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Creating Social Value through Business

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Creating Social Value through Business

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THERE has been a growing awareness of corporate social responsibility (CSR) in recent years as it has taken on a significant role across many companies. While CSR has traditionally been thought of in terms of regulatory compliance and playing a positive part in society through volunteer work or other forms of philanthropy, the essence of CSR is about meeting the demands and expectations of stakeholders, meaning that it is nothing less than a fundamental part of management and of business operations.

The international standard for CSR, ISO26000, was published in 2010. Taking impetus from this establishment of common international rules, many companies are adopting CSR strategies that go beyond compliance, respect for human rights, CSR procurement, and other aspects of risk management, and are also placing emphasis on CSR as a competitive strength that can enhance corporate value. The concept of "creating shared value" promoted by Professor Michael E. Porter of Harvard University has attracted attention as an advanced form of CSR that generates value for both society and corporations by simultaneously helping to resolve social issues and strengthen corporate profitability and competitiveness.

Contributing through business activities to resolving the challenges faced by society and engaging with local communities in ways that are distinctive of a particular company have an important role to play in developing global business activities in a sustainable way and earning the acceptance of stakeholders. This issue of *Hitachi Review* is broadly divided into two parts, both of which are informed by these new developments in CSR.

The Technotalk and Overview articles focus on Hitachi's CSR philosophy, including the implementation strategy for CSR and how CSR relates to our business. These articles also make reference to Hitachi's Mission that lies at the heart of our CSR activities and dates back to the company's formation, and to the Five-year CSR Roadmap that lays out directions for the future.

The remaining articles include examples of education promotion, environmental protection, recycling, and regional development involving solutions that draw on Hitachi's technical capabilities, including examples from the Social Innovation Business that forms the core of our activities. In each of these, the focus is on examples of how solutions achieved through business activities result in the creation of new social value that is the essence of CSR.

I hope that you will find these articles on Hitachi's CSR activities and philosophies to be both interesting and useful.

expert's commentary

Business Strategies for Sustainable Global Prosperity

Businesses with global reach like Hitachi are essential architects of social and economic progress. Before considering the role of business in today's world, it is crucial to consider the many ways that our world is changing, very fast, and in fundamental ways.

The world is changing in fundamental ways. Technology is connecting individuals and communities, and we are about to enter an era in which the "industrial internet" will enable smart buildings and smart transportation systems that lead to large advances in efficiency that reduces the need for natural resources. Empowered individuals and connected communities will also lead to "bottom up" solutions through social entrepreneurship. Importantly, all institutions are facing far greater transparency than ever before.

Changing demographics are also creating fundamental change. For the first time in human history, more than half the world's people live in cities. Mature economies in Japan, the US and Europe, as well as China, are getting older, while many large economies in the Middle East and many parts of Asia are facing the need to create jobs for large number of young people entering the economy. And around the world, family size is shrinking, which enables more and more women to enter the formal workforce for the first time.

These changes have contributed to steadily rising living standards for many people across the globe. These changes have lifted more people out of poverty in the past generation than at any other time in human history. Indeed, gross domestic product (GDP) per capita has increased by 80% in the past 25 years. Unfortunately however, we are also beginning to face natural resource constraints that raise the risk that future generations will not continue to enjoy these levels of progress. More and more regions of the world are considered "water-stressed." Biodiversity is decreasing, by 30% in the tropics over the past 30 years. And of course there is climate change, with carbon emissions increasing 36% since 1992, and the ten hottest years in recorded history occurring since 1998.

And, as has too often been the case, governments have not been able to provide enough of the solutions that we need, globally and locally.

In this context, both the challenge and opportunity for business to be a powerful engine on human progress is clear. But business as usual will not automatically deliver strong enterprises and a prosperous world. Companies will meet 21st century challenges by taking four key steps.

First, aligning business strategy with big global challenges. Businesses innovation has delivered the tools that have produced remarkable means of improving our lives, and we will continue to see remarkable leaps in the 21st century. To attain the goal of widespread global well-being, this creative force should be focused on the great challenges of our time: transportation systems enabling urban mobility; personalized health care for an aging global population, and an industrial internet that significantly reduces the waste of natural resources. Technologists and designers should be focused on the biggest human challenges to deliver great outcomes for a planet with nine billion people.

Second, businesses need to engineer powerful partnerships, with other companies, governments, and non-governmental organizations (NGOs). It is clear that no single sector of society, and indeed no single

Aron Cramer

President and CEO, Business for Social Responsibility (BSR)

Aron Cramer is recognized globally as a leading authority on corporate responsibility by business, NGOs, and the public sector. Under his leadership, BSR has doubled its staff and expanded its global presence, which includes offices in Beijing, Hong Kong, Paris, Sao Paolo, New York, and San Francisco. He advises senior executives at BSR's nearly 300 member-companies and other global businesses, and is regularly featured as a speaker at major events and in a range of top tier media outlets. Mr. Cramer is co-author of the book Sustainable Excellence: The Future of Business in a Fast-changing World, about the sustainability strategies that drive business success. He joined BSR in 1995 as the founding director of its Business and Human Rights Program, and opened BSR's Paris office in 2002, where he worked until assuming his current role as President and CEO in 2004. Previously he practiced law in San Francisco and worked as a journalist at ABC News in New York.

business, can create the outcomes our global community requires. It is therefore essential that companies focus increased attention on partnerships, to co-develop new technologies, to ensure that value chains operate in an optimal way, and with the social and non-profit sector to engage communities and other experts in tackling big global challenges. Companies without clear collaboration strategies will struggle to implement basic business strategies.

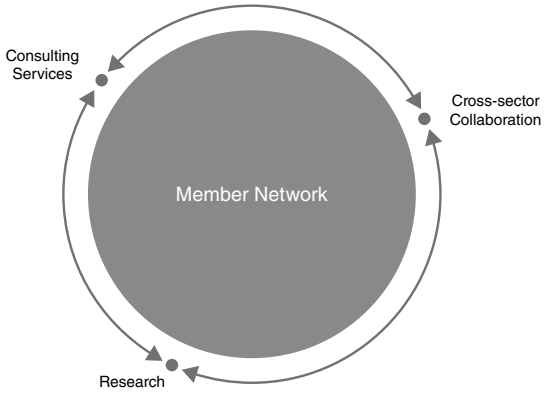
Third, businesses will be most effective if they have strategies that enable bottom up solutions that leverage the creativity of their employees and their customers. Social networks and the concept of open innovation are redesigning the ways that all institutions go about their business. Companies are now able to draw upon the creative talents of more people than ever before. The best new solutions will therefore be created by those businesses that learn how to promote individual initiative and open processes, using competitions, social networks, and incentives for individual and team action.

Finally, the businesses that develop creative ways of achieving quantum leaps in resource efficiency will shield their businesses from price volatility and limits on access due to spikes in demand. The “internet of things” will help in this regard, but it will also be crucial to significantly reduce water and energy use in manufacturing, and this will involve new incentives across widespread supply chains, and a “war on waste” both by consumers and enterprises.

With its social innovation strategy being applied in a truly global fashion, Hitachi is very well-positioned to put this approach at the center of its business. My colleagues and I at Business for Social Responsibility (BSR) are proud of our association with Hitachi, and look forward to supporting the company as it continues to pursue this approach to its business.

About BSR

BSR works with its global network of nearly 300 member companies to build a just and sustainable world. From its offices in Asia, Europe, and North and South America, BSR develops sustainable business strategies and solutions through consulting, research, and cross-sector collaboration.



Technotalk

Toward Realization of Sustainable Society through CSR-centered Management

Hideto Kawakita

CEO of IIHOE, the International Institute for Human Organization and the Earth

Founded IIHOE in 1994 to support the management of NGOs, social entrepreneurs, and CSR-oriented enterprises, and the development of foundations to foster collaborations between citizens, business, and governments.

Hiroaki Nakanishi

Representative Executive Officer and President, Hitachi, Ltd.

Joined Hitachi, Ltd. in 1970. His appointments have included Managing Director of Hitachi Europe Ltd. in 1998; Vice President and Executive Officer in 2003; Senior Vice President and Executive Officer in 2004; and Chairman & CEO of Hitachi Global Storage Technologies, Inc., Executive Vice President and Executive Officer, and Representative Executive Officer and President since April 2010.

In the midst of accelerated globalization, today's society faces various emerging issues including economic disparity between regions and global environmental problems. Corporate activities that contribute to solving these issues are growing in importance. Having had a long involvement in the construction of social infrastructure systems, both in Japan and throughout the world, Hitachi is now adopting a management strategy centered on CSR for operating its Social Innovation Business in cooperation with partners from various parts of the world. The company's goal is to help realize a sustainable society by expanding CSR-centered businesses and also by sharing values with society.

CSR as a Business Activity

Kawakita I have had the pleasure of helping prepare CSR reports and training courses for Hitachi. Today, I am very delighted to have the opportunity of asking President Nakanishi directly about management and CSR. To begin with, I would like to ask about the role of CSR in Hitachi's business strategy.

Nakanishi The shape of the manufacturing industry has changed greatly in recent times. Manufacturing industry has been literally the industry of "manufacturing and selling products," but its substantial meaning has changed. Simply manufacturing "quality products" is not enough. What matters now is, firstly, what is meant by a "quality product," and also the gap between what customers demand and are satisfied by and what we believe to be good for customers.

As far as Hitachi's businesses are concerned, customers cannot be bracketed into any one category. Instead, they include various types, including business-to-business (B-to-B) and business-to-consumer (B-to-C) customers. In any case, there is a strongly recognized need to rethink what constitutes strength by considering which features are genuinely beneficial to customers and which are pertinent to security, safety, and well-being.

In this context, the essential element for manufacturing products that satisfy customers and the market is the

extent to which we can look at questions from a customer's viewpoint. As corporate activity has an increasingly broad influence, "customers" in this case means society. Providing society with the security, safety, and comfort people truly want is what constitutes genuine corporate social responsibility.

In other words, CSR is not limited to social contribution or to the redistribution of profits to society. CSR is itself corporate activity. What will be demanded from companies in the future is that their corporate activities will themselves be based on social responsibilities.

Kawakita Global corporate giants claim that they are taking up the challenges posed by the issues that societies will face in the future. It appears that, instead of taking a conventional "research and development (R&D) first" approach, CSR derives from the idea that companies exist to solve issues together with society.

Nakanishi That's true. Seeds-oriented technologies and products are of course important. And careful analysis is also necessary to see if they really help with the progress of society.

Kawakita The essential point here is not to "sell what we make," but to have a thorough debate before manufacturing. In this context, I believe that CSR relates not only to outputs, but also to the adequacy of the processes used to produce the outputs. Furthermore, judgments about this adequacy must not be kept within the company; rather there should be an open attitude to the outside world that includes cooperation with society.

Nakanishi Yes, I think so too. In the case of developing consumer products, such process can be constructed step-by-step. On the other hand, it may face difficulties when we deal with "B-to-B" products. For example, whereas IT systems have in the past been used to improve the efficacy of business operations, attention is now shifting to how we can help identify and make use of knowledge. Underpinning all this is the question of how to achieve a sustainable society rather than having an exclusive focus on growth. In respect to this question, corporate activity should not be concerned purely with the performance of individual products. Our corporate activities themselves must exemplify our social responsibilities.

Management goals during Japan's high-growth era were very clear. They concerned such matters as increasing production and rationalizing operations. As society matures, however, the issues of concern can be seen much more as being about balancing diverse elements to achieve sustainability. Resolving these issues is a difficult challenge, and as such it provides an opportunity for Hitachi to demonstrate its values.

Kawakita Another important aspect of this challenge, and one of particular significance to Japan, is how to cope with the falling birthrate and aging population. Transportation, too, is a critical factor. One example of what can be done with advanced infrastructure would be a service that allows users to access information such as medical treatment schedules by scanning their local resident registration card with their smartphone. The service could also be combined with technologies such as intelligent transport systems (ITSs) to provide the users with an automated vehicle to get them to their hospital appointment. Naturally, services like this that combine advanced technologies or that integrate mass transportation with personal mobility require that the associated infrastructure be in place, and this in turn requires governmental leadership. I also believe that companies like Hitachi have a role to play in responding to this challenge.

Nakanishi Transportation, I believe, will become a critical field not only in Japan, but also globally. The development of the automotive infrastructure, and its increased sophistication, should proceed in step with the development of railway and other forms of public transportation. To create a sustainable system, what is needed are plans and proposals that consider the current status and future outlook for both types of transportation. This problem is particularly severe in developing economies, and it is made even more difficult by the fact that it cannot be dealt with by individual companies on their own. In any case, sticking to a firmly held vision and philosophy will be essential.

Turning Contributions to Society into a Form of Investment

Kawakita In managing your businesses, what are you focusing on as you seek to turn CSR into a common global language for Hitachi?

Nakanishi We are focusing on the global development of our Social Innovation Business. In practice, the changes in the manufacturing industry that I referred to earlier are most evident in our overseas businesses.

Hitachi has contributed to the establishment of infrastructure with unrivalled quality in Japan. This was made possible by the presence of competent people in both government and business who combined an ability to manage the necessary technologies with a vision for social design. With such an environment in place, all that we needed to do was to work on getting better at manufacturing our own products in accordance with the vision and plans that were handed down to us.

The situation overseas is different, especially in developing economies. It is not easy for such nations to share a vision with manufacturers on what role specific technologies or products should take in fulfilling social responsibilities and in the design of their society. Furthermore, in operating our business and making a contribution to local communities, we need to act as a responsible corporate citizen. This means taking our social responsibilities seriously and ensuring that

we fully understand the details of what these responsibilities entail. At the same time, we also need to be prudent and avoid creating misplaced or inflated expectations about the extent to which we can contribute to the national economy and society.

This means having a clear vision of the principles and rules associated with social responsibilities. With such a vision, the design of social infrastructure that can truly contribute to the society it serves could pose a significant management challenge in our business.

Kawakita A well-known strategy employed by The Procter & Gamble Company and Unilever for developing their businesses in developing economies has been to ensure that they do a good job of informing the public about the value of their products, particularly in the area of hygiene education. While allowing for the differences between consumer products and social infrastructure, this suggests that we also should make use of education, including, in certain cases, the education of consumers.

Nakanishi We need to be able to communicate our true intentions. As a company, we rely on our profitability to maintain our business activities, and we may also need to educate people about what this means.

Kawakita The Japanese Government, economic organizations, and companies already provide various forms of educational assistance and technical training, mainly in Asian countries. Meanwhile, the development of human resources will become increasingly important in the future, particularly people with the skills required for planning of social systems. The more people there are outside the company who understand the common language of CSR, the better we can share the process of value creation. In the social infrastructure business in particular, fostering people who will be quick to comprehend the value of the system and be capable of policy making is very important.

Nakanishi While I agree with this, there is no general method that will achieve this everywhere. In practice, it may be necessary to target some activities, such as the establishment of educational organizations, at regions where the potential benefits are high.

Kawakita In this case, it is important to look at social contribution as a form of social investment, rather than seeing it merely as a process of returning profits to society. In this respect, the activities of The Hitachi Foundation in the USA may provide a model. One of the reasons why The Hitachi Foundation enjoys a good reputation in the USA is that it has a strong presence in particular fields. In Japan, social contribution tends to be thought of as activities in a wide range of different fields. If it is to be treated as a social investment, however, it may be necessary to concentrate on certain areas and to enhance value from a long-term perspective.

Nakanishi The Hitachi Foundation was founded in 1980s to fulfill our social responsibilities in the USA. The foundation is operated by US citizens for US society. One factor in its durable reputation is that it has built relationships that are independent of Hitachi. Now, however, we are discussing what will be the ideal way for Hitachi to establish its citizenship in the future and fulfill our social responsibilities in the USA.

Since there is a limit to how much of a social contribution we can make, we need a consistent vision so that we can decide where our focus should be. That is why CSR should be an activity conducted in close collaboration with business management.

Variety of Viewpoints with a Wealth of Human Resources

Kawakita One of the critical elements in pursuing the open processes required for CSR is the diversification of human resources. In Hitachi's case, you have appointed several non-Japanese executives as outside directors to improve the diversity of your senior management. How do you see the relationship between human resources strategy and CSR?

Nakanishi One key area where companies contribute to society is employment. Human resources come at a cost, but they also represent a strategy in themselves. They are also an important factor in CSR. For now, the reality at Hitachi is that our diversity is insufficient. As I mentioned earlier, greater diversity in the gender, ethnicity, and nationality of our human resources will enhance the capabilities that our customer expect from us.

Kawakita It will lead to an intensification of competition and will help keep the company alert in a good sense.

Nakanishi In the conventional corporate culture of Hitachi, you always face obstacles if you want to do something drastic. A major reason for this is that we are a uniform and well-established large organization consisting of Japanese people only. The youth of today are said to be introverted, but I do not think so. They can become active when given the right incentives. Large organizations have a tendency to become stratified with numerous obstacles to advancement, and this is enough to make people lose motivation. By incorporating diversity, there are people who do not see these hurdles as being hurdles. This is important.

Actually, having more outside directors, including two non-Japanese directors, has entirely changed the atmosphere of the Board of Directors. Companies in the future may need to make provision for overturning the assumptions that apply within homogenous groups, so that discussions and decision-making can take in different viewpoints, for example. Whether obstacles can be overcome is not only a problem for the individual, it is also a responsibility of the management who helped establish the environment.

Kawakita It is also important to take note of a wide range

of opinions from both inside and outside the company. To sustain a good reputation in the field of CSR, a global corporation needs to maintain ongoing communications with counterparties such as non-governmental organizations (NGOs) from the early stages of any business activity. In addition to helping deal with any problems that may arise, this is also useful when planning future strategy.

Nakanishi I agree. While security has been an important factor in recent business activities, what needs to be protected against what depends on the nature of the project and its particular circumstances. Furthermore, it is society that determines what is to be protected and to what extent. However, as society includes a wide range of different people whose interests may conflict, it is important to listen to these people's various different views. It is true that companies are part of society, but the problem is that we tend to conduct our discussions and make our decisions internally.

Kawakita I believe that companies' CSR divisions are becoming more important.

Nakanishi Paradoxically, though, it would be better for CSR divisions to be eliminated in the future. While CSR is about supplementing the deficiencies of management, CSR is also the driver behind social contribution activities and it plays a critical role in establishing satisfactory relationships with entities outside the company. If CSR is now to be equated with the management strategy, it therefore needs to be integrated into the management process. In this context, the expectation of CSR is that it will assist management judgment and help assess whether management has implemented the critical points in the process of executing their social responsibilities.

The principal role of CSR in the future may be to educate management. Ensuring an adequate understanding of the meaning and practical implementation of social responsibilities by everyone in management will be the key to corporate growth.

On the basis of its Founding Spirit of "Harmony," "Sincerity," and "Pioneering Spirit," Hitachi is working to overcome the fundamental challenges of regional society in order to create a sustainable society in which people can achieve wellbeing and live safely and comfortably. CSR will have a central role in the management of businesses characterized by accelerating innovation, making Hitachi a perpetually trusted member of global society.

Creating Social Value through Business

Yukiko Araki

CSR: CENTRAL TO CORPORATE MANAGEMENT

TO many people, corporate social responsibility (CSR) brings to mind ideas such as sharing the profits of business activity with the community, engaging in activities that benefit society, volunteer work by employees, and compliance. While these remain critical elements, driven by the globalization of business activities and its increasing impact on society, CSR has also grown to become an integral part of management and of business activity. Companies are nowadays expected to satisfy the increasingly diverse expectations and demands of stakeholders and to adapt to changes in society (see Fig. 1).

In its interactions with society, business is expected to live up to two different types of expectation: minimizing negative effects and maximizing positive effects. The former involves reducing the load on the environment and respecting principles of compliance and human rights. These relate to measures both within the company and also in the supply chain. As neglecting these issues may result in law suits or damage to brand value, they are ultimately a matter of life or death for companies. Maximizing positive effects, on the other hand, means making a positive commitment to enhancing corporate value (or brand value). One example might be business growth achieved through the development of environmentally conscious products.

While the minimization of negative effects is essential to the continued existence of a company, the maximization of positive effects, in contrast, has conventionally been seen as a fortunate byproduct of activities aimed at minimizing the negative. Furthermore, a failure to proactively pursue positive benefits does cause any problems in the short term. As corporate activity becomes broader and more global, however, companies whose business activities fail to deliver social value over the long term will find it difficult to survive amid intense global competition. In the future, CSR will be a core element of management strategy that increases corporate value, both by minimizing negative effects on business activities and various stakeholders and by maximizing the creation of positive value (see Fig. 2).

GLOBAL TRENDS IN CSR

ISO26000 International Standard for CSR

While CSR has often lacked an agreed definition, the increasingly global nature of corporate activities has prompted the development of an international standard. In 2010, the International Organization for Standardization (ISO) published ISO26000, an

Fig. 1—Essential Elements of CSR.
The essence of CSR is to satisfy the expectations and demands of stakeholders.

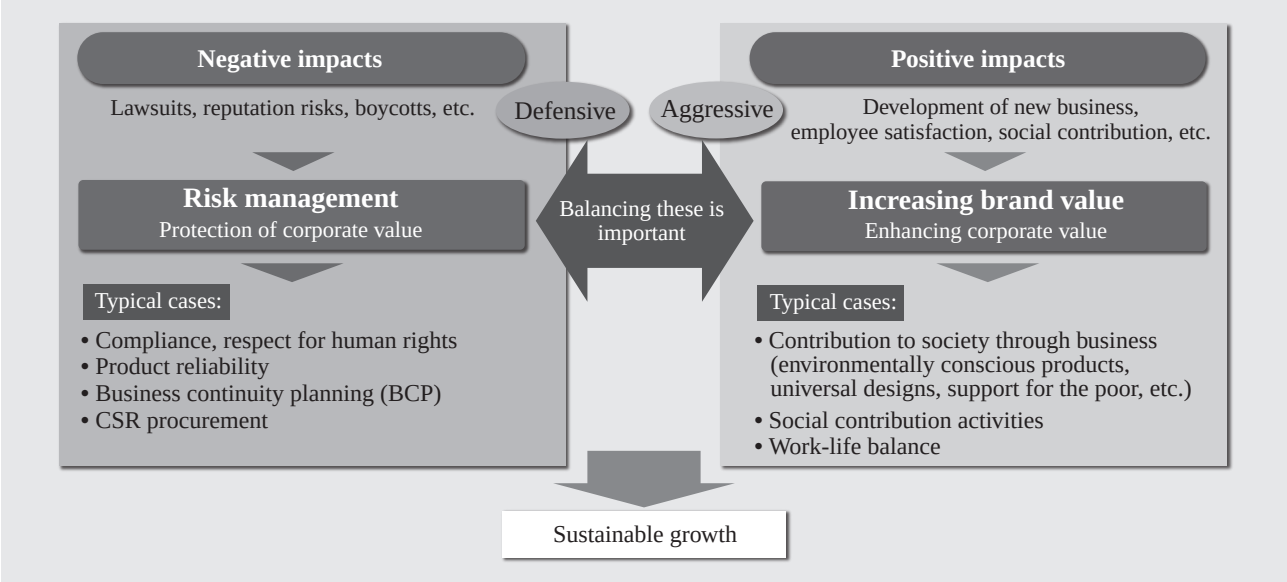


Fig. 2—Role of CSR.
CSR leads readily to the sustainable growth of companies.

international standard for CSR (see Fig. 3). This definition of social responsibility (SR) was formulated with cooperation from a wide variety of multi-stakeholders, including government officials, industry, and non-governmental organizations (NGOs) from more than 90 countries. It is applicable not only to corporations, but also to other kinds of organizations and entities. Examples include HSR (SR for hospitals) and USR (SR for universities). Unlike other well-known ISO standards such as ISO9001 for quality control or ISO14000 for the environment, ISO26000 is not intended as a certification scheme. Rather, it provides guidance recommending how corporations and other organizations should behave.

The common global rules specified in the ISO standard make it clear that CSR is not about charity, but is part of management itself. Also, companies are held accountable based on how they comply with this international standard. The scope of this accountability extends beyond customers, investors, and affiliated subsidiaries, also encompassing the overall supply chain.

New Management Concept

The concept of "creating shared value" (CSV) was proposed by Professor M.E. Porter of Harvard University in 2011. CSV is about creating value for both society and companies by striking a balance

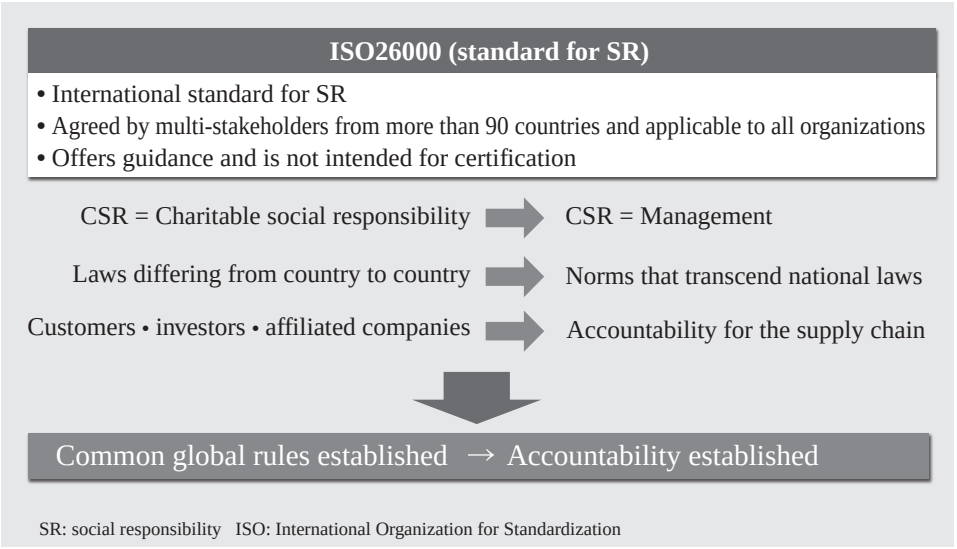


Fig. 3—ISO26000 Standard.
The ISO26000 international standard for CSR was published by the ISO in 2010.

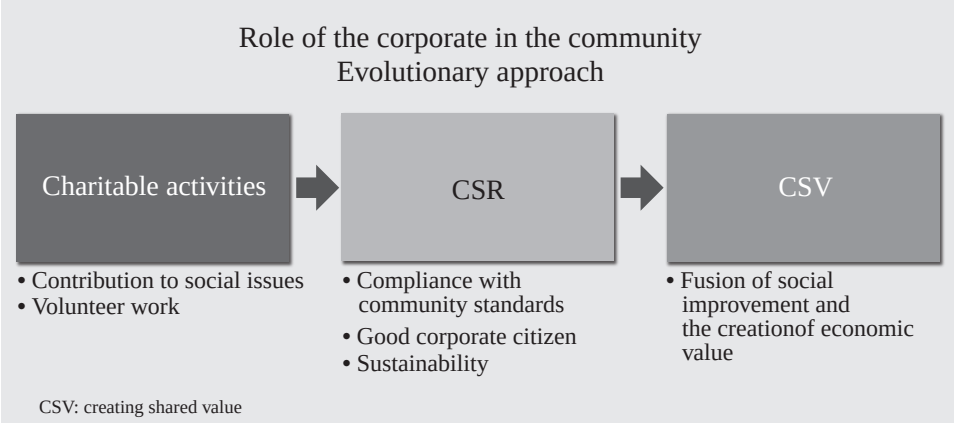


Fig. 4—CSV.
An evolutionary CSR approach is to create value that can be shared by both society and business.

between solving social issues and strengthening corporate profits and competitiveness. It means treating CSR not only as a "responsibility," but also as an "opportunity" whereby a positive approach to CSR can enhance a company's competitiveness (see Fig. 4).

PAST ACHIEVEMENT OF CSR MANAGEMENT

Principles at Hitachi – Hitachi Founding Spirit

The ideas of Namihei Odaira, who founded Hitachi about 100 years ago, are well represented in the corporate Mission of "contributing to society through the development of superior, original technologies and products." His intentions live on today in this corporate Mission and in Hitachi Founding Spirit, which is based on the Values of "Harmony, Sincerity, and Pioneering Spirit." These are the roots of CSR at Hitachi, and they have played a central role in the company's business over the more than 100 years in which Hitachi has been working to solve social issues in collaboration with society (stakeholders) and establishing relationships of trust by acting with sincere intent (see Fig. 5).

These concepts that date back to Hitachi's foundation have been redefined in the context of the current social environment as the Vision, which sets forth "Hitachi delivers innovations that answer society's challenges. With our talented team and proven experience in global markets, we can inspire the world." Aimed at achieving this Vision, Hitachi has set out eight CSR policies (see Fig. 6).

Five-year CSR Roadmap: Mid-term Plan for CSR

The Five-year CSR Roadmap was developed in 2010 to clarify the future direction for Hitachi. Hitachi will undertake activities based around a different theme for each year, with a final goal of: "Becoming a truly global corporation, or One Hitachi" (see Fig. 7).

For example, "Hitachi Group codes of conduct" to be applicable group-wide was formulated in 2010, the first year of the five-year roadmap. This was based on the theme of "Reinforcing Group governance and globalizing operations and activities." The

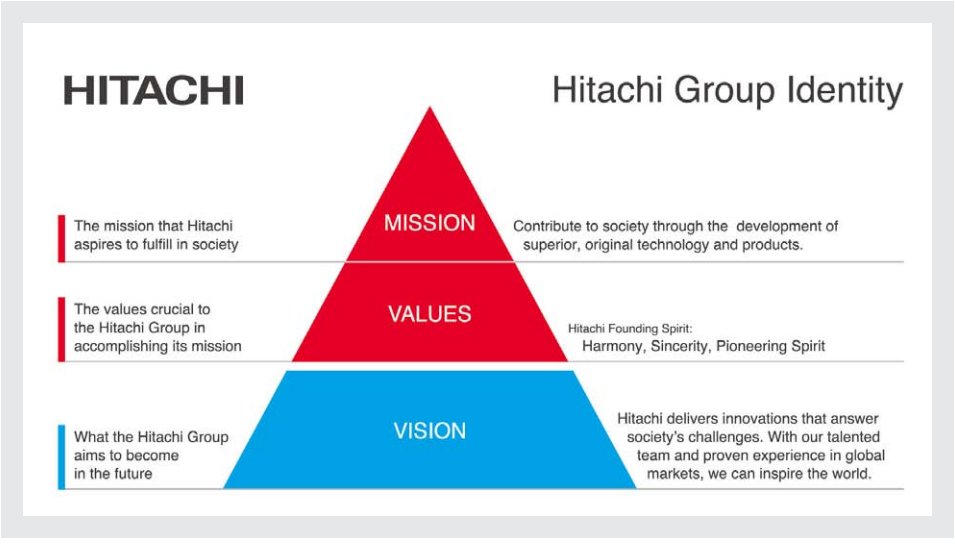


Fig. 5—Hitachi Founding Spirit (Values).
CSR at Hitachi is rooted in its corporate Mission and Hitachi Founding Spirit (Values).

CSR Policy of the Hitachi Group

1. Commitment to Corporate Social Responsibility (CSR)
2. Contribution to Society through Our Business
3. Disclosure of Information and Stakeholder Engagement
4. Corporate Ethics and Human Rights
5. Environmental Conservation
6. Corporate Citizenship Activities
7. Working Environment
8. Responsible Partnerships with Business Partners

Fig. 6—CSR Policies.
The fundamental concepts that underpin Hitachi, including its Founding Spirit, have been redefined in the context of the current social environment.

code was incorporated into the internal rules of all group companies throughout the world (about 900 companies). While codes of conduct had existed at each company prior to this initiative, there had been no common code applicable throughout the world.

Measurement to Reputation Risk

As business becomes increasingly globalized, reputation risk, too, becomes a global issue. For example, if a supplier in one country is associated with environmental contamination or human rights violations, this is likely to attract sensationalized media coverage in other countries. In addition to this risk, the company which is doing business with such a supplier may also face substantial criticism, perhaps even extending to boycott or protest campaigns organized by international NGOs.

While respect for human rights is an obligation that has traditionally been imposed on countries, as noted above, ISO26000 clarifies companies also have responsibility for the first time. Companies must ensure that they have measures in place to take into account the human rights of internal and external stakeholders involved in their business activities (such as suppliers or the local community in locations where the company operates), and to protect these rights from violation. Hitachi has a designated person responsible for CSR at each of its overseas regional headquarters. Because European countries have had a greater awareness of human rights, globally, it is European CSR teams who have been the leaders in this field. In China and other Asian countries, on-site supplier audits have been instigated to strengthen management of human rights risk.

HITACHI'S LONG-TERM GOAL FOR CSR

Fusion of Business Strategy and CSR

Fig. 8 shows how Hitachi sees the relationship between CSR and business, with social value on the vertical axis and economic value on the horizontal axis. The four quadrants that result are as follows.

(1) Low level of both social and economic value

This "no value" quadrant is not considered here.

(2) High social value and low economic value

This means activities that contribute to society without generating any profit for shareholders because they are performed independently of the company's business.

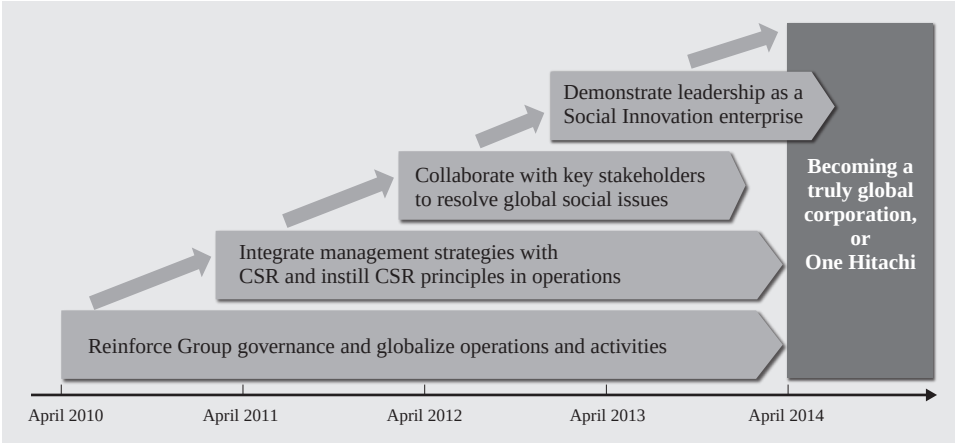


Fig. 7—Five-year CSR Roadmap.
The five-year CSR roadmap covers the period from 2010 to 2014.

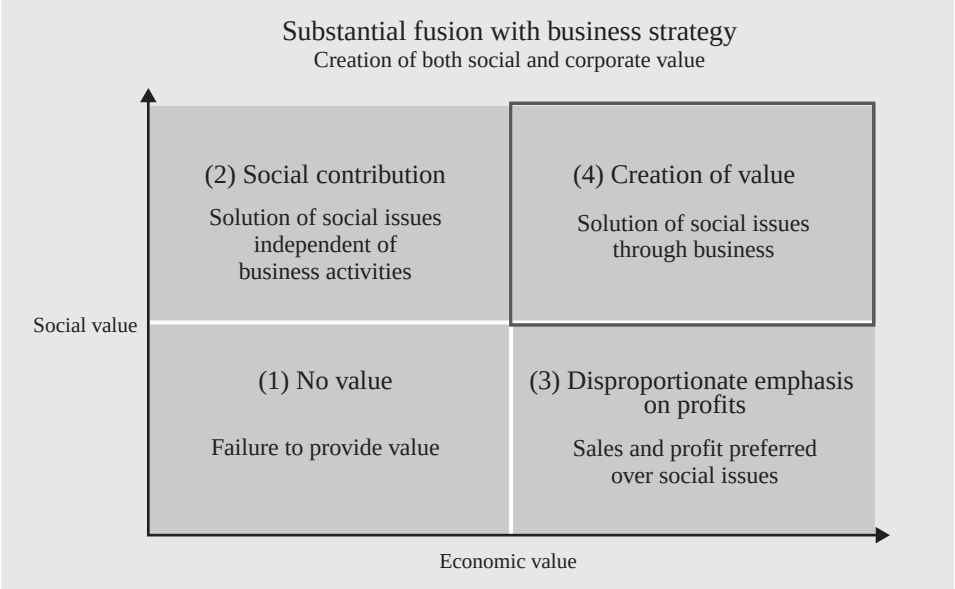


Fig. 8—Relationship between CSR and Business. Hitachi is seeking to become a truly global corporation with sustainable growth by integrating CSR into its business strategy to share a sense of value with society.

(3) Low social value and high economic value

This means a disproportionate emphasis on the profits. Companies that take this approach will fail to achieve sustainable growth because they will be out-competed by companies that generate higher social value.

(4) High social and economic value

Hitachi aims to achieve this type of value creation in which business strategy and CSR combine to work towards the resolution of social issues through business activities.

Since its foundation, Hitachi has been involved in the construction of social infrastructure in Japan and elsewhere. Its aim for the future is to expand this Social Innovation Business globally through "co-creation," which means developing businesses in collaboration with partners from all over the world.

Hitachi seeks to exploit its technological capabilities to develop social infrastructure businesses throughout the world, such as electric power, transportation, and water. By doing so, it can play a role in achieving sustainability by helping resolve the challenges faced by society at both a regional and global level. Examples include how Hitachi is helping limit carbon dioxide (CO_2) emissions by promoting a shift to more efficient electric power equipment in developed economies, and how it is solving urban problems in the developing world through the development of transportation and wastewater treatment systems.

Examples from Key Businesses

Smart city projects taking place in various parts of the world, such as the one in Tianjin, China, provide good examples of how social issues can be resolved. This resolution is achieved through a fusion of infrastructure and information technology (IT), a particular strength of Hitachi. Future growth is anticipated in water services and healthcare in particular.

CSR by Means of Products and Solutions

Hitachi has made a broad-based contribution to various aspects of society, including education, the environment, and international peace. This has been achieved through the provision of products and solutions and by taking advantage of its technological capabilities. In particular, this issue of *Hitachi Review* includes articles on the following topics.

(1) Use of tabletop microscopes in education

TM3000 tabletop microscope is developed by Hitachi High-Technologies Corporation that combines the resolution of an electronic microscope with the ease of use of an optical microscope. The TM3000 tabletop microscope is used in Japan and elsewhere in a wide range of both industrial and educational applications, including in elementary and junior high schools. Hitachi is helping promote scientific education throughout the world to give children the opportunity to develop an interest in science.

(2) Ecosystem protection using IT

Opened in April, 2011, the Hitachi IT Eco Experimental Village provides a venue for the use of Hitachi IT equipment and solutions in ecosystem conservation. In addition to aiding conservation in the surrounding countryside and local forests (in the Satochi-Satoyama area), the village is also involved

in work on the scientific assessment of the effects of a changing environment on living organisms. In cooperation with local authorities and schools, Hitachi and its employees are also working to raise awareness of ecosystem conservation in the region as a whole.

(3) Rare earth recycling technology

Because rare-earth magnets are indispensable to high performance and energy efficiency in hard disk drives (HDDs), motors, and high-efficiency air conditioners, steps are being taken to secure a reliable supply of these materials. Hitachi has developed and implemented a recycling technology that recovers and recycles rare-earth magnets from used products. This is an example of how resource recycling helps achieve a sustainable society. Hitachi is collaborating on this work with a number of other industrial groups.

(4) Application of biometric authentication systems

Hitachi's finger vein authentication technology is a precise and easy-to-use biometric authentication system used in applications such as internal security, compliance, and access control for public facilities. The technology has also been adopted in the fight against infectious diseases, where it is used in surveys of residents of developing countries to provide a means of identification in areas that lack the infrastructure for tracking the local population. Initiatives like this will help in the development of future healthcare and other public services.

ACHIEVING CORPORATE-LED INNOVATION THROUGH B-TO-S BUSINESS MODEL

Hitachi intends to continue both taking note of what society is saying and also making effective use of its technology, know-how, and solutions to deliver innovations. In this sense, Hitachi sees its core social infrastructure business as being neither business-to-consumer (B-to-C) nor business-to-business (B-to-B), but rather business-to-society (B-to-S)[(a)]. That is, the customers for its products extend beyond direct customers to also include the rest of society in all its diversity. In other words, this is a departure from the conventional approach to business, and instead requires a restructuring of management resources aimed at achieving corporate-led innovation. Finally, if Hitachi is to maintain both a sustainable business and a good reputation in society over the next 100 years or more, it is vital to learn from the past. This brings us back to the business mission of Namihei Odaira, namely to "contribute to society through the development of superior, original technologies and products."

(a) B-to-S
The concept that upholding the corporate mission and operating the business in ways that benefit both stakeholders and society will enhance corporate value.

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Creation of Social Value in Key Business Sectors

Makiko Osawa
Noriaki Shin

OVERVIEW: Based on a corporate mission that it has pursued since its formation, Hitachi has sought to operate its businesses in ways that make a broad-based contribution to society. The embodiment of this corporate mission in the present era is Hitachi's core Social Innovation Business through which it is working to overcome the challenges faced by Japan and other countries or regions and to realize a sustainable society. Hitachi's aim for the future is to operate its businesses globally to create new social value through the construction of social infrastructure and the solution of problems.

INTRODUCTION

AS economic activity becomes increasingly global, the nations and regions of the world are facing a variety of challenges, including global warming due to climate change, rapid urbanization in emerging economies, and aging populations and falling birthrates in developed economies. Hitachi operates its Social Innovation Business globally. In addition to corporate profitability (economic value), it is seeking to create new social value by helping overcome these challenges.

This article gives an overview of Hitachi's Social Innovation Business and describes some major examples of solutions that deliver social value in the water, smart grid, and mobility sectors.

SOCIAL INNOVATION BUSINESS

Overview

Hitachi's Social Innovation Business is based on its Mission "contributing to society through the development of superior, original technology and products" that dates back to the company's formation. This mission has been handed down for more than 100 years, and Hitachi's Social Innovation Business is all about continuing to put this mission into practice in the future.

Japan and other countries around the world face a variety of social problems in areas like the environment, energy, education, and healthcare, creating a need to help resolve the problems that challenge these countries and regions and thereby put global society onto a sustainable basis. It is for this reason that Hitachi is pursuing its Social Innovation Business that combines products, services, and information technology (IT) (including the cloud) to deliver all-encompassing solutions.

To provide the products and services that these nations and regions genuinely need, it is important to have an accurate understanding, including of their markets, economic circumstances, and culture, and to be able to adapt to these flexibly. In addition to locally based management, this requires an active approach to globalization through measures such as the building of partnerships.

Key Technologies

The key technologies in Hitachi's Social Innovation Business are water, mobility, elevators and escalators, IT, smart grids, healthcare, construction machinery, materials, and key devices. The following sections describe each of these in turn.

(1) Water

The water sector will become increasingly important around the world in the future due to the need to make effective use of precious water resources, including water treatment and improving the efficiency of water distribution. With its extensive water-related technology, Hitachi has supplied numerous water treatment, sewage, and other water related systems, including monitoring and control systems, to sites around the world. Its aim is to help improve the world's water environment by combining this know-how with advanced IT to implement more advanced intelligent water systems.

(2) Mobility

Transportation infrastructure continues to play an important role, both in the increasingly urbanized emerging economies and in developed economies where the concerns are about things like disaster resilience and the aging of infrastructure. Hitachi delivers solutions that provide total support for railway systems, extending from the design and manufacture

of rolling stock to traffic management, maintenance, and travel and other information services. As a total systems integrator for mobility, Hitachi is working to build the next generation of transportation infrastructure, including developing technology for electric vehicles (EVs) to provide a transportation environment that gives greater consideration to the natural environment.

(3) Elevators and escalators

The primary role of the elevator and escalator business is to create a convenient environment in which people can move from place to place in safety and comfort. In addition to seeking to deliver functions and other design features that suit specific facilities such as office buildings, hospitals, or railway stations, Hitachi also provides a variety of functions and services in response to social needs, such as greater security and higher energy efficiency. Hitachi also takes a global approach to development, including the research and development of large capacity elevators that operate at very high speeds for use in the world's large high-rise buildings.

(4) IT

Hitachi sees IT as having an essential role underpinning social infrastructure. Specifically, its activities include research and development in technologies such as big data, cloud computing, storage, next-generation networks, radio-frequency identification (RFID), and also the fusion and integration of these technologies with social infrastructure and other services with the aim of creating a sustainable society that is safe and comfortable.

(5) Smart grids

Smart grids have an important part to play in the realization of a low-carbon society. The use of IT to control the balance between suppliers and consumers is essential to ensuring a reliable supply of electric power while also making efficient use of renewable forms of energy that are anticipated to enter wider use in the future. Hitachi develops and supplies smart grid systems by drawing on its distinctive capabilities that arise from its diverse range of technologies, including the communication and control technologies needed to maintain the stability of power systems.

(6) Healthcare

The rise of social issues such as the aging population and an increase in lifestyle diseases make healthcare an important sector. Hitachi sees healthcare as an essential part of the infrastructure. By utilizing its comprehensive strengths in technology development and in the supply of relevant systems, solutions, and services, it seeks to help create a society in which everyone can enjoy a healthy and secure way of life.

(7) Construction machinery

The construction machinery sector, which has been experiencing ongoing growth against a background of economic development in emerging markets, has an urgent need for environmental measures. Specifically, this means complying with the increasingly severe exhaust emission regulations being adopted in developed economies, and improving energy efficiency to help prevent global warming. Hitachi is actively working on the development of new construction machines that combine performance enhancements with environmental features through a diverse mix of technologies, including electric drive and control techniques.

(8) Materials and key devices

Hitachi's Social Innovation Business is made up of systems from fields that fuse IT with social infrastructure, and also the materials and key devices that help make these systems more sophisticated and competitive. Hitachi supplies materials and key devices that deliver high performance and efficiency to meet the needs of society, while also researching and developing materials such as amorphous metals and rare earth magnets, and key devices such as electric motors, inverters, and lithium-ion batteries.

RECENT EXAMPLES

Among the technologies used in the Social Innovation Business described above, water, smart grids, and mobility lie at the core of the smart city business to which Hitachi is devoting considerable effort. This section describes solutions in these fields that help create social value.

Water

One notable example from the water sector is a seawater desalination project in the Indian state of Gujarat (see Fig. 1). The project involves the construction of a seawater desalination plant at an industrial complex in the Dahej Special Economic Zone (SEZ) in Gujarat and is intended to provide a reliable supply of water for industrial use over a 30 year period.

Having experienced strong economic growth in recent years, India faces concerns about increasingly severe water shortages due to greater industrialization. This has created an expectation of growing demand for water recycling and for seawater desalination in coastal regions. Hitachi has formed a consortium

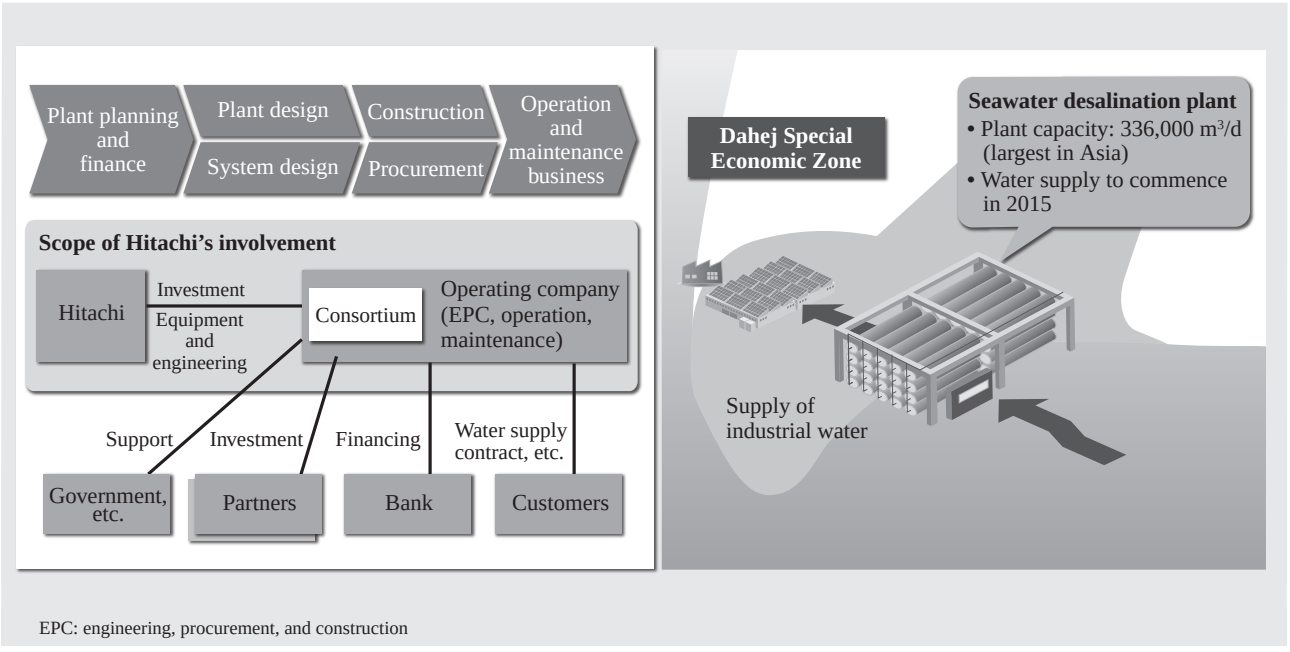
comprising a Japanese company and Hyflux Ltd., a large Singaporean water treatment company, and has been studying the potential for the business as part of the "FY2010 Infrastructure System Export Promotion Study Project (Feasibility Study of Smart Community Business in Global Markets)" project of Japan's Ministry of Economy, Trade and Industry that is targeted at the construction of energy-efficient and low-carbon smart communities. A water supply contract was signed with Dahej SEZ Ltd. in January 2013, including agreement on the volume of water to be supplied (336,000 m^3/d), contract duration (30 years, including construction), and pricing.

The project is proceeding as part of the Delhi-Mumbai Industrial Corridor Project, a joint venture between the governments of Japan and India for utilizing private investment to establish industrial sites along the approximately 1,500 km between Delhi and Mumbai. It is seen as a project that will facilitate the effective use of water resources in India. Hitachi intends to continue its discussions with Dahej SEZ Ltd., including working through the environmental assessment and consenting process, with a goal of reaching a final agreement.

Smart Grids

Hitachi is working on a number of projects in Japan aimed at the development of smart cities, and is also actively involved in this field elsewhere. One example is the Japan-U.S. Island Grid Project (see Fig. 2). The project is being undertaken by the New Energy and Industrial Technology Development Organization (NEDO) based on a technical collaboration between Japan and the USA on clean energy, with Hitachi having been contracted to run a demonstration project until the end of FY2014 on the Hawaiian island of Maui in collaboration with the state of Hawaii, the Hawaiian Electric Company, Inc., the University of Hawaii, a US National Laboratory, and other partners.

Maui is installing renewable energy, primarily wind power, with the objective of replacing 40% of the total power generation capacity on the island by 2030. However, because Maui is a remote island where the cost of electric power is comparatively high, and because renewable energy is influenced by the weather, there is a need to use energy as efficiently as possible. There are also issues such as variations in the output of renewable energy influencing the frequency and causing problems with grid voltages. The demonstration project will seek to minimize these problems as it works toward the target of 40% renewable energy. The project will utilize EVs and construct a smart grid that incorporates advanced technologies that have been developed over time, including distribution grid control, consumer load control, and EV operation and charging control. It will also investigate the results of deploying these technologies.



EPC: engineering, procurement, and construction

Fig. 1—Seawater Desalination Project in Indian State of Gujarat.
This seawater desalination project is located in the Dahej Special Economic Zone in Gujarat.

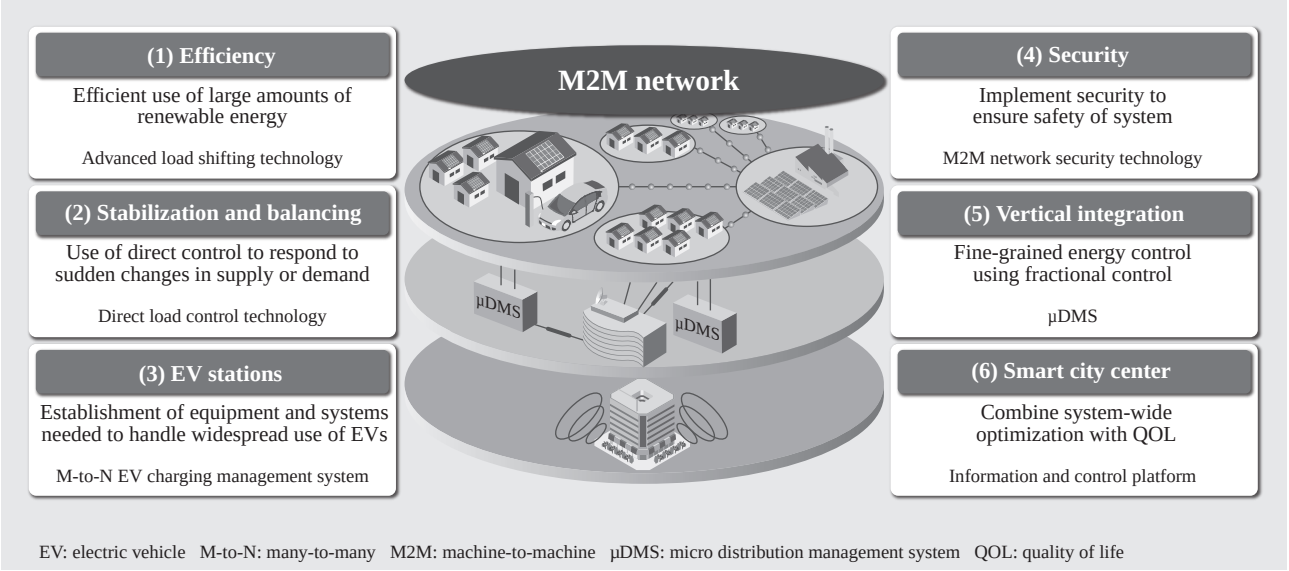


Fig.2—Hitachi's Involvement in Japan-U.S. Island Grid Project in Maui, Hawaii.
This demonstration project will showcase six advanced initiatives being pursued by Hitachi.

Hitachi will also conduct an economic assessment of the results of the demonstration project with a view to deploying the business in other areas by establishing business models for low-carbon society systems on remote islands.

Mobility

While Hitachi operates its transportation infrastructure business globally, one project that has attracted considerable attention in Japan and elsewhere is its successful bid for the UK Intercity Express Programme (IEP), a major project for the replacement of aging express trains. The final contract was signed in July 2012. The project involves the leasing of rolling stock for the East Coast Main Line and Great Western Main Line in the UK, and includes the manufacture of 596 cars and a 30-year maintenance contract (see Fig. 3).

The factors behind this success include the strong reputation in the UK of Hitachi's Class 395 trains, which were used for shuttle services at the London Olympics. Because the UK standards for rolling stock are different from those in Japan, it was not possible simply to export Japanese rolling stock and railway systems unmodified. The high-speed Class 395 trains that run between London and the Channel Tunnel comply with European standards for safety and other requirements, and they have achieved high reliability and contributed to trouble-free operation since commercial operations formally commenced in December 2009. The IEP project also included research and development work aimed at resolving issues specific to Europe. Hitachi has taken steps to establish itself in the UK, including the recruitment of local staff to ensure that it accurately understands and conforms to the railway market and culture in that country.

For the future, Hitachi is preparing itself for the commencement of IEP operation in 2017 through initiatives that include establishing a rolling stock production facility at Newton Aycliffe in County Durham in the UK, and also a research and development organization and maintenance facilities.

CONCLUSIONS

This article has given an overview of Hitachi's Social Innovation Business and described some major

Fig. 3—Intercity Express Programme Train for UK (Computer-generated Image).
The project includes the manufacture of 596 cars and a 30-year maintenance contract.

examples of solutions that deliver social value in the water, smart grid, and mobility sectors.

Hitachi utilizes the technology and the know-how it has built up in the past and brings together capabilities from across the group to operate its various Social Innovation Businesses on a global basis. These initiatives result in the creation of new value that leads innovation in the wider world, and can help build safe and secure societies.

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Support for Use of Tabletop Microscopes in Science Education

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Masahiko Ajima
Robert J. Gordon
Daihei Terada
Martin Heid

OVERVIEW: The TM3000 tabletop microscope manufactured and marketed by Hitachi High-Technologies Corporation is designed to combine the resolution of an electron microscope with the ease-of-use of an optical microscope. Revolutionizing the conventional idea of an electron microscope, the TM3000 is used in a wide range of fields in Japan and other countries, ranging from the private sector to government agencies, hospitals, science museums, and educational institutions such as elementary or junior high schools. The TM3000 tabletop microscope is also being used to support education in Japan and elsewhere as part of Hitachi's CSR activities. By providing children with an opportunity to experience the micro-world first hand, potentially inspiring them to develop an interest in science, the aim is to help foster people able to work in the science and technology sector.

INTRODUCTION

BASED on the principles and strategies underpinning corporate social responsibility (CSR) activities at Hitachi, Hitachi High-Technologies Corporation and its group companies (the Hitachi High-Tech Group) have selected three specific areas on which they are focusing their own activities. These are: support for science education, protecting the global environment, and regional assistance. In particular, as a science and technology business, the Hitachi High-Tech Group is seeking to make the most of its scientific instruments and other products and technologies to provide support for science education, underpinned by a basic philosophy of creating value through high-tech solutions.

A waning of interest in science and technology has been noted in the youth of Japan in recent times. International comparison studies conducted by the Organisation for Economic Co-operation and Development (OECD) and the International Association for the Evaluation of Educational Achievement (IEA) found that, even among pupils who do well in science, the proportion who enjoy the subject has fallen to a low level. This drift away from science and technology was also corroborated by the analysis of results and survey of questions in the national academic achievement and learning situation survey (national achievement tests) conducted by the Ministry of Education, Culture, Sports, Science and Technology, Japan in elementary and junior high schools during April 2012. This waning of interest in science and technology by young people has implications for the development of the future workforce for industry. It poses a major challenge not only for Japan but for all developed economies.

Given this reality, the Ministry of Education, Culture, Sports, Science and Technology has been instigating a variety of initiatives since FY2002 under a plan for encouraging interest in science and technology with the aim of making Japan into a nation that is creative in science and technology.

Through the development of the TM3000 tabletop microscope, Hitachi High-Technologies Corporation is helping prevent the waning of interest in science and technology by providing opportunities for the children who are the potential engineers of the future to develop an interest in science.

This article describes how the Hitachi High-Tech Group is using its tabletop microscopes to encourage and support science education.

TM3000 TABLETOP MICROSCOPE

Hitachi High-Technologies Corporation manufactures and markets electron microscopes that are used in applications such as quality control and for a variety of industrial research and development, including in fields such as nanotechnology and biotechnology. It designed the TM3000 tabletop microscope, which was first released in April 2005, to be a leading-edge electron microscope even easier to use and more accessible to people.

Fig. 1—TM3000 Tabletop Microscope.
Because the electron microscope is small enough for tabletop use, there are few restrictions on where it can be installed.

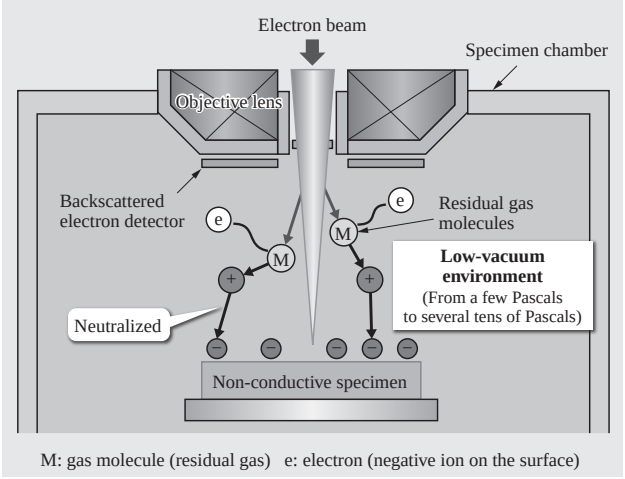

Fig. 2—Principle of Low-vacuum Observation.
A lower level of vacuum in the specimen chamber means more residual gas molecules. Collisions between the electrons and these gas molecules cause them to ionize into positive ions that neutralize the buildup of charge when they reach the specimen surface.

While conventional electron microscopes have demonstrated their effectiveness in fields such as materials analysis that involve high resolution and high definition[2], factors such as their somewhat cumbersome specimen preparation requirements mean that, unlike optical microscopes, they are not an instrument that just anyone can use with ease. The TM3000 has a maximum magnification of ×30,000 (more than is available on optical microscopes) and a startup time of only about three minutes (compared to around 20 minutes for previous models). It also features an energy-efficient design that does not require continuous electric supply, supports three observation modes [5-kV mode, 15-kV mode, and high-intensity energy-dispersive X-ray spectrometer (EDX) mode], and is equipped with a number of automatic adjustment functions including auto-start, auto-focus, and auto-brightness/contrast. Operation is also simplified by features such as the image shift function and control buttons.

Because the TM3000 can obtain realistic images with a good depth of focus and higher magnification than an optical microscope, it is used in a wide range of fields such as food, bioscience, semiconductors, and electronics. Also, because even first-time users can familiarize themselves with it quickly, it is also used for educational purposes in schools, science museums, and similar facilities.

The main features of the TM3000, released in 2010, are listed below.

(1) Compact tabletop design means simple installation

The small size of the microscope and the fact that it operates from a standard 100–240 V alternating current (AC) power supply using a three-pin plug mean that there are few restrictions on where it can be located (see Fig. 1).

Conventional general-purpose scanning electron microscopes (SEMs) use a condenser lens with an exciting coil to produce a tightly focused electron beam. The TM3000, in contrast, uses a condenser lens with a permanent magnet to reduce weight and power consumption. Similarly, whereas the power supplies in conventional SEMs incorporate a large transformer, the weight of the TM3000 has also been reduced by using a newly developed, compact transformer-less power supply to supply direct current (DC) to the control circuits. This allows the microscope to be made small enough for tabletop installation. The design is also conscious of the environment, using a compact, dry (oil-free) vacuum pump.

(2) Non-conductive specimens do not require special preparation

SEMs obtain an image from the secondary electrons or backscattered electron signal that results from exposing a specimen to an electron beam in a hard vacuum. In the case of non-conductive specimens, however, some of the incident electrons remain in the specimen under the hard vacuum conditions, resulting in a buildup of electric charge (charge-up). This causes image noise and makes it impossible to obtain a crisp image. Normal practice for preventing this phenomenon is to use preparation techniques such as the deposition of metal on the specimen surface. The TM3000, in contrast, minimizes charge-up by using an observation technique that works in a low vacuum and therefore can be used without special specimen preparation (see Fig. 2).

Fig. 3—Screen Shot from TM3000 Tabletop Microscope.
The screens are designed to be intuitive and easy to understand, and a full range of automatic functions that can perform adjustments at a single touch makes operation easy and magnification changes smooth.

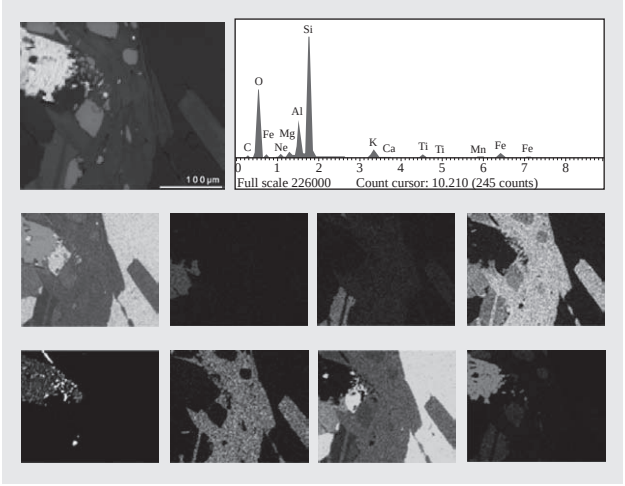

Fig. 4—Example Elemental Analysis of Rock Specimen (Elemental Spectrum and Elemental Distribution Mapping Data).
Analysis of the chemical elements contained in a specimen can also be performed without the need for pre-treatment.

(3) Simple operation

Hitachi High-Technologies Corporation has developed technology that allows the TM3000 to be used simply by connecting it to the USB port on a personal computer, with intuitive and simple operation screens designed to work in a similar way to a digital camera (see Fig. 3). To make the microscope even easier to use, Hitachi has also improved the speed and accuracy of the automatic functions that adjust the focus, brightness, and other settings at the press of a button. This means that even first-time users find it easy to produce images.

(4) Elemental analysis (option)

Because the TM3000 can be configured as an energy-dispersive X-ray system, it can be used not only to magnify the specimen, but also to determine its elemental composition.

As with conventional imaging, elemental analysis does not require any special specimen preparation (see Fig. 4).

USE OF TABLETOP MICROSCOPES

The Hitachi High-Tech Group has since the 1990s been providing children with the opportunity to experience the micro world using SEMs at its own facilities. Since the release of the TM3000, however, with its compact design, these events have been able to move outside the company.

Loan to Educational and Other Institutions

Since 2008, the Hitachi High-Tech Group has been supplying the TM3000 on loan to support the activities of institutions that plan and operate their own educational programs aimed at getting children interested in science.

As of January 2013, regular events that use the TM3000 to provide a hands-on experience of using an electronic microscope are being held at four sites around Japan [the National Museum of Emerging Science and Innovation (Miraikan), Izumo Science Center, the Nagoya University Museum, and The Japan Society of Applied Physics] (see Fig. 5). The Izumo Science Center, for example, is sharing the TM3000 between schools with an interest in enriching and developing science and technology education, particularly those designated as Super Science High

Fig. 5—Tabletop Microscope at the Nagoya University Museum.
The Hitachi High-Tech Group supports science and technology education by loaning out tabletop microscopes.

TABLE 1. Events Held during FY2012
Hands-on electron microscopy events using the tabletop microscope were held at the National Museum of Emerging Science and Innovation (Miraikan), Izumo Science Center, Nagoya University Museum, and The Japan Society of Applied Physics.

Institution	Event	Number of participants or visitors
National Museum of Emerging Science and Innovation (Miraikan)	High-Speed Cameras and Microscopes	353
Izumo Science Center	Temporary loan to SSHs and other schools	1,098
Nagoya University Museum	Micro Expedition*	195
The Japan Society of Applied Physics	Fascination of Science that can be Studied for Fun, etc.	1,087

SSH: Super Science High School
* Micro no Tankentai (Micro Expedition) is a registered trademark of Nagoya University.

Schools (SSH) by the Ministry of Education, Culture, Sports, Science and Technology, Japan.

As of February 2013, the total of more than 16,000 participants had been given a chance to experience the thrill of science at these hands-on electron microscopy events held across the different institutions.

Table 1 lists the main events held in FY2012, along with estimates of the number of participants or visitors.

Hands-on Learning Events Involving Radio Program

Another initiative by Hitachi High-Technologies Corporation in support of science education is Masaki Omura's Science Kids, a radio program that has been running since October 2006 (on Nippon Cultural Broadcasting Inc.). Each episode of this science program focuses on a different topic aimed at unlocking a sense of wonder in the children.

Each year during the summer holidays, the program stages a public recording event to allow direct communication with its elementary school children listeners. The events include a hands-on corner where visitors can try using the TM3000 for themselves (see Fig. 6).

Children bring objects from their daily lives, such as household goods, groceries, cloth, plastics, plant material, or insects, and are able to look at them using the TM3000 under guidance by staff from the Hitachi High-Tech Group. This is followed up in subsequent days by activities that make the microscopic world feel even more familiar to them, such as an electron microscope photography competition using the microscope images they obtained.

The questionnaires used to survey participants at each event are full of comments that express their delight at having access to an electron microscope for the first time and their surprise at the high-resolution images.

Participation in STEM Education Programs in USA

Hitachi High Technologies America, Inc. (HTA) is involved with science, technology, engineering, and mathematics (STEM) programs proposed by President Obama for encouraging education in these fields. STEM education is being pursued as a policy that seeks to boost national competitiveness of the USA by developing human resources in the fields of science and technology.

Hitachi, Ltd. is a member of Change the Equation (CTEq), a non-profit organization established to promote STEM education in 2011. As part of Hitachi, HTA provides demonstrations of the TM3000s or loans them out for use at school or science museum events run by CTEq. Currently, 17 TM3000s are available for loan, including units at HTA sales agents, with anywhere between five and 15 in use on any given day. Between September 2011 and January 2013, HTA was involved in education support activities at more than 110 different sites around the country (see Fig. 7 and Fig. 8).

Other educational activities by HTA include seminars and workshops for the teachers who instruct pupils at educational institutions. These provide advice on how to prepare future lessons and programs,

Fig. 6—Hands-on Corner at Event.
Hitachi High-Technologies Corporation sponsors the Science Kids radio program (Nippon Cultural Broadcasting, Inc.) for elementary school children that seeks to foster children's interest in science.

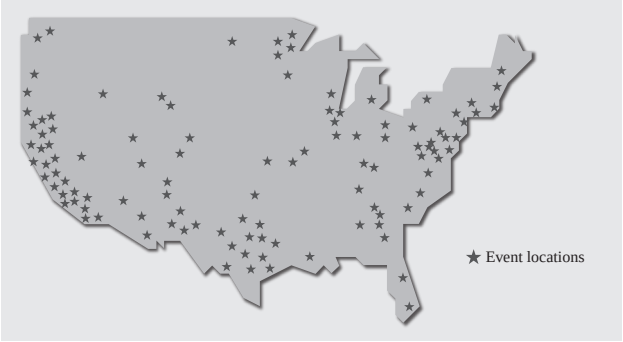

Fig. 7—Support for Education in the USA (from September 2011 to January 2013).
Education support activities by Hitachi High Technologies America, Inc. include loaning TM3000 tabletop microscopes and conducting demonstrations. Such activities have taken place at more than 110 sites to date.

Fig. 8—Science Education Event in Dallas, Texas.
HTA has participated in events run by the US non-profit organization, Change the Equation (CTEq), at schools, science museums, and other venues. Its involvement has included the loan of TM3000s and the conducting of demonstrations.

and they cover subjects such as how to operate the TM3000, case studies of successful practical programs and the issues they face, and other data and topics relating to STEM education.

Also, a STEM education website went on-line in August 2012. In addition to posting information about STEM education, the aim is for the site to act as a valuable support tool by providing educational tools and learning modules that use the TM3000, and through the exchange of information and advice between teachers.

Other Activities

In Europe, Hitachi High-Technologies Europe GmbH (HTE) is supporting the nanoTruck project introduced by the German Federal Ministry of Education and Research in 2010 (see Fig. 9).

The nanoTruck project is a trailer containing a variety of small experimental apparatuses and science-related exhibits that visits schools, universities, and other organizations around Germany to demonstrate to the public how nanotechnology relates to their daily lives. Its aims are to boost interest in advanced technology, increase the number of people interested in studying the natural sciences, and eliminate distrust and misunderstanding of nanotechnology.

HTE has endorsed this project, including loaning a TM3000 free of charge, and has collaborated with the project managers to devise a way of installing the TM3000 that retains its performance as the trailer travels around the country. This ensures that it continues to provide people with a chance to experience the nano world for themselves, even inside a vehicle. In doing so, the TM3000 has proved to be

Fig. 9—nanoTruck with TM3000 Tabletop Microscope.
Hitachi High-Technologies Europe GmbH supplied a TM3000 tabletop microscope to support the nanoTruck project run by the German Federal Ministry of Education and Research.

particularly popular among the nanoTruck's exhibits, with many visitors being moved by the nano-world experience it provides. HTE has also loaned out microscopes in the UK, including to the British Museum and the Natural History Museum.

In the Naka district of Ibaraki Prefecture in Japan where the TM3000 is manufactured, the Hitachi High-Tech Group has complemented its promotion of science education by also running science classes for elementary school children as part of its regional outreach activities (see Fig. 10). At science classes held in December 2012, design staff from the Hitachi High-Tech Group taught children about the differences between optical and electron microscopes, and gave them the opportunity to use these instruments to look at objects such as hair or the eyes and feelers of ants.

Fig. 10—Science Class at Elementary School.
The Hitachi High-Tech Group runs science classes for elementary school children as part of its regional outreach activities in the Naka district of Ibaraki Prefecture, Japan where the TM3000 is manufactured.

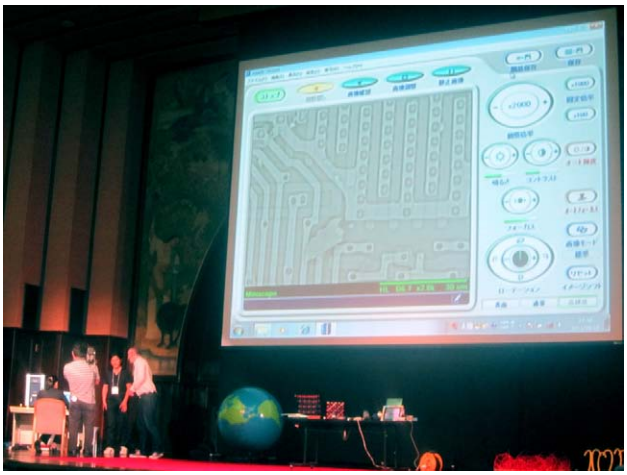

Fig. 11—The Royal Institution Christmas Lectures.
The Hitachi High-Tech Group assisted with the Royal Institution Christmas Lectures (organized by the British Council and others) held at The University of Tokyo in September 2011, including the loan of a TM3000 tabletop microscope and handling operation on the day.

Experiencing for themselves the expressions of surprise with which the children attending the science classes greeted the electron microscope images reminded the designers afresh of the fascination of microscopy.

Elsewhere, the Hitachi High-Tech Group also accepts invitations to collaborate on external events. In September 2011, the Group cooperated with the British Council, a public international cultural exchange organization from the UK, on the Royal Institution Christmas Lectures. This included the loan of a TM3000 and handling operation on the day at The University of Tokyo (see Fig. 11). The program brought a science experiment program run by The Royal Institution of Great Britain to Japan with the aim of helping provide a rounded education to the young people who are destined to take up the challenges of the 21st century, while also demonstrating why science is fun and interesting. During his presentation, Professor Mark Miodownik, Professor of Materials and Society at the Department of Mechanical Engineering of University College London, utilized the TM3000 in demonstrations and audience-participation experiments, displaying detailed electron microscope images on a screen.

In September 2012, a TM3000 hands-on corner and the public recording of a radio program were included in "Tohoku Miraizukuri Day with Hitachi in Kesennuma," a traveling event in support of the Tohoku recovery that was organized by Tohoku Hitachi. The event provided an opportunity to mingle with children from the disaster-affected region hit by the Great East Japan Earthquake in 2011.

CONCLUSIONS

This article has described how the Hitachi High-Tech Group is using its tabletop microscopes to encourage and support science education.

Giving children a chance to view the microscopic world for themselves provides an opportunity to make them feel more comfortable with science, and this has the potential to help foster the people who will advance and develop the high technology of the future. By drawing on these features of its business to make an ongoing contribution, the Hitachi High-Tech Group can fulfill its social responsibilities as a corporate citizen.

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Ecosystem Protection Using IT

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Mitsukiyo Tani
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OVERVIEW: The 11th meeting of the Conference of the Parties (COP11) to the Convention on Biological Diversity held in India in 2012 included stronger measures aimed at encouraging corporate action on biodiversity, including the provision of aid to emerging nations. With aim of creating a sustainable society, Hitachi adopted a medium- and long-term Environmental Vision in 2007 based around the three pillars of "Prevention of Global Warming," "Conservation of Resources," and "Preservation of Ecosystems." This includes supplying products and services that contribute to the protection of the environment and operating its global business in ways that reduce the load on the environment. Seeking to place greater importance on environmental activities in its information and telecommunications divisions, Hitachi also adopted its global environment contribution plan in June 2010 to contribute to the global environment through activities that use IT to achieve a bountiful planet. With the preservation of biodiversity being one of the themes of this plan, Hitachi opened the Hitachi IT Eco Experimental Village in April 2011 where it is running a nature restoration project in collaboration with universities and the local community.

INTRODUCTION

THE environments in which organisms live are coming under severe threat due to factors such as global warming or human activity and development, leading to the destruction of ecosystems, loss of natural habitat, and invasion by exotic species.

Recognizing this situation, Hitachi decided in 2010 to look at what it could do as a company to help protect ecosystems. With information technology (IT) being part of Hitachi's core business, this led to the opening in April 2011 of the Hitachi IT Eco Experimental Village in Hadano City in the Kanagawa Prefecture of Japan as a site for studying the use of IT in ecosystem protection.

This article describes the activities and experiments being conducted at the IT Eco Experimental Village, their application to business, the associated corporate social responsibility (CSR) activities, and plans for future expansion.

ACTIVITIES AT IT ECO EXPERIMENTAL VILLAGE

Village Opening

From its corporate perspective, Hitachi has three aims for the work being conducted at the IT Eco Experimental Village. The first is to achieve, through human intervention and in cooperation with the local community, the restoration of the species that traditionally populated the area and an increase in their numbers. The second is to demonstrate the use of IT in the field so that it can be used in future ecosystem preservation work. The third is to improve environmental awareness through a project model that features staff participation.

The choice of a site for the village focused on local bodies that were actively engaged in ecosystem preservation in the Kanto region. Among the potential candidates, Hadano City in Kanagawa Prefecture was particularly strong on environmental activities and was a place in which Hitachi, Ltd.'s business had deep roots, having operated a plant there for more than 40 years. Recognizing this as somewhere it could make an even greater corporate contribution to the environment, Hitachi in cooperation with the city chose a block of land approximately 7,000 m^2 in size (in Chimura, Hadano City) comprising forested hills and fallow farmland that had remained unused for many years.

To ascertain what species were already living on the land prior to human intervention, a wildlife survey was conducted at this point in collaboration with Tokai University (with whom Hadano City had conducted other ecosystem surveys in the past). This survey found that populations of rare species were present at the site, including Lefua echigonia, a species of freshwater fish that is listed as a Class IB Endangered

species[*1] in the Ministry of the Environment's Red Data Book, a compilation of wildlife at risk of extinction.

Hadano City designates fields or wetlands where rare or precious wildlife live or breed as "Chimura The Living Village." The IT Eco Experimental Village is the first site managed by a private business to receive this designation. The project is an example of regional cooperation between industry, government, and academia. A committee made up of Hadano City Hall, community councils, the Chimure Sato no Kai non-profit organization (NPO), and land holders was formed to act as a parent organization coordinating activities at Chimura The Living Village.

Areas and Activities at IT Eco Experimental Village

The village is split into separate areas based on the land characteristics, with the conservation work in each area having the respective objectives described below (see Fig. 1).

(1) Fallow Farmland Restoration Area

Drains and biotopes (habitats) were established to convert an area of formerly fallow land into paddy fields (approximately 2,975 m^2) and dry fields in a way that provided a suitable habitat for wildlife. Forest thinnings from the Broadleaf Forests Restoration Area were used to build rest stops and footpaths. Kiju Mochi mochi rice and Kinuhikari uruchi paddy rice were grown on the restored paddy fields without the use of agricultural chemicals or fertilizers, producing a harvest of approximately 180 kg.

(2) Broadleaf Forest Restoration Area

Originally a stand of mixed forest, this area had, through many years of neglect, become overgrown with bamboo, turning it into a dense and dark thicket. Accordingly, the bamboo was cut down and the trees thinned to let in more light. Also, an area of grassland where seasonal flowering plants would be able to blossom was established on the slope facing the Fallow Farmland Restoration Area. People involved with the village used the thinnings from this area to make notebooks, coasters, and other craft items that have been used as novelties by Hitachi Group booths at environmental exhibitions and other events.

(3) Wildlife Observation Area

This is a region of elevated wetland surrounded by bamboo where Impatiens textori and Reineckea carnea grow in profusion. As rare species such as badgers are known to inhabit the area, human intervention is kept to a minimum and it is maintained as a place for observing the animals in their natural habitat.

(4) Flora Observation Area

This area is currently covered by large amounts of amur silver-grass, a species of grass that grows in wetlands. As amur silver-grass provides a habitat for small mammals, this area is left largely untouched other than the removal of foreign species, and is used as a site for evaluating the recovery of flora and fauna.

Also, to raise interest in aspects of traditional village ways of life, Hitachi is also involved through its CSR activities in rice planting (May) and harvesting (October), with participation by community councils, land holders, Hadano City Hall, nearby elementary schools and kindergartens, and Hitachi staff (see Fig. 2). The harvested rice is donated to homes for the elderly and other welfare facilities, and is used in communal activities such as making mochi (rice cakes).

The aim for the future is to use activities like these to deepen interactions with the people involved in the IT Eco Experimental Village.

Products and Solutions Used at Village

A variety of different IT devices have been installed to collect environmental information at the village. The following sections describe their features and how they are used.

(1) Hitachi wireless sensor-net system

This system uses small sensors capable of measuring four different types of basic environmental

*1 Species facing risk of imminent extinction in the wild.

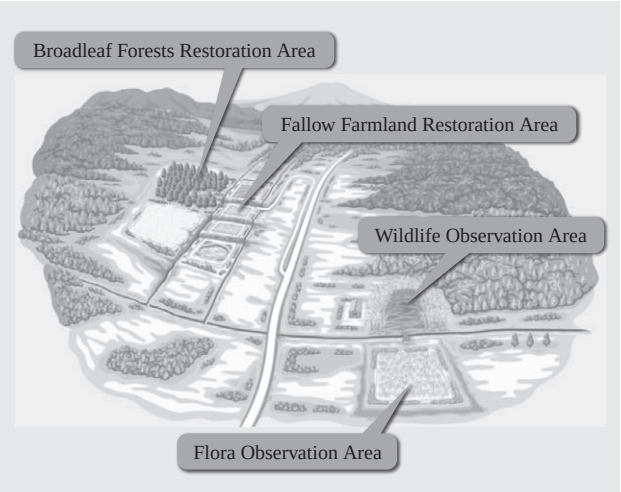


Fig. 1—Hitachi IT Eco Experimental Village.
The block of approximately 7,000 m^2 is divided up into four areas, with different activities in each area depending on its characteristics.

Fig. 2—Kindergarten Children Planting Rice along with Local Volunteers and Village Staff.
Regular events are held as part of the children's environmental education. These include rice planting and events run by teachers and students from Tokai University that provide children with a chance to view the village's aquatic and plant life.

data (including temperature and humidity) and wirelessly transmitting the results back to a server. The sensors are installed at four different locations around the village (Fallow Farmland Restoration Area, Broadleaf Forest Restoration Area, drains, and Wildlife Observation Area) where they are used to collect temperature, humidity, soil temperature, and water temperature at one-hour intervals. The system at the village is powered by rechargeable batteries charged by photovoltaic panels.

(2) GeoPDF*[2] (Hitachi Solutions, Ltd.)

Observations of plants and animals can be entered into a smartphone and sent via e-mail to a personal computer (PC) tagged with latitude and longitude data obtained using the global positioning system (GPS). GeoPDF also has a mapping function that can show locations and other observation details on a smartphone or PC map.

(3) Sensor cameras (Hitachi surveillance camera system)

Timely 24-hour-a-day observations of wildlife in their habitat are provided by a single networked video camera and six still camera sensors that use infra-red detectors to capture images at night or other times when animals are present (see Fig. 3). Realtime images of the village are also available on the IT Eco Experimental Village's web site*[3] via a web camera.

*2 GeoPDF is a registered trademark of TerraGo Technologies, Inc. in the USA and other countries.
*3 http://www.hitachi.co.jp/environment/iteco/

Environmental Data Visualization System

This is an experimental system that takes temperature, humidity, soil temperature, water temperature, and other environmental data collected from the village by Hitachi wireless sensor-net system and automatically stores it in a cloud server for display on the web site. The remote control system is used to transfer the data and the cloud server is provided by SecureOnline, a secure IT platform service that is part of Hitachi's cloud computing solution. The system is designed to provide "visualization" by sharing environmental data with people involved in the project (see Fig. 4). Testing demonstrates that this system is suitable for use in ecosystem preservation and other environmental and agricultural applications.

USE OF IT IN ECOSYSTEM PRESERVATION

Objectives

In addition to its work on preserving natural habitat to support biodiversity, the IT Eco Experimental Village is also involved in efforts to assess scientifically (quantitatively) how environmental change is impacting the flora and fauna.

In the past, the agencies that measure and analyze basic environmental data such as temperature and humidity have operated separately from those who survey and analyze the populations and circumstances of flora and fauna, with nobody engaged in consolidating their respective work. However,

Fig. 3—Wildlife Captured by Sensor Cameras at Hitachi IT Eco Experimental Village.
A variety of wildlife has been observed at the IT Eco Experimental Village.

detailed assessments of how recent global warming has affected plants and animals will likely prove very important for maintaining biodiversity in the future. Accordingly, this project has installed a wide range of different IT devices to continuously collect and collate information about the environment, and is formulating and testing hypotheses about how it can be used to assess biodiversity.

Examples of Experimental Work

Hitachi places top priority on working closely with the local community when conducting ecosystem preservation activities. First among these at the IT Eco Experimental Village was experimental work on rice cultivation involving the restoration of fallow farmland.

The experiment involved using environmental data from the year concerned to predict the best time for harvesting the rice, something that in the past had always been determined by farmers based on rules of thumb. With an ongoing fall in the number of experienced farmers, the aim was to formalize their implicit knowledge so that it could help their less experienced colleagues (or volunteers coming in from outside the area) decide on the best harvest timing, and to do so remotely if necessary.

Fig. 4—Screen from Environmental Information Visualization System.
Hitachi wireless sensor-net system is used to measure air temperature, humidity, soil temperature, and water temperature. The data is sent wirelessly and in realtime from the sensors to a cloud server where it is made available on the web site.

Consultations held with experienced local farmers (known as "tokunoka") and agricultural specialists from the university as part of the experiment identified the following two key points.
(1) Based on their long experience, farmers make their decision about when to harvest based on the time since the ears first appeared on the rice plants.
(2) Theory predicts that a correlation exists between plant development (growth and flowering) and the integral of temperature over a certain period of time (cumulative temperature).

As these two points indicate that the harvest decision is made by experienced farmers based on daily observation of the condition of the rice plants and the effective temperatures they experience in the period after the ears appear, it was hypothesized that an appropriate harvest timing could be chosen by correlating the harvest timing against air temperature measurements. The experiment was conducted to test this hypothesis.

Experiment Method

The experiment was conducted as follows.
(1) In 2011, the measured cumulative temperatures around the farm site were analyzed with reference to the timing of ear emergence and the harvest time chosen by the farmers.
(2) The same information was again collected in 2012 and compared against the data for 2011.

The air temperature data used in this work was obtained by accumulating daily averages calculated from hourly measurements taken in the vicinity of the paddy fields. The basic environmental data was collected from four locations in the village. During summer, the results sometimes showed a difference of several degrees between the daily average temperature at the Fallow Farmland Restoration Area near the paddy fields and that at the Broadleaf Forests Restoration Area. This indicates that it is important to use data measurements from as close to the site being studied as possible.

Experiment Results

The experiments in both 2011 and 2012 found that the best time for harvest was when the cumulative temperature during the period after ear emergence exceeded 1,200°C, indicating a strong correlation with air temperature. This was also corroborated by the harvest being three days earlier in 2012, a year in

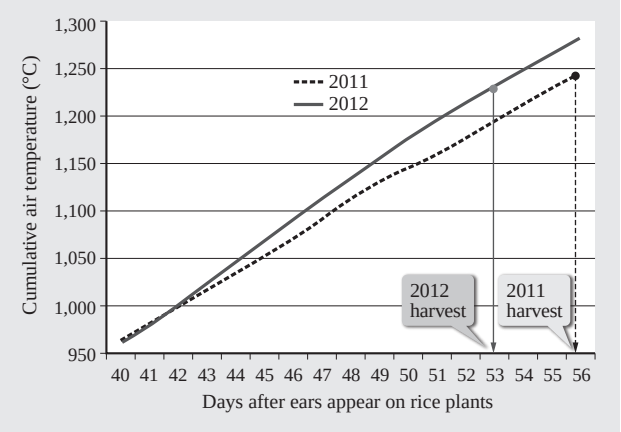


Fig. 5—Graph of Cumulative Air Temperature and Days after Ear Emergence.
In both 2011 and 2012, the best time for harvesting was judged to be after the cumulative air temperature exceeded 1,200°C.

which the temperatures prior to harvest where higher than in 2011 (see Fig. 5).

Future Work

Given that it is only two years since work started at the IT Eco Experimental Village, it is considered important to continue collecting and assessing data to strengthen confidence in the hypothesis.

While Hitachi wireless sensor-net system can be used to collect basic environmental data remotely, a base station and server need to be located within wireless communications range of the sensors. As it is also necessary to provide a power supply at the sensor locations, an experiment was initiated in 2012 aimed at eliminating this requirement by trialing the use of photovoltaic power generation and rechargeable batteries. Three similar systems were installed at sites in the village that experienced different levels of sunlight, and their power generation and usage were then assessed to ascertain the amount of power generation and battery capacity required. In addition to this experiment, further work is planned to facilitate installation at sites that would have been impractical in the past, including the sending of data via a mobile communication network (see Fig. 6).

A major issue associated with checking the condition of the grain (in this case, the timing at which ears appeared on the rice plants) was that it required an on-site inspection. With a view to the technology being applied to large fields or in other countries in the future, it is important to be able to check the growth of the grain remotely. One potential method for achieving this is to perform spectral analysis on satellite images to assess the progress of grain development on the plants. To improve the accuracy of these assessments, an experiment is currently being run using a vegetation map of the village produced from a survey by a plant specialist, with more targeted experimental work planned for FY2013 and later.

EXPANSION OF ACTIVITIES AT IT ECO EXPERIMENTAL VILLAGE

Development of Programs Focused on Ecosystem Preservation

Work aimed at restoring wildlife attracts more participants to the village and leads to more activities by the extra people involved or by those with a raised awareness. Also, increasing the number of people able to contribute to other activities, including those outside the village, is the best way in the long term to expand protection for ecosystems. Accordingly, steps are being taken to promote and expand activities at the village, including bringing in more participants by increasing the program of events held there (including giving people a chance to experience rice planting, harvesting, or other farm work), with numerous nature watching sessions or presentations on work at the village, for example. Regarding the relationship with

Fig. 6—Hitachi Wireless Sensor-net System and Photovoltaic Power Unit.
A trial is being conducted to assess whether photovoltaic power generation and a rechargeable battery are adequate to power the sensors.

the local community and broader society, activities have been run in collaboration with educational institutions such as universities or local elementary schools and kindergartens, bringing the total number of visitors to the village during the roughly two years since its opening to nearly 3,000, and helping increase the number of people with an interest in ecosystem preservation or who are able to contribute to the activities (see Fig. 7).

To expand the use of IT for ecosystem preservation, weather sensors have also been installed since 2012 at three other sites that have also been designated as Chimura The Living Village by Hadano City. These sensors are collecting similar measurements to those in the village. By comparing differences such as the characteristics of the location, its elevation, and the surrounding environment, for example, this work is helping with the "visualization" of mountain habitat protection by local government.

The promotion and expansion of the village itself has come about from the boost in motivation achieved by demonstrating the results of the work, such as how it has led to activities both by companies and by volunteers working with the local community (Chimura Nature Club), or the extent to which conservation has been enhanced compared to the past by undertaking conservation work through the village. Meanwhile, companies have established plans for strategically expanding conservation areas and have obtained the consent of the community. Autonomous volunteer groups have also been formed that are able to conduct their own conservation work. These developments represent a way for companies to go about making a contribution to the environment and society, something that was rare in the past.

In another initiative, a nature watching event sponsored by Hadano City was held at the IT Eco Experimental Village in 2012 to get more people interested in rare species. Work has also started on using IT to collect observations as part of research into ecosystem preservation by the Research Center for the Future City Design Corresponding to Global Environment Problems that was established in July 2012. This uses smartphone-based augmented reality (AR) technology to share existing information at the site and also as a way of identifying the observed wildlife and recording observations. It was demonstrated with a limited number of species (see Fig. 8).

Initiatives Using IT in Ecosystem Preservation

The Research Center for the Future City Design Corresponding to Global Environment Problems established in July 2012 is an industry-government-academia research consortium made up of nine different organizations, including Hitachi, Ltd. Based in the Yokohama National University, its aim is to design future cities that are adapted to the global

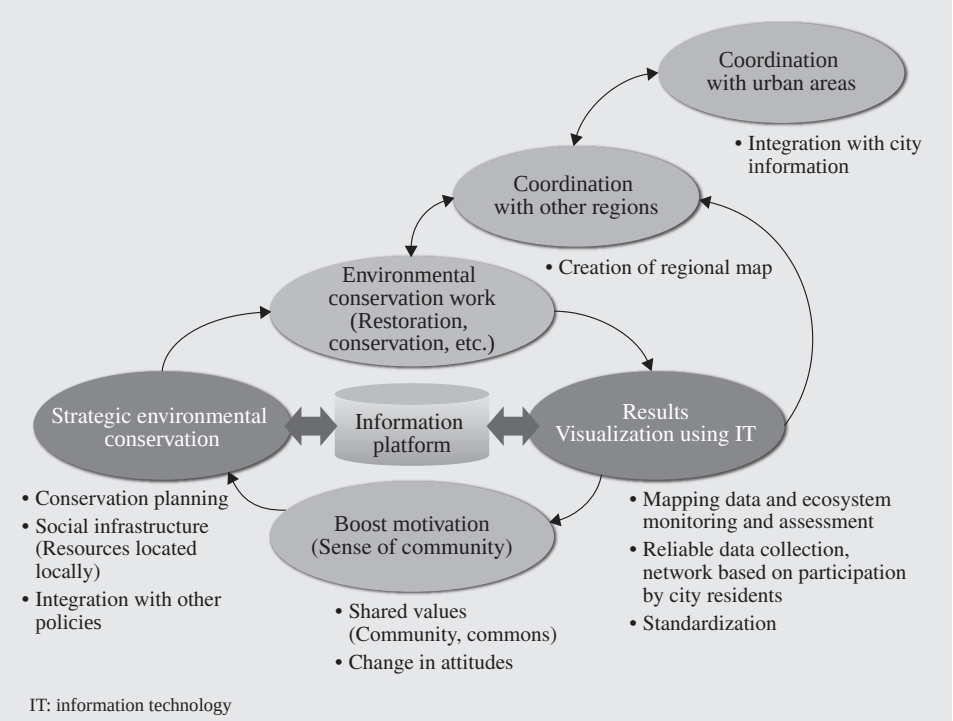


Fig. 7—Ecosystem Preservation Spiral.
The figure shows the concept ("spiral") behind the ecosystem preservation work conducted by the IT Eco Experimental Village and Chimura Nature Club together with an overview of the use of IT for visualization. The Chimura Nature Club is a volunteer group made up of Hitachi associates and land holders that engages in activities at the IT Eco Experimental Village.

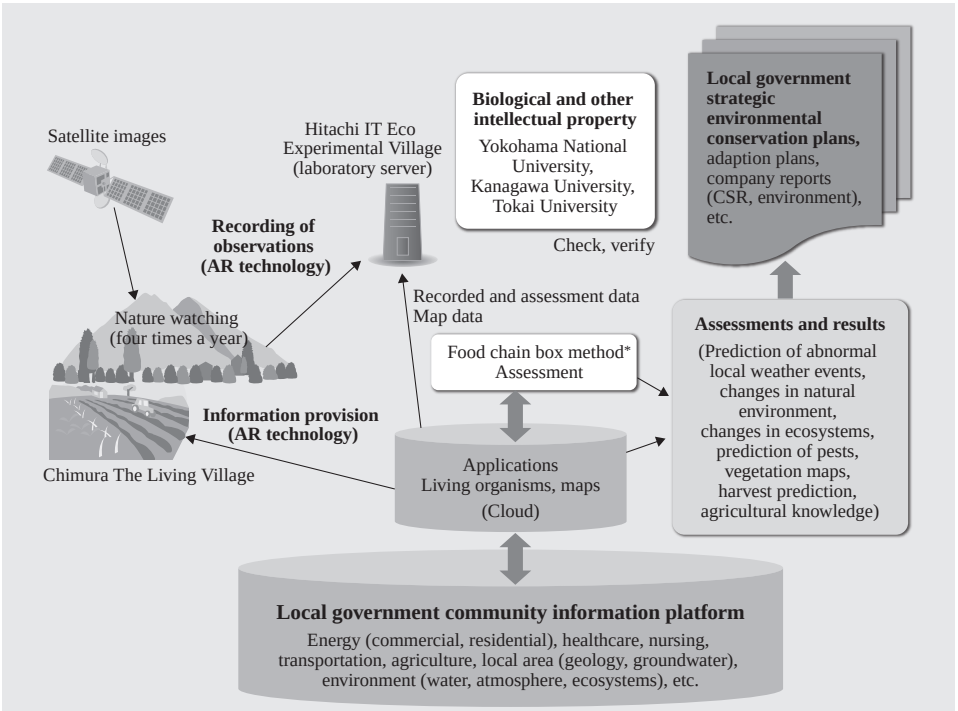
Fig. 8—Nature Watching Event Using IT.
Demonstrations were conducted involving the experimental use of augmented reality (AR) technology at a nature watching event in July 2012.

environment. The work of its ecosystem research group includes producing an electronic guide book of living organisms and research into a geographic information system (GIS) vegetation map and point evaluation using the food chain box method.

This initiative will investigate participation by residents in the collection of local environmental data to raise the visibility of ecosystem preservation. It is intended in the future to include embarking on the design of information platforms for regional conservation plans and for conservation work performed through collaboration between the region and catchment area, with the IT Eco Experimental Village to act as the venue for these experiments and data collection (see Fig. 9).

Measures Encouraging Greater Interest in Participation

Taking note of the views of participants, the IT Eco Experimental Village is considering what form it should take in the future to make itself more attractive. The aims and activities differ depending on whether it is used as a place for ecosystem preservation work and for companies to conduct environmental conservation and CSR activities, or as a place for conducting business experiments that utilize IT. Nevertheless, combining as it does people (land holders and participants), society, and nature, the IT Eco Experimental Village suits many different varieties of activity. In particular, it can be seen as having a role as somewhere where regional resources can be utilized to preserve the natural environment and also as a place for conducting CSR activities. Located in a region with an aging population and where farmland is becoming degraded and depopulated, the IT Eco Experimental Village has the potential to provide a CSR model for restoring natural habitats, and is pursuing a model



CSR: corporate social responsibility
* A simple method proposed by Professor Kawase of Kanagawa University for assessing a regional ecosystem based on a model for assessing the ecosystem pyramid by plant and animal species.

Fig. 9—Ecosystem Preservation and Uses for IT.
Overview of application to environmental conservation, adaption, and other planning involving the collection of observational data from daily nature watching events and integration with the local information platform.

based on collaboration between corporations and the community involving participation in activities such as the formulation of regional conservation plans.

In order to continue acting in a vigorous and sustainable way, the IT Eco Experimental Village intends to continue engaging on its own initiative in a higher level of social contribution, information sharing, and dialogue to meet the implicit and explicit demands of society, while also investigating how people and other organisms can coexist (a society able to coexist with nature).

CONCLUSIONS

This article has described the activities and experiments being conducted at the IT Eco Experimental Village, their application to business, the associated CSR activities, and plans for future expansion.

The IT Eco Experimental Village has been operating for two years since first opening. During this time it has engaged in ecosystem preservation work based on three objectives that are of value to companies, namely working with the community on nature restoration, raising awareness through staff participation, and the utilization of IT to conduct ecosystem preservation activities efficiently. Nearly 3,000 people have participated during these two years in activities such as nature watching or rice planting and other farm work events, working with not only company employees but also local schools and government. Although this means that the village has served to raise awareness of ecosystem preservation, its scope remains limited. Also, while it has succeeded in demonstrating through the analysis of the data collected from the environmental sensors installed at various locations in the village that it is possible to determine when to harvest rice based on cumulative temperature data, a decision that in the past was based on the experience of farmers, the specialist experiments, including the application of data, remain inadequate in some respects. Utilizing the results of these two years of operation, there is a need to produce more definitive results in relation to the three objectives and to establish more efficient ways of strengthening activities and providing benefits to the community.

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Rare-earth Magnet Recycling

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Yuzo Hiroshige
Takeshi Nemoto

OVERVIEW: The ongoing depletion of limited underground resources means that resource recycling has become an inescapable issue. In particular, the concentration of production of neodymium and dysprosium in certain countries has created a need for risk reduction measures in order to ensure security of supply. These two elements are used in rare-earth magnets, which are considerably stronger than conventional magnets. Hitachi has developed technology that can efficiently separate rare-earth magnets from used products. The company is currently working to bring this recycling system into full commercial operation, while also emphasizing the CSR aspects of the project.

INTRODUCTION

HUMANITY'S progress since the industrial revolution has been underpinned by fossil fuels such as oil and gas, and by iron, copper, aluminum, rare metals, and other mineral resources. With increasing populations, however, ever greater quantities of these resources are needed to deliver prosperous lifestyles in emerging economies and other regions. While fossil fuels extracted from the earth release carbon dioxide (CO_2) into the atmosphere when burnt, there is no corresponding reduction in the total quantity of mineral resources after they are mined and put to use. In cities with a high population density, in particular, quantities of rare or precious metals such as gold, silver, or platinum lie hidden inside electrical, mechanical, and electronic products. The term "urban mine" is used to refer to this resource. The energy-efficient air conditioner is a familiar example of a low-carbon product, while hard disks are used for data storage inside the computers that support the information age.

Hitachi has published an Environmental Vision that designates the sustainable society as the goal of its environment management, and is pursuing activities aimed at the "Prevention of Global Warming," "Conservation of Resources," and "Preservation of Ecosystems." As part of Hitachi's resource recycling initiatives, these activities also include the recycling of rare-earth magnets. This article focuses on rare-earth magnets that contain neodymium and dysprosium.

Rare-earth magnets are a key material in energy saving and digital equipment such as hard disk drives (HDDs), high-efficiency air conditioners, hybrid vehicles, and wind power generators. They also play a role in preventing global warming. However, a dependence on overseas suppliers for raw rare-earth metals means that securing an alternative supply of these materials is essential for the steady and sustainable production of these products.

Fig. 1 shows short-, medium-, and long-term measures for ensuring a secure supply of rare earths. The short-term measures consist of increasing stockpiles and decreasing consumption, the medium-term measures involve recycling, and the long-term measures involve the development of new mines and alternative materials. Recycling means separating the rare-earth magnets from used products so that they can be reused as raw materials, making it a measure that companies can conduct for themselves, independently of underground resources. Rather than simply being

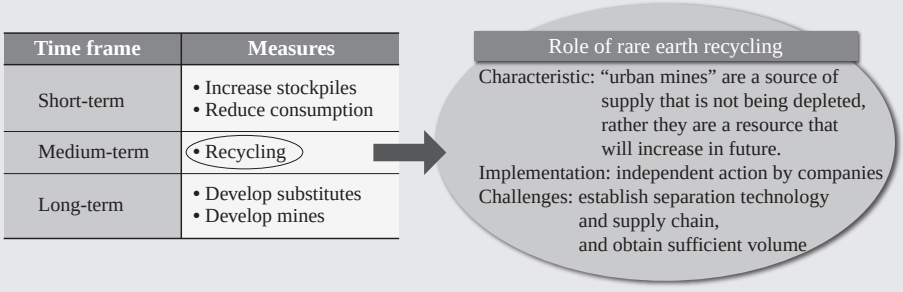


Fig. 1—Measures for Ensuring a Secure Supply of Rare Earths. Initiatives aimed at ensuring a secure supply of rare earths include short-, medium-, and long-term measures. Recycling is not dependent on underground resources and provides a sustainable supply based on recovery from "urban mines."

about the recycling of resources, this can also be seen as something that companies ought to be doing to help achieve a sustainable society.

This article describes Hitachi's involvement in the recycling of rare earths from "urban mines."

TECHNOLOGIES FOR RARE EARTH RECYCLING

Hitachi has developed magnet recovery machines designed for use with specific products that contain rare earths, namely HDDs and air conditioner compressors.

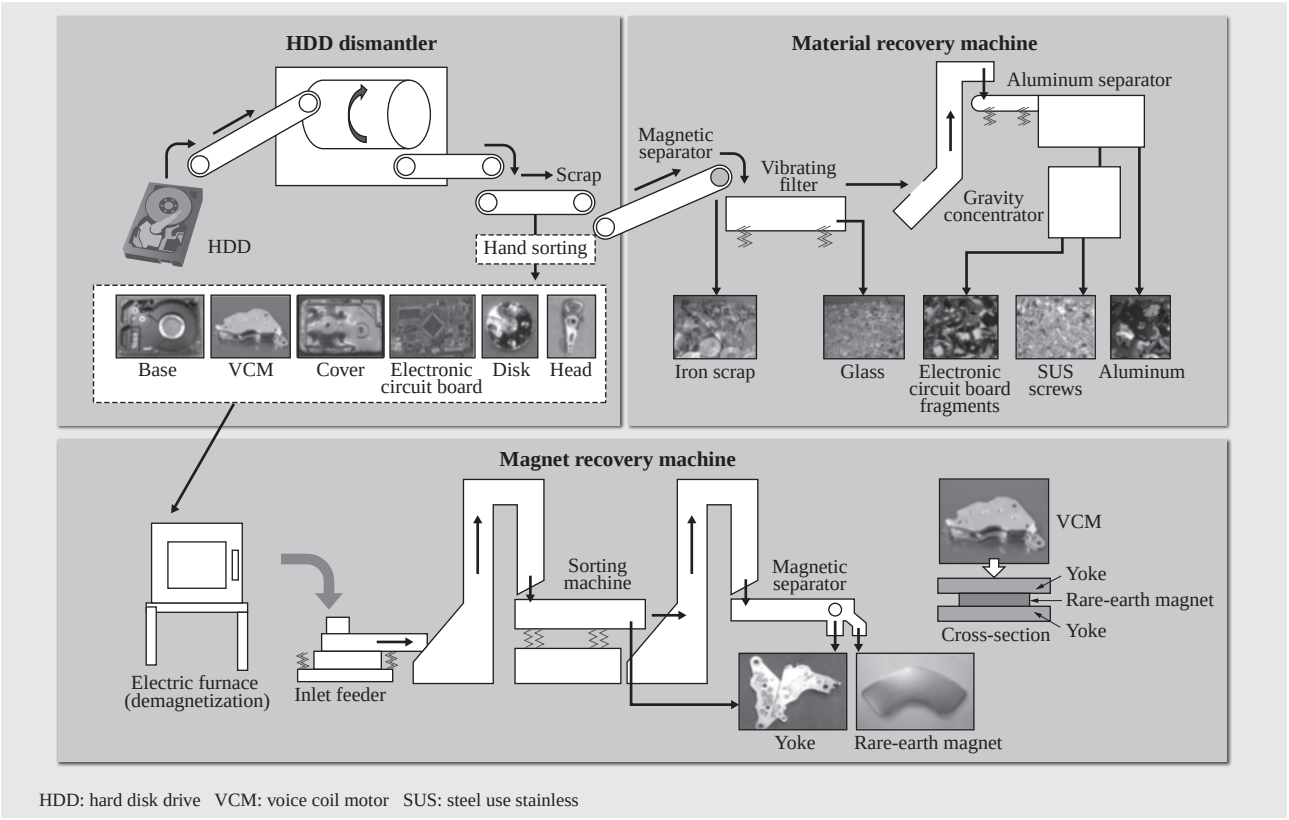
Rare Earth Magnet Recovery Machine for HDDs

The electric motors in HDDs contain rare-earth magnets. These are called voice coil motors (VCMs). Fig. 2 shows the process used to separate and recover the rare-earth magnets. While development of an HDD dismantler[(1)] that removes VCMs from HDDs and demagnetizes them has already been completed, Hitachi also developed new recovery machines for the magnets and other material respectively. The magnet recovery machine automatically removes and separates the magnets from the demagnetized VCMs, and the material recovery machine efficiently recovers the different materials from the scrap left over by the HDD dismantler. The VCMs disassembled by the HDD dismantler are then demagnetized in an electric furnace, but the external yoke and rare-earth magnets that make up the VCM remain joined by a carbonized adhesive. The magnet recovery machine then separates the rare-earth magnets from the yoke, using a machine for performing the process.

The scrap from the HDD dismantler contains iron, glass, electronic circuit board fragments, steel use stainless (SUS), and aluminum. The material recovery machine uses a combination of techniques, including a magnetic separator, vibrating filter, and gravity concentration, to separate and recover the different materials from this mixture. As electronic circuit board fragments, in particular, contain precious metals, this process acts as a form of precious metal recovery.

Rare-earth Magnet Recovery Machine for Air Conditioners

Rare-earth magnets are used in the compressors of energy-efficient air conditioners. The process used to recover these includes a mechanical unit for cutting



HDD: hard disk drive VCM: voice coil motor SUS: steel use stainless

Fig. 2—Process Used to Separate and Recover Rare-earth Magnets from HDDs.
Hitachi has developed and commercialized a process that separates the rare-earth magnets from HDDs and also sorts the other scrap to automatically separates fragments of precious metals or other valuables.

open the casing, a rotor removal machine that extracts the rotor from the motor, a demagnetizer that operates at room temperature using resonance damping demagnetization, and a magnet removal machine with a drop impact mechanism (see Fig. 3). The basic technologies for these already exist[1]. However, while all compressors may have the same basic design, there are minor differences in the shapes and structures used by different manufacturers that the system must be able to cope with. Accordingly, the practicality of the machines was enhanced through improvements that increased their operational performance and processing speed. This included modifying the process to work with compressors whose section shapes are elliptical, for example.

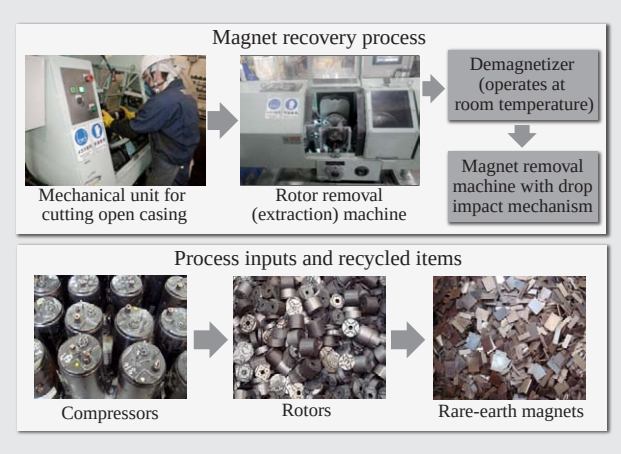


Fig. 3—Process Used to Separate and Recover Rare-earth Magnets from Air Conditioners.
The energy-efficient compressors used in air conditioners contain rare-earth magnets. Hitachi has developed a machine that damps the strong magnetic field and uses a mechanical process to separate and recover the magnets efficiently. High-volume production trials are currently being conducted on a commercial scale.

Preparations for Commercial Operation

Tokyo Eco Recycle Co., Ltd. is a Hitachi Group company based in Koto ward, Tokyo that was founded as a recycling business for recovering resources from home appliances and personal computers (PCs). It has been using the magnet recovery machines on HDDs and air conditioner compressors since FY2012 and a trial is proceeding smoothly with the quantity of magnets produced being in the order of tons. The plan is to increase plant utilization by ramping up the quantity of material collected from the market in step with the available processing capacity.

While the recovery of rare-earth magnets is the primary purpose of the newly developed machines, they are also designed to separate the other materials so that they can fetch a good price. The aim is to guard against fluctuations in the price of rare-earth magnets by augmenting the business through the sale of other materials.

FUTURE DEVELOPMENT

The security and pricing (economics) of raw material supplies pose a challenge for companies that produce products using rare earths. When recycled material is supplied to manufacturing, increasing plant utilization in accordance with material availability provides an effective way of enhancing the economics of the business. Nevertheless, the business is still influenced by fluctuations in the sale price not only of rare earths but also of the other materials produced by separation.

Meanwhile, companies that use PCs or other equipment with embedded computers also have growing concerns about non-economic considerations, including security concerns such as the erasure of data, compliance management by contractors when material is disposed of as industrial waste, and the recycling of rare-earth materials. In response to this, Hitachi seeks to collaborate on aspects such as recovery and business model design with companies that place a high priority on corporate social responsibility (CSR) considerations and include the creation of a society characterized by resource recycling and low carbon emissions in their environmental management policies. Fig. 4 shows a cycle of rare-earth recycling based on this sort of collaboration.

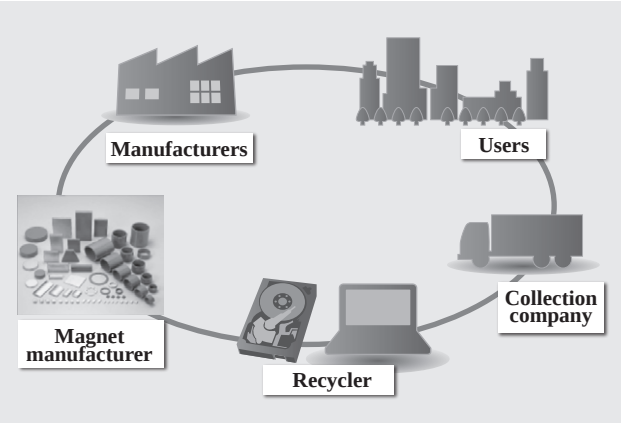


Fig. 4—Cycle of Resource Recycling (for HDD Rare-earth Magnets).
The creation of a network that recovers and recycles precious metal scrap as well as rare earths from the HDDs opens up the potential for obtaining a reliable supply of material from "urban mines."

CONCLUSIONS

This article has described Hitachi's involvement in the recycling of rare earths from "urban mines."

The development of technologies like those described here is not the only consideration associated with solving the sort of resource problems exemplified by rare earths. Factors such as economic viability and the sourcing of reliable supplies of used products are also important. Accordingly, because there is a limit to what the actions of a single company can accomplish, a contribution to making resource recycling part of society can be achieved by working with other interested parties and coordinating activities across a number of industrial groups.

The development of the technology described in this article was conducted through the "FY2009 Subsidies for Projects Associated with Resource Recycling (Urban Resources Recycling Promotion Project - Development of Technology for Recycling Rare Earths from High-performance Electric Motors)" of the Ministry of Economy, Trade and Industry and the FY 2011 "Rare Metal Substitute Materials Development Project (Grant for Practical Application of Rare Metal Substitution and Usage Reduction Technology), Development of Technology for Removal of Magnets from Products Containing Rare-earth Magnets and Recovery of Rare Earths" of the New Energy and Industrial Technology Development Organization (NEDO). Hitachi would like to express its sincere thanks for this assistance.

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report

Use of Finger Vein Authentication for Population-based Surveys in Developing Countries

OVERVIEW: A Health and Demographic Surveillance System (HDSS) is a longitudinal population data collection process for public health research in rural or marginal regions of developing countries in Africa and Asia. The lack of a residential registration system in such regions makes it impossible to calculate basic demographic information, like populations or births and deaths. Instead of the official registration system, the HDSS registers people and provides basic information for public health research and disease control programs, such as infectious disease control. However, because people in such regions sometimes change their names for reasons that relate to the local customs and culture, the system faces the problem of how to identify individuals definitely. Additionally, people in these regions are often not conscious of dates, and this makes it difficult to use date of birth for identification of individuals. In response to this challenge, an HDSS being worked on by the Institute of Tropical Medicine, Nagasaki University and the Research Institute for Humanity and Nature, Kyoto, has adopted Hitachi's finger vein authentication technology. This has made a major contribution to the research by dramatically improving the accuracy of personal identification, preventing people from registering more than once, for example. This outcome also indicates the potential for extending and enhancing not only healthcare but the full range of public services in developing countries. This article looks at further applications for finger vein authentication and upcoming business developments.

HEALTHCARE WORK IN KENYA BY INSTITUTE OF TROPICAL MEDICINE, NAGASAKI UNIVERSITY

NAGASAKI University was founded based on the Igaku Denshusho (Medical Training Institute), Japan's first ever modern, western-style hospital (established in 1857). It has a long history of working at the forefront of medicine, including the establishment in 1942 of the East Asia Research Institute of Endemics within the university. After the successful eradication of endemic diseases in Japan (such as malaria, filariasis, and schistosomiasis) in its early years, the focus of its activities in the post-war era shifted overseas. In 1967, it was renamed the "Institute of Tropical Medicine" and has devoted its efforts since then to health promotion and the prevention of tropical diseases in developing countries, working in conjunction with the School of Medicine. In particular, from the early 1960s up until 1975, the institute was actively involved in combating tropical diseases, sending medical teams to the Republic of Kenya as part of a healthcare collaboration project by the Overseas Technology Cooperation Agency (OTCA), the forerunner of the current Japan International Cooperation Agency (JICA).

Despite such initiatives, the number of people with infectious diseases such as malaria, pneumonia, and tuberculosis still showed no sign of declining. Given this situation, the institute recognized the need to strike at the underlying causes of disease.

In 1979, Nagasaki University and JICA, in collaboration with the Kenya Medical Research Institute (KEMRI), which had only just formed at the time, embarked on a project researching measures against infection diseases. In 1985, facilities were established at KEMRI headquarters (laboratory and administration, etc.) with financial aid from Japan. They were used for research and control activities

Professor Kazuhiko Moji, Research Institute for Humanity and Nature Inter-university Research Institute Corporation, National Institutes for the Humanities, Japan.

Operational sites of the Institute of Tropical Medicine in the Republic of Kenya and its base in the capital, Nairobi.

against infectious diseases (such as viruses, bacteria, protozoa, and parasites) with researchers and staff members from the Kenyan government. In 2005, the Institute of Tropical Medicine established an overseas research station at KEMRI funded by a special grant for education and research from the Ministry of Education, Culture, Sports, Science and Technology Japan. The institute has established two research bases for field surveys, one in the Suba District of Nyanza Province on the shores of Lake Victoria in western Kenya where malaria is endemic, and another in the Kwale District of Coast Province, which is located on the Indian Ocean and surrounded by savannah.

ECOHEALTH PROJECT

The EcoHealth Project (Environmental Change and Infectious Diseases in Tropical Asia), which involves surveys and research in which staff from the Institute of Tropical Medicine, Nagasaki University also participated, is being run by the Research Institute for Humanity and Nature (RIHN), Inter-University Research Institute Corporation, National Institutes for the Humanities, Japan. Project Leader Professor Kazuhiko Moji explains the nature and significance of the project as follows.

"This project is concerned with environmental change and infectious diseases in the tropical monsoon regions of Asia. It treats infectious disease as part of people's way of life and the environment in which they live, and attempts to document and analyze this situation in an integrated and cross-disciplinary manner. The 20th century is seen as an era in which people acquired health along with economic progress, particularly in developed countries. Health in the 21st century, in contrast, rather than being proportional to wealth, is something that needs to be achieved alongside a reduction in the load on the global environment. This project aims to look into what form healthcare should take in this new era."

For example, clonorchiasis (liver fluke infection) is one of the infectious diseases that afflict the tropical monsoon regions of Asia. The disease is caught by eating the raw flesh of freshwater carp, and while it is

Personnel involved in EcoHealth Project (Environmental Change and Infectious Diseases in Tropical Asia) (From left: Jiang HongWei, researcher; Bumpei Tojo, researcher; and Professor Moji of RIHN; Professor Satoshi Kaneko, Institute of Tropical Medicine, Nagasaki University; and Professor Makoto Ito, Aichi Medical University).

not immediately life-threatening, the infection can, if it persists over time, lead to liver cirrhosis. Infectious diseases like this one arise from local factors, in other words the ecosystem and the way people live. This intimate relationship with the natural environment and cultural and economic practices (which are distinctive of specific locations) makes such diseases hard to eradicate.

"Accordingly, rather than relying on drugs or other medical procedures as in the past, our aim was to find solutions that would be tailored to the social systems in each community. In the case of liver fluke infection, for example, if surveys can tell us the season in which the fish are dangerous to eat, we would be able to deploy this information in education programs. We then want to go on and consider these in terms of the problem at the national level or at the level of the regional environment so that it can lead us to a comprehensive solution." (Professor Kazuhiko Moji)

HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEM (HDSS)

The Health and Demographic Surveillance System (HDSS) has attracted attention for its use in the study of methods for dealing with infectious diseases in developing countries.

Intended for use in regions that lack adequate measures for keeping track of the static and dynamic aspects of their demographics, such as not having a register of births and deaths or a residential registration system, an HDSS provides a method for registering everyone who lives in the region to allow the systematic and ongoing tracking of changes in residency. First proposed by Professor John Gordon, an epidemiologist at Harvard University, it has proven an extremely effective tool for the provision of health and healthcare information in the sort of regions described above, and are being adopted in a variety of developing countries in Africa, Asia, and Central and South America. In practice, an HDSS involves visiting each household about once every one to three months to survey everyone living there, including information about marriages, births, deaths, or relocations. This sort of patient investigation is essential to the fight against infectious disease.

Professor Satoshi Kaneko, Institute of Tropical Medicine, Nagasaki University.

During his time at Nagasaki University, Professor Moji was involved in the small-scale use of an HDSS in studies of maternal and child health and in research into infectious disease pathogens in the 1980s and 1990s. Unfortunately, these initiatives were fraught with problems.

"The surveys were recorded in paper notebooks making it difficult to avoid entering information incorrectly or registering people more than once. It meant searching and cross-checking were very time consuming. Also, because operating a proper HDSS was expensive and labor-intensive, we were not able to expand its scope. In the end, all we seemed to achieve was an increase in the volume of paper survey forms." (Professor Moji)

USE OF INFORMATION TECHNOLOGY IN HDSS, AND THE CHALLENGES THIS POSES

Once Nagasaki University had set up its research bases in Kenya, it embarked on two HDSS research projects, one at each of the bases and each involving 50,000 people (100,000 in total). This increase in scale demanded a step up in the efficiency of survey and research work.

While this was going on, Professor Satoshi Kaneko moved to the Institute of Tropical Medicine, Nagasaki University to work on system development with a focus on HDSS site selection and information technology (IT).

"At that time, I had been working at the National Cancer Center on a cancer surveillance program development in Japan. This consisted of the "Regional Cancer Registry," a prefecture-based registration system, and the "Hospital Cancer Registry," a hospital-based cancer registry used to calculate incident case numbers

and survivals of cancer patients. Based on my experience of that system development, my aim was to also make full use of IT systems in the establishment of an HDSS in Kenya. A paper-based system for surveying 100,000 people, for example, would require 100,000 pieces of paper. Repeat the survey four times a year over 10 years and the total will reach 4 million. Not only would you need to obtain somewhere large enough to store all this paper, it would not be easy to retrieve information. Accordingly, we dispensed with paper for the survey and instead adopted IT, including personal digital assistants (PDAs) and the global positioning system (GPS). This significantly reduced the workload, time, and cost associated with the survey."
(Professor Satoshi Kaneko)

Nevertheless, a number of problems arose, one in particular being the difficulty of using names to identify and consolidate duplicate data. Underlying this problem were differences in people's concepts of name and address and the particular circumstances in each region.

"For example, there are people with more than one name and people who frequently change name due to superstition. There is also the cultural practice of not wanting to let strangers discover your name. Added to these are people with more than one address and itinerant people who move frequently from place to place. Along with the complexities of family structure in areas where polygamy is practiced, there also exist customs of giving children the same name and cultural taboos against counting the number of children. Uncertainty about date of birth is common and some respondents I met even claimed to be 400 years old. In other words, using residency information like name and address to identify individuals is very problematic."
(Professor Moji)

HDSS research without use of IT systems requires a large storage area for paper records.

While they tried issuing identification (ID) cards to overcome this situation, these were frequently lost. There were also past examples of research institutions from other countries using fingerprint-based biometric authentication in HDSS, but the accuracy of identification was a problem as fingerprints can become worn down.

ADOPTION OF FINGER VEIN AUTHENTICATION

"This left me wondering whether there was a better method. The way I became aware of Hitachi's finger vein authentication was when I visited an automated teller machine (ATM) while I was back visiting Japan from Kenya. It immediately struck me that this was something we could use. Learning that Associate Professor Yoshifumi Ueshige at the Information Media Center of Nagasaki University was conducting research into the use of biometric authentication for the personnel records of researchers at the university, I asked him to help me with the work. Associate Professor Ueshige then introduced me to Professor Yoichi Seto of the Advanced Institute of Industrial Technology, a leader in the field of biometric authentication research (and previously a researcher at Hitachi, Ltd.), and this led ultimately to my being able to contact the relevant people at Hitachi and ask for their cooperation and assistance."
(Professor Kaneko)

They went on, in March 2012, to trial the use of finger vein authentication in a survey tracking 500 people in Kenya. Whereas the reception process in past surveys invariably became very crowded, the ability to identify people simply by having them place their finger on a scanner dramatically improved the efficiency of the survey.

Another trial of the use of finger vein authentication took place in July 2012 in a survey of forest environments and malaria infections conducted in the Sepon District of Savannakhet Province in the south of the Lao People's Democratic Republic as part of the EcoHealth Project. The survey included everyone aged six or over (approximately 4,000 people) and operated an HDSS in collaboration with the Lao Ministry of Health's National Institute of Public Health and the Savannakhet Provincial Health Department.

Finger vein authentication was also used in a health survey, including fecal examination, that was conducted in December 2012 for approximately 500 junior and senior high school students in Lahanam in

Hitachi finger vein authentication system. The system is used for personal identification at bank ATMs.

the Songkhone District of Savannakhet Province. The use of finger vein authentication succeeded in boosting the accuracy with which survey participants could be identified and matched to their fecal samples.

In addition to Laos, the RIHN also plans to conduct similar work in China, the People's Republic of Bangladesh, and other countries in the tropical monsoon regions of Asia.

"Based on the results of these demonstrations, I believe finger vein authentication will be useful for many different types of record-keeping, such as vaccine inoculation records, changes in antibodies, or the provision of anti-mosquito bed nets for malaria prevention."
(Professor Moji)

"Our aim is to make extensive use of finger vein authentication in HDSS in the future, and to link it to other data sources such as hospital records or information from a geographic information system (GIS). We want to help deliver comprehensive healthcare through the comprehensive collection and analysis of data across entire communities."
(Professor Kaneko)

Shigenori Kaneko (Senior Engineer at the Global Product Department, Security & Smart ID Solutions Division, Information & Telecommunication Systems Company, Hitachi, Ltd.) who was involved in the technical development of the finger vein authentication system, described the product issues that have been highlighted by the demonstrations as follows.

"The survey participants include infants. Identification problems sometimes occur with small children because it is difficult for them to insert their fingers far enough into the scanner, or because their finger vein patterns change as they grow. Also, because these sorts of surveys are often conducted outdoors, there is a need to improve identification accuracy under conditions of strong sunlight. While these sorts of issues were not anticipated, the product being

Demonstrations in the Lao People's Democratic Republic were conducted in Savannakhet Province in the country's south.

Use of finger vein authentication in surveys in Kenya (left) and Laos (right).

EcoHealth Project Sub-Leader Futoshi Nishimoto working on a survey (researcher, RIHN).

originally intended for office use, we want to utilize these discoveries in future product development and to improve the ways in which the system can be used. We are also finding other unexpected conclusions and pointers from these new initiatives that use finger vein authentication."

POTENTIAL OF BIOMETRIC AUTHENTICATION

Professor Moji sees three major benefits that the use of biometrics for personal identification offers to future healthcare. He describes these as follows.

"The first is providing centralized access to personal information such as your medical history or hospital attendance records. This should help reduce cases of patients having to repeat their stories at different hospital visits or undergo the same tests multiple times. It also offers benefits for healthcare administration by simplifying the tracking of what treatments each patient requires and what care they should be receiving. The third benefit is that, because it facilitates the use of IT for data storage, it supports the application of big data to the monitoring of people's health."

That is, it makes it possible to obtain new knowledge from areas that have not been looked at in the past, such as determining how the environment influences people's health by comparing people's data against monitoring information on environmental change to identify any correlations. Analyzing big data on personal health and using this information appropriately has the potential to bring about major changes in how society functions.

Meanwhile, biometric authentication technology also has the potential to make enhancements across the full range of public systems. In India, for example, a project currently underway is establishing a database of biometric information for the entire population of about 1.2 billion. This involves recording not only fingerprints but also iris (the thin membrane that regulates the quantity of light entering the eye) and facial photographs, and tying this biometric information to each person's national ID. It is anticipated that emerging and developing countries will proceed with more initiatives like this in the future, and that they will help extend a wide range of different public services, such as census taking, patient registration by medical institutions, and the design and implementation of healthcare systems.

"It may be that developing countries will be able to establish their own superior systems that leapfrog the social infrastructure that developed countries have built up over many years. In the case of Laos and Bangladesh, close to the entire population has mobile phone coverage. To the extent that they have avoided over-regulation, their IT environments are in some ways

better than Japan's. If advanced techniques can be made to work successfully in such places, it is not unrealistic to expect systems from developing countries to be imported back to developed countries in the future." (Professor Kaneko)

Developed world technology that undergoes a process of evolution in developing countries—what is needed for this to occur is a flexible remaking of uniquely Japanese systems that have undergone their own isolated "Galapagos-style" evolution. In regard to this, Yasushi Ikeda (General Manager of the Solution Sales Group, No. 2 Sales Department, Sales Management & Accounting Division, Information & Telecommunication Systems Company, Hitachi, Ltd.), who is involved in promoting new applications for finger vein authentication, explains their motivation as follows.

"Hitachi's finger vein authentication was originally developed for security applications where it needed to satisfy very stringent requirements. On the other hand, the main objectives in developing countries are things like ID management and personal IDs, and the ways in which the technology is used and the environments in which it must operate are many and varied. It seems likely that we will need to change the specifications in the future to suit different uses. Meanwhile, when it comes to collecting a diverse range of information and then linking it together, there are the problems of how to handle big data and how to utilize cloud computing. Not only are these questions with which Hitachi is currently wrestling, they are also our areas of expertise, and therefore we see scope for making further contributions in the future."

Shigenori Kaneko, Senior Engineer at the Global Product Department, Security & Smart ID Solutions Division, Information & Telecommunication Systems Company, Hitachi, Ltd. (left) and Yasushi Ikeda, General Manager of the Solution Sales Group, No. 2 Sales Department, Sales Management & Accounting Division, Information & Telecommunication Systems Company, Hitachi, Ltd. (right).

In the long-term view, the implementation of public systems that draw on know-how in biometric authentication systems, big data, and the use of the cloud can be thought of as infrastructure exports in the software sense. It is clear that this will play an important core role in future business activities in developed as well as developing countries.

Demonstration in Kenya (March 2012)

Problem
- Difficulty of personal identification when compiling databases of regional residential information in developing countries

Solution
- Use finger veins as a form of personal ID

Result
- Registration of approximately 500 people and significant reduction in time required for identification at regular health checks that started in April. Eliminated queuing that had occurred in the past.

Phase 1 Demonstration in Kenya	Phase 2 Demonstration in Laos	Phase 3 Use as medical ID	Phase 4 Use as social ID
	Demonstration in Laos [(1) July and August, 2012 (2) December 2012] (1) Number of participants increased to 3,200. Used for personal ID in malaria study and to link individuals to their samples. (2) Number of participants increased to 7,000. Used for personal ID in fecal examination study and to link individuals to their samples.	(1) ODA proposal to Ministry of Foreign Affairs of Japan and JICA (2) Proposed for use as medical ID for hospital in Republic of Vanuatu	Applications such as driver's license, social insurance, or mother-child notebooks

ID: identification ODA: official development assistance JICA: Japan International Cooperation Agency

Overview of past work and future strategies.