# Development of E-Commerce to Improve Customer Experience in Parts Purchasing
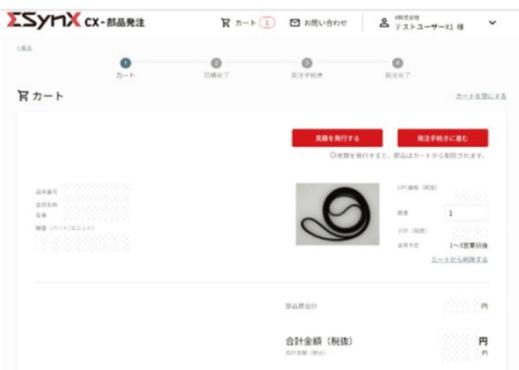
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*Today, the application of digital transformation (DX) for after-sales service in the manufacturing industry is indispensable as a part of the customer experience regarding the product. Mitsubishi Heavy Industries, Ltd. (MHI), a manufacturer of a wide variety of mechanical products, has also focused on improving the customer experience in parts purchasing and has developed E-Commerce for mechanical products. This enables customers to purchase parts anytime and anywhere via the internet. This report describes the customer experience and functions provided by E-Commerce, its architecture, the results obtained, and future prospects.*

## 1. Introduction

MHI handles a wide variety of products, mainly mechanical products. In order to ensure safe use of these products by our customers, it is important to ensure that necessary parts replacement is performed in the after-sales service. In the past, for sales of replacement parts, mainly MHI service center representative received a request from the customer's representative by phone or e-mail, and then each time prepared a quotation and sent it by e-mail or other means. For customers, however, the current parts purchasing is problematic; it takes time to receive a quotation, and it is impossible to place an order for parts in an emergency at night, and so on. Therefore, it has been imperative to establish a system that allows customers to easily purchase parts or to obtain the necessary quotations for such purchases anytime and anywhere, in order to realize a customer experience where customers can easily obtain replacement parts.

## 2. Researching parts purchasing experience required for mechanical products

In order to ensure the stable operation of mechanical products, customers need to replace parts not only periodically but also unexpectedly to cope with machine breakdowns and other problems. Basically, customers identify parts to be purchased from the parts lists and drawings provided by MHI. However, it is difficult to accurately identify the parts in a short time from the thousands to tens of thousands of parts that constitute a mechanical product, and therefore parts purchasing is mainly based on communication by phone or e-mail between the customer representative and MHI representatives. We visited and interviewed several customers regarding their parts purchasing experience, and found that they have the following problems.

- The parts to be purchased may not be identified, which requires an inquiry to MHI representative.
- After making a request to an MHI representative for a quotation, it may take time to receive it, which requires contacting the representative multiple times to inquire about the processing status for some cases.
- When it is necessary to purchase parts unexpectedly, the customer may not be able to contact MHI representative to place a purchase order for the parts immediately.

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Furthermore, we found that MHI representatives also have the following problems in customers' purchasing parts.

- Inquiries from customer representatives regarding parts purchasing may be biased to a specific MHI representative, which increases the workload of the representative.
- Multiple departments are often involved in the preparation of quotations, which may result in a lot of time required to reply to the customer.

In order to solve the above problems and provide customers with an easy replacement parts purchasing experience, we have developed E-Commerce, which allows customers to search for parts, issue quotations, and place parts orders by themselves on a web system. This enables customers to purchase parts anytime and anywhere as long as they have an internet environment, and also enables significant reduction in workload on MHI representatives in terms of inquiries about parts purchasing and the preparation of quotations.

# 3. Whole picture of E-Commerce for mechanical products

## 3.1 Parts purchasing experience provided to customers

We categorized a customers' easy replacement parts purchasing experience into five actions and determined the functions that E-Commerce can provide.

(1) Identifying parts
(2) Preparing quotations
(3) Placing purchase orders
(4) Checking order status from its placement to shipping
(5) Viewing customer's quotation and order history

## 3.2 Functions that E-Commerce provides

E-Commerce provides the following provision functions in order to realize each of the experiences described above.

(1) Identifying parts
- E-Commerce has a filtering function based on where parts are used (model/unit) and whether the parts have been purchased in the past (**Figure 1**-A) and a field search function in which partial match search and keyword search are available (Figure 1-B) in order to identify parts to be purchased from the thousand to the tens of thousand parts registered therein.
- When the customer knows the part number, part name, or model number, the field search is used to identify the part. On the other hand, when the customer does not know the part number, part name, or model number, the filtering function and the field search function are used in combination to narrow down and identify the part.
- To support parts identification, E-Commerce provides detailed information such as product descriptions, photos, parts categories, and specific points of use.

(2) Preparing quotations
- E-Commerce provides information on selling prices and standard delivery times for parts, and has the prices adjusting function for the provision of selling prices, which are based on the contract between the customer and MHI.
- E-Commerce has a purchase cart function in which customers can freely adjust the number and combination of parts (Figure 1-C). This function allows the customer to view the total price that includes shipping and other expenses and discounts according to the contract between the customer and MHI.
- The purchase cart function allows customers to instantly download the quotation for parts put in the purchase cart as a PDF document (**Figure 2**-A).

(3) Placing purchase orders
- The customer can place an order for parts put in the purchase cart, regardless of whether the quotation has been prepared (Figure 2-B). In this order placing procedure, the delivery address, shipping method, and estimated delivery date can be confirmed, and the customer can also enter requests and other matters to be communicated to an MHI representative in the remarks field (Figure 2-C). Furthermore, by selecting the target (machine model) for which the parts being ordered are to be used, the customer's parts

purchase history can be supplemented by MHI (Figure 2-D).
- Once an order is placed, the order information is coordinated with the business unit's enterprise systems and the commercial processing proceeds.

(4) Checking order status from its placement to shipping
- E-Commerce has a function to send an e-mail to notify the customer of the completion of the receiving process of the order they placed.
- After the completion of the receiving process of an order, E-Commerce provides the latest information on the shipping date of an order based on our stock and the arrangement/allocation states. The shipping information is clearly indicated by the following statuses: Not Shipped, Partially Shipped, Shipped, and Canceled (Figure 1-D). This indication is based on coordination of the order information registered in the business unit's enterprise systems.

(5) Viewing quotation and order history
- History information can be grouped by the company or organization to which the customer belongs, allowing the customer to view and utilize the history information of other users in the same group.
- The quotation history clearly indicates the status of issued quotations with Not Ordered, Ordered, or Expired (Figure 1-E).
- The order history can provide information on all parts orders placed, including orders placed through conventional processes, not just those placed through E-Commerce.
- For mechanical product parts purchasing, which often includes the same parts and is usually made on a regular basis, a function to put the same parts as the parts in the history information in the purchasing cart is provided to save labor.
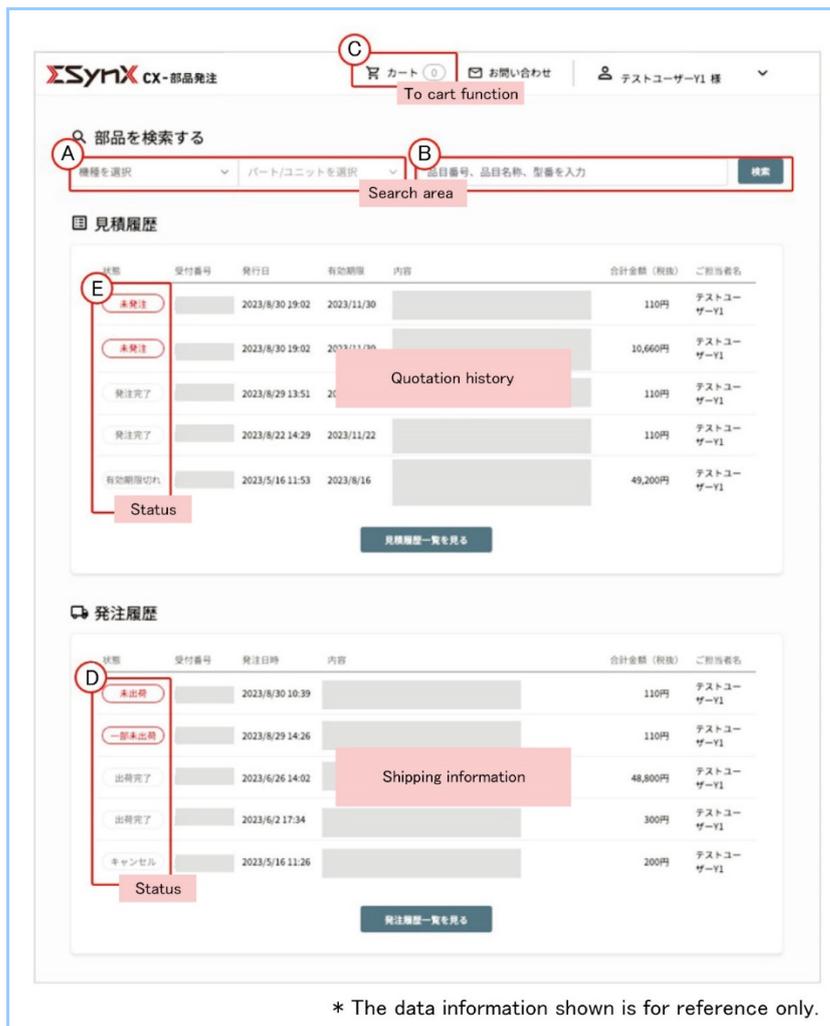


**Figure 1　Typical functions of E-Commerce - 1**
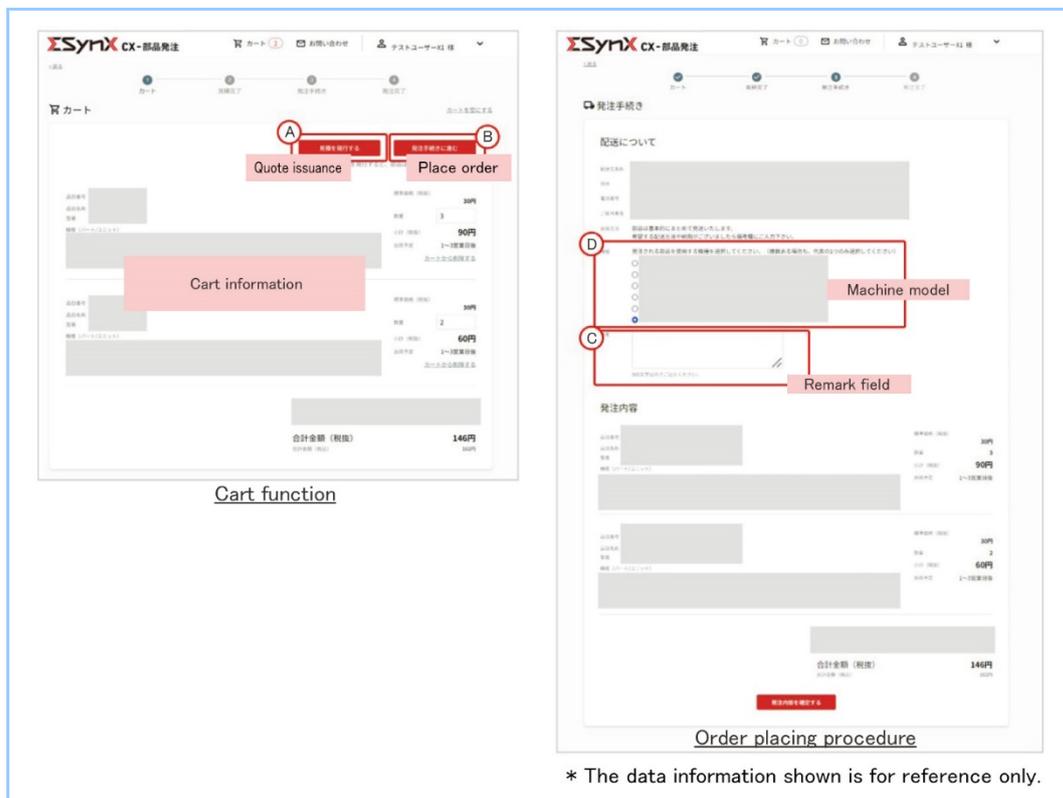
**Figure 2　Typical functions of E-Commerce - 2**

## 3.3　Basic configuration and architecture

As its basic configuration to realize the functions described above, E-Commerce assumes that users registered in advance access the system through web authentication. Furthermore, E-Commerce employs an authorization control mechanism that ensures that information such as quotation and order history related to a group can be viewed only by users belonging to the group by flexibly setting user grouping by company or organization. **Figure 3** shows the architecture of E-Commerce. This architecture is characterized by the following features.

(1)　Adoption of headless architecture

One possible way to realize E-Commerce is to utilize SaaS (Software as a Service) specialized for E-Commerce. However, we decided not to adopt SaaS because the functions provided by SaaS do not necessarily match the required functions of E-Commerce for mechanical products, for example, it is difficult to conduct flexible searches that reflect product categories unique to mechanical products with the function SaaS provides.

A common method for building E-Commerce by in-house development is the monolithic architecture, in which the front end and back end are built as a single structure. This method has the advantage of maintaining strong data consistency between the front end and back end, but the data checking and processing processes are distributed or duplicated between the front end and back end, which may result in complexity when extending or changing functions. This means that the development efficiency and maintenance/operation efficiency will become issues.

In view of the characteristics of E-Commerce, it is possible to choose a simple configuration in which data checking and processing are concentrated in the back end, and the front end displays the information processed in the back end. Therefore, this development adopts a headless architecture in which the front end and back end are data-coordinated via an API (Application Programming Interface). This enables high efficiency in development, maintenance and operation, and at the same time, high usability is ensured by developing the front end as a SPA (Single Page Application SPA) from scratch.

(2)　Adoption of SaaS and managed services

The back end adopts a policy of implementing high functionality in a short period of time by actively using cloud-based managed services. Furthermore, this configuration minimizes operational man-hours and ensures stable service provision.

(3)   Flexible coordination between systems using data integration platform

Data integration is required between E-Commerce and the enterprise systems operated by the business unit, and bi-directional coordination is achieved using a data integration platform that utilizes cloud services, etc. The data integration platform absorbs and converts differences in the data structure between E-Commerce and each business unit's enterprise systems, enabling data integration between E-Commerce and each business unit's enterprise systems without any modifications on the E-Commerce side.
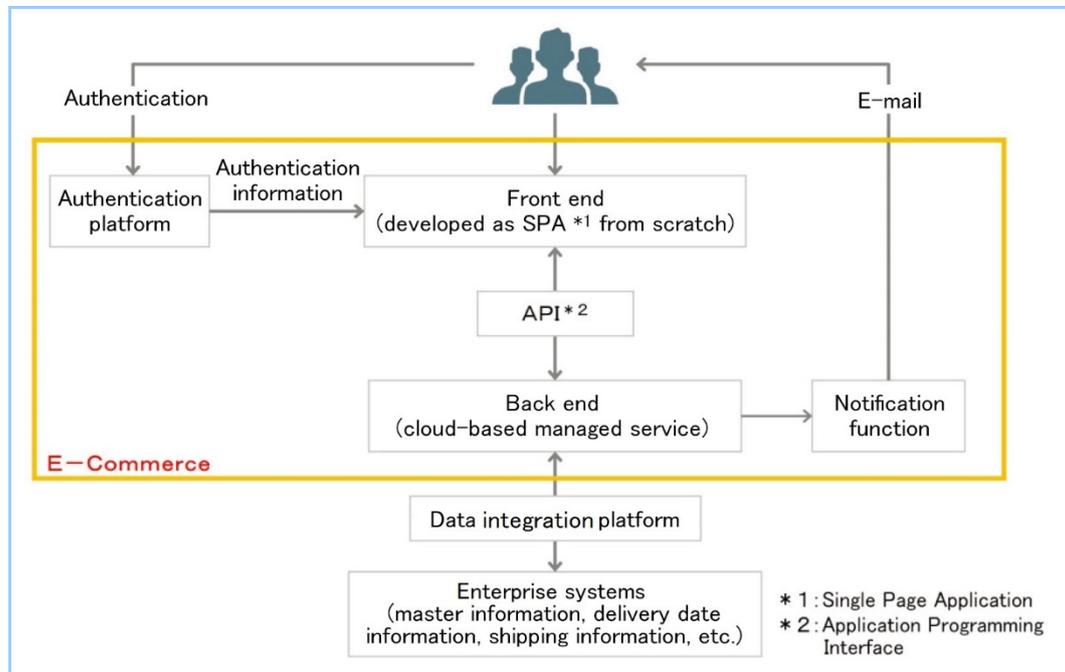


**Figure 3    E-Commerce utilizing headless architecture**

## ▌ 4.  Effects of E-Commerce

MHI released the first version of E-Commerce in October 2021 and has continuously improved its functionality since then. As of the end of July 2023, Printing and Packaging Machinery Headquarters and Infrastructure Facilities Business Division (Food & Packaging Machinery) of Mitsubishi Heavy Industries Machinery Systems, Ltd. have implemented E-Commerce. Customers of these two business units have highly appreciated the experience that E-Commerce provides, such as the possibility to obtain quotations and purchase parts anytime and anywhere, which confirms that the problems customers had in purchasing parts in the past have been resolved. Partially due to these effects, we are developing improvement activities in which customers and MHI work together is being lead, such as the customer themselves promoting the application of E-Commerce to their other plants.

The implementation of E-Commerce for Printing and Packaging Machinery Headquarters has gradually increased the number of parts available for purchase there, and its parts handling coverage ratio has reached a high level as of the end of July 2023. In addition, as customers using E-Commerce purchase approximately 50% of their entire parts purchases through E-Commerce, the digital migration of parts purchasing experiences is proceeding at a steady pace.

The implementation of E-Commerce for Infrastructure Facilities Business Division (Food & Packaging Machinery) has involved about 20 customer plants, mainly major users. As a result, it is estimated that the number of days required for customers to obtain quotations has been reduced by a cumulative total of about 2,000. Accordingly, the man-hours required for MHI representatives to prepare parts quotations has also been reduced. In this way, the introduction of E-Commerce is bringing benefits for both customer value and MHI business value.

## 5. Future prospects

We plan to promote two initiatives to provide our customers with an easier way to purchase parts. One is continuous functionality improvement of E-Commerce, which we have been developing, including, for example, a function to allow a customer who purchases a large number of multiple parts in preparation for an overhaul to import a list created in a separate file, rather than having to select the parts each time in E-Commerce. In this way, we plan to promote the development of functions that can respond to the customer's situation.

The other one is to improve customer experiences, including ones prior to parts purchasing, so that parts purchasing through E-Commerce becomes a common practice for customers. For example, from a bird's-eye view, the customer experience leading to parts purchasing is the process of deciding on the replacement of parts through routine maintenance work and then purchasing the parts. However, at present, the user experiences are fragmented between routine maintenance work and parts purchasing, and as a result, the parts may be purchased over the phone or by e-mail rather than through E-Commerce. One way to resolve this fragmentation of experiences is to coordinate E-Commerce with a maintenance support system for managing customers' routine maintenance work, which MHI has already developed and put into operation. By using this, we plan to establish a seamless mechanism that allows customers to be directed to E-Commerce to purchase parts when they need them in managing routine maintenance work planning and results.

## 6. Conclusion

We have developed E-Commerce for mechanical products as a mechanism to improve customers' parts purchasing experience in the after-sales service field, and have confirmed that it is effective in resolving problems both customers and MHI are facing. We believe that the developed E-Commerce is applicable to customers of MHI group's wide range of businesses, and so we will actively promote it in horizontal deployment to quickly resolve problems the customers are facing. Furthermore, we will actively apply DX to our after-sales service business, thereby contributing to the enhancement of customer value and the growth of MHI businesses.

Going forward, we will offer digital solutions for MHI products to customers as part of our digital innovation brand, ΣSynX® series. E-Commerce developed this time, which is an element contributing to ΣSynX®, makes it possible to "connect smartly" customers' fragmented experiences thereby creating new experiential value.

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