

Applying Human-Centered Design (HCD) Solutions in Industrial Machinery Products Manufacturing

TERAKADO Yoshiaki

Abstract

The development of multi-featured, high value-added industrial machinery products is essential in the current severe market environment. Under this circumstance, NEC is offering development support consultation services based on our human-centered design (HCD) expertise. Development supports of Customer Orientation and of Design Thinking that are based on HCD allow us to help our customers to improve the usability of their products as well as to increase customer satisfaction, reduce costs, and enhance corporate value. These goals are achieved by contributing to competitive superiority in the market and by enabling customers to create products that are user and society-friendly.

Keywords



industrial machine, human-centered design (HCD), development support consultation service, customer-oriented, design thinking, improved usability, improved customer satisfaction, reduced costs, enhanced corporate value

1. Introduction

Used in various areas of society, industrial machinery such as the machine tools used in factories are indispensable for the realization of society in which people may live prosperously and comfortably.

NEC offers various solutions that contribute to diversity and high added-value for industrial machinery, one of which is a development support consultation services based on human-centered design (HCD). This paper introduces NEC's HCD development support consultation services that offer solutions with development processes that will create new values while helping solve issues, understand needs, and improve usability in the industrial machinery market.

2. Market Environment and Issues of Industrial Machinery

2.1 Market Environment and Issues

The environmental situation now faced by manufacturers, including that of industrial machinery, is very severe. Global competition is intensifying as is evident in the fact that manufacturers in the newly emerging countries are now entering

the market of high value-added products that had hitherto been the special domain of Japanese manufacturers. European and North American manufacturers in competition with Japanese counterparts are also entering the market for low-priced goods. Accompanied by the fierce competition, the demands for severe cost reductions and production-relocation overseas are rapidly increasing. This trend is resulting in significant changes in market structures.

An efficient distribution of management resources by the appropriate selection and concentration of businesses is crucial for management decision-making and this trend can also determine the competitive outcome in the market. Japanese manufacturers are no exceptions to such market change. Segmentation of the target market and diverse product strategies are becoming issues of vital importance.

Moreover, the market is demanding that industrial machinery manufacturers propose working processes and solutions that will accelerate the development of automated, multi-featured complex products. To prevent labor accidents, satisfying both ease of use and safety is required. Such constraints place manufacturers in a situation where they have to meet complex market demands and cost reductions at the time of their developments processes.

Since the products are sold in global markets, it is also necessary to consider the operator skill levels of the various countries. Not only does the development of easy-to-use products lead to the improvement of operational efficiency, but it also leads to a reduction in product introduction costs and training costs, thereby significantly contributing to a reduction in the overall cost.

Moreover, by taking assembly and maintenance issues into account during the product planning and design phases, we can significantly improve the manufacturability and maintainability of the product, which further leads to a cost reduction for the overall product life cycle.

2.2 HCD Process Application Possibilities

Product differentiation via the development of new functions and the provision of advanced performance/functions are underway at each manufacturer as noted above. However, this alone can no longer guarantee competitive superiority over the emerging competition.

Therefore, we are now focusing on improvements to the development process based on the HCD method as a product development approach. This procedure is slightly different from that offered by the former methods that focused on performance improvements and advanced feature developments.

We have so far adopted this new strategy for the development of our various products and services, and by incorporating component technologies owned by the NEC Group, we have been able to add new values to our products.

This approach allows us to match potential “needs” of end users/target markets, with “seeds,” which are the various component technologies owned by NEC, and thereby enabling us to deliver innovation to the market.

We believe that by applying our HCD expertise and processes at the product concept development and planning stages of the “upstream” product cycle, we can contribute to a further differentiation of our customers products and services, and assure competitive superiority.

3. NEC's HCD Consultation Service

3.1 NEC's Approach to Developing Products with Customer-oriented, Design Thinking-based Processes

The HCD method comprises the following four steps:

- 1) **Understanding and grasping user data**
 - Knowing the targeted users
 - Questionnaires and Interviews
 - Observation and Intrinsic Value Extraction Methods
- 2) **Clarification of objectives**
 - Setting targeted users
 - Setting usability goals by specifying usage conditions

- Persona and User Scenario Methods

3) **Solutions by design**

Designs that solve the problems of users
Designing measures to improve ease of use

- Problem Listing, Prototyping, and Guidelining

4) **User evaluation**

Usability (ease of use) evaluation
Effectiveness and efficiency evaluation

- Checklists and Walkthroughs
- Heuristic Evaluation and User Testing

Inherent issues and values of end users are extracted via these processes and used to solve problems and prove values. In many cases, manufacturers are aware of inherent values, so that the direction to be taken will become apparent when making an approach to top management.

By assessing potential needs and creating concepts that add competitive strength in the market, Japanese manufacturers can produce high value-added products that have competitive superiority over those of European and North American manufacturers. This strategy can also lead to the strengthening of brand values that are not susceptible to price competition.

Meanwhile, in recent years the displays of industrial machinery screens are becoming increasingly complex with the addition of many controls for advanced functions, thereby introducing adverse effects both on visibility and operability. Customer-oriented, Design Thinking-based solutions both in software and hardware aspects are essential for enabling Japanese manufacturers to compete with European and North American manufacturers that have superior operability and design functions.

3.2 The Value of a Required Supportive Approach from the Upstream

Due to the acceleration of function diversity over many years, room for improvements in the area of screen design for industrial machinery has reached its limits in many cases. New solutions are now required, such as a design approach that meets ease of use and safety standards, universal design compliance, and manufacturability and maintainability. These will contribute to an overall cost reduction.

Consequently, the implementation of product developments that require minimum re-working will become possible by applying HCD-based process improvements from the upstream end, such as for supporting concept development and product planning.

We will thereby be capable of supporting the production process of industrial machinery manufacturers with a consistent backing system, from the concept making and planning to development, prototyping, mass production, and maintenance stages.

By working together on investigations from upstream, we

are able to propose various component technologies simultaneously that will bolster advanced functionality and high added-value to the products. Moreover, we will also be able to support the development and implementation of suitable technologies during customer-oriented and Design Thinking approaches.

4. NEC's Embedded Solution Business Model

We are committed to offering our customers added-value to their products, helping to achieve cost reductions and providing innovation by combining our user interface technologies and a variety of component technologies. These are based on our customer-oriented, Design Thinking-based development support, as well as on our HCD expertise. At NEC we call this strategy the “Embedded Solution Business,” which is now being deployed aggressively (Fig. 1).

Our Central Research Laboratories have many technologies in which we excel. These include: recognition, vibration sensing, invariant analysis, and security technologies among others. We will leverage these technologies and implementation know-hows under the vision of “Value Co-Creation Research Laboratories,” whereby we will create market value in cooperation with our customers. We will work together with our customers to create new business models that will fully utilize the component technologies and expertise of the NEC Group.

Based on the NEC Manufacturing Co-Creation Program (Fig. 2), we can also contribute to our customers’ manufacturing process. We are able to offer assets that include our expertise in SCM (Supply Change Management), manufacturing procedures such as production innovations fostered at NEC, and our inherited component technologies.

Our “Embedded Solutions Business” supports our customers at various stages of the manufacturing process - from the upstream to the downstream stages. The upstream stage includes

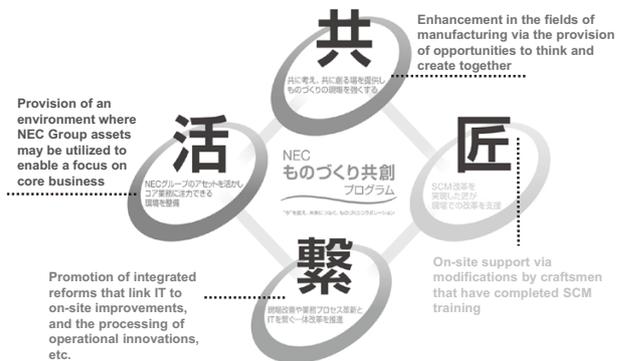


Fig. 2 The NEC Manufacturing Co-Creation Program Concept.

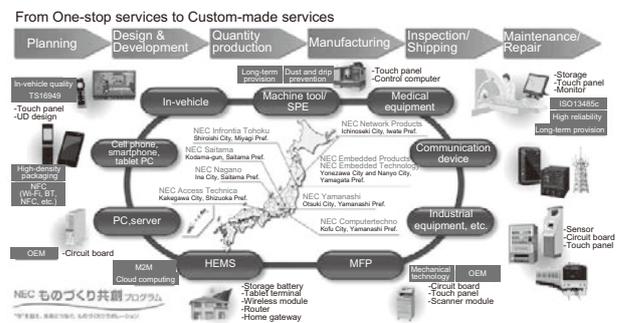


Fig. 3 NEC's ODM and EMS services.

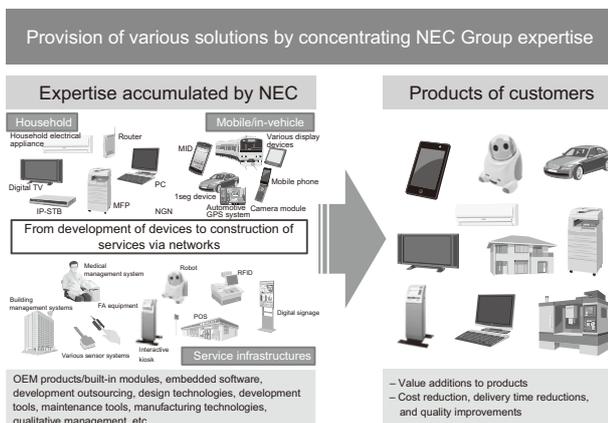


Fig. 1 Built-in solutions assets.

5. Actual Activities and Their Results

HCD consultation services for industrial machinery products are of proven effectiveness. Details of their activities and effects are described in below.

5.1 Consultation and Development Support Activities

In the various industrial machinery fields: such as machine tools, semiconductor production devices, injection molding

machines, measurement/examination equipment and medical equipment, the manufacturers are always trying to add more functions and achieve performance improvements. However, more industrial machinery manufacturers are recently probing to achieve a differentiation of operability and also to employ next-generation UIs for control and operations software solutions.

By utilizing the HCD method and expertise, NEC is providing effective consultation aimed at resolving the various issues of the industrial machinery market and we are thereby undertaking concept creation and new product developments based on the needs that were defined above.

5.2 The Effects of Consultation and Development Support

By starting at the product planning and development stages and incorporating NEC's HCD method and expertise, industrial machinery manufacturers become capable of creating the following effects.

1) Superiority over the competition

- Innovation and state-of-the-art intellectual property by the incorporation of Design Thinking in concept making and development
- Improvement of product value by applying innovative and high value-added functions and mutually compatible UI operability
- Revealing and making use of the strengths and admirable functions that the customer already possesses, in order to clearly define competitive threats

2) Improvement of customer satisfaction

- Manufacture of products by incorporating the requirements of users
- Improvements in the ease of use for users
- Improvements in the productivity and operational efficiency of users
- Improvements in corporate image and brand values based on user rationale as an influence on product development

3) Cost reduction

- Reduction of backtracking man-hours in the development procedures influenced by user evaluation from the upstream end
- Reduction in introduction training costs due to the operating UIs that maximize safety and minimize errors
- Reduction of the number of inquiries from end users resulting in reductions in user support costs
- Reductions in manufacturing costs and improvements in effective maintenance capabilities due to easy-to-assemble designs

6. Conclusion

We will continue leveraging our component technologies to support our customers' improved product performances and features, while at the same time, providing our HCD processing and know-how to back up our customers' innovations.

We believe that the difficult market conditions we are now facing are demanding customer-oriented and Design Thinking-based product developments that will help create human-friendly and society-friendly products and services.

As outlined above, we will make every effort to support our customers in the various stages of the product life cycle, a policy that will in turn enable a better society in which people will be able to live in comfort and prosperity.

Authors' Profiles

TERAKADO Yoshiaki

Manager
Minami-Kanto Branch Division

* The stated titles and departments of the authors that appear in this paper are as of March, 2014.

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