

# Co-innovation with Customers in Research and Development

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*The intention behind Yokogawa's corporate brand slogan, "Co-innovating new value with customers," is also reflected in the activities of the R&D Division. The R&D Division is committed to conducting R&D and developing co-innovations in partnership with customers. This paper explains how we address these tasks. Specifically, innovation comprises three stages, and we define research themes targeting the three fields of biotechnology, materials, and energy, then carry out R&D. We aim to create new value while identifying actual needs and solving customers' problems.*

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## INTRODUCTION

Yokogawa uses the phrase "Co-Innovating tomorrow" as a corporate slogan. This slogan represents Yokogawa's determination to co-create new value for solving customers' problems while cultivating a long-term partnership with customers.

In line with this slogan, Yokogawa's R&D department is also shifting the direction of the R&D activities from not only developing new technologies and creating value on its own to co-creating new value in cooperation with customers.

The concept of co-creation with customers can be seen in many books and activities these days. Prahalad said that we must abandon the conventional concept of company-centric value creation, establish a new paradigm of value co-creation between companies and customers, and radically change the business activities to align with it <sup>(1)</sup>. Furthermore, the concept of design thinking <sup>(2)</sup> that is attracting attention these days urges us not to get an idea solely from technologies, but go out into the field, observe users, and create an idea from empathy for users <sup>(3)</sup>.

This paper describes how Yokogawa's R&D department

is carrying out its activities under such circumstances and then describes which fields the R&D department targets and how it selects its research subjects, and finally describes the direction of the research subjects and their relationship with other papers in this special edition.

## YOKOGAWA'S R&D STRUCTURE

There are roughly two types of R&D activities for Yokogawa. One is product development/applied research activities and the other is innovation activities (Figure 1). The R&D activities are carried out by different departments depending on their missions. The former activities target a relatively predictable near future for which needs can be predicted based on the current business. The business headquarters are mainly responsible for these activities. The latter innovation activities target an uncertain, unpredictable future for which new business opportunities are sought. The R&D department (Innovation Center at Marketing Headquarters) is mainly responsible for these innovation activities. This paper describes the latter innovation activities.

## INNOVATION ACTIVITIES

To ensure that Yokogawa grows and develops in a sustainable manner, it is essential to always seek new business opportunities and create next-generation businesses. We believe that to do so, innovation to change human behavior, including the transformation of consciousness, is essential.

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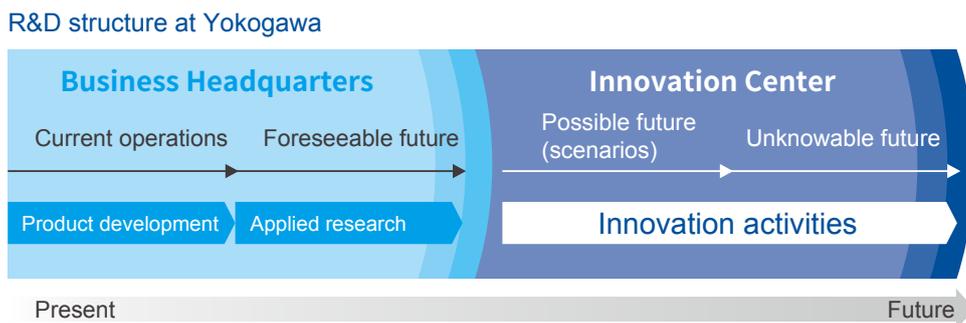


Figure 1 R&D structure at Yokogawa

There is a limit to automation that depends solely on machines in the automation system. More sophisticated systems can be created by combining excellent human capabilities and machines. If we can systemize operations that have up until now been dependent on human qualities such as experience and gut feeling and machines can help humans to make a decision, we are able to use the time saved by the systemization for activities that create higher value. Yokogawa’s innovation activities aim to co-create solutions with customers. Such solutions not only provide systems merely as products but also allow for creating a new way of working by urging customers to transform their consciousness.

The Innovation Center responsible for the duties of the R&D department defines its mission as a contribution to creating value for customers by engaging multiple organizations inside and outside the company including customers (co-creation). The Innovation Center carries out the R&D activities in line with the following three operational policies.

- Create innovation scenarios through co-creation and reflect them in the R&D activities.
- Link the R&D activities to the business incubation and acquire necessary technologies.
- Create a structure that enables continuous R&D and technology acquisition and develop human resources.

**Three Stages**

Yokogawa’s innovation activities consist of three stages and their support activities as shown in Figure 2.

Activities in the external environment at the outermost layer in Figure 2 are intended to grasp the field information of the markets and customers and the signs of change in society obtained by scanning and other techniques described later on. These activities support the innovation activities at the innermost layer along with the standardization, intellectual property, and open innovation activities<sup>(4)</sup> at the second layer.

The innovation activities that consist of three stages are intended to create an idea, refine the technologies to realize the idea through R&D, and incubate it at the incubation stage. A cycle of these three stages is executed repeatedly to achieve commercialization.



Figure 2 Innovation activities

**Activities at Each Stage**

The following describes each of the activities at the three stages described above.

**Idea Creation Stage (Ideation Stage)**

Yokogawa carries out future exploration activities using scenario planning and scanning techniques<sup>(5)</sup>. The scenario planning technique continuously creates multiple future scenarios and considers issues common to each scenario to ensure that we can flexibly adapt to and create new value even if unpredictable non-continuous changes occur in the future. The scanning technique refers to future insight activities to grasp the signs of change in society 10 to 20 years from now. These activities engage a variety of members and experts inside and outside the company in Japan and abroad in dialogs and utilize the results and direction of the dialogs for the R&D activities and the subsequent business development activities.

Yokogawa held a Global Scenario Workshop (GSW) in 2011 in three countries, the UK, India, and US, and invited experts of various fields from companies, research institutes,

and industry groups and journalists. Multiple future scenarios “Future Sense” created by Yokogawa were discussed at the workshops.

At the workshops, dialogs were held with experts in various countries about the direction of change in the world based on four scenarios created by considering various possibilities. Despite the fact that dialogs were held in geologically and culturally different countries, the results of the dialogs in each of the countries happened to point to the same directions (1) to (3) below.

- (1) There may be a shortage of three resources essential for the survival of human beings: food, energy, and water. This shortage will be caused by human beings.
- (2) Shortage should not be understood as unfortunate. The definition of abundance must be changed to turn a shortage of resources into an abundance of wealth, health, and happiness.
- (3) The key lies in human behavioral innovation. Values transformed by the human behavioral innovation will create innovative new markets.

A possible shortage of food, energy and water in (1) gives us a hint for issues that we must solve. Furthermore, (2) and (3) give us an insight that we must focus on human behavior when we consider research subjects.

Detailed background to the scenario planning technique and other activity results are summarized in a white paper entitled “Future Sense 2012”<sup>(6)</sup> and available to the public.

### R&D Stage

We find various research subjects based on the market needs identified at the idea creation stage. Some have a promising future but some are accompanied by problems. At the R&D stage, we select promising research subjects and refine them to produce specific technical results. In technical development, we do not adhere to in-house development, but we carry out development jointly with internal and external partners with useful technologies that complement the core technology of Yokogawa.

At this stage, we do not limit the R&D activities to pursuing the technologies set as targets in the research subjects, but we conduct a review in cooperation with marketing members to determine whether each subject is feasible as a business. In the review, we not only analyze the market but also develop the market if necessary. Furthermore, we also carry out a proof of concept (PoC) to determine whether the technology to be offered will create value for customers. The PoC is carried out from the early idea creation stage of the development in cooperation with customers who are early adopters.

### Incubation Stage

When R&D progresses and it becomes obvious that the technology under development will create value for customers and the goal comes into sight, an incubation stage starts. At this stage, we carry out a PoC with the customer at the customer’s site to demonstrate how much value the technology

under development provides to the customer. By carrying out a PoC at the customer’s site, we are in a better position to refine the technology under development to provide a more optimal product or solution to the customer. Also at this stage, we work together with the business administration, sales, and marketing members regarding commercialization activities from business launch to business continuity. This kind of collaboration aims to reduce the time until business launch and provide value to customers as early as possible.

## TARGET RESEARCH FIELDS

### Setting Target Fields

Based on a possible shortage of three essential resources identified in scenarios created by the future exploration activities at the idea creating stage, the Innovation Center focuses on these three fields: biology, energy, and materials, and carries out R&D targeting these fields (Figure 3). The Innovation Center carries out a co-creation activity with various organizations inside and outside the Yokogawa Group in the respective fields to accelerate R&D.

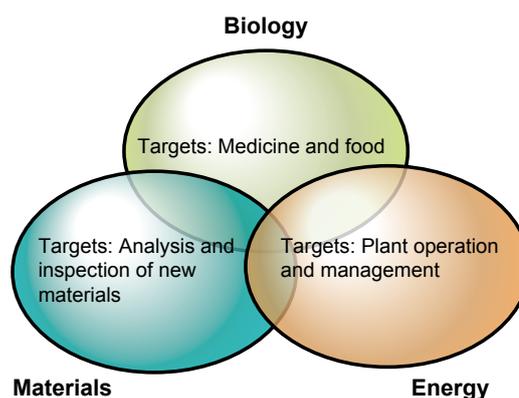


Figure 3 Target research fields

### Special Edition Papers and Target Fields

Papers contained in this special edition are related to any of the above three target fields. Table 1 shows each paper and its target field. R&D of each subject is carried out at the R&D stage or incubation stage.

Table 1 Target fields and special edition papers

Target Field	Special Edition Paper
Biology	Development of a Nucleic Acid Detection System for Rapid Microbial Tests
	Development of Glassless All-solid-state pH Sensor
Materials	Development of Polarization Imaging Sensing Technology for Controlling the Quality of Printed Electronics Manufacturing
	Development of an Electric Field Sensor Using the Electro-optic Effect
Energy	Efficient Field Communication with Augmented Reality
	Technology for Estimating the Battery State and a Solution for the Efficient Operation of Battery Energy Storage Systems

### Co-creation Activities with Customers

For more information on the achievements of the R&D department, please refer to each paper. These papers also show that we are carrying out the activities in the respective subjects closely in contact with customers. These activities include the identification and sharing of issues and needs with customers, joint development of necessary technologies, and verification of value with customers. These activities also actively incorporate behavioral observation <sup>(7)</sup> and other techniques to grasp the real issues and needs customers are faced with.

In his book about design thinking <sup>(8)</sup>, Peter Rowe says that there are two classes of problems: “well-defined” and “ill-defined.” With problems that fall into the latter category, the problem or issue is unclear and there may be various solutions. The current innovation activities deal with the “ill-defined” problems. We believe that, to find a solution to such problems, it is important to repeatedly discuss with customers at each of the stages about the setting an issue, developing a technology to solve the issue, and verifying value in the field using the developed technology, and always to gain feedback. Always keeping this in mind, we are carrying out the innovation activities.

### Future Development

We will continue the R&D activities of the subjects on which we are currently working and we plan to strengthen the activity to develop a new sensing technology and a technology that adds value to data. This plan is based on the customers demand for visualization to make visible what is currently invisible. We think that a new sensing technology to acquire data and statistical analysis and artificial intelligence (AI) technologies to utilize the acquired data will be important to meet this demand.

We have already started development of these technologies to meet the visualization demand. A paper in the materials field in this technical report presents some of the achievements for the sensing technology. For data utilization technologies, there are some activities that have already delivered results, such as projects of Yokogawa <sup>(9)</sup> and application to the plant operation optimization <sup>(10)</sup>. We plan to further strengthen these kinds of activities to deliver results.

### CONCLUSION

First, this paper described the position of the R&D department in Yokogawa and then the details of the innovation

activities that are carried out by the R&D department. Second, it described that based on the results of the future exploration activity in the innovation activities, three target research fields were identified and research subjects have been set. Finally, it described which field each paper in this special edition targets.

These R&D activities are based on co-creation with customers. Each paper presents how we set our subjects and verify value in close relationship with customers, in addition to the research achievements gained from such activities. We hope you will see from each paper that unlike the R&D activities of the previous R&D department which adhered to the development of technologies on its own, the current R&D department is carrying out R&D activities in line with the concept of co-creation with customers.

We will further strengthen the bond with customers and further develop the R&D activities to co-create real value for customers in cooperation with customers.

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\* “Co-innovating tomorrow” is a registered trademark of Yokogawa Electric Corporation.