

■ Title

Bicycle Business Frontline -Bicycle Structure and JATCO's Drive Unit Edition

■ Sub

JATCO's "2-in-1" Bicycle Drive Unit Technology Leverages the Company's Strengths

■ Lead

JATCO is enjoying change and boldly taking on new business challenges. This issue features an interview with the team that is taking on the challenge of the bicycle business, which started a social experiment in Fuji City on September 2 and aims for mass production in FY2024. The first part is about the technology. What kind of technology is packed into JATCO's bicycle drive unit?

■ Member Introduction



Fig1. From left to right: Mr. Okamoto (project leader), Mr. Inaoka (in charge of sales), Mr. Sasaki (in charge of sales/technology), and Mr. Suzuki (in charge of application development) of the New Business Promotion Department

■ Types of Bicycles

First, let's look at the types of bicycles.

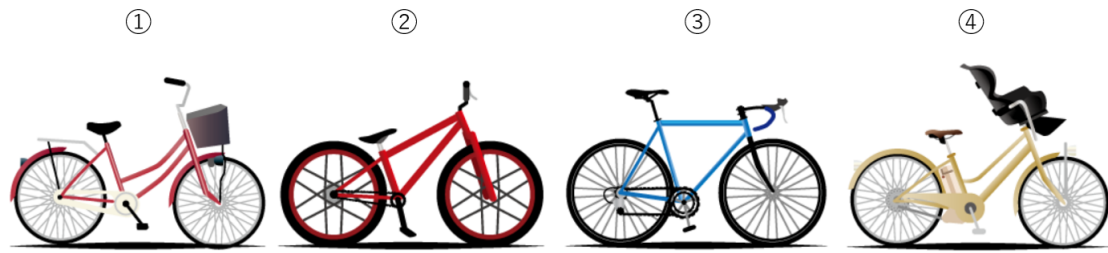


Fig2. Bicycle types and market share

City bicycles: the most commonly ridden bicycles (market share: approx. 70%)

(2) Mountain bikes: bicycles suitable for riding on mountain roads, etc. (6%)

Road bikes: Bicycles used in competitions and other events (5%)

Electric bicycles: Bicycles suitable for carrying children and riding uphill (19%)

Develop a proposition and differentiated electrically power assisted bicycle.

Okamoto: What we have developed this time is a drive unit for electrically power assisted bicycles (motor assist and gear shift mechanism; *see Fig. 4), which was also exhibited at the Automotive Engineering Exposition 2023 YOKOHAMA (hereafter, Hitotsu-Tech Expo 2023). Many companies have entered the electrically power assisted bicycle business, including the three major manufacturers Panasonic, Yamaha Motor, and Bridgestone, as well as home centers such as Aeon and Cain's, and companies specializing in bicycle sales such as Asahi Cycle and Cycle Mate. As a means to "expand the possibilities of mobility," which is one of JATCO's Purposes, we took advantage of our gear technology, one of JATCO's strengths, to develop a bicycle drive unit.

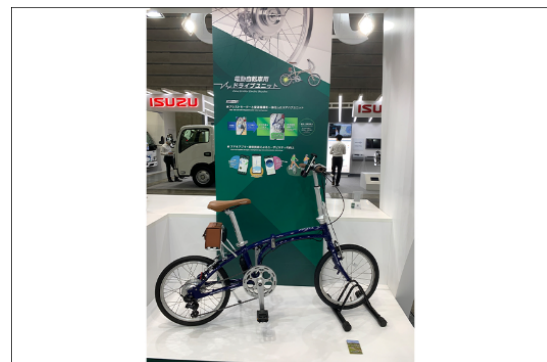


Fig3. Mr. Okamoto Fig4. Bicycle exhibited at the Hitotech Exhibition 2023

Inaoka: The drive units for electrically power assisted bicycles that JATCO develops are planned and developed together with bicycle manufacturers. Assist motors and transmissions

are already the sole domain of major parts manufacturers, and bicycle manufacturers are often planning and developing bicycles by selecting from the products that already exist. In order for JATCO, a latecomer to win in the bicycle business, we felt it was important to incorporate customer needs and how to differentiate ourselves from other companies.

Sasaki: First, let us focus on the drive unit mounting position. There are three basic types of drive unit mounting positions: front, center, and rear (Fig. 5).

The drive unit currently under development will be a rear type, which will stabilize the center of gravity and provide high safety, and the scale of frame modification can be kept small, which will benefit the customer by reducing the man-hours required for frame development. However, simply mounting the drive unit in the rear is not enough to differentiate the product.

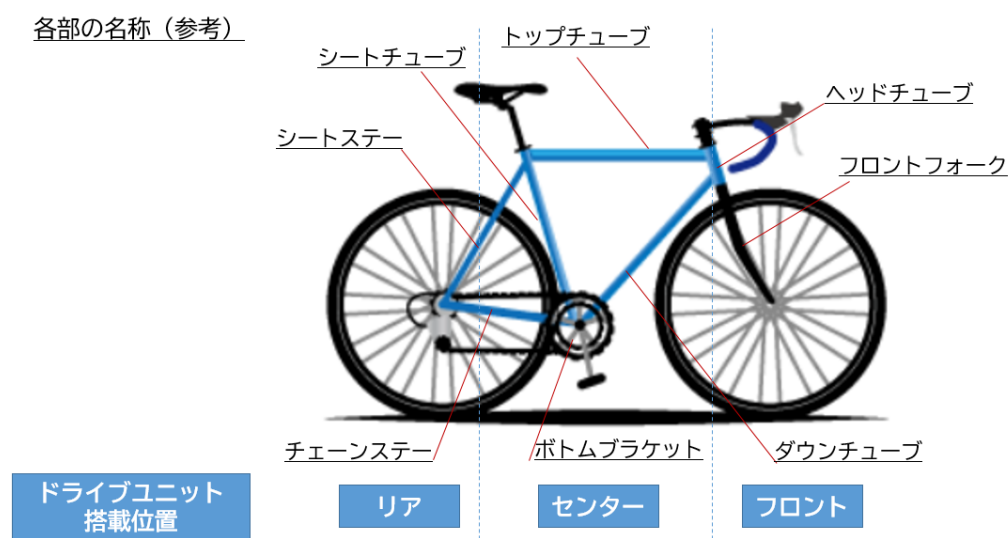


Fig5.Position of drive unit (Name of each part * Preliminary knowledge of bicycles)

Next, we turn our attention to the structure of the gear shift mechanism. There are two types of gear shift mechanisms: external gear shift and internal gear shift (Fig. 6).

While external gear shifting and internal gear shifting each have their merits and demerits, internal gear shifting is characterized by a greater degree of technical difficulty. The mechanism needed to change gears must be housed in a component called a "rear hub," which requires advanced gear technology and layout techniques, and therefore, few bicycles in the industry as a whole use interior shifting.

Okamoto: I thought that gear and layout technology was JATCO's strength itself. I thought that with JATCO's strengths, we might be able to create a valuable product in a new industry

that JATCO has not been involved in before, in the area of interior gear shifting, which is considered to be a technically challenging area.



Fig. 6 External gear shift Internal gear shift

External gear shift】 【External gear shift

Most common type of transmission used in sports bicycles, etc.

The gearbox is exposed to the outside and is called "exterior".

Strengths: Easily multi-leveled, lightweight, simple structure, easy maintenance

Weaknesses: noisy, chain comes off easily, cannot shift gears while stopped.

Only chain drive system can be selected, and it is easily rusted due to exposure.

Interior gear shift】 【Interior gear shift

Transmission used in city bicycles and sport bicycles used mainly for city riding

It is called "interior" because the mechanism needed to change gears is housed in a box called a rear hub.

Strengths: Quiet, can shift gears while stopped,

Chain-driven or belt-driven system can be selected.

Weaknesses: Heavy in comparison with external gearboxes, troublesome to attach and detach wheels, expensive for those with a large number of gear shifts

Higher technical difficulty than external gear shifting

■ Birth of the world's first 2-in-1 drive unit for electrically power assisted bicycles

Sasaki: The final product we came up with is a 2-in-1 bicycle drive unit consisting of an assist motor with 250W output, two sets of planetary gear mechanisms, and a clutch (Fig. 8). One of the planetary gear mechanisms functions as a reduction gear in combination with the motor,

and the other is a transmission that can change speeds in three stages depending on the state of the clutch engagement.

It takes more than ordinary technology to fit an assist motor and gear (transmission) into this extremely small space. JATCO's gear technology cultivated over a long period of time with CVT/AT and packaging technology that has adapted the shape of the unit to fit the engine compartment of many automobile manufacturers are what made this product possible, and that is why we have created the world's first drive unit!



Fig7. Mr. Sasaki Fig8. 2in1 drive unit. Silver sphere (rear ha.)

The motor and transmission are housed in a

■Control applications are also developed independently

Okamoto: What we are considering is not only the hardware part of the drive unit. We thought that offering the product as a set with a smartphone application that performs assist control would be a high value-added product that would please our customers. Since Suzuki-san, who was well versed in programming, was available, we asked him to join our team and began development of our own application.

Suzuki: I am currently taking on the challenge of developing a bicycle control application by utilizing my previous experience in language development for supercomputers. The concept of application development is thoroughly customer-oriented. The speed at which they feel comfortable and the force with which they pedal their bicycles differ, so we aim to provide the end user's preferred riding comfort from a smartphone application, such as the start-up time of the motor assist force and the duration of the assist.

In addition, since many people are health-conscious these days, we are also working on a prototype of a "fat-burning mode" that automatically controls the amount of assist so that the force of bicycle pedaling becomes aerobic exercise, allowing those who normally cannot take time for exercise to easily improve their health during their commute to work and school.

If you are interested in taking on the challenge of acquiring new technologies such as

programming and cloud computing, please join our team.

Inaoka: Smartphone apps are also focused on appearance and usability, right?

Suzuki : That's right. The key to a smartphone application's UI is its design ability, including its visibility and intuitive handling. As an art university graduate, I am also very particular about design (Fig. 9). Although the application is not yet complete, I will not give up until the last minute and want to make it into an application that will please the end user.



Fig9. Easy operation with a smartphone Fig10. Mr. Suzuki
Control application under development

■Next goal is the second generation

Okamoto: We are also working on the development of the second generation, which aims to reduce size and weight so that it can be applied to more bicycles.

Sasaki: First of all, regarding the size of the drive unit, while the current unit is 140 mm wide, we aim to reduce the size of the second-generation unit by about 50% to 75 mm wide. We are also taking on the challenge of reducing the weight by about 30%, from the current 3 kg or more to the low 2 kg range.

Inaoka: Once this second generation is completed, the range of customers will expand greatly. With the currently developed product, due to size issues, it can only be installed on wide rear frames with external gear shifting, but with the second generation, it will be possible to install it on city bicycles as well (Fig. 2). This will increase the number of potential users several-fold, and may encourage more customers to choose JATCO units!



Fig11. Mr. Inaoka Fig12. Second-generation drive unit (under development)

9/2 Fuji City Collaboration Social Experiment Starts!

On September 2, earlier this month, the Fuji City Social Experiment Start Ceremony was held at the Fujikawa Rakuza Service Area on the Tomei Expressway. CEO Sato and other employees involved in the bicycle business attended the ceremony.

We will continue to report on the social experiment, so stay tuned!



Fig13. Ribbon-cutting ceremony Fig14. Start of rental bicycle service in Fuji City

We will bring you the Bicycle Business Startup Edition in next month's issue. Enjoy!Â