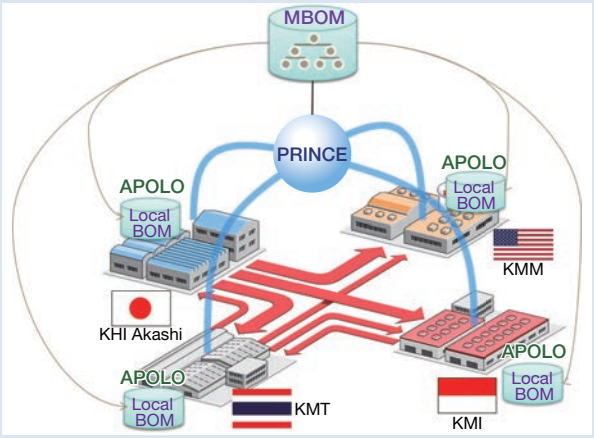
Efforts toward Global Supply Chain Innovation



While developing our business globally, we are promoting local procurement and in-house production of parts at our overseas production factories, resulting in increased complexity with regard to mutual parts supply among our factories, especially in Asia.

To address this situation, we are developing a business system for enhancing the efficiency of our global supply chain.

MBOM : Global manufacturing BOM system, PRINCE : Global production planning system, APOLO : Integrated production management system

Introduction

Today, motorcycles are popular all around the world. In order to respond to the worldwide demand, motorcycle companies have been expanding their business globally.

1 Background

The motorcycle market is likely to grow rapidly in emerging countries, such as India and Vietnam, and especially in India, the market for leisure motorcycles, which Kawasaki excels at, is expected to expand.

We needed to make further efforts toward globalization, in anticipation of making a full-scale entry into these markets.

2 Globalization of production

Kawasaki has been globalizing its production ever since it established its KMM Lincoln Factory in the U.S. in the early 1970's, and after 2000, it has been focusing on producing leisure motorcycles mainly in emerging countries in Asia. Currently, Kawasaki is producing motorcycles at nine factories, four-wheel vehicles and PWC (personal watercraft) at one factory, and general-purpose engines at two factories all over the world as shown in **Fig. 1**.

3 Supply chain in global production

(1) Increased parts supply between factories with an increased local parts procurement rate

In the early stage of production globalization, we normally shipped parts procured in Japan to overseas factories as parts to be assembled locally, and each factory used these parts with parts procured from local suppliers to produce finished vehicles. However, the local procurement rate of low-price parts has increased because local suppliers' capabilities have increased in each country, and in addition, the motorcycle market has become competitive. As a result, more and more low-price parts are procured, not only from Japan or the final assembly factories, but also from many other factories.

(2) Global promotion of "Big Combined Manufacturing"

While the type of models and volume of production are increasing at each factory, their in-house manufacturing capabilities, including assembly, machining, welding, and painting, are improving. Meanwhile, Kawasaki has been globally promoting "Big Combined Manufacturing" as its business strategy through efficient division of labor with a focus on reducing equipment investments and making efficient use of factory capacity throughout the Kawasaki group.

(3) Increasingly complicated global supply chain structure

When we began full-scale production of leisure motorcycles in Asian emerging countries in 2000, both the manufacturing and parts supply structures were simple. However, as a result of expanding parts supply between factories and promoting "Big Combined Manufacturing" in global production as previously described, the manufacturing structure had already become complicated in 2008, with parts being purchased (or supplied),

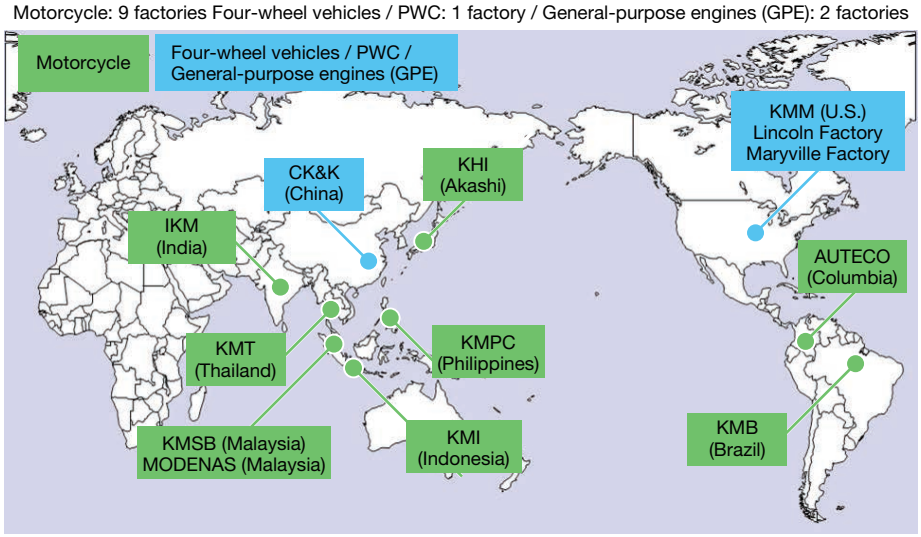


Fig. 1 Overseas production factories for motorcycles

manufactured in-house, and supplied in multiple steps involving multiple factories as shown in **Fig. 2** and **Fig. 3**.

For parts supply among factories throughout the Kawasaki group, it is general that parts supply factory purchases local parts, produces in-house parts, and ships them synchronizing production plan of receiving factory because of the knock-down production system adopted by each overseas factory when it was established. Therefore, each factory must accurately understand the types and numbers of parts and semi-finished parts, which can be classified into the following four categories, before starting relevant operations:

- Parts that a factory must purchase on its own
- Parts and semi-finished parts that a factory must receive from another factory
- Semi-finished parts that a factory must produce in-house
- Parts and semi-finished parts that a factory must ship to another factory

N:Month, A:Half month (to 15th day), B:Half month (from 16th day)

[2000]		N-4		N-3		N-2		N-1		N	
	Factory	A	B	A	B	A	B	A	B	A	B
Produced in Thailand EX650	KMT (Thailand)										
	KHI (Akashi)										

(a) Before business expansion into Asia

N:Month, A:Half month (to 15th day), B:Half month (from 16th day)

[2008]		N-4		N-3		N-2		N-1		N	
	Factory	A	B	A	B	A	B	A	B	A	B
Produced in the Philippines AX125	KMPC (Philippines)										
	KMI (Indonesia)										
	KMT (Thailand)										
	KHI (Akashi)										

(b) After business expansion into Asia

Fig. 2 Changes in manufacturing structure associated with global business expansion into Asia

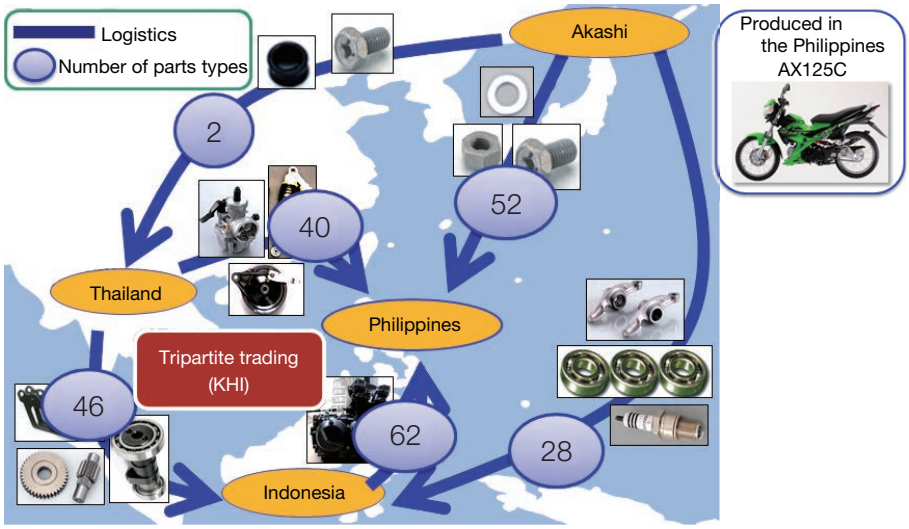


Fig. 3 Parts supply routes among production factories and number of types of parts (AX125C, produced in the Philippines)

However, the types of models and volume of the production are steadily increasing at each factory. The number of parts locally purchased or manufactured in-house by each factory is increasing accordingly. Therefore, it was extremely difficult for each factory to control every part or semi-finished part it is responsible for on its own.

4 Global supply chain innovation

We needed to develop the following three systems in order to ensure that each factory runs efficiently and correctly in the complicated supply chain:

- MBOM (global Manufacturing Bill Of Material), global manufacturing BOM management system that covers the global supply chain
- PRINCE (PRoduction planning system INtegrative for CEntral control), global production planning system used to make a production plan and parts supply plan for each factory based on the MBOM
- APOLO (Akashi PrOduction and LOgistics management system), integrated production management system which supports procurement, production, and shipment operations in a synchronized manner for each factory based on the production plan and parts supply plan

(1) Development of the global manufacturing BOM management system MBOM

We must comprehend clearly which factory must purchase what kind of local parts, which factory must produce what kind of in-house parts, and which factory must ship them to other factory for producing finished vehicle at final assembly factory. Therefore, we developed a system, MBOM, which allows us to easily understand the complicated manufacturing structure of each model. This system can be used effectively on any operations at each factory.

(i) Features

As an information management method for appropriately controlling and showing the manufacturing structure of each model, we decided to apply the same method for managing manufacturing BOM that is applied to each factory's production system with a view to future effective use at each factory.

In addition, we related factory codes, which indicate the factories responsible for parts procurement or in-house manufacture, to each item code in parts structure. The part structure is used to understand how parts and semi-finished parts move among factories and display the global manufacturing structure on a product-by-product basis.

These features have made it possible to not only understand parts supply routes information between factories by confirming the hierarchy of the parts structure but also understand manufacturing structure of each model easily as shown in **Fig. 4**.

(ii) Operation

In order for the MBOM to function globally, we need to understand, consolidate, and manage the roles of each factory and relationships between factories in a comprehensive manner. Therefore, the operation of the MBOM unifies the management at Akashi factory, which is the mother factory.

No	Level	Factory	Item Qty.					
			Local Purchase	Receive	Make	Through	Total	Ship
0001	0----	KMIN	65	371	30	0	466	0
0002	1---	AKA	100	0	3	0	103	98
0003	1---	IKM	5	0	0	0	5	5
0004	1---	KMT	533	86	140	0	759	268
0005	2--	AKA	95	0	22	0	117	86

Fig. 4 Manufacturing structure by MBOM

Operation of the MBOM began in October 2008.

(2) Development of the global production planning management system, PRINCE

To synchronize the supply of purchased parts from other factories and in-house parts with production at the final assembly factory, we developed a system that integrates the production plan for the final assembly factories and parts shipment plans for the parts supply factories.

(i) Features

For controlling parts supply among all factories, we must calculate a parts shipment plan for all factories at the same time based on the master production plan of all the final assembly factories while taking into consideration the procurement, in-house production, and logistics lead times. Therefore, we developed a system that not only integrates management of production planning but also enables management by individual factories.

In regards to controlling the master information system for making multilevel parts shipment plan, we established a master file for managing global shipping. We use a manufacturing structure linked from MBOM for basic master data, and we set standard lead times of parts procurement, in-house production, and logistics to each factory.

In order to create multilevel parts shipment plans for each factory, as shown in **Fig. 5**, we developed a function that creates a leveled daily production plan based on the monthly master production plan of the final assembly factory, creates a daily lot plan based on leveled daily plan, and automatically creates a "slide" multilevel shipment lot plan using the global shipping management master.

In order to apply the system to each factory's local operation, we implemented a function to create a leveled daily production plan for all final assembly lines and engine assembly lines of each factory based on the monthly master plan and parts shipment plan. Currently, this function has been implemented at KHI Akashi Factory only.

(ii) Operation

Creating multilevel parts shipment plan for all factories must be operated in a comprehensive manner. Therefore, Akashi factory is managing all planning operations.

Operation of the PRINCE began in November 2015.

(3) Development of the integrated production control system, APOLO

We needed to restructure Akashi Factory's old production control system. Therefore, we began developing a new production control system in an effort to innovate the supply chain innovation with a view toward implementing it globally.

We established a production control system by making global operation standards of parts ordering/parts inventory management/in-house production control/finished vehicle production/parts shipment based on Akashi Factory's operations. We will implement this system at each factory, thereby strengthening and streamlining the global supply chain.

(i) Features

For the BOM, which constitutes the core part of the production control system, we developed a system that automatically links up the item information and parts structure information from MBOM, just as we did when developing PRINCE.

For parts ordering management, with a view to applying the system globally, we implemented a function that can apply different order processing cycles (Akashi: Four times per month, Overseas factories: Once or twice per month) and can change the ordering cycle as needed.

For parts inventory management, in order to ascertain the difference between physical inventory and system inventory easily, we applied the system for calculating inventory not only by using actual production figures of

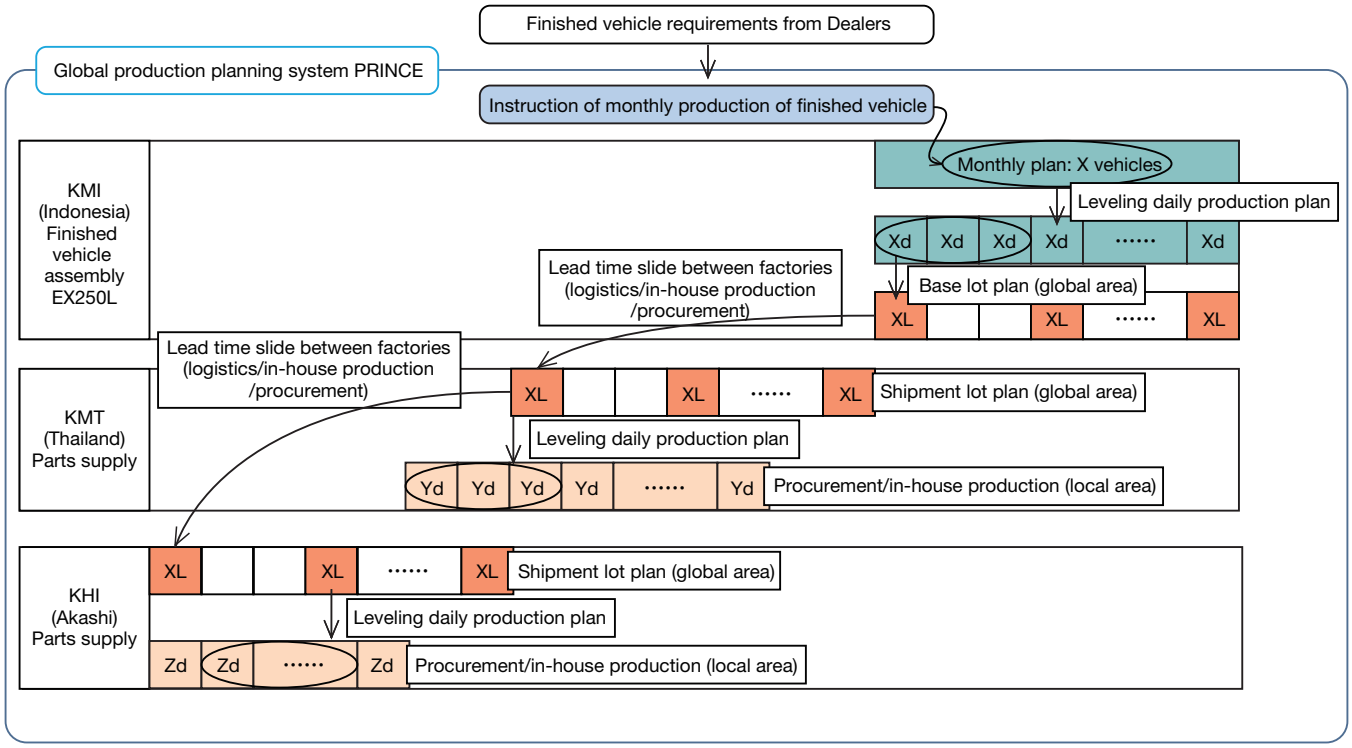


Fig. 5 Multilevel parts shipment plan for each factory

finished vehicles but also the actual production figures of other in-house parts (engine assembly, machining parts, and so on) which are managed by the production plan. In addition, in order to check the excess and shortage of parts at the right time, we implemented a parts shortage check function that matches the parts usage plan calculated based on the production plan, and the system inventory and the parts delivery plan.

(ii) Operation

Operation of the APOLO began in October 2017.

5 Utilization of System

(1) Managing consolidated profit by model

We can summarize proportional cost and shipment cost of each model by linking MBOM managed as the global master by Akashi factory and the local production/shipment control system managed by each factory. Then we began to manage consolidated profit by a model using cost information and in-house production costs managed by another Akashi Factory system.

(2) New model mass-production preparation

In the work related to start mass-production of a new model, we were able to clearly indicate the factories responsible for of parts procurement, in-house production, and shipment by using MBOM production preparation stage for the new model. This method has been applied for transferring production of models between factories and it is having noticeable effects.

Conclusion

We are promoting the deployment of PRINCE and APOLO at overseas factories in order to further improve and strengthen the global supply chain.

So far, we have developed a production control system at each factory's different environments. However, we will apply the operations and system of the Akashi Factory for each factory as the basic premise and standard going forward.

We will continue to enhancing each factory's operation level including the Akashi Factory and further streamline our operations.

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Yoshihiko Tasaka
Supply Chain Control Department,
Supply Chain Division,
Motorcycle & Engine Company

Takekazu Hirata
Logistics Department,
Operations Planning Office,
Planning Division,
Motorcycle & Engine Company

Kazuki Morita
Managerial Information Systems Department,
Operations Planning Office,
Planning Division,
Motorcycle & Engine Company

Gakuto Yoshiki
Managerial Information Systems Department,
Operations Planning Office,
Planning Division,
Motorcycle & Engine Company

Makoto Miyatake
Managerial Information Systems Department,
Operations Planning Office,
Planning Division,
Motorcycle & Engine Company

Noritomo Matsumoto
ICT Manufacturing Improvement Department,
Manufacturing Improvement Center,
Corporate Technology Division