



Production line at the Ricoh Manufacturing (Thailand) Ltd. plant which is located on the Amata City Industrial Estate in Rayong Province, Thailand.

### Pursuing process innovation on a global scale aimed at achieving highly productive, low environmental impact manufacturing that has the capacity to adapt to change.

The Ricoh Group launched the Engineering Process Innovation Center in April 2008 with the aim of strengthening the overall capacity of its production sites around the world. Ricoh aims to establish a strong manufacturing system capable of responding to a diverse range of market environments.

#### Establishing a production system that has the capacity to adapt to change and enable easy adjustment of production volume and equipment models

As globalization progresses, strengthening the operational and overall capacity of production sites around the world has become an issue amongst product manufacturers. The Ricoh Group's production system is currently spread over 29 (major) production sites in five regions throughout the world: Japan, Americas, Europe, China, and the Asia-Pacific region.

The year 1985, when the Ricoh Gotemba Plant began operating as a core production site for imaging equipment such as copiers and printers, was a period of expansion for OA equipment, and mass production was started as conveyor lines that gave high production efficiency through automation were installed at production sites. However, copiers subsequently acquired many additional functions, including printing, scanning, and network functions, and in response to diversifying customer needs there was a large increase in the variety of copier models, with the industry entering a period of high-mix low-volume production. The conveyor manufacturing system was suitable for low-mix high-volume production, but not for production equipment model changes or high-mix low-volume production. In 1999, Ricoh began gradually eliminating fixed conveyor lines and introducing a layout-free production system capable of responding flexibly to production volume and equipment model changes.

In an example of this, the "cart production line," multiple carts are lined up in a row and powered by air cylinders. The carts move along the production line carrying products. Because huge, high-energy consuming conveyors are not required, this system has brought huge reductions in environmental impact and energy costs<sup>1</sup>; moreover, because layout can be changed freely, the formation can be rearranged on a case-by-case basis to suit equipment models and production volumes. In-process inventory, lead time, space, and maintenance are all reduced by 70-80%. In addition, because of the reduction in space, reductions in air-conditioning and lighting costs are also achieved.

1. Air cylinders are used to move the carts, enabling a reduction in electricity consumption of 99% compared with conventional conveyor line motors.



Cart production line



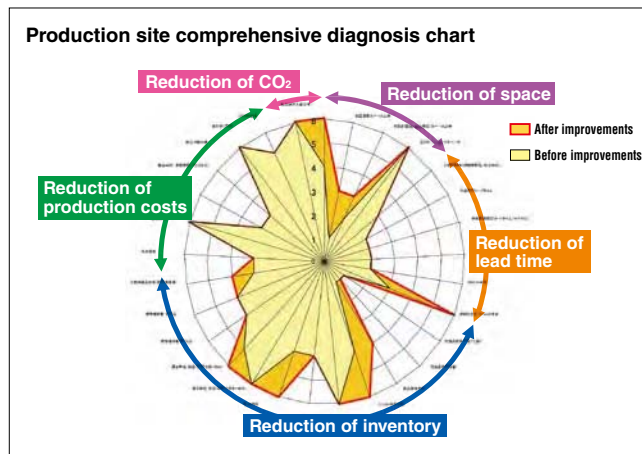
## Launch of a manufacturing innovation center to improve the overall capacity of the Ricoh Group's production system

In April 2008, innovation/improvement professionals from Ricoh's production planning and production management bodies joined forces to launch the Engineering Process Innovation Center. The Center's mission is to globally spread the production systems as well as manufacturing innovation strategies and know-how that Ricoh has developed through countless modifications and improvements over the years. "Higher productivity, lower environmental impact, and the ability to adapt to change" form the foundation of the Ricoh Group's production system.

The Engineering Process Innovation Center first of all comprehensively diagnosed the manufacturing capacity of each production site, which until then had not undergone objective evaluation, to directly identify each site's strengths and weaknesses before undertaking action to strengthen and improve the production capacity. Diagnosis covered a total of 28 items in five blocks—space, lead time, inventory, production costs, and CO<sub>2</sub>—to facilitate the formulation of concrete improvement methods. Production systems suitable for the products to be manufactured and equipment characteristics were considered and production tools<sup>2</sup> for resolving problems specific to each line were introduced. Following the new concept of the production line design, production tools were also developed in accordance with the concept of "small, inexpensive, portable, immediately operable, and environmentally friendly." This was to enable the system to be installed in any plant anywhere in the world and to eliminate the need for lengthy start-up periods and additional power sources.

In addition, Ricoh's manufacturing capacity is supported by software, hardware, and "humanware." The Engineering Process Innovation Center also backs up training provided to workers implementing improvements in the workplace. The "GPD Dojo"<sup>3</sup> is a program that trains key people implementing improvements through lectures on improvement methods and basic quality control in line with Ricoh's basic manufacturing philosophy.

2 & 3. Please refer to the table below.



### 2. Waste elimination and paraphernalia supporting product quality

A characteristic of Ricoh's manufacturing innovation is the clear separation of aspects that do and do not depend on people in undertaking improvements in the pursuit of product quality.

#### ● Eliminating waste

For example, in focusing on mounting screws, eliminating waste—completely eliminating actions that create no direct value, such as choosing screws, lining up the screws with holes, etc.—enables minimization of worker load and improves the quality of the screw mounting. Elimination of waste also shows results in reducing takt time, production costs, and environmental impact and is the basic concept underlying Ricoh's production system.

#### ● Paraphernalia (production tools)

An example of solving a problem with "paraphernalia" would be introducing CCD cameras and image-identifying machines into the process for visually checking product labels for incorrect or crooked affixation. No matter how proficient workers are, human mistakes cannot be totally eliminated, but using appropriate production tools can reliably prevent mistakes.

### 3. What is the GPD Dojo?

The keys to improvements on the factory floor are "tools" and "people," and so the GPD Dojo was established in 1999 with the purpose of providing worker training. As of March 2010, 293 workers at five production sites within Japan had completed training in the GPD Dojo and are now acting as key persons in the improvement of operations at their respective production sites.



#### The five schools of the GPD Dojo

<b>Tool School</b>	Parts selection, electrical safety training, relay circuits, sequence control and other paraphernalia improvements, and basic knowledge of electrical improvement
<b>RIPS School (Basics)</b>	RIPS = Ricoh Production System. Methods for spotting and rectifying/eliminating overstrain, waste, and inconsistency from the standpoint of economic performance
<b>Problem Solution School</b>	Approaches to problem-solving and implementation of approaches to fact-spotting
<b>Quality Control School</b>	Role of production managers and approaches to work; improvement methods required for product quality control
<b>RIPS School (Application/Implementation)</b>	Implementation of Group improvements, comprehensive process improvements leading to financial contributions, and development of even better production technology, with the central focus on graduates from the RIPS School (Basics)



**Inserting ourselves into the workplace and cooperating with improvement efforts, making comments and lending a hand: it's a system that gets results.**

The purpose of the Engineering Process Innovation Center's activities is to spread the strengths of a production site to other production sites and to correct the weak points of a production site through the lateral spread of other production sites' best practices, resulting in an upward spiral for the Group overall.

Ricoh's already excellent production processes have expanded globally, but operations have been placed in the hands of each production site and disparities have arisen between production sites in results and progress due to weak lateral coordination, leading to lost opportunities. The Engineering Process Innovation Center's Traveling Improvement Unit, which "makes comments, lends a hand, and gets results," inserts itself into the workplace at each production site and works together with the workers to improve operations. For example, with respect to the diffusion of production tools, the



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Unit obtains feedback on items customized on-site and applies this information to the improvement of core tools. Workers at each production site also see immediate results, leading them to make their own innovations, which in turn leads to a positive cycle of improvement.

**The ultimate production line, consolidating Ricoh know-how accumulated over the years, begins operation in Thailand**

A new Ricoh imaging equipment production site, Ricoh Manufacturing (Thailand) Ltd. (RMT), began operation on September 17, 2009. Engineering Process Innovation Center members involved in launching the production line compared and considered several production systems, finally adopting the Vertical Rotation Module Production System.<sup>4</sup> In Ricoh's newest production line, the line can be lengthened or shortened by inserting or removing a module, and equipment models and production volume can easily be changed. Very little equipment is fixed and setup is fast, enabling a huge reduction in operating costs and environmental impact. Moreover, Ricoh has introduced production tools with proven results at production sites around the world, establishing a highly efficient production system.

[4. See page 12.](#)



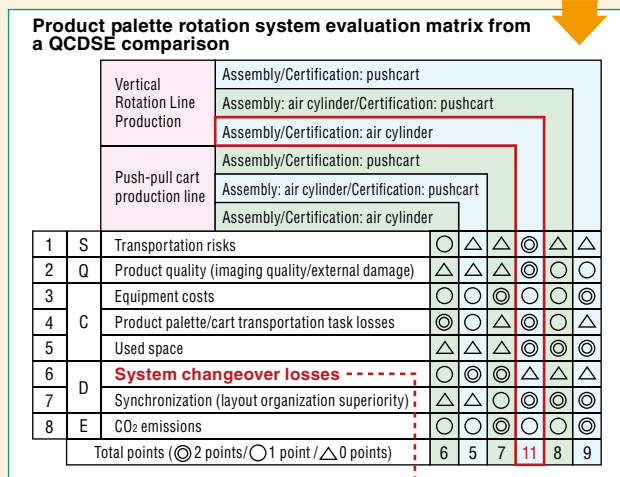
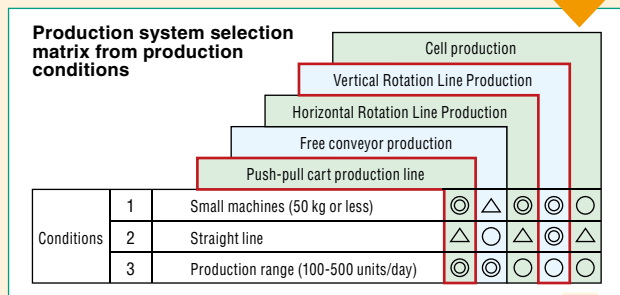
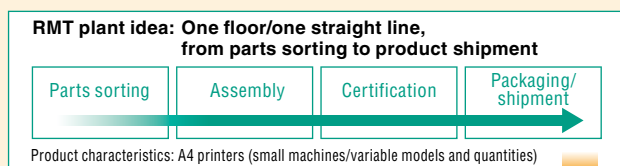
Opening Ceremony for the new Thai plant  
(Shiro Kondo, President of Ricoh, is sitting third from the left in the front row.)



Exterior view of the new Thai plant

## Characteristics of the Vertical Rotation Module Production System

(1) Selection Background (shows how the selection was made from amongst which production systems using what selection criteria)

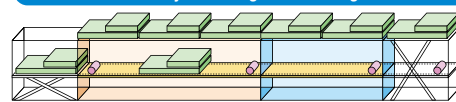


(2)

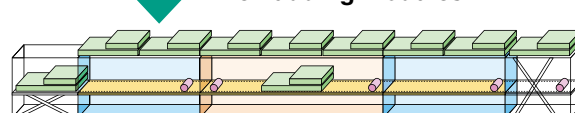
### ● Characteristic 1

#### ● Resolution of conventional problems ●

The production line can be lengthened or shortened by inserting or removing modules



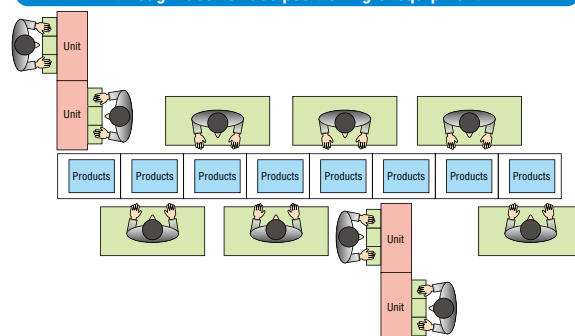
When adding modules



- Ignition costs are reduced through introduction of modules
- Takt times can be set for each assembly and certification area
- Automatic insertion of modules is also fully operational

### ● Characteristic 2: effective use of space on both sides of the production line

High efficiency and space reduction achieved through face-to-face positioning of equipment



Simultaneous unit processing made easy by the efficient utilization of line-side space

\* The best product system is selected for each production site in accordance with the production environment and conditions for each site.

## Reducing environmental impact while simultaneously improving productivity—this is a practice that is unique to Ricoh.

The concept of eliminating waste has penetrated Ricoh Group production sites. Without our being conscious of these activities being especially environmentally friendly, I believe various improvements have led to a reduction in environmental impact. Attaching the same priority to environmental activities and improvements to production workplaces is something that is unique to Ricoh and is implemented in our sustainable environmental management. Improvements cannot move forward if we think that inventory must be held on to and absorbed in order to respond to fluctuations in production volumes; inventory hides a range of problems. The world has been in economic recession since 2008, and all product manufacturers have agonized over adjusting production volumes, with large inventories worsening cash flow. It is therefore meaningful to create procurement, production, and

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supply processes that can endure change, without relying on inventory. Since its establishment, Ricoh's new Thai plant has implemented many mechanisms that Ricoh has cultivated over the years in order to realize high productivity and low environmental impact, and we will continue to make further improvements with the aim of achieving manufacturing that can endure and adapt to change.

\* Case examples of production process innovations (optimum product control using RECO-View RFID Tag Sheets)

See page 39.