

MOMENTUM

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Insights into
analytical
instrumentation of
the future



MOMENTUM



3 **President's Message** **Supporting a Safe, Secure, and Abundant Lifestyle for Everyone**

President & Chief Executive Officer **Akira Nakamoto**



4 **Interview** **Hidetoshi Nakata** **Connecting Japan with the world**



8 **Energy Foresights** **Insights into analytical instrumentation of the future**

Shimadzu Center for Advanced Analytical Chemistry at
The University of Texas at Arlington

14 **Innovative Healthcare and Medicine** **Trends in medical tourism** Spotlight on Bumrungrad International Hospital



20 **Shimadzu Technology Focus** **New eyes for aircraft pilots**

22 **Shimadzu Global Network** **Shimadzu USA Manufacturing, Inc.**

23 **Corporate Social Responsibility** **Continued Support for United Nations University Environmental Projects**

Supporting a Safe, Secure, and Abundant Lifestyle for Everyone

Kyoto is the birthplace of Shimadzu Corporation. The history of Kyoto begins with the decision by Emperor Kammu to found a capital city in 794. From then on for over a thousand years until the transfer of the capital to Tokyo in 1869, Kyoto was the center of Japanese government, economics, and culture. In this long flourishing metropolis, a distinctly Japanese lifestyle and culture were cultivated, and a number of historical treasures were amassed.

The highly cultural environment also had a significant impact on craftsmanship in Kyoto, fostering a number of traditional industries around kimonos, ceramics, and sake brewing. This accumulation of tradition spawned a number of technological enterprises brimming with venture spirit, and shaping Kyoto into the industrial metropolis it is today.

Shimadzu Corporation was founded in Kyoto in 1875, as one such technological enterprise. At the time, Japan was in the midst of a cultural awakening, striving to absorb science and technology from Western Europe so as to become a modern industrial nation. Living during this era, Genzo Shimadzu Sr burned with the desire to see Japan reborn as a scientific nation. Our company was founded when he renovated his private residence, and began to manufacture physics and chemistry equipment for educational use. Once established, Shimadzu Corporation carried on the tradition of craftsmanship in Kyoto, while introducing various technologies from Western Europe. In the process the company created a succession of new technologies and products.

“Contributing to Society through Science and Technology,” has been our corporate philosophy since our inception. It is always kept firmly in mind, and we strive to realize its aims in all our present activities. To create new technologies, we face difficulties with enthusiasm, stretch our intellects, and learn from our mistakes, while striving to contribute to the development of science and society. Our technologies and products have become indispensable to activities for the purposes of research and development and quality control in various fields, including the environment, medical care, and agriculture. At the same time, while the explosion of scientific and technological development that began in the 20th century has been very fruitful, it has also dramatically expanded human activities, and led to a number of problems. We are now living an age faced with a variety of problems on a global scale, including resource depletion, global warming, damage to the ozone layer, and the appearance of new diseases. These too must be solved through further advancement and the appropriate application of science and technology. In solving such problems, we take as our goal the management principle of “Realizing Our Wishes for the Well-being of both Mankind and the Earth.” We shall continue to strive with our eyes on the future, so as to provide science and technology that plays an optimal role in ensuring the safety and peace of mind for everyone worldwide.

This magazine is published to promote awareness of our aspirations as broadly as possible. We appreciate you taking the time to read its contents, and welcome your frank opinions on what they offer.



President & Chief Executive Officer

Akira Nakamoto

Hidetoshi Nakata

From soccer to social action, Hidetoshi Nakata's travels around the world prompted the Take Action Foundation for community development and revitalization support, as well as an epic exploration of all 47 prefectures in his homeland. He explains how he discovered the importance of fun and the value of Japanese ideals to keep improving.

Starting soccer at the age of eight, Hidetoshi Nakata stood out from an early age for his excellent physical ability and technique. He was offered entry to 11 of the 12 Japan League Clubs that existed at the time and joined Bellmare Hiratsuka (now Shonan Bellmare) after graduating from high school. He went on to play for the national football team for many years. Nakata gained recognition for his brilliant performance in a qualifying competition in France for Japan's first appearance in the World Cup finals and three other group-league matches. The following year, he transferred to AC Perugia in the Italian Series A, expanding his stage to the world.

Meanwhile, Nakata was keen to "be a person who knows things other than just soccer". He avidly absorbed everything he could and was constantly looking not only at soccer but also at things that lay beyond the playing field. As one example he became diligent in his language studies during his playing days.

Since retiring, he has continued to take new challenges, always maintaining a view of the broader horizon of the world at large with the aim of exceeding the scope of an ex-soccer player. So what does he see for the future and what is he trying to do?



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Connect with the

An elevated appreciation of soccer from traveling the world

After the World Cup in Germany, Nakata traveled the world for more than three years.

He hadn't decided what to do after retirement, and was fortunate to have plenty of time. Having always been a curious kind of person who likes foreign countries, he wanted to travel and see the world with his own eyes. "I wanted to see what kind of lives people overseas are living and what opinions they have," he explains. At the same time, he wanted to explore what might be his role in the world and discover his potential.

"In overseas tours during my playing days, I only moved between the hotel and the stadium," says Nakata. "There were no opportunities for getting to know an area's culture or way of life." He adds that back then, when he had a few days off he would travel to European countries by himself, sometimes to Northern and Eastern Europe. After retirement he mainly visited non-European countries including

Asia, South America and the African continent, places he had not visited as much before. "In so-called developing countries, there are a lot of things that you can't know unless you actually visit the place," he says. He discovered that people in these countries tend to come up with all kinds of new ideas and inventions precisely because they don't have everything already.

He made many friends from various countries during his travels and noticed that wherever he went in the world people always recognized him. He came to understand the universal awareness of soccer as a sport and how much it is enjoyed globally. "And surprisingly enough, soccer has a greater presence in developing countries," he adds.

Generally speaking, soccer is often conducted commercially on a purely win-or-lose basis. But during his travels, it struck him that there could be other ways of conducting soccer. For example, players just enjoy playing soccer games, which in its own way contributes to society. In 2009 he established the TAKE ACTION FOUNDATION (*)based on these sentiments. "Basically, I consider it important for people to find doing something fun and exciting," he explains.



Hidetoshi Nakata

Profile

Representative Director, TAKE ACTION FOUNDATION

As a player for the national football team, Hidetoshi Nakata played in three World Cups: in France in 1998, in South Korea in 2002 and in Germany in 2006. He retired after the World Cup in Germany. Based on his experiences from travelling to more than 100 countries and regions around the world after retiring, he started the "TAKE ACTION! 2008+1 Campaign" in 2008, and established the TAKE ACTION FOUNDATION in 2009. In the same year, after beginning to travel to all of the 47 prefectures of Japan, he started a project at the foundation to support traditional culture and craftwork. He has also been the CBO (Chief Branding Officer) for Tohato since 2003.

ing Japan
world

“There are various forms of social action and their objectives are surely important, but I personally think that people will only continue them if the participants feel they are fun.” He takes charity as an example - rather than just asking people for money for a charity, he suggests encouraging them to do something unusual and fun precisely because fundraising for charity is a special occasion. “I want to plan fun events that would not happen if they weren’t for charity, like recruiting unusual members to play soccer.” He adds that those donating would also be more motivated to participate again if the events were fun.

Social action is often talked about in recent years. Nakata believes that having groups or organizations with great social influence actively conduct exciting events will brighten society and lead the world in a positive direction.

Rediscovering Japanese ideals

During his travels around the world, Nakata had the strong impression that many foreigners were interested in Japan. He found that wherever he went he was asked a number of meaningful questions about Japan. However he couldn’t answer properly because he had left Japan when he was 21 and hadn’t really studied his homeland before then. “And then I realized it – I’ll always be Japanese. If I’m going to be asked about Japan like this by foreigners in the future as well, I must know more about Japan.” With this

determination, he started to travel through all of the 47 prefectures of Japan.

“When I started this domestic journey in 2009, I had little information and knowledge, so I thought three days for one prefecture would be enough,” he recalls. “However, continuing the journey, I realized the importance of getting to know the natural environment of the area, which alone requires a few days.” He would look into various aspects of the area: Is it close to the sea or the mountains? Is it warm or severely cold? “These factors affect the culture and characteristics of people living there,” he explains. “I came to know that “food” in particular is the basis of their living and culture.” His interest continued to broaden, and he began to explore different aspects, such as the area’s food culture, liquors, traditional crafts and the religion — the shrines and temples. In addition, because lodging is an important factor for a traveler, he changed accommodation every day and so experienced many different types of lodging. He found his travels came to require at least three weeks per prefecture, quite a difference from three days. After a penetrating look at how people live, he came to understand just how great Japanese people’s manufacturing skills were, as well as their passion for it.

The Japanese ideal for constant improvement and manufacturing

“If I were now asked about what characterizes the Japanese, I would probably say that Japanese people, rather than attempting to complete something, try to continue to make good things,” says Nakata. He



Starting to travel all over Japan in 2009, Nakata witnessed each area's culture and industries and felt anew the attractions of Japan. He currently works on a project that aims at preserving traditional culture and mastery craftworks at a foundation where he is the Representative Director.

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He organized charity matches in Thailand and Singapore in 2011 for providing disaster assistance in the wake of The Great East Japan Earthquake. Proceeds from the matches were donated to Japanese Red Cross Society via the local Red Crosses, and used to provide jerseys to soccer teams in devastated areas.

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explains how many aspects of Japanese culture include the word ‘do’ in them, which means ‘way’ or ‘road’. Examples are *judo*, *sado* (art of tea ceremony), *kado* (art of flower arrangement) and *shodo* (art of calligraphy). “‘Roads’ have no end,” says Nakata. “So we are patiently walking the road of continuing to manufacture good things.”

This is quite in contrast to foreign countries where people value mastering techniques and aim for completed products. Japanese craftspeople nonchalantly say that they have at last progressed a little at the age of 70 or 80, or that 30 or 40 years of age in their field is still half-fledged. “I think such a spirit is great,” says Nakata. “And this Japanese character and spirit are also evident in the area of advanced industrial technologies. This seems to be the reason why Japanese products are trusted.”

Connecting Japan and the world

Now Nakata has traveled the world, and Japan, and feels that he can see how to effectively use the accumulated experience and discoveries he has made along the way. He plans to continue creating activities that are based on “Japan” as his lifelong career.

“I witnessed with my own eyes that there are many great things in Japan. Globalism has long been talked about, but the present world puts the economy ahead of all else in every field, basically viewing everything from the standpoint of costs and compensation.” He describes how nowadays being inexpensive, easy and quick is the trend. “However, just living isn’t such an easy thing for humans to

do.” Nakata wants to foster an appreciation for a culture where people make good things with effort.

He is looking into the idea of holding a fair in Kyoto, Japan, to which craftspeople from all over the world would be invited — of course with an eye to economic potential as well. “Japanese manufacturing has been attracting interest from many people around the world. My role is to act as a bridge connecting Japan with the world. And I would like to keep on doing it.”

Nakata’s journey through Japan will end soon. But he wants to do it again and meet more people, make new discoveries and raise public awareness of things. “I want to be a person who knows more about Japan than anyone else in the world. And I want to continue to act as a bridge for people around the world so that they can learn more about the various aspects of “Nippon,” in a way that’s fun for everyone.”

* TAKE ACTION FOUNDATION

The foundation was established in 2009 with the theme, “Just one thing, whatever you can do.” It aims to create a springboard for everyone to think about what they can do as individuals and how to take action and continue these activities. The main activity of the foundation is using soccer matches as a vehicle for providing assistance to developing countries, contributing to community revitalization and providing disaster assistance in the wake of The Great East Japan Earthquake. Activities also include initiatives in collaboration with companies conducting corporate social responsibility (CSR) activities, as well as supporting traditional Japanese culture.

Insights into instrumentation the future

Shimadzu Center for
Advanced Analytical Chemistry at
The University of Texas at Arlington



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Forecasts of dramatic increases in the world's population have triggered efforts worldwide to find new sources of energy and more effective ways of exploiting conventional energy sources.

The focus on energy has also prompted concerns over associated environmental issues and the impact of energy consumption and generation processes on water, air, and soil. Fossil fuels are a prime example, where continued reliance on coal could lead to greater amounts of carbon dioxide being released into the atmosphere, escalating a number of environmental problems.

Needless to say, it is necessary to devise alternative energy solutions that have a low impact on the environment.

At Shimadzu Corporation we want to use our internationally renowned analytical instruments to solve energy-related environmental problems. For example, the Gas Chromatograph Mass Spectrometer (GC-MS) enables the qualitative and quantitative analysis of the chemical composition of samples. This analytical instrument can help towards evaluating and improving the efficiency of energy generation techniques—for both conventional and new approaches.

Another example is the Total Organic Carbon Analyzer (TOC). The analysis of samples of water from energy extraction sites allows environmental evaluation and identification of different sources of pollution. In particular, the carbon content of water is a useful indicator of water pollution. Our TOC is used extensively for these kinds of environmental applications. In this way analytical instruments manufactured by Shimadzu Corporation can be used for ongoing monitoring of environmental health, as well as one-off evaluations thus contributing to society through science and technology

Shimadzu Center for Advanced Analytical Chemistry

In this issue of Momentum, we meet Kevin Schug, The University of Texas at Arlington (UT Arlington) Associate Professor of Chemistry and Biochemistry, Shimadzu Distinguished Professor of Analytical Chemistry and Shimadzu Science Advisor to the Vice President for Research. He tells us about his challenging research on the environmental effects of extracting shale gas in northern Texas and how Shimadzu instruments contribute to his work.

“We have one of almost every analytical instrument produced by Shimadzu,” explains Schug. “Collaboration and partnerships with Shimadzu have been extremely productive in helping us meet our analytical goals.” The suite of instruments at the Shimadzu Center for Advanced Analytical Chemistry (SCAAC) include a TOC, a headspace gas chromatograph (headspace-GC), multiple GC-MS, multiple liquid chromatograph mass spectrometers (LC-MS), and an inductively coupled plasma optical emission spectrometer (ICP-OES).

The SCAAC was opened on 9 April 2012 with Dr Kozo Miseki representing Shimadzu Corporation. The Center houses chromatography, spectroscopy, and mass spectrometry equipment worth US\$6 million. Its mission is to provide support for science and engineering research to academia, government, and industry, either per sample or on a contract basis.

It is part of UT Arlington's Shimadzu Institute for Research Technologies. The Institute is a \$25.2 million (US) endeavor fueled by Shimadzu Scientific Instruments' \$7.5 million corporate gift to the University and their previous in-kind gift of nearly \$3 million in instrumentation.

“I have used analytical equipment made by Shimadzu since my graduate school days”, says Schug. “I am able to act as a conduit for new research avenues for the Center and local researchers in academia and industry. I also coordinate partnerships between UT Arlington, Shimadzu Scientific Instruments, Inc., and Shimadzu Corporation.”

The roots of Schug's research are in chromatography but he is extending his work towards studies aimed at a better molecular level understanding of separation systems. An example is the improved methods under development for metabolite analysis based on hydrophilic interaction liquid chromatography.

Electrospray ionization is another area of expertise for the Schug group. Here the goal is to develop increased throughput methods for measurement by mass spectrometry of non-covalent binding for high-efficiency drug discovery protocols.

The applications of Schug's research stem from his fundamental understanding of the advantages of combining high-efficiency separations with high-sensitivity mass spectrometry detection.

Furthermore, Schug is optimizing on-line sample preparation using restricted access media, specifically the CoSense instrumentation set-up and MAYI semi-permeable surface phases, in conjunction



with LC-MS workflows.

“This approach is under-exploited in the United States,” says Schug. “We have first-hand experience of the significant benefits of direct injection of biological fluids for the determination of traces of small bioactive molecules.” Experiments on the determination of steroid hormones and endocrine disruptors from matrices, such as plasma, cerebrospinal fluid, urine, and saliva, show higher recoveries and improved detection limits using CoSense compared with off-line sample preparation techniques. The instrumentation at SCAAC has played a pivotal role in Schug’s research on the potential impact of industrial processes on the environment. These include ‘fracking’ and its effect on the quality of water in private wells in Texas. The studies have made full use of Shimadzu instruments, such as GC-MS and ICP-OES for chemical and metal speciation in water samples. “We are quite excited about our most recent acquisition of GCMS-TQ8030 technology,” says Schug. “This will be used to determine the byproducts of disinfection and other environmental contaminants in water.”

The Shimadzu Center is also a hub for student education. Schug explains how his students are highly trained users on many of the instruments in the Center. “Their experience of working on research projects enables them to train other researchers,” he adds.

Schug is also participating in the development of new inquiry-based

laboratory experiments for introductory chemistry courses at UT Arlington. Notably, of the US\$18.5M allocated for acquisition of instrumentation for the Shimadzu Institute for Research Technologies, which was formally established in February 2013 and includes the SCAAC, approximately US\$3M was earmarked for instrumentation

for undergraduate teaching. The accessibility of instrumentation at SCAAC within a research environment provides an unprecedented opportunity for students at UT Arlington to contribute to research and development.

As Schug stresses, there are few other places in the world where first-year

undergraduate students are exposed to state-of-the-art GC-MS, LC-MS, and other spectroscopy instrumentation as part of their science laboratory coursework.

“The collaboration between Shimadzu and UT Arlington is a truly unique partnership, and it is exciting to play a central role in directing much of this activity.”





Research on the environmental impact of ‘fracking’

Hydraulic fracturing or ‘fracking’ is a procedure used to recover gas and oil from layers of shale rock lying several kilometers below the Earth’s surface. More precisely, in the process of fracking, a hole is drilled into the Earth after which a high-pressure liquid mixture of water, chemicals, and sand is injected into the rock with the goal of forcing the gas to flow to the well head. Often, the well is drilled horizontally into the rock to create cracks that release gas.

Schug is working with colleagues to clarify whether fracking has any negative effects on private well water quality. But why look at private wells? Schug explains that

in spite of fracking being ‘big business in Texas’, with extraction sites near highly populated areas, organizations such as the Environmental Protection Agency only regularly monitor municipal water quality. Private well water is not regularly tested.

In a recent publication Schug and his colleagues reported finding higher levels of arsenic in groundwater near North Texas shale gas wells [1]. “We analyzed water from 100 wells in this, the largest study of its kind ever conducted,” says Schug. They used a variety of analytical techniques including Shimadzu GC-MS, Shimadzu headspace-GC, and an ICP-MS.

The findings generated considerable interest within the media and the scientific community. The researchers at UT Arlington are keen to document their findings for use as ‘best practices’ for minimizing potential contamination related to fracking.

Schug and his team have started further studies in other parts of Texas where new fracking is starting. “In west Texas, we were able to initiate a time course study to include a baseline of water quality parameters prior to the start of hydraulic fracturing activities,” says Schug.

Recent research highlights from the Kevin Schug Group

Antibacterial drug discovery

One of Kevin Schug's projects is on the development of new materials for antibacterial drug discovery based on an ambient ionization mass spectrometry workflow [2]. This is research that is being conducted with two other UT Arlington chemists: physical materials chemist, Professor Richard Timmons and synthetic organic chemist, Professor Frank Foss.

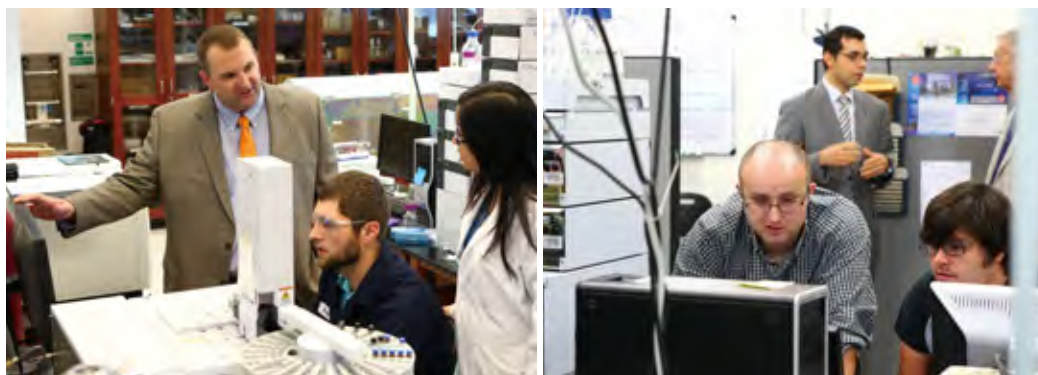
The initial proof-of-principle results of this project demonstrate what may potentially be a promising method for identifying unknown bioactive compounds in complex mixtures. Their approach further develops functionalized polymeric mesh screens for selective compound extraction and direct analysis by transmission-mode desorption electrospray ionization (TM-DESI) mass spectrometry. The researchers envision this tool offering a new approach for natural-product drug discovery from less well-known natural sources that are only present in limited quantities.

Bulk derivatization for high-sensitivity detection of target molecules

In conjunction with his research on CoSense and on-line sample preparation, Schug is also working on bulk derivatization [3]. Here, a derivatization reagent, which acts as a probe to target small molecules of interest, is added directly to a biological fluid sample prior to any other pre-treatment, except perhaps pH adjustment.

The role of the derivatization reagent is to facilitate increased ionization efficiency in electrospray ionization mass spectroscopy. This improves the lower limits of detection for the target compound.

"Although derivatization in general is often considered to be a hassle, it is our experience that as much as two to three orders of magnitude in sensitivity can be gained with molecules such as estrogens by appending a group that increases the surface activity and a propensity for charge acquisition," says Schug.



The researchers are preparing manuscripts for publication that fully describe automated protocols so that a biological fluid sample need only be placed in the auto sampler for the necessary pre-treatment. Schug adds that such methods would be especially useful for the analysts at the SCAAC at UT Arlington.

The future of analytical instrumentation

Schug has his own vision of how analytical instrumentation will evolve by "getting smaller and more sensitive". He also expects a revolution in the next few years with increased use of cloud computing to handle big data.

He adds that massive data mining will allow researchers to address many questions in parallel and get answers back fast. The challenges include devising effective training methods, namely, interfacing computer science and informatics with analytical chemistry.

Shimadzu Corporation has an excellent pedigree to lead the advance of this new analytical technology with its wide-ranging instrumentation. Indeed, UT Arlington is working with Shimadzu to develop new streamlined solutions for data analysis by using cloud computing resources at UT Arlington.

"We are extremely excited about our future plans for collaborating with Shimadzu to develop multivariate data correlations in research areas as diverse as environmental contamination and disease biomarker discovery."

Further information

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An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation

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Trends in medical tourism

Spotlight on Bumrungrad
International Hospital



Why medical tourism?

The concept of travelling to find high quality medical care is not new. So-called medical tourism has its roots in ancient civilisations, where people travelled great distances to places famed for curing certain illnesses and diseases. In more recent decades, with the increasing ease and affordability of international travel,

the world has seen an upsurge in medical tourism, predominantly and perhaps surprisingly from Western to Eastern countries.

Spiralling medical costs, problems with health insurance, pressures on public health boards and lengthy waiting times for operations in the USA, UK, and Europe

have contributed to an increase in people travelling abroad for medical care. Over fifty countries now class medical tourism as a major contributor to their national economy—in Thailand, for example, medical tourism earns the country billions of dollars every year.





Bumrungrad International Hospital in Bangkok

Thailand's success in the global medical marketplace is mainly due to the hugely successful Bumrungrad International Hospital in Bangkok, a company traded on the Thai stock exchange. The hospital, whose name translates as 'care for the people', prides itself on being a 5-star facility in terms of its services, its international team of medical professionals, and its state-of-the-art technology. Shimadzu Corporation is proud to support the high level of technology underlying the hospital. With over 550 beds, 33 specialist centers, and the ability to see over 400 in-patients and 3000 out-patients per day, Bumrungrad is leading the world in terms of high quality, efficient and effective medical care. In fact, the hospital has now been accredited a total of four times by the Joint Commission International—the American gold standard for hospital quality.



World class doctors and hospital management

Bumrungrad's success is due to a number of different factors, not least their total commitment to three key aims: to satisfy patients, to satisfy all members of staff and to continuously develop and improve the hospital. Although the main intake of patients is from Thailand, over 40% of patients are from across the globe. Twenty-five thousand patients every year are from the USA, where medical bills are rising so fast that it can be tens of thousands of dollars cheaper to travel to Bumrungrad for hospital care. Another fifty thousand a year come from Europe and East Asia, and a staggering

one hundred thousand patients per year arrive from the Middle East.

With so many people travelling to Bumrungrad every year, the hospital endeavours to make visiting the center as easy as possible. The hospital's 1200 doctors all speak English, and many of them spent time training in the USA, the UK or Europe. The high calibre of staff is an attribute the hospital management are most proud of.

The hospital has a dedicated international medical coordination office which deals with incoming medical care requests and ensures that necessary medical records detailing

patients' treatment at Bumrungrad are sent for the patients' doctors back home. The technology behind patients' medical data and record-keeping has been awarded for its innovation. Most information is inputted and stored on computer, reducing paper use and increasing speed and efficiency.

In addition to high tech data management, the hospital has also installed one of the first robotic medication dispensing system of its kind in Asia. The Swisslog™ system prescribes and dispenses exactly the right type and dosage of medicine for individual patients, significantly reducing human error in the process. This and other technologies are integrated with work process management to deliver excellent patient safety, operating efficiency, and return on the hospital's assets.



State of the art medical technology

Robotics also plays a key role in the medical technology available to the doctors at Bumrungrad. Robotic arms assist joint replacement surgery, for example. The very latest positron emission tomography (PET) scanners improve chances of early cancer detection and diagnosis, while digital mammography aids in improving scanning resolution for breast cancers. Patients expecting a baby can opt to have four-dimensional scans – a high-tech application of ultrasound that takes twenty-five snapshots per second allowing parents-to-be and medical staff to see live film of the baby in the womb. An onsite, automated lab, plus PACS image management system, give doctors throughout the hospital campus

quick access to important diagnostic information.

Shimadzu Corporation is one of the companies making important contributions to the hospital's technology. With over 100 years of experience in developing x-ray and imaging equipment, Shimadzu specializes in developing the newest digital equipment for radiography, cardiology, mobile x-ray and fluoroscopy. Our aim is to provide flexible, high resolution, low radiation imaging systems for use in hospitals across the globe. The direct conversion flat panel detector developed by Shimadzu for example, together with the circulatory organ diagnostic system onto which the detector is mounted, is a unique x-ray imaging device.

The detector produces the highest quality digital x-ray images available on the market. Our surgical mobile C-arm equipment can be used in many different fields of medicine. New energy-dispersive x-ray fluorescence spectrometry equipment will also supply a flexible, easy-to-operate system for medical professionals in addition to providing a much safer scanning procedure for patients.

Shimadzu Corporation also manufactures analytical and measuring equipment for clinical and pharmaceutical use, in particular for the research, development and quality control of new drugs. All of these technologies contribute significantly to the day-to-day work of the hospital, allowing for high speed, high resolution imaging results and quick patient diagnoses.

The hospital is committed to diversification, expanding its specialist departments to cater to international demand, and equipping itself for the challenges of treating newly discovered diseases. With these goals in mind, Shimadzu Corporation will continue



to provide the latest technology for Bumrungrad and its specialist centers in the future.

Bumrungrad's management team are more than aware of the increasing competition from other high tech and highly specialized medical centers in other countries. India, Singapore, Taiwan, and Malaysia, for example, offer increasingly high quality of care in many of their hospitals, and are

adopting advanced technology, too. Rather than worrying about the competition, however, Bumrungrad's staff are relishing the challenge of competing and remaining a leading care center.

The management team at Bumrungrad are confident of overcoming competition predominantly through the quality of its internationally-trained doctors and nursing staff. Boosting staff morale through listening

and acting upon their ideas for the future will continue to build trust and commitment to the hospital from the staff. Staff are given incentives through a reward scheme which encourages them to contribute ideas and provide exemplary patient service. They are also trained regularly in new technology and computing systems at the hospital's own education center on site.

Global network

The hospital also has a network of referral offices in many countries, ranging from neighbors such as Cambodia and Myanmar to more distant patients sources in Australia, Mongolia, Africa and the Middle East. Bumrungrad also has contractual agreements with dozens of leading health insurers, offering expatriates and tourists convenient

access when they are covered by the insurers' plans.

The numbers of true 'world hospitals' like Bumrungrad will rise in the coming years. They will help serve the needs of increasingly aging populations living in countries with inadequate or strained healthcare resources. The demand for high level, highly specialized

technology will also continue to grow, and Shimadzu Corporation is committed to meeting that international demand. As each hospital builds on its knowledge base, staff training and expertise, new technologies will be developed to help fill current knowledge gaps, increase chances of early diagnosis and provide doctors with the tools they need to perform high precision operations. Shimadzu aims to lead the way in equipping the best world hospitals of the future.



Shimadzu helmet mounted display equipped on the JAXA research helicopter

New eyes for aircraft pilots

Pilots of a particular type of aircraft have a helmet mounted display (HMD) installed in their visors. Shimadzu Corporation and Japan Aerospace Exploration Agency (JAXA) are now coordinating their research to apply this technology effectively to disaster relief efforts.

The HMD detects head movements, so the pilot can acquire all the information they need regardless of what direction they are facing. A range of information is projected on the display, including flight data, route guidance, and 3D terrain. Furthermore, thanks to an infrared camera, the images viewed remain clear regardless of weather conditions or the time of day or night. The product can be said to provide pilots with a new pair of eyes, since they can acquire necessary information by simply looking outside.

There has been a heightened consciousness of disasters in Japan in the wake of the Great East Japan Earthquake of March 2011. In this social context, a great deal of attention is focused on the role of rescue helicopters. The HMD is expected to play a larger role in rescue missions in the future, improving the potential to save lives, as well as aiding fire-fighting activities.

How HMD may help save lives

The Shimadzu HMD is already used on the US-2 search and rescue amphibian plane, which is important for rescue efforts at sea. Shimadzu is the only company in the world to provide HMD for search and rescue use.

At the same time, effective use of helicopters is also crucial for lifesaving efforts, such as searches in mountainous regions and emergency transport on outlying islands. These services are often in particularly high demand in conditions where the weather is bad and the visibility is low. Ensuring safety is the priority, and to this aim, improving the situational awareness (SA) of pilots is important.

Utilizing information obtained from sensors on the aircraft and from databases, and then, using the HMD to present pilots with details of the external field of view and the location and position of other the aircraft, all contribute to improving pilot SA.

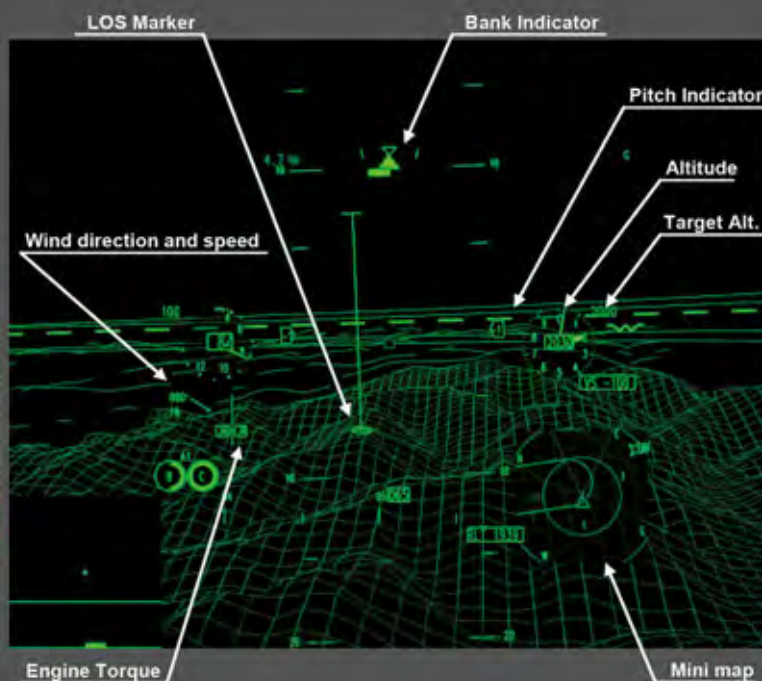
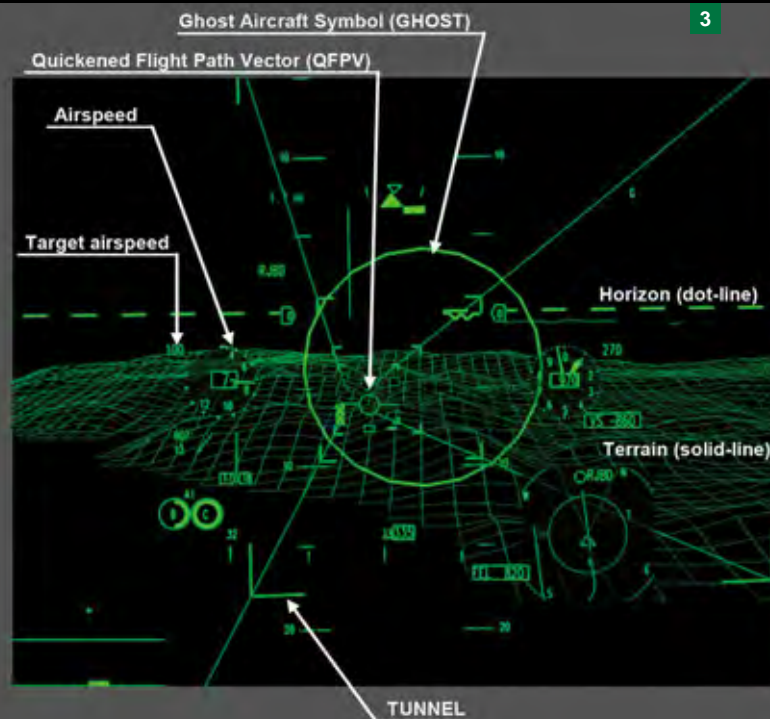
The most important objective of search and rescue helicopters is to find people as quickly as possible. For this, two things are essential. The first is to free pilots from looking at flight instruments, thereby



1 Flight test at night

2 Guidance for fire fighting showing optimal flight approach and water release timing

3 HMD indicating route guidance and marker tracking



increasing the amount of time spent visually searching for survivors. The second is to be able to see the outside world clearly even in bad weather or at night. HMD gives pilots more time and a clearer field of view to find survivors, and thus boosts lifesaving opportunities.

Our new project: SAVERH

Since 2009, research has been conducted in collaboration with JAXA on a project called Situational Awareness and Visual Enhancer for Rescue Helicopter (SAVERH), based on the technology developed for the US-2 search and rescue amphibian plane. SAVERH presents pilots with effective visual information that supports search and rescue missions. The objectives are to use HMD to support flight handling under low visibility conditions, and at the same time, to remember the position of survivors when they are spotted, so that they can be found again if pilots lose sight of them.

If this project is extended, it could also be applied to fighting bush fires, for example. The cooperative research has been conducted with JAXA and ShinMaywa Industries, Ltd. In aerial firefighting efforts, the amount of water that a helicopter can carry is limited, so it is important to increase the efficiency with which fires are extinguished with each flight. The trajectory of water released during the flight is calculated by computer, based on a variety of factors including the aircraft speed, location and position, as well as the power and direction of the wind. The efficiency of aerial firefighting can then be

enhanced by using the HMD to guide pilots as to the optimal flight approach and water release timing for the most efficient fire-fighting. Within the SAVERH project, we are currently performing flight tests at night in mountainous and coastal areas. The HMD, infrared cameras and display system have all proved successful in terms of basic operations and validity checks. Continued flight tests will help to improve the display systems further. At present, helicopter flights under low visibility conditions are restricted by regulations. We plan to attempt to initiate legislative reforms, in order to promote the practical use of HMD.

The Shimadzu HMD and our contribution to society

It has been over 20 years since Shimadzu began research and development on HMD, and we will continue to expand this technology to develop cockpit display systems that are more efficient and user-friendly. By challenging ourselves in areas like this where the technology is relatively undeveloped we aim to meet certain societal needs. Our hope is that HMD will make significant contributions to lifesaving and disaster prevention, in line with our corporate philosophy since Shimadzu's inception: "Contributing to Society through Science & Technology". While work at the Shimadzu Aircraft Equipment Division is demanding, we remain intent on consistently developing new products like this, and thereby helping people, and enhancing their quality of life.

Shimadzu Corporation's flagship in North America

Shimadzu USA Manufacturing, Inc. (SUM) is located on a 15 acre site in the town of Canby, in Portland, Oregon. Built in 1997, SUM currently employs 125 skilled personnel who manufacture analytical instruments such as high-performance liquid chromatograph (HPLC). The annual sales of SUM are US\$50–55 million, making it Shimadzu Corporation's flagship in North America for manufacturing, as well as research and development.

"I was asked to move from my position at a Shimadzu subsidiary on the East Coast of America to take charge of establishing SUM," says Shigeaki Fujimoto, now back at Shimadzu headquarters in Kyoto, Japan. "It was one of the most challenging and rewarding experiences of my life."

Why did Shimadzu choose to locate in Canby, a small town approximately half an hour from Portland Airport? Fujimoto lists several reasons. "Canby offered us access to a technically qualified workforce and supply

base because other high-tech companies were also in the region; affordable land and cooperative state and local governments; and ease of access to Japan and other subsidiaries."

Joe Shaddix, Vice President of Operations and Factory Manager, started working at SUM in April 1997 after being hired by Shigeaki Fujimoto. "At

the time, there was no factory and no people to manage!" he explains. "We were going to build the factory from scratch. I had to hire flexibly minded people because they were going to work for an organization that did not exist yet."

In April 2012 SUM doubled in size by a 54,000 square foot expansion of the original factory building. The same crew that built the original factory carried out the expansion. The includes space for high-tech shops for machining and sheet metal, as well as a welding shop.

"We will increase our staff to 154 by the end of 2013," says Shaddix. "The personnel turnover at this factory is low, with 25% of the people having been here for more than 10 years. This is unheard of in the US!" Shaddix stresses the importance of effective communication for ensuring the ongoing success of SUM since it was built 16 years ago. Visitors may be surprised to find white boards located all over the factory to enable staff to 'get their message across' with words and symbols.



SUM operates on a truly global level, exporting approximately 60% of the goods manufactured at Canby to Asia, the European Union, and Canada. Specifically, SUM manufactures instruments for other subsidiaries of Shimadzu who in turn sell them to customers worldwide. End users of analytical equipment include research and hospital environments, as well as pharmaceutical companies.

Recently, in July 2013, SUM received ISO 13485 certification. Together with Shimadzu Corporation it will register with the US Food and Drug Association (FDA) to manufacture medical devices. This certification will enable Shimadzu to extend applications of its products in clinical and medical areas.

SUM is truly integrated within the local community at Canby. "We make a valuable contribution to the local community as a highly respected employer, a global contribution to the world of analytics, and in the future this will also include medical instrumentation," says Shaddix.



Continued Support for United Nations University Environmental Projects

The project “Environmental Monitoring and Analysis in the East Asian Region: Technology Transfer and Environmental Governance” has been implemented by the United Nations University since 1996. It involves monitoring chemical pollutants in the coastal environments of 10 Asian countries. To date, investigative research has focused on volatile organic compounds (VOC), endocrine-disrupting chemicals (substances that interfere with the hormone system), and persistent organic pollutants (POP). The research has been implemented in five phases, each phase taking three years to complete.

The project is in line with the Shimadzu corporate philosophy of “Contributing to Society through Science and Technology,” and the company has provided comprehensive support since the project began in 1996. In addition to improving capabilities to monitoring environments in detail in various countries, definitive results have been amassed over the first 15 years of the project: detailed data analysis techniques have improved, a social network has been constructed across the major research institutions in Asia, and new analysis and data-accumulation methods have been developed.

The fall of 2012 saw the implementation of “Monitoring and Governance of Persistent Organic Pollutants (POPs) in Asia --Monitoring of PFCs --,” a 3-year plan for the 6th phase of the project. Shimadzu decided to continue its support, and a signing ceremony for a support-related agreement for the 6th phase of the project was held on November 12, 2012 at the United Nations University headquarters (Aoyama, Tokyo). The agreement was signed by the two highest officials of the respective organizations: Akira Nakamoto, President of Shimadzu Corporation, and Dr Konrad Osterwalder, Rector (at the time) of the United Nations University.

At the signing ceremony, President Nakamoto noted that the agreement could be expected to further strengthen the established network of researchers, thereby elevating analytical technologies to a higher level. Furthermore he promised even stronger support than what has previously been provided. The objective of the



6th phase is to study and monitor the status of FPOS (perfluorooctane sulfonate) and POA (perfluorooctanoic acid) pollutants in aquatic environments. In this phase, Shimadzu is providing the latest ultra fast liquid chromatograph mass spectrometers (LCMS) which are capable of monitoring compounds

with larger molecular weights.

The results of this project at the United Nations University are expected to promulgate through the Asian countries and beyond to emerging nations in the Fifth Phase (January 2009 to December 2011)

First Phase(1996-1999)

Environmental Monitoring and Analysis in the East Asian Region
Target: Technology Transfer and Environmental Governance



Second Phase(1999-2002)

Environmental Monitoring and Governance in the East Asian Coastal Hydrosphere
Target: Endocrine Disruptors in River and Coastal Waters



Third Phase(2002-2005)

Environmental Monitoring and Governance in the East Asian Hydrosphere
Target: POPs in the East Asian Coastal Hydrosphere



Fourth Phase(2005-2008)

Environmental Monitoring and Governance in the Asian Coastal Hydrosphere
Target: Monitoring of Persistent Organic Pollutants (POPs) in the East Asian Hydrosphere



Fifth Phase(January 2009 to December 2011)

Environmental Monitoring and Governance in the Asian Coastal Hydrosphere
Target: Monitoring of PCBs and other Persistent Organic Pollutants (POPs) in the Asian Region



Japan's First Successful Manned Balloon Launch

In the summer of 1877, Genzo Shimadzu Sr, the founder of Shimadzu Corporation, received a request from the Kyoto prefectural government to build a hydrogen balloon. At the time he had been engaged in manufacturing educational physics and chemistry instruments. The Kyoto government's decision to launch a manned balloon was their way of highlighting their view that introducing Western physics and chemistry education was the only way for the city to recover from its stagnation after losing capital status to Tokyo in 1869. However, there had never been a successful manned balloon launch in Japan before then, and there were no design plans or other resources available to instruct how to make the balloon. A single drawing of a hot air balloon in a foreign country was all Genzo had to work from. Furthermore, he was given less than four months to build it.

Genzo had a natural desire to embrace challenges and had soon developed a hydrogen generator system based on the drawing using eleven sake barrels. However, making the balloon proved to be more difficult. To carry a human passenger, the fabric needed to be very light, strong, and impervious to gases. After much trial and error, and in a battle against time, he finally solved the problem by coating silk fabric with dammar gum resin dissolved in perilla (egoma) oil. On December 6, the day of the flight, Genzo's manned balloon rose to an impressive height of 36 meters, amidst thunderous applause from the approximately 50,000 spectators witnessing the event. This spectacular feat, achieved in Japan for the first time, reinvigorated the people of Kyoto and also boosted the fame of Genzo Shimadzu Sr.

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