1 shows the operating income margin of construction equipment business of major manufacturers in the last five years; it is seen that Komatsu maintained the operating margin of over 10% between 2005 and 2008. Komatsu's profitability deteriorated in 2008 and 2009 because of the global recession triggered by bankruptcy of Lehman Brothers, and its operating income margin went below 10%. However, in comparison to other companies, Komatsu still kept its edge.

While Caterpillar Inc. recorded an operating loss, Komatsu maintained an operating margin of 6.5%. Another Japanese manufacturer, Hitachi Construction Machinery Co., Ltd., also suppressed the deterioration of profitability caused by the global recession at the modest level. At all events, Komatsu's profitability is higher and steadier compared to its competitors such as Caterpillar Inc. and Hitachi Construction Machinery Co., Ltd.

Figure 1 Changes in operating income margin of construction equipment business of major manufacturers



Note: The graph was created on the basis of the annual reports and the annual securities reports of each company. Fiscal year ends in December for Caterpillar Inc. and Terex Corporation; in March for Komatsu and Hitachi Construction Machinery Co., Ltd.; and in October for Deere & Company. For Komatsu and Hitachi Construction Machinery Co., Ltd., results for the year ended March 2010 are quoted as 2009 results. Similarly for other years, the results for these two companies are slightly out of alignment of the year in the graph. For Terex Corporation, the figures include the results of the whole company, and for others, the figures include the results of construction equipment business only. The sales figures do not include inter-segmental transactions when they are specified.

Although Komatsu enjoys high profitability nowadays, it used to suffer from losses few years ago. For example, Komatsu recorded a net loss of 80 billion yen for the fiscal year ended March 2002. As discussed later, the demand for construction equipment decreased dramatically in Japan since the mid-1990s because of reduction in government spending. At that time, the construction equipment business was said to be a declining industry. Even before that, Komatsu had started to seek to diversify its business in search for new sources of revenue, but none supplemented construction equipment business. In the late 1990s, Komatsu again concentrated its resources on construction equipment as its primary business. What did they do since then?

Komatsu's strength comes from various aspects: intensive cost reduction; strong penetration in emerging markets; "manufacturing," which emphasizes a long lasting relationship with its suppliers; and post-sale services that highly utilize information and communication technology (ICT). In this paper, I will introduce some examples of those strengths and show how Komatsu's construction equipment business "as a whole" functions successfully from my viewpoint.

## 2. Characteristics of construction equipment business

Construction equipment is the equipment used for the development of infrastructure including transportation network such as roads, ports and railways, soil and water conservation such as dams and erosion controls, water source development, agricultural land development, and other land development. Hydraulic excavators and bulldozers are commonly known. Initially, bulldozers were the major equipment, but in the mid-1970s, hydraulic excavators superseded them. This was due to the shift in the construction works from industrial infrastructure to social infrastructure. While bulldozers are used to push, pile up, and smoothen earth and sand, hydraulic excavators can be used to perform various functions such as lifting things and smashing rocks as well as digging, piling, and smoothing soil with different attachments to the multijointed articulated arm.

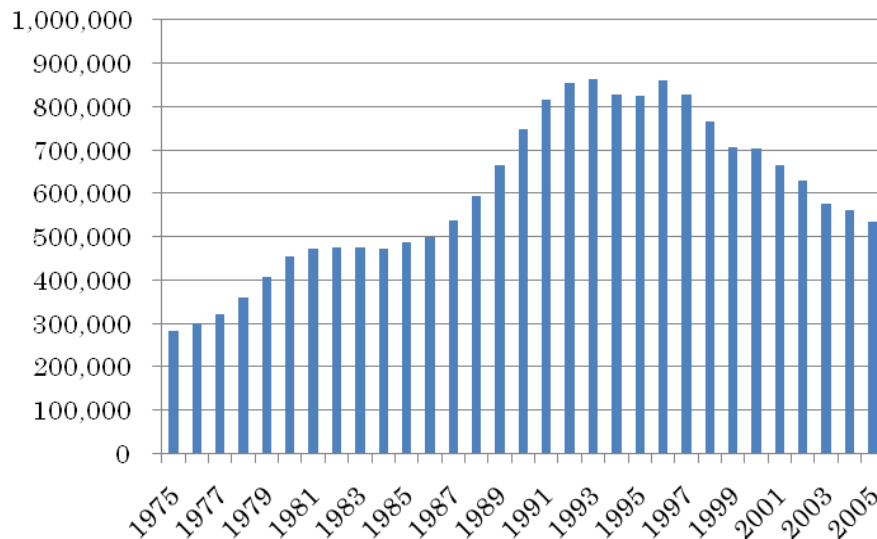
Circumstances surrounding the construction equipment industry, especially Japanese construction equipment manufacturers, have some characteristic aspects. They can be found in the "Research paper on future perspective of construction equipment industry in Japan 2005" by The Japan Machinery Federation and Japan Construction Equipment Manufacturers Association. In summary, Japanese construction equipment manufacturers are experiencing three major environmental changes: 1) stagnant domestic market and expansion of emerging markets, 2)

emergence of the product lifecycle in the international market including emerging markets, and 3) increasing importance of post-sale services.

Stagnant domestic market and expansion of emerging markets

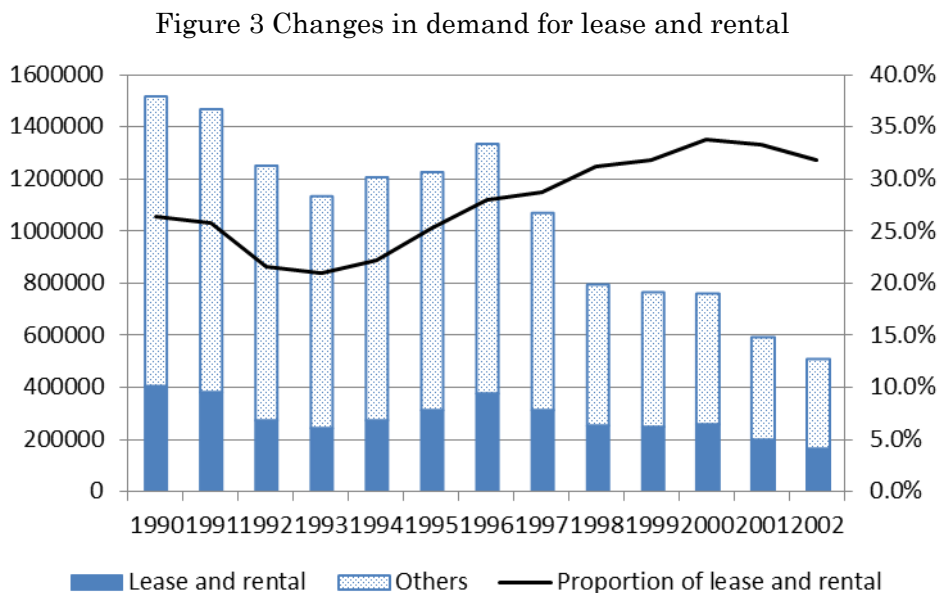
The ever-increasing growth as seen in the past cannot be expected in the Japanese construction equipment market. Investments in construction, both from private and public sectors, increased dramatically until 1990. Although investment from private sector was on a downward trend as the bubble economy burst in the early 1990s, investment from the public sector was steady at peak level until 1996. However, in the late 1990s, investment in construction decreased substantially. Figure 2 shows the changes in the amount of work completed (original contracts only) in the construction industry. The figures do not include subcontracts from other constructors. The amount of work completed soared steadily since 1975 and peaked in 1993 at about 86 trillion yen. It then declined to about 53 trillion yen in 2005. Investment in construction scaled down to two-thirds over 10 years.

Figure 2 Changes in the amount of work completed (original contract)



Note: The graph was created on the basis of the “statistics on construction undertaken” by the Ministry of Land, Infrastructure, Transport and Tourism. The unit of vertical axis is hundred million yen. Abscissa axis shows years.

As construction investment decreased considerably, constructors who were forced to reduce cost started to review procurement of construction equipment. This caused a shift from the ownership of machinery to lease and rental. Thus, the domestic demand for construction equipment decreased considerably. Although the demand for lease and rental decreased as well, its extent is moderate compared to the decline in the overall demand for construction equipment, resulting in greater presence of lease and rental demand in the total demand. Figure 3 shows that the proportion of lease and rental was 21%, at its lowest, in 1993 and it increased to 31.9% in 10 years in 2002. Equipment that has particularly higher proportion of lease and rental are hydraulic excavators and mini-excavators with lease and rental proportions of about 39% and 47%, respectively, in 2002.



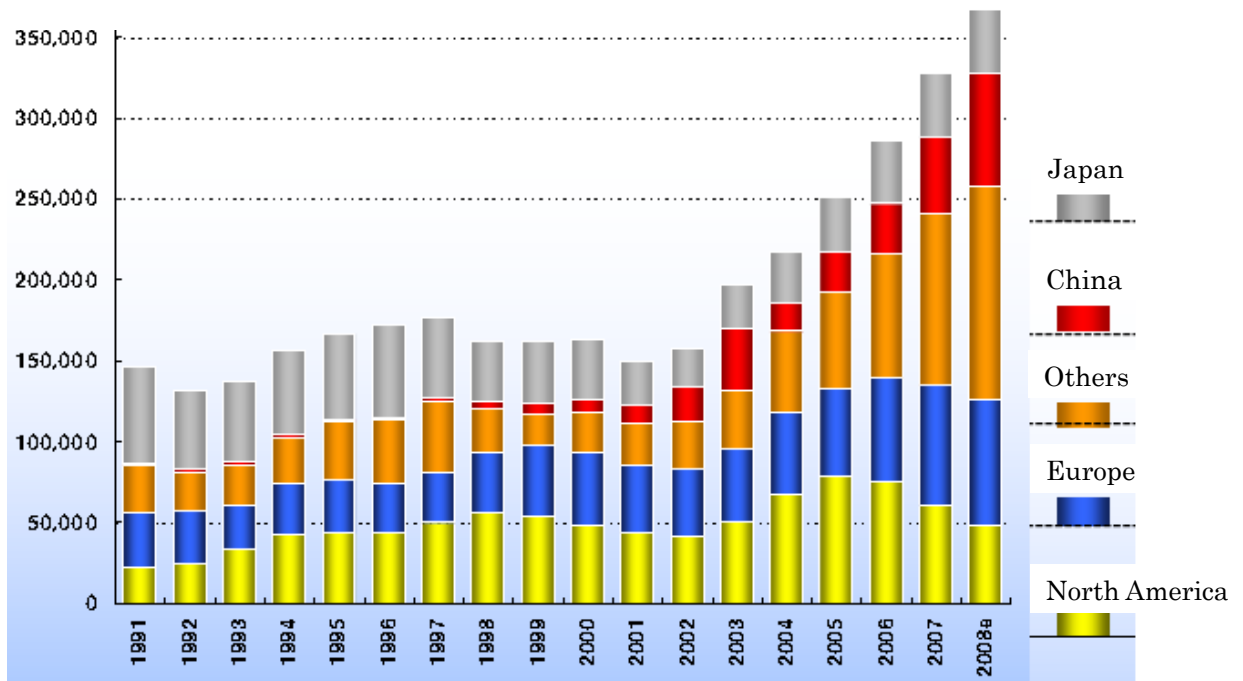
Note: The graph was created on the basis of the “Trends in worldwide shipments of construction machinery (value)” by the Japan Construction Equipment Manufacturers Association. The unit of vertical axis is a million yen. Abscissa axis shows years. Figures on vertical axis indicate domestic demand only. Data for 2003 or later are not available.

In contrast to the stagnant domestic market, demand for construction equipment is rapidly increasing in emerging countries. Figure 4 shows the shift in the demand for major construction equipment by region. In 1991, the demand for major construction equipment existed mainly in three regions: North America, Europe, and Japan. At that

point, the demand for construction equipment in China was insignificant. However, the demand in China and other regions started to rise dramatically from 2000. On the contrary, the demand in Japan and North America is on a declining trend. Although the demand in Europe is on an increase, the growth is rather slow compared to the rapid increase in China and other markets. Figures in 2008 indicate that North America, Europe, and Japan, which used to be major markets, now have much less presence as compared to China and other markets. More than half of the demand for construction equipment is now in emerging markets including China.

Figure 4 Changes in demand for major construction equipment by region

Number of construction machines in demand



Note: Data provided by Komatsu

### International product lifecycle

In accordance with the reduction in the construction work, the supply of used equipment increased in Japan. The trade volume of used construction equipment never exceeded the sales volume of the brand new equipment until 1996. However, the sales volume of the new equipment gradually decreased since 1996. The trade volume of used equipment, which had already exceeded the sales volume of the new equipment in 1997,

and the gap between them has widened ever since. In 1997, the sales volume of the new equipment and the trade volume of used equipment were almost even at around 100,000 machines; however, in 2004, the former was around 60,000 while the latter reached around 110,000. Collaterally, the volume of domestic stock (the total number of equipment held by users after sales) is also on a downward trend. It hovered at around 1,200,000 until 2000 but declined to 800,000 in 2004.

The volume of domestic stock decreased as they are exported as used construction equipment to the Chinese market, which is active because of the urban development, and to the Middle East market, which is enjoying surging oil price. The export price remains at a high level, boosting the export volume. Although used construction equipment used to be resold mainly in the domestic market, the domestic resale volume started to decline in 1996. At its peak, about 60,000 used machines were sold in the domestic market per year. The export volume of used equipment constantly increased and exceeded the domestic resale volume in 2000, reaching around 50,000 units per year. In 2004, approximately 70,000 were exported overseas.

The product lifecycle of construction equipment varies from small-to-mid equipment such as bulldozers and hydraulic excavators to larger equipment such as massive dump trucks used in mines. Newly sold equipment require overhaul after three to five years. Overhaul means disassembling parts, washing, and reassembling them. By doing so, the equipment regains the performance level like a brand new machine. Large equipment are scrapped after this overhaul process is repeated two times. On the contrary, small-to-mid equipment are often replaced by new ones when the first overhaul is required. As users of rental equipment tend to prefer brand new machines, leasing companies are encouraged to own new ones. Increasing popularity of rental and lease furthers this trend. Machines that are no longer used are traded in and then sold to emerging markets. In general, the price of construction equipment is relatively cheap in Japan. In North America and Asia, the price of machinery is around 10% higher than that in Japan. As the demand in emerging countries expanded rapidly, construction equipment became scarce, and at one stage, Japanese-made used equipment were sold for the same price of brand new equipment locally made in emerging countries.

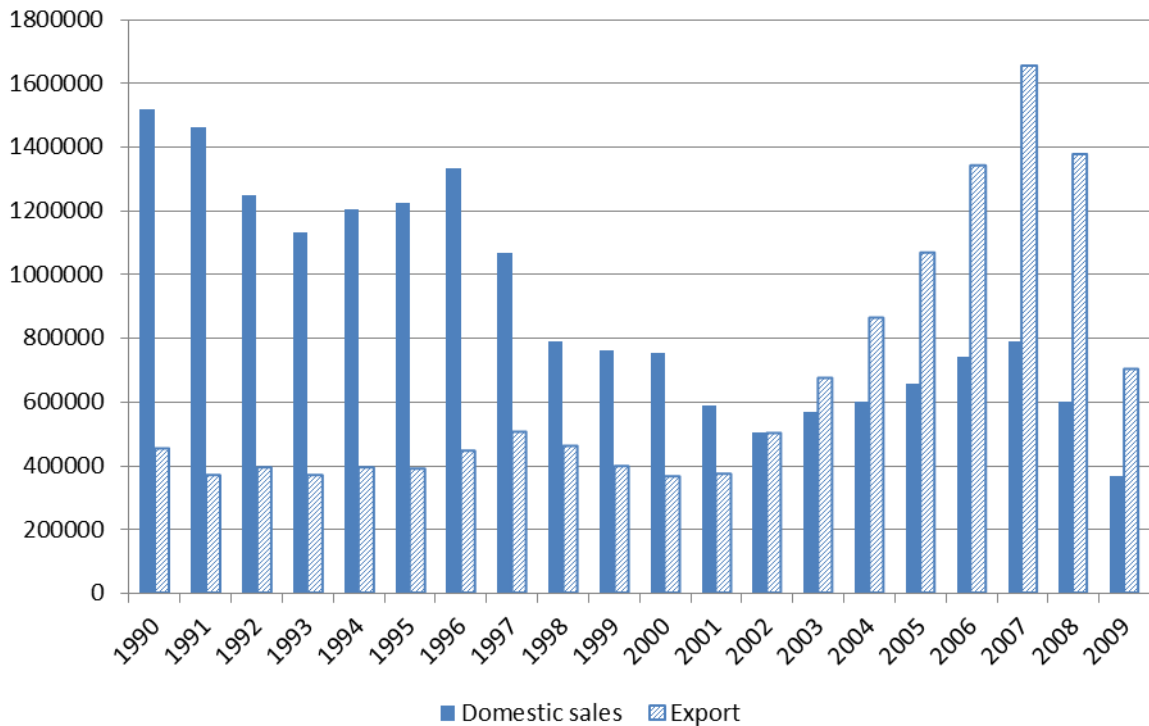
Japanese-used equipment are popular overseas not only because Japanese-made construction equipment is high in quality but also because the equipment leased in Japan incur less damages. Users in Japan generally treat construction equipment more carefully than those in North America, China, or other countries in South East Asia. In addition, while the average operating hours per year are about 1,200 and 2,100 in North America and China, respectively, they are only about 800 per year in Japan.



Furthermore, genuine parts of the brand are used when the parts are replaced during maintenance; thus, the damage is minimal even with used machines and high performance is maintained. Between 2002 and 2007, the soaring demand for used equipment in emerging countries stimulated the domestic demand for the replacement of equipment in Japan, which caused the so-called “used equipment bubble” phenomenon. (Figure5)

As just described, in the construction equipment industry, the international product lifecycle has been created, where the equipment used in Japan are sold as used equipment in emerging countries.

Figure 5 Changes in domestic sale and export of construction equipment



Note: The graph was created on the basis of “Trends in Worldwide Shipments of Construction Machinery (Value)” by Japan Construction Equipment Manufacturers Association

Importance of post-sale services

As expected, parts of construction equipment wear away or break down through hard work such as digging hard surfaces and drilling a hole in rock hills, and thus damages

are inherent in them. Therefore, the industry is formed on the premise that it requires post-sale services, in contrast to the electronics industry, which expects trouble-proof products.

There are two types of replacement parts: functional and essential parts, which only the manufacturer can supply, and consumable parts such as bearing, seal material, and hoses. A construction machine can be built by combining all these parts. It usually consists of 30,000 parts of 5,000 different types. If the original price of a complete machine is 1, the total price of those parts would be 3 to 4. In other words, the total price of the parts would be three to four times more than that of the whole machine. This can possibly be interpreted in two ways. The simple way of looking at it is that the sale of parts is more profitable. However, it can also be interpreted that having a supply system of parts is costly. Some of the parts are only a few hundred yen, but selling these parts takes as much time and effort as selling a machine itself, which costs a few million yen. In fact, post-sale services are more laborious. If the parts are sold, it can be profitable. However, if they are not sold, the risk of defraying the cost is high. Therefore, post-sale services were not considered as a source of profit.

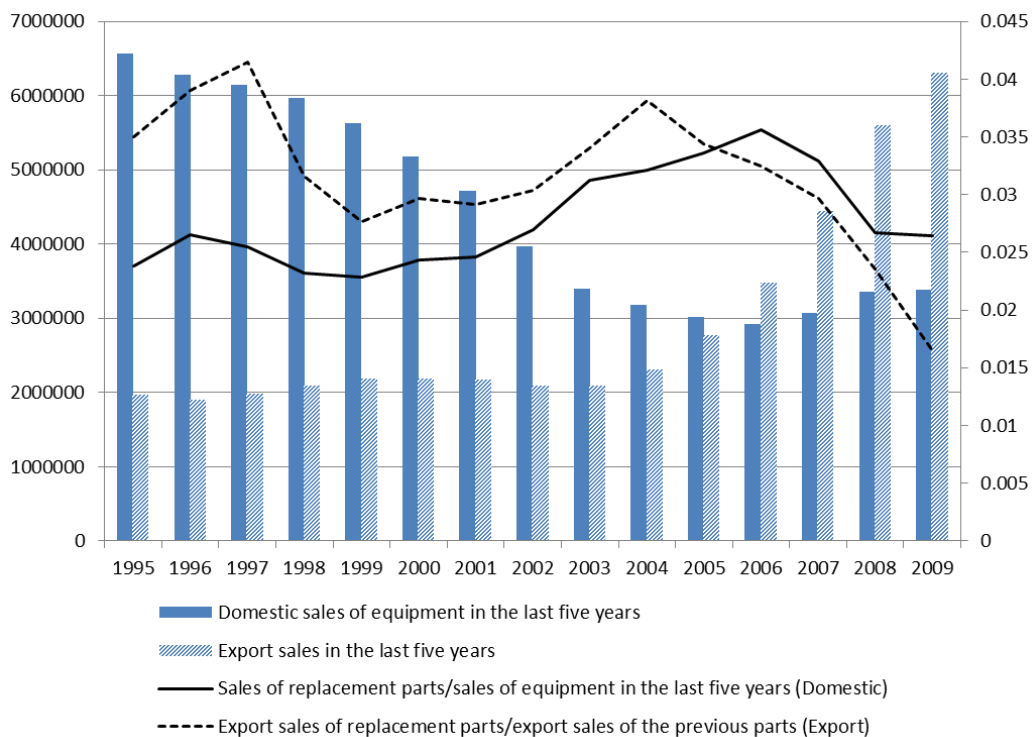
Local distribution outlets are responsible for post-sale services. In Japan, equipment manufacturers often have capital alliances with them, but those capital alliances do not exist in other countries.

Post-sale services are required continually after the sale of the equipment. As the equipment sold and held continues to produce income through replacement of parts and sales of consumables, this business model of the sale of the equipment itself combined with the sale of replacement parts and consumables can be referred to as “*stock business*.” Because an already sold machine provides opportunities of sale of consumables, it enables manufacturers to maintain more stable sales revenue and be less susceptible to the change in the annual sales of equipment. The more hours the equipment is used for, the more the demand for consumables; thus, the operating hours of the equipment have a great influence on the revenue of post-sale services.

Figure 6 shows the changes in the proportion of sales of replacement parts for the year to the total sales of the equipment for the last five years. The domestic figures indicate that the proportion of sales of replacement parts increased as the sales of equipment decreased between 1995 and 2006. This is because the sales of the equipment dropped while the operating hours of the equipment increased (thus machines are used more efficiently) and each manufacturer focused on post-sale services. Next, the proportion of sales of replacement parts declined sharply. This is considered to represent the fact that the sale of the equipment increased because of

used equipment bubble but the operating hours did not increase. It might be more appropriate to say that the proportion of sales of replacement parts shifted back to the previous level rather than saying that it declined. On the contrary, export figures show a rapid increase in the sales of replacement parts since the late 1990s. This is considered to be triggered by the increased operating hours of equipment due to the rise in government spending and construction demand before the expansion of the equipment market. Once the sales of the equipment started to soar in 2004, the proportion of sales of replacement parts decreased sharply. This can be interpreted in two ways. First, the equipment has been more widely supplied, but the operating hours of the equipment have declined and thus the sales of the replacement parts have not been increasing. Second, although the sales of the equipment have increased, there has not been enough provision of post-sale services.

Figure 6 Changes in proportion of sales of replacement parts



Note: The graph is created on the basis of “Trends in Worldwide Shipments of Construction Machinery (Value)” by Japan Construction Equipment Manufacturers Association

As mentioned above, the sales of the equipment cannot be expected to increase drastically in Japan. Therefore, equipment manufacturers need to increase revenue from post-sale services in order to maintain stable profit. The decrease in the proportion of sales of replacement parts is considered to be triggered by the two factors mentioned above, and thus, the challenges for Japanese construction equipment manufacturers are how to pursue post-sale services, which are laborious but necessary to maintain the quality of the equipment in the expanding emerging markets, and how to produce steady income through widely supplied equipment.

### 3. Komatsu's approach

So far, I have explained three major environmental changes faced by Japanese construction equipment manufacturers: 1) expansion of emerging markets, 2) international product lifecycle, and 3) increasing importance of post-sale services. In this section, I will examine Komatsu's approach to these challenges

#### Penetration in emerging markets

Komatsu's strong business is supported by its competitive edge in Asia. Komatsu calls Japan, North America, and Europe traditional markets and regions such as Asia including China, former Soviet Union, Middle East, South America, and Oceania strategic markets. They particularly emphasize a region named greater Asia, which includes China, South East Asia, Middle and Near East, and former Soviet Union. In the United States and Europe, Caterpillar Inc. historically has great competitiveness and Komatsu has only held the position of number two. However, Komatsu is considered to be number one by far in Asia, and it has more than 20% of the market share in China, which is the biggest market ("New Mid-Range Management Plan" by Komatsu, April 27, 2010).

Komatsu has a long history of penetration in the Chinese market. They successfully received a sizable order for bulldozers back in 1964. (Komatsu Limited, 1971) Through dedicated efforts, Komatsu has now built its competitive edge in Asian region. The difference in the approaches to overseas operations between two major players, Caterpillar Inc. and Komatsu, is interesting.

In case of Caterpillar Inc., the existing large distributors are responsible for overseas operations. Therefore, as soon as they enter a local market, a strong network of dealers is created. On the other hand, Komatsu establishes a local enterprise itself even at a small scale to develop relationships with local distributors. Caterpillar Inc.'s approach

to build a network of dealers and production base concurrently takes longer time, but it unfailingly creates a value-creating and value-capturing system. On the contrary, Komatsu enters emerging markets actively from the smaller scale. In some cases, the establishment of the base for parts supply and post-sale services is followed at a later stage. While Caterpillar Inc. introduces all product lines, Komatsu sells limited products that are smaller and construction related, such as bulldozers and hydraulic excavators for cheap price in order to secure the market share. In contrast to Caterpillar Inc., who dominates North American and European markets with full-service including large-scale post-sale service network, Komatsu forges ahead in the emerging market rapidly and builds its brand (“Weekly Economist” September 4, 2007).

Komatsu, in their New Mid-Range Management Plan “Global Team Work for 15” released in April 2007, declared that the establishment of a more flexible production system was their top priority and that they would aim to set out a global production system that is able to flexibly correspond to the shift in the demand. To be more precise, there are three key points. First, the equipment is assembled in regions with large demand. For example, major product lines of typical construction equipment such as hydraulic excavators are manufactured in seven factories in Japan, China, Europe, Asia, and the United States. Second, the production of key components (such as engine and hydraulic equipment) is centralized in Japan. They once sought the possibility of producing key components overseas, but came to the conclusion that Japan excels at refinement, and therefore, manufacturing those components domestically would give them cost competitiveness (Personal interview, January 24, 2011). Third, they aim to enhance competitiveness in manufacturing, which includes other factories that manufacture the same type of equipment by realizing cost reduction at the time of product development or remodeling. This can be achieved by integrating the manufacturing sector and the development sector through the system that gives the “mother factory” the function of product development. Mother factories are not limited to Japan but exist worldwide in nine different areas as of the end of June 2010 (one in the United States, four in Europe, and four in Japan).

Komatsu has expanded into the emerging market through prompt penetration and establishment of a flexible production system, but they will need to deal with the competition with local companies as well. In China, which is the largest growing market, SANY group has made remarkable growth. They excel at low-end products and have a close relationship with the local government. Their market share was only 2% in 2007, but increased by about 2% in a year, and most recently in September 2010, it is considered to have increased by as high as 8.5% (Personal interview, January 24, 2011).

In 2010, SANY group announced that they will build a construction equipment factory in Thailand. They are expected to enter the market in ASEAN countries. Major Chinese companies import the key components from overseas and assemble them, and they have been accumulating technical capabilities through this process.

### Recycling business

As the rental market and the used equipment market expanded, Komatsu focused on recycling business. Komatsu's approach can be summarized as an attempt to be actively involved in the whole process from the sale to the disposal of equipment. In other words, a factory is considered as the heart of the body and a network of dealers, who distribute products to the market, is considered as an artery. Recycling business here refers to establishing a vein that collects blood once pumped out and redistribute the products.

Komatsu reorganized the internally founded "Recycling business project team" as "Recycling planning department" in October 2010 and officially applied its recycling business model they developed for used construction equipment to industrial machinery. In accordance with the introduction of new models in April 2011, they will buy old models from their customers and repair them to make them available in the market to compete with cheap foreign products ("The Chunichi Shimbun" November 15, 2010).

In 2006, Komatsu founded Komatsu Rental, which carries out rental business of construction equipment. In 2007, Komatsu announced the acquisition of shares of BIG RENTAL and its merger with Komatsu Rental. Komatsu also retains Komatsu Used Equipment Corp. (KUEC), which sells used equipment and holds auctions of used construction equipment regularly since they held the first auction in Japan in 1994. Participants come from various regions and countries including Asia, North America, and Middle and Near East Africa. In 2009, they achieved domestic sales of 1,800 units (approx. 4.1 billion yen) and overseas sales of 7,400 units (approx. 23.6 billion yen). More than 80% of the total sale is exported overseas (Personal interview, January 24, 2011).

As mentioned previously, small-to-mid construction equipment are often traded in and replaced with a brand new machine at the time of the first overhaul. Local dealers (brokers) in other countries buy these used machines in auctions and import them to their countries. The guarantee period is usually expired for the equipment sold overseas this way, and Komatsu's local distribution outlets perform maintenance and repair for profit. Although consumable parts can be replaced with generic parts, essential parts of construction equipment are brand specific and cannot be manufactured by other companies, so the maintenance of these parts needs to be performed at a local agency of

the manufacturer. Used equipment is registered at the agency at this point.

In the Chinese excavator market, there have been many used machines imported from Japan, but as the sales of the new equipment grow, more locally used machines are expected to be available in the market. Although Komatsu has increased their price worldwide, they have not been able to raise price in China as intended. The key lies in used equipment and if the price of used equipment increases, it will become possible to set higher price for brand new equipment. However, the revenue from parts and services is low, at only 5% of the total in China. When parts break down, Chinese customers often use cheap copy products instead of Komatsu's genuine parts (Interview with Kunio Noji, president and CEO of Komatsu Limited, "Nikkei Business" December 13, 2010).

The quality of used equipment is a critical issue that influences profitability of sales of brand new equipment. Therefore, it is necessary to be involved in not only the sales process but also in the process of collecting machines in the market. To maintain the quality of used equipment, genuine parts must be used. It is a challenge for them to encourage the users to maintain the quality of the equipment using the genuine parts especially in emerging countries.

#### Post-sale services utilizing ICT

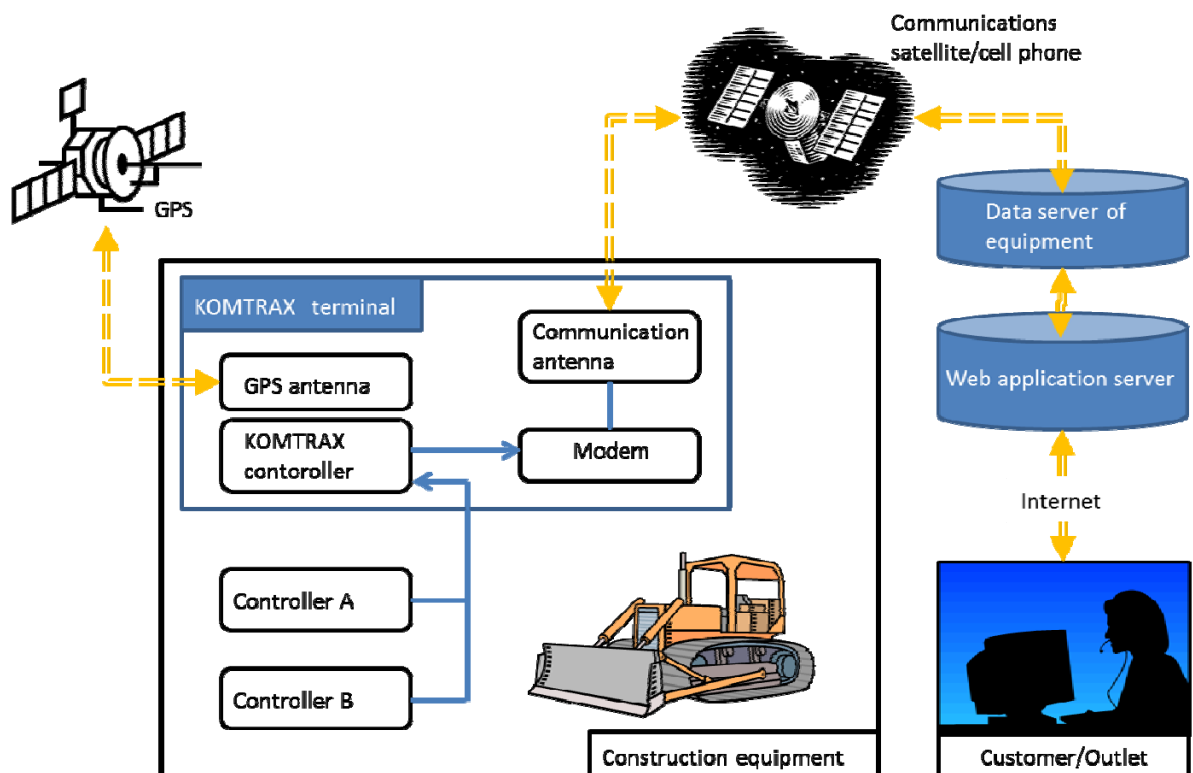
In construction equipment business, distribution outlets are the ones who directly deal with customers. Products are supplied to customers through these outlets and they perform post-sale services such as maintenance and repairs. However, post-sale operation is complicated. Komatsu utilizes ICT and provides a post-sale operation tool to distribution outlets to ensure their profitability.

Post-sale operation consumes a lot of time and labor of both Komatsu and the distribution outlets. The distribution outlets are required to 1) acquire necessary information (information on replacement parts, repair service information, quality information, and product information); 2) submit quotations of replacement parts and place orders to the manufacturer; and to 3) provide the manufacturer with customer information (operational status of equipment and quality information). Komatsu then needs to 1) provide information required by distribution outlets, 2) process quotations and orders from outlets, and 3) gather customer information. There are around 5,000 types of parts used for construction equipment and hundreds of thousands of industrial documents on these parts. Each time maintenance is required for equipment that belong to tens of thousands of customers, it is required to search in hundreds of thousands of industrial documents and find the necessary parts, check stock, and place

order. It can be easily imagined that this post-sale operation consumes enormous time. This is where Komatsu makes effective use of ICT.

Komatsu has introduced a system called KOMTRAX, which is a machine with telecommunication function and is fitted as standard equipment (Figure 7). Other companies also have installed a similar system, but Komatsu is the only company that includes it as standard equipment. Information on the location, operating hours, and status of the construction machine can be obtained through this system. Komatsu started to install the system as standard equipment in 2002, and now they can obtain operational information of 190,000 machines worldwide. Post-sale market depends on the operating hours rather than the number of equipment delivered. Therefore, operating hours is more important. By looking at the operating status, it is possible to estimate the demand for post-sale services. Information on KOMTRAX is provided to distribution outlets through the internet.

Figure 7 KOMTRAX system



Note: Created on the basis of the “Fact Book 2009” by Komatsu



KOMTRAX makes it possible to know which machine is used where in the world and in what status, and if there is an error, what sort of errors. This type of information used to be available only at the customer end. Now it can be shared among three parties including the manufacturer and distribution outlets. This system enables distribution outlets to make suggestions such as oil change, which is due at the next repair. When only customers had such information, all outlets were able to do is to wait for orders from customers. Implementation of KOMTRAX enabled distribution outlets to monitor the status at the same level as customers, and thus, more proactive business became possible.

The system also helps effective operation of construction equipment. For example, KOMTRAX can detect the fact that the engine of a machine at a customer site has been on for 10 h but the actual operating hours is only 6. Therefore, outlets can advise the customer to shorten the idling hours.

KOMTRAX is a sensor to gather data. CSS-Net, on the other hand, distributes information from KOMTRAX and various industrial documents that headquarter has compiled to outlets. The information provided includes parts catalogs, product catalogs, news updates on services (such as information on recalls), operation manuals, repair manuals, and fitting procedures. While these documents are generally paper-based and provided from manufacturers to outlets, Komatsu provides electronic data via internet using CSS-Net. In Komatsu's system, each industrial document exists as a separate database. Other companies also possess a similar database. However, Komatsu is unique in that each database is connected to CSS-Net so that all the information necessary for post-sale services can be obtained simultaneously. They started using this system in 1998 when the internet use started to rise drastically.

Digitalization of industrial documents and distribution of data through the internet have mainly six benefits. First, electronic data of the documents are centrally managed at a computer center and the latest documents can be provided equally and promptly to all distribution outlets in the world. Second, cost of media such as paper and CD can be reduced substantially by digitalizing documents. Third, it enables rapid search of necessary documents from hundreds of thousands of industrial documents by using a powerful computer search function. The fourth benefit is information sharing with other systems such as KOMTRAX and quality information management systems (SMAP: system that utilizes a computer network to centrally manage quality information). The fifth benefit is that it enables prompt referral of delivery time and market price by linking to ordering systems for replacement parts, and thereby reduces incorrect orders. The sixth benefit is that the distribution server has records of access regarding "who"

used “which document” and “how” and at “what time,” because the system users are recognized by an ID. By analyzing these records, it is possible to grasp the movement of post-sale market statistically. Utilization of this information substantially reduces the research cost for service planning.

Implementation of CSS-Net not only reduces information search cost by digitalizing paper-based data but also enables prompt and appropriate access to necessary information, and thereby reduces operation cost for post-sale service and improves quality at the same time. Komatsu sells the CSS-Net system to other companies and it has been used by Japanese agricultural equipment manufacturers.

#### 4. Komatsu’s business model

Through the installation of ICT, Komatsu has been trying to transform complex post-sale service from costly operation to source of profit, and in fact, they have already been successful in Japan (Personal interview, January 24, 2011). In international markets, many of the outlets do not have significant capital alliances with Komatsu; therefore, helping local distribution outlets to make sufficient profit will be the key for Komatsu to successfully promote their products. This is a particular business challenge for Komatsu who takes a different approach from Caterpillar Inc., who uses existing large distributors to forge ahead in overseas markets. There is also a risk of vicious cycle. If they fail to build a framework to ensure profit from post-sale services, the performance of distribution outlets for repair and maintenance services will deteriorate, which will lower customer satisfaction, which will then reduce the repeat rate at the time of renewal, resulting in further deterioration of service performance and decreased profitability of distribution outlets. Furthermore, if they fail to maintain the quality of construction equipment that customers are using, it will have adverse effect on the price of used equipment, which will then trigger a collapse in the prices of brand new equipment. Komatsu has been involved in the whole lifecycle of its products through various means that interactively underpin Komatsu’s healthy business performance.

KOMTRAX was originally developed as a countermeasure for a series of incidents where construction equipment was stolen and used to rip off the whole automatic teller machine in Japan. By installing KOMTRAX, customers were able to reduce the cost for burglary and theft insurance. In addition, customers thought it would be beneficial as it would support preventive maintenance by outlets as it would provide information on the status of the machine. The original business model assumed Komatsu to receive service fee in return, and it was still an option that required additional fee for

installation. However, two years later, they changed their mind. They realized that being able to obtain information on the status of equipment is actually beneficial for the manufacturer, so they decided to use it as a tool for the manufacturer. In 2002, Komatsu made it a standard equipment and stopped charging customers additional fee.

KOMTRAX has enabled visualization of status of equipment. Not only can this be used for product development, but this has also enabled Komatsu to differentiate itself in support services. Distribution outlets can now be proactively involved in post-sale services, and CSS-Net has simplified the complex operations. For customers, this has eliminated the risk of theft of construction equipment and enabled them to receive prompt post-sale services. With post-sale services, the quality of equipment will be maintained and it may be used for a longer time or the trade-in value may be higher. As a result, Komatsu has been able to make profit from post-sale services, exploit the emerging markets, and maintain prices for brand new equipment. Komatsu has successfully built win-win-win relationship among manufacturers, distribution outlets, and customers. Furthermore, the utilization of CSS-Net and information from KOMTRAX enabled customers, distribution outlets, and Komatsu to share equipment information at the same level, eliminating miscommunication and thereby improving the quality of post-sale services. KOMTRAX by itself is a mere sensor. However, by connecting it to industrial documents through CSS-Net, Komatsu successfully established strong ties between distribution outlets and customers. Komatsu has given a new meaning to their business by transforming a mere sensor to something more.

This visualization has also shown other benefits that were not originally expected. In 2004, when the Chinese government implemented fiscal austerity measures that triggered a decline in demand, construction equipment industry suffered from excess inventory. However, Komatsu was able to take preemptive measures before the decline in demand came to the surface and stopped production lines for three months. The decision was made on the basis of the data from KOMTRAX, which indicated reduction in operating hours of construction equipment. When the Chinese government again implemented a tight money policy in 2006, the prevailing view in the construction equipment industry was that the market would shrink. However, in reality, the demand was rising and the industry suffered opportunity losses from the shortage of hydraulic equipment, which is an essential part. Komatsu, on the other hand, established a new factory instead of reducing supplies and ended up in increasing the market share (“Nikkei Business” June 4, 2007).

Komatsu’s ICT is effective in market development as well. Major customers of hydraulic excavators in China are sole proprietors. Since the unit price is high,

installment sale is common, but selecting customers by credit ratings will limit sales. With KOMTRAX, as operational status after sales can be tracked, it can eliminate the concern of the collection of receivables. If the machine is operating, the customers are considered to have the ability to pay as they should receive a fee for the work. If the payment is not made, the engine can be stopped by remote control. If the machine is not operating, it can be seized depending on the circumstances (interview with Kunio Noji, president and CEO of Komatsu Limited, “Nikkei Business” December 13, 2010).

Therefore, Komatsu has exploited new business possibilities with ICT. As a result, it has been utilized for the whole product lifecycle from production and expansion of sales channels to improvement in quality and profitability of post-sale services. The product lifecycle here does not refer to just one cycle from sale to replacement. Komatsu facilitates the whole cycle in which replacement takes place a few times. They continue to be involved in the whole lifecycle from production of a machine to its disposal. This is Komatsu’s approach to maintain product quality and provide a mechanism that supports the operation of distribution outlets.

Figure 8 Komatsu’s hybrid hydraulic excavator



Note: Material provided by Komatsu

While reducing the manufacturing cost by more than 10%, Komatsu has focused on the development of leading products with advanced technologies that will take other companies at least three to five years to catch up. The hybrid hydraulic excavator is one example (Figure 8). The total cost of construction equipment for the whole lifecycle including purchase price of equipment, cost for repair, maintenance, consumables, fuel, tires, machine management, and the labor cost of operators will be 10 times that of the purchase price. Considering the total cost of construction equipment, cheap purchase price itself is not enough. Komatsu introduced new hybrid construction equipment to the Chinese market. In China, as the labor cost of operators is only one tenth of that in Japan, technologies to reduce the cost (for example, automatic control of construction equipment) are less beneficial for the customers. However, the cost of fuel is the same as that in Japan. Because hybrid construction equipment is three to four times more fuel efficient, it makes more sense to introduce these leading-edge products to the Chinese market. Especially in China, where equipment is used three times more than that in Japan, fuel efficiency substantially boosts customer's profitability.

These leading-edge products are a perfect example that represents Komatsu's technological competence. However, competitors will start selling similar products at some stage or the essential parts of those products might be obtained by competing companies in emerging countries. The speed at which Chinese companies accumulate technologies is phenomenal, and they will soon be able to develop products of a similar level of technology. How will Komatsu make effective use of three to five years they gained with the leading-edge products? The win-win-win relationship Komatsu has established with distribution outlets and customers will be the first step.

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