

Winning Red Dot Design Award for Forklift Trucks



reddot award 2015
winner



Rocla Oy

The Red Dot Design Award, an international product competition for product designers and manufacturers, is one of the largest design competitions in the world. Rocla Oy (hereafter Rocla), the European arm of Mitsubishi Nichiyu Forklift Co., Ltd., won a Red Dot Design Award successively in 2015 and 2016. This paper presents the history of Rocla's product development and technologies through general descriptions of the Red Dot Design Award, and explains the characteristics of Rocla's product development such as product concept creation from the perspective of users and simulation-based preliminary verification of components and software by presenting the case example of the award-winning small electric counterbalance forklift truck.

1. Introduction

Rocla was established as a heating apparatus manufacturer in 1942. They started the manufacture of lifting and transfer moving equipment in the 1950s, followed by automated guided vehicles in 1983. In 1992, they started supplying products under the brand name of MHI. In this manner, they have been supplying advanced warehouse trucks to the European market centered on the Nordic countries for many years.

Finland is known for its Nordic design, which is characterized by functionality and beauty, as well as its supporting technological capabilities and technological networks established jointly by the public and private sectors. Rocla utilizes such advantages for the development of products. They won a Red Dot Design Award in 2008 for the first time, and successively in 2015 and 2016 for their small electric counterbalance forklift truck and the electric reach truck, respectively. This paper presents the development of the small electric counterbalance forklift truck as a case example of an award-winning product.

2. Summary of Red Dot Design Award

The Red Dot Design Award is a design competition that has been held every year since 1955 mainly by the Nordrhein Westfalen Design Center (Design Zentrum Nordrhein Westfalen) located in Essen, a city in Germany. This competition also plays a role in highlighting the importance of design in business and society internationally by providing the latest information about design from experts, holding seminars and workshops in the museum where award-winners are exhibited, and cooperating with and participating in other design competitions in an active manner.

The competition is classified into product design, communication design and design concept. The product design award that Rocla won targets excellent design products and is divided into 47 sections including furniture, home appliances, kitchen goods, children's products, cosmetic products, bags, glasses, clocks, jewelry, robots, cars, industrial vehicles, etc., covering various sections of the manufacturing industry. For each section, a winner is selected by a disinterested group of experts based on evaluation criteria such as design innovation, functionality, ergonomics, ecology, durability, etc. The winners are allowed to display the world-famous Red Dot mark and therefore can strongly highlight their excellent design.

Figure 1 shows all the award-winning products of Rocla, which has won the award five times since its first win in 2008.

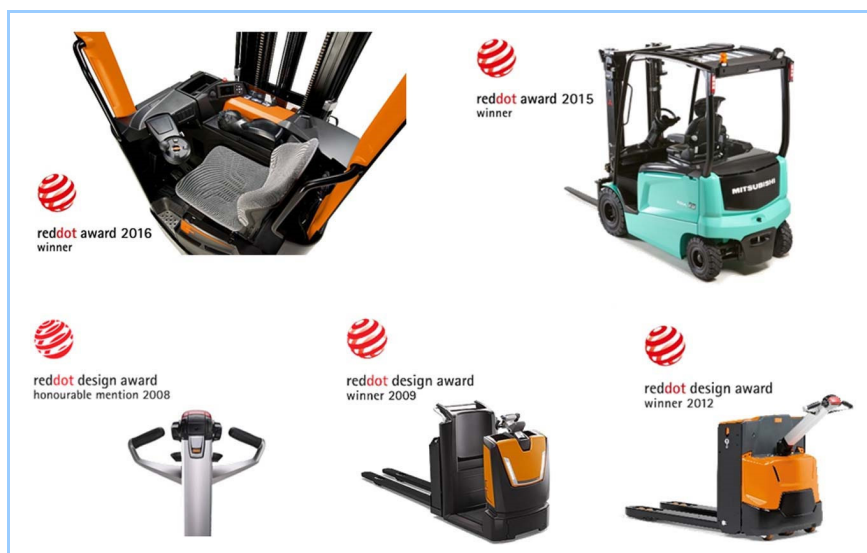


Figure 1 Rocla award-winning products

3. History and characteristics of Rocla's product development

3.1 History and characteristics of Rocla's product development

Rocla's product development is strongly based on Nordic design, which is entrenched in Finland and characterized by functionality and beauty as described above. It can be said that the history of Rocla's product development is the history of industrial design. **Figure 2** shows the history of Rocla's design. Design in the 1970s was conscious of the appearance and impression of the product itself, and similarities between products of the same brand. In the 1990s, ergonomics and further leading-edge styling were focused on. In the 2000s, the focus shifted to ease of usability and user interfaces. Now in the 2010s, product development from the perspective of users, called User Experience (hereinafter referred to as UX), is the focus. UX is the process to complete a product through product development in close cooperation with users from the stage of concept design and prototype production to verification and the start of production. Such product development in which functions and products that users really need are pursued is Rocla's great strength and the key to growth of its business.



Figure 2 Rocla design history

In the product development of a new forklift truck, generally, some of the main components such as the drive and steering axles, motors, controllers and hydraulic valves are newly developed for updating according to the development concept, in order to achieve the target and in response to the advancement of technologies. On the other hand, Rocla generally has used existing components that have been brought into practical use by other manufacturers, and focused on the development of software as an important element that adds extra value to their products and differentiates them

from those of other manufacturers. **Figure 3** shows the history of Rocla's software development. Rocla has been developing software independently since 2003. The advantages of this independent development have contributed to not only the enhancement of warehouse trucks, but also to the differentiation of automated guided vehicle systems (hereinafter referred to as AGV) as described below.

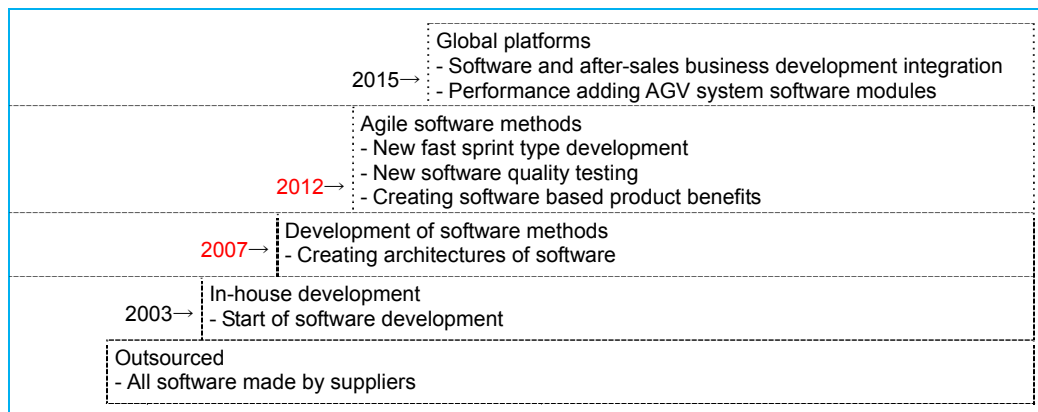


Figure 3 Rocla software development history

3.2 Product lineup

As shown in **Figure 4**, Rocla has independently developed, produced and sold warehouse trucks for use in logistics warehouses and factories and the AGV derived therefrom for many years. Small electric counterbalance forklift trucks that are used both indoors and outdoors for conveying cargo from a truck and other similar operations were designed and developed by the present Mitsubishi Nichiyu Forklift Co., Ltd. and only produced by Rocla. There is high demand for electric forklift trucks in the European market, and a wide product lineup centered on those products for loading and unloading cargo on and off of high racks is required in particular. Rocla has been extending its model lineup to meet the demand.



Figure 4 Rocla product portfolio

4. Development of small electric counterbalance forklift truck

In November 2014, Rocla started sales of the EDiA EX, the first small electric counterbalance forklift truck that was developed by Rocla. The development of this product is presented below as a case example.

4.1 Development policy

Rocla had no expertise in the development of counterbalance forklift trucks. The development was implemented based thoroughly on the following policy in order to be completed in a short amount of time.

- (1) The target level of basic vehicle performance including the traveling and lifting performance, visibility, low electric power consumption, small turning radius, safety, etc., was set to the level equivalent to that attained by European competitors in order to avoid risk in the development of new elements, and all the main components such as drive and steering axles, motors, controllers and hydraulic valves used existing components that have been brought into practical use by other manufacturers as a general rule in Rocla's product development. In addition, it was determined that the lifting component (mast) of another forklift truck produced at that time could also be used for the developed model without change according to a user evaluation.
- (2) Differentiation from the products of other manufacturers was achieved by the elements related to the operation of the vehicle, such as the creation of the compartment, the ease of getting on and off, the operability of the steering and the lifting levers, the realization of fine adjustment in lifting and the traveling operability including fine operation and inclined-surface operation.
- (3) The vehicle control software that was the key to the achievement of (2) above was developed independently. In parallel to the fabrication of the prototype vehicle, the software was simulated by on-bench simulation test equipment using actual main components. As a result, the labor required for the debugging of the software in the verification of the prototype vehicle was reduced.
- (4) For the evaluation of the counterbalance forklift truck, in which Rocla had no experience, the design standards, verification methods and evaluation criteria accumulated by Mitsubishi Nichiyu Forklift Co., Ltd. were used without change.

4.2 Realization of product concept and user experience (UX)

For the realization of the product concept from the perspective of users, the engineers visited 37 dealers in Europe, discovered and shared problems with older models, established an improvement plan and targets, created the product concept and made efforts toward its achievement. **Figure 5** shows the main features of the EDiA EX that were realized as a result of the improvements worked on this time.

As a result of these efforts, the EDiA EX received a significantly improved evaluation from dealers in comparison with the existing model as shown in **Table 1**, and brought about significant potential for the enhancement of market share. We believe that the pursuit and achievement of this product concept from the perspective of users led to the winning of a Red Dot Design Award.

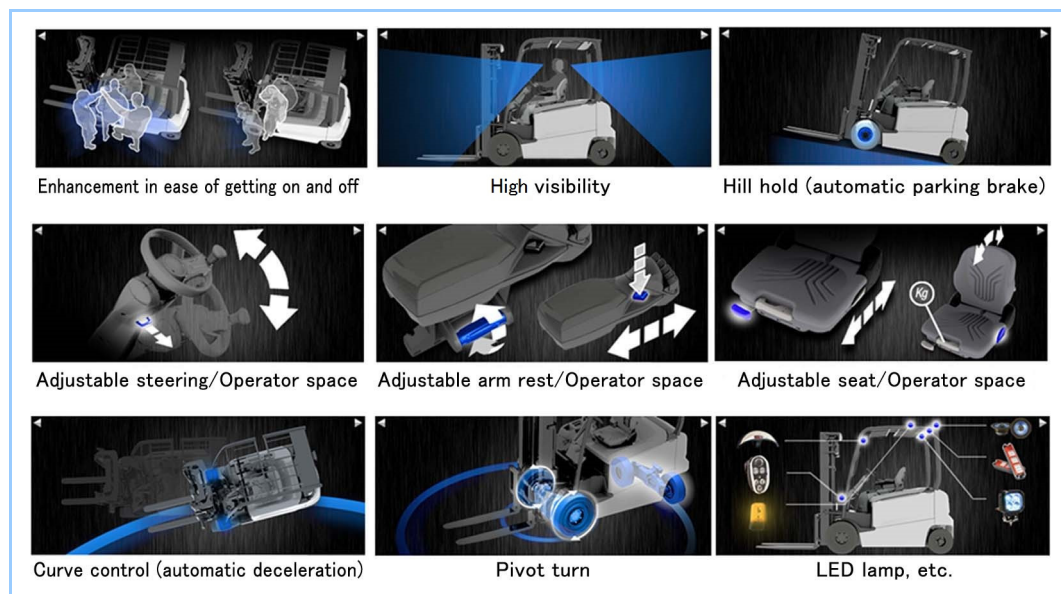


Figure 5 Main features of the EDiA EX based on UX

Table 1 Comparison between evaluations of the EDiA EX and conventional forklift truck

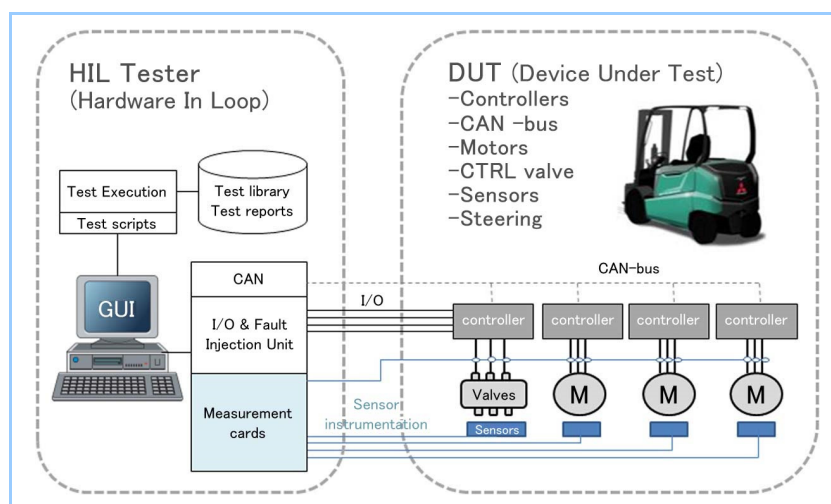
Item	Unsatisfactory← →Satisfactory					Number of answers	Average score	Average score of conventional forklift truck
	1	2	3	4	5			
Appearance	0	0	1	19	38	58	4.64	2.43
Silence (noise level)	0	1	3	19	35	58	4.52	2.72
Touch and feel	0	0	6	21	31	58	4.43	2.54
Satisfaction	0	0	2	37	19	58	4.29	2.74
Ergonomics	0	0	2	27	29	58	4.47	2.5
Easy to use	0	0	1	27	30	58	4.5	3.21
Functionality	0	0	0	29	28	57	4.49	3.17
Safety	0	0	2	20	35	57	4.58	3.4
Total	0	1	17	199	245	462	4.49	2.84

4.3 Preliminary verification and evaluation of software

The enhancement of the degree of completion of the software is one of the important factors in vehicle development, and the occurrence of bugs is one of the inevitable issues in development. In conventional development methods, software is developed in parallel with the development and verification of the vehicle and components (hardware), and then the verification of the software is implemented after the completion of an actual prototype vehicle. However, there was a concern about the extension of the development period and the degradation of reliability because of the following issues.

- (1) In the verification of the software, bugs are searched for on the prototype vehicle and then debugging to eliminate the bugs is carried out, followed by the repeated verification of the measures to enhance accuracy. For this reason, the unavoidable issue is the degree of completion of the prototype vehicle.
- (2) In addition, in many cases where taking measures against problems is performed progressively in the development of the hardware, in particular the components, parameters that effect the software need to be changed and as a result the revision of the software is required.

For the development of the EDiA EX, Rocla performed preliminary on-bench software simulation testing using actual components instead of software verification on a prototype vehicle in order to avoid the issues described above and enhance the degree of completion within the scheduled development period. **Figure 6** and **Figure 7** show the summary and elements of the on-bench test equipment. The verification consists of a basic operation confirmation test that assumes actual vehicle operation patterns, behavior confirmation using inputs simulating maloperation by the operator, confirmation and verification of debugging, etc. This allows the confirmation of the basic performance of the main components simultaneously.

**Figure 6 Summary of on-bench simulation equipment**

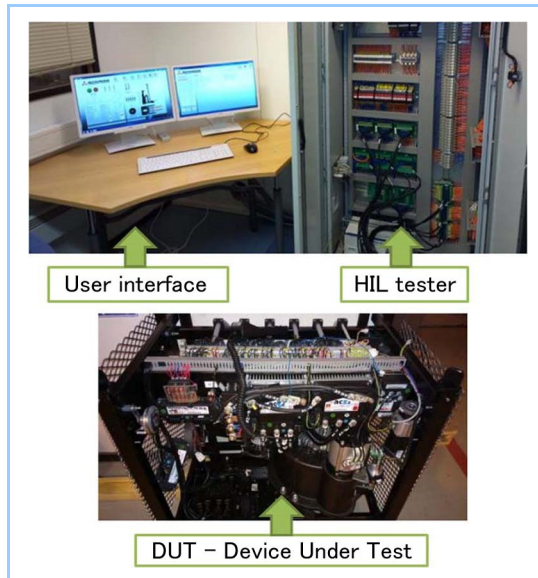


Figure 7 On-bench simulation equipment

5. Conclusion

Approximately two and a half years after starting the creation of the concept in April 2012, Rocla put its first counterbalance forklift truck, the EDiA EX, developed based on the development policy and concept described above on the European market in November 2014. The EDiA EX earned a good reputation soon after the start of sales. In addition, backed by the winning of a Red Dot Design Award, Rocla has started to significantly recover market share due to the EDiA EX, which is a replacement of older models that were losing market share because of the degradation of their attractiveness.

The market trend of forklift truck products has been increasingly changing from focusing on hardware to focusing on software and shifting to a business model that integrates the control of logistics and the management of items in warehouses. In addition to the enhancement of the attractiveness of the product itself, the acceleration of product development and understanding of user needs in response to this trend are among the essential duties of a manufacturer.