

Middle Size Electric Counter-balanced Forklift Truck “EDiA XL” with Automatic Travel Boost Function



Mitsubishi Logisnext Europe Oy
<https://www.mitsubishilogisnexteurope.fi/>

This report introduces EDiA XL, a middle size 4- to 5-ton electric counterbalanced forklift truck launched by Mitsubishi Logisnext Europe (MLE) in September 2021. This product was developed as the third in a series following the EDiA EX (2 to 3 tons) and EM (1 to 2 tons) introduced in the Mitsubishi Heavy Industries Technical Review Vol. 54 No. 1 and Vol. 56 No. 2, and is sold mainly in Europe, North America, and some regions in Asia and Oceania.

We conventionally sold our middle size electric vehicles for Europe by providing our brand to our competitor. Driven by the recent sustainability and electrification trends, however, there has been rapidly growing demand for electrification in the middle and large ranges, as well as in small forklift trucks which have long been electrified. As such, in order to strengthen customer responsiveness and price competitiveness, the EDiA XL was developed in-house by one of MLE's development and manufacturing bases, Finland-based Mitsubishi Logisnext Europe Oy (MLFI).

This report describes the features of the EDiA XL and its innovative selling point, the automatic boost function (AutoBoost).

1. Concept of EDiA series

There are various ways of using forklifts and different usage environments depending on the customer, and it is very important for product development to understand the needs of each customer. The EDiA series was designed for ease of use based on customers' own experience and work culture learned through communication with various customers, with user experience as the most important concept.

This product series aims to provide values in the areas of "work efficiency," "safety," and "comfort," which are of interest to many customers. To that end, this series harmonizes features developed based on the user experience with sophisticated design by being equipped with functions that enable efficient work with excellent operability. These include the automatic travel boost and truck vibration suppression in the front/rear direction when lowering a heavy load quickly, etc., safety-enhancing structures and functions such as high visibility and automatic corner deceleration, a step with ample legroom for easy entry and exit, and an adjustable operator's seat that allows operators of various body shapes to comfortably ride in the vehicle, and so on as shown in **Figure 1**.

In addition, by modularizing the operator's compartment and electronic control functions, the EDiA series not only allows operators who use both new and existing EDiA models to operate them without discomfort, but also allows new functions and improvements introduced in new models to be efficiently deployed in existing models as shown in **Figure 2**, continuously improving product quality in a short cycle, which has been highly evaluated by customers and dealers.



Figure 1 Features of EDiA XL

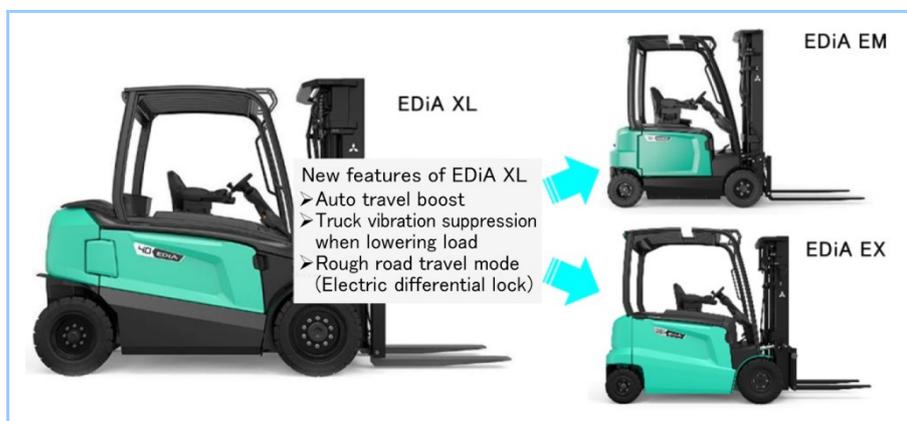


Figure 2 New feature deployment in existing models

2. Product characteristics of EDiA XL

2.1 Product design and structure

The exterior (Figure 2) and interior (Figure 3) design of the EDiA XL is based on a series concept that is common to EDiA EX and EM. The operator's compartment is fixed to the frame via a cushion rubber to reduce transmission of vibration and noise during operation. In addition, the improved easiness to entry/exit and expanded operator space, which have been employed for the EDiA EM, have been retained. In the cabin, which is a key feature especially in Northern Europe, a comfortable operating environment is provided with easily accessible pockets and operating switches, long door handles for easy opening and closing, large glass windows and a low-positioned wiper motor that does not obstruct the view, interior lighting, radio unit, and other features. The user interface is also common to the EDiA series, with a small-diameter steering wheel, armrest-type lift control lever, and accelerator and brake pedals optimally positioned based on ergonomics and customer feedback, contributing to operator fatigue reduction. In addition, for the steering wheel and armrest-type lift control lever, which are directly related to operability, optional interfaces such as a mini-steering and joystick lever are available to suit customer preferences (Figure 4).

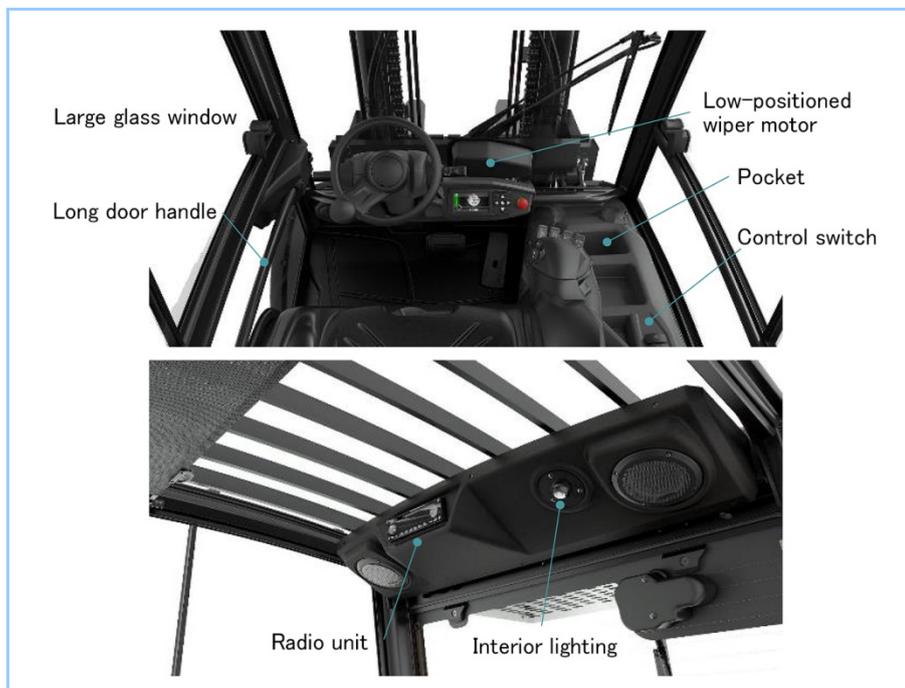


Figure 3 Operator space and cabin

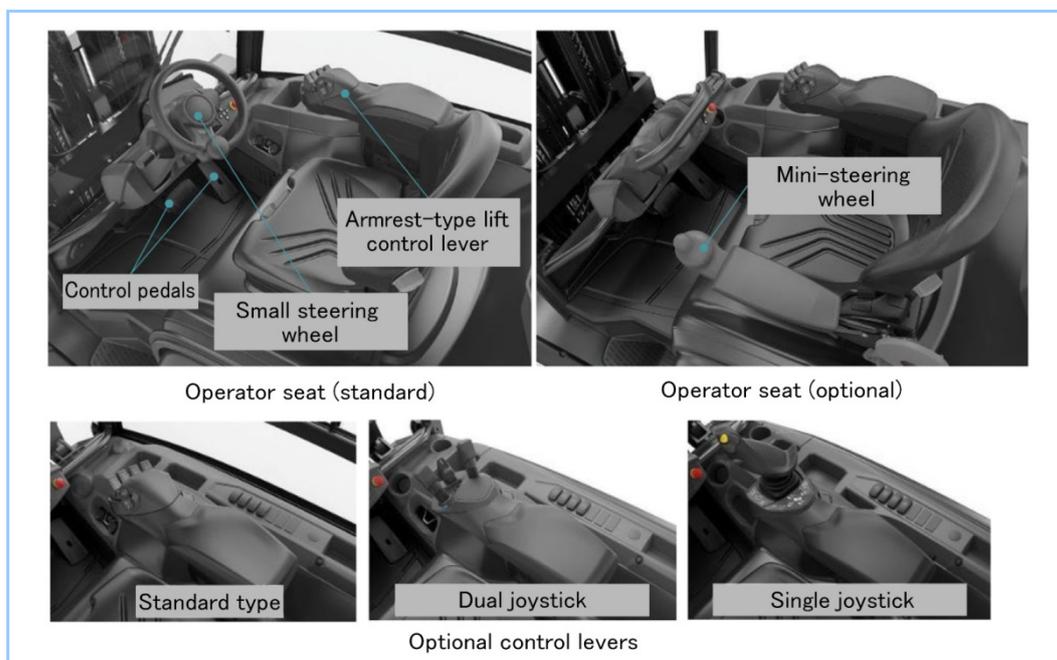


Figure 4 Optional user interfaces

The mast is the same as that used for engine-driven forklift trucks (hereinafter engine forklift trucks), which has been proven in the market to be highly reliable. However, the routing of the hydraulic piping has been optimized to increase forward visibility, resulting in a slight reduction in operator posture changes to look into blind spots. This helps reduce fatigue during long hours of operation. In addition, the EDiA XL features a waterproof and dustproof motor in consideration of use outdoors, where engine forklift trucks were mainly used conventionally, and arranges its electrical components to prevent water from entering through the terminals.

2.2 Assist control function

EDiA XL is equipped with an operation assist control function inherited from EDiA EX and EM. Specifically, the Sensitive Drive System (**Figure 5**) sensitively and automatically adjusts the operating speed during traveling and lift operations so that quick operation of levers and pedals results in a quick action and slow operation of levers and pedals results in a soft action, and Intelligent Curve Control (**Figure 6**) allows the traveling speed to be finely and smoothly changed according to the steering angle during forklift truck turning. These functions were introduced in

response to customer feedback to ensure both safety and workability.

The EDiA XL has employed new control functions based on the user experiences of automatic travel boost and rough road travel mode (differential lock function). The next chapter describes the automatic travel boost in detail.

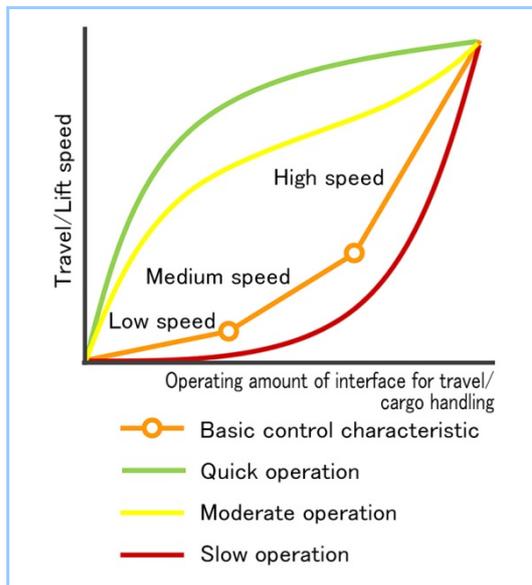


Figure 5 Control characteristics of Sensitive Drive System

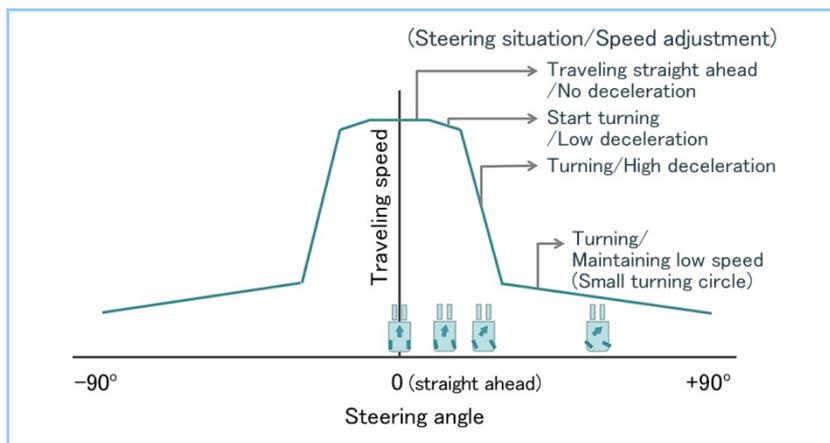


Figure 6 Control characteristics of Intelligent Curve Control

3. Auto travel boost (AutoBoost)

3.1 Concept and mechanism

The concept is to provide powerful usability so that the operator does not feel stressed, by preventing unintended deceleration when climbing slopes where the traveling load increases, and accelerating agilely in response to the accelerator pedal operation on flat roads when the operator wants light travel.

Specifically, this function automatically identifies situations where traveling torque is required without any special action by the operator, and then electronically increases the torque of the traveling motor instantaneously as shown in **Figure 7** to achieve the conceptual traveling feeling. There are two operation modes: (a) slope climbing mode and (b) acceleration mode.

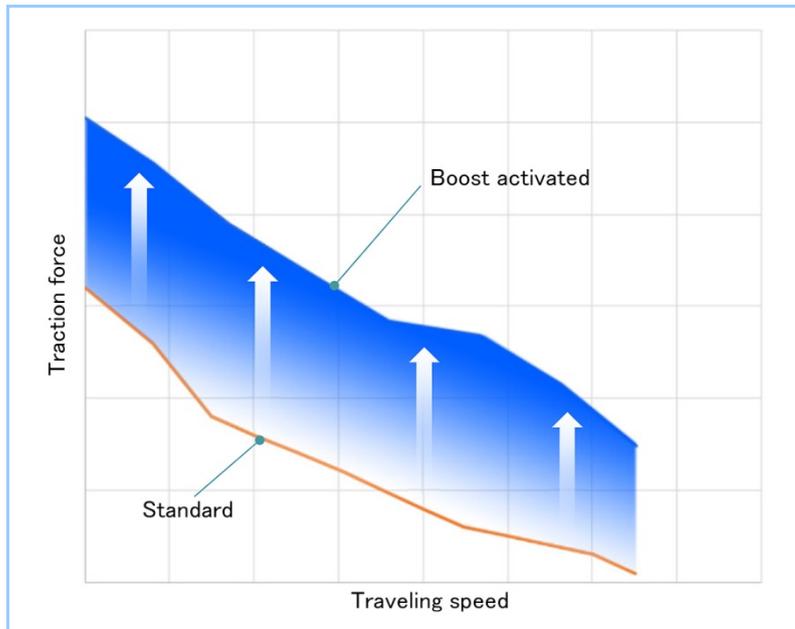


Figure 7 Traction force when AutoBoost activated

- (a) Slope climbing mode: Increases the output torque to maintain a constant forklift truck speed when the load on the traveling motor exceeds a certain level and the traveling speed decreases slightly.
- (b) Acceleration mode: Increases output torque when the accelerator pedal is depressed by more than a certain amount of stroke or to full throttle.

In both modes, the forklift truck behavior is tuned so that the operator can perform operation without discomfort. Furthermore, since the motor is likely to overheat when AutoBoost is being activated due to the large current flow, a timer function for limiting the time of one continuous activation, an interval function for cooling between repeated activations, and an abnormality detection function by monitoring the temperature of components such as motors are provided.

3.2 Advantages

We measured the actual acceleration time from 0 km/h (stopping) to 15 km/h without a load handling and compared the performance evaluation of the acceleration modes (**Figure 8**). In the standard mode, the time required to reach 15 km/h was comparable to that of MLE 4- to 5-ton engine forklift trucks, which emphasize traveling torque in the low-speed range. On the other hand, when AutoBoost was activated, the truck accelerated sharply from the start, and the acceleration time was reduced to less than half, which resulted in the time required for acceleration of about 40% less than that of our competitors. This not only gives the operator a sense of ease of use, but is also effective in increasing work efficiency, especially for relatively short cycles, such as unloading from a truck with frequent and repeated acceleration. Furthermore, by controlling torque on demand, the power consumption of the traveling motor can be suppressed when the traveling load is small, such as when traveling on level ground without a load. As a result, the EDiA XL has achieved top-class energy-saving performance in terms of power consumption in a cycle pattern.

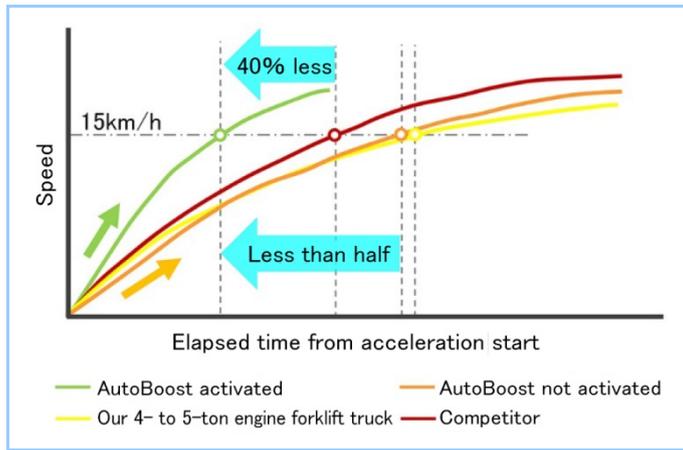


Figure 8 Acceleration performance of AutoBoost function

4. Future prospect

The logistics industry is facing major challenges such as the difficulty of securing human resources and a declining workforce due to the aging of the population in developed countries such as those in Europe, the United States, and Japan as well as achieving a decarbonized society. In response, customers are increasingly interested in electrification and automation of logistics equipment and in auxiliary functions that allows everyone to use the equipment reliably and safely, and their needs are also changing. We will continue to learn much from the user experience and develop products that are tailored to our customers' way of using them.