KSU-HONDA FOUNDATION
International Symposium

Partnership for Innovation
The experience of Saudi Arabia and Japan

キングサウード大学（KSU）・本田財団共催
国際シンポジウム 2014
イノベーションのためのパートナーシップ
サウジアラビアと日本の経験

A Report of KSU-HONDA FOUNDATION International Symposium

公益財団法人 本田財団
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For Publication

The present report is an account of the remarks and speeches from the international symposium entitled "Partnership for Innovation — The experience of Saudi Arabia and Japan" held in Riyadh, Saudi Arabia on December 17th, 2014.

The symposium at this time was jointly organized by King Saud University (KSU) and Honda Foundation. Founded by King Saud bin Abdulaziz in 1957, King Saud University is Saudi Arabia's premier University, and one of the top tertiary institutions in the region. With a wide range of colleges, advanced research centers, and collaborations with distinguished researchers around the globe, King Saud University is equipping the nation's future leaders.

The goal of the symposium was to discuss how to draw a roadmap towards a bright future of Saudi Arabia, and how Japan can be supportive in this context, mainly focusing on the experience of Japan in its industry development as well as ideal industry-academia-government relationship. Speakers literally from industries, academia and the government provided insightful observations and opinions, having the audience mainly from faculty members and students at KSU and its affiliated organizations. The first session of "Industrial and Human Development," reviewed the history of industry development in Japan to look for lessons to be shared. Then in the second session of "Innovation, Culture and Spirits," we talked about innovations backed by corporate culture and spirits. And finally, the last session regarding "University-Industry-Government collaboration" discussed how the collaboration among various sectors should work.

It was fortunate that the symposium was coinciding with the celebration of 60th anniversary since the Kingdom of Saudi Arabia and Japan have established their diplomatic relationship in 1955. We hope the event had played a role to further enhance the movements toward accelerating human resource development as well as diversification of the industry for further prosperity of the Kingdom of Saudi Arabia.

At Honda Foundation, its founding prospectus defines that our mission is to contribute to "creating a truly humane civilization." It is our strong hope that the discussions and friendships cultivated through this meeting will contribute to realization of a truly humane society in the future.

Satoshi Matsuzawa

Managing Director, Honda Foundation

KSU-HONDA FOUNDATION International Symposium

Partnership for Innovation The Experience of Saudi Arabia and Japan

King Saud University, Riyadh, December 17, 2014

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Opening Remarks

Prof. Abdullah S. Alghamdi

KSU Knowledge Industry Eco-system

We are going to talk about the partnership and innovation, we hope that we will learn from the Japanese experience in this regard, we know the Japanese government has played a central role in bringing together the industry, academia, and society in order to come up with innovative products that can serve better the society. I would like to give a quick presentation about the situation here in Saudi Arabia and KSU on innovation management. Basically this event coincides with the celebration of 60 years since the establishment of political relations between Japan and Saudi Arabia. I'm going to talk first about Saudi Arabia, it is the only nation that has a coast on the red sea and Arabian Gulf, and we are situated in the eastern area, and covering most of the area of the Arabian peninsula. Basically Saudi Arabia has two holy mosques, in Mecca city and Medina. It is a focal point for the Islamic world. Riyadh is the capital of Saudi Arabia and we have a population of about 7 million people, and Riyadh basically is a metropolitan city that has many heritages.

King Saud University is located in the northwestern area of Riyadh, covering an area of 9 km^2, and it is the first institute of higher education. King Saud University basically has achieved a leading a position according to international ranking systems, we are among the best of many universities. Also according to the QS ranking 2014 we are ranked in 249, and according to the Webometrics we are 356, we are the top Arabic university in the region. And as you can see the jump we made from 2007 until now. The university was established in 1957, with a vision and mission to disseminate and promote knowledge in our kingdom for widening the base of scientific and literary study. We have 24 colleges and most of the colleges are accredited by the international accreditation. We have 146 academic programs in different departments, we have

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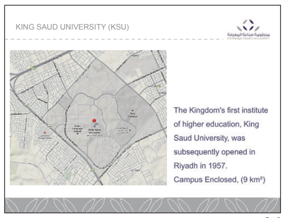

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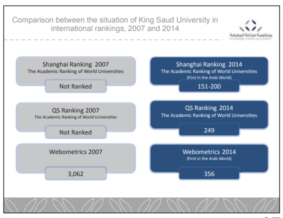

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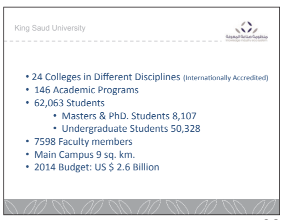

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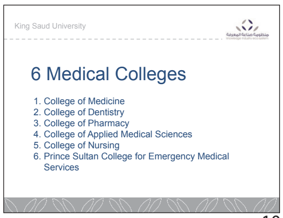
more than 60,000 students studying for their master's and PhD, we have 7500 plus faculty members and the budget for this year is 2.6 billion US Dollars. We have six medical colleges, 6 science and engineering colleges. Let me focus more on the topic, which is related to our activity today, the knowledge development centers.



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As you can notice Saudi Arabia has identified a number of strategic areas. We have identified strategic research areas starting with water, which is important for our country, oil and gas, space, also information technology, electronics and communications, energy and environment and advanced materials, these represent strategic research areas for the country. And at KSU we align our knowledge centers to go with these areas. We have established the Riyadh Techno Valley, which is almost a science park that was created in 2007 as the center for knowledge investment at the university. We also have Riyadh Techno Valley Company that was established to commercialize the knowledge based products of the university, we also have the nanotechnology institute for nanotechnology that was established in 2007, and specialized in nanotechnology.

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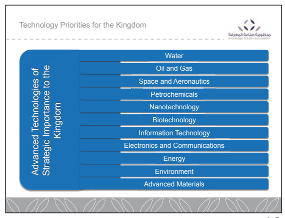

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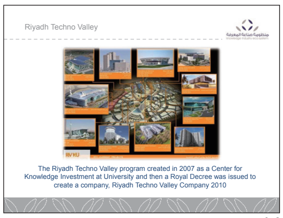

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Also we have Prince Sultan institute for applying advanced technological research that was established in 2008 in collaboration with the Ministry of Defense and Air force. We have Prince Naif Center for Health science research that was established in 2011, to focus more on researches related to the medical sector. We have Advanced Manufacturing Institute. They have good collaboration with Japanese side. It was established in 2012. Its aim is to basically expand capabilities and technological facilities to sell to clients and also provide training opportunities for the students and research test for researchers and faculty members. We also have 4 main centers of excellence that was approved by the Ministry of Higher Education. Basically each university has a research center of excellence, and no other university is allowed to open the same research center in the same area. We are lucky to have 4 of those centers. One is for information security, and the other one for engineering materials, biotechnology, and also for the development of science and mathematics education. They also came up with some patents, some of them managed to commercialize their products. There is also the SET, which is the Sustainable Energy Technology center, which specializes in conducting research in renewable energy, wind energy, solar energy, and all types of alternative energies.

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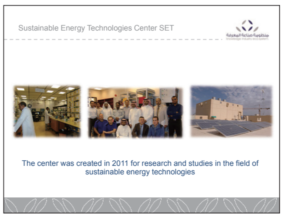

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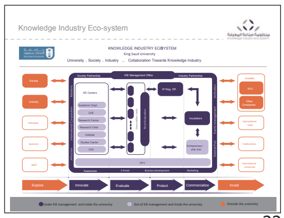
We have also a number of scientific societies, around 50 scientific societies in the university.



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Mentioning those knowledge base centers, now we have a big challenge to transform these knowledge base products to more commercialized products for the benefit of the society. We came up with a framework. We call it the knowledge industry ecosystem framework that can manage the innovation from the earth of the innovative idea, passing through the development of the prototypes, ending with the commercialization of knowledge-based products. As you can see this is the framework that we follow here at KSU. The centers that we just mentioned come into this area. We call them knowledge development centers that can cover the strategic areas of this country. Basically we have this big dark blue boundary that separates the internal components of this university from the outside wall. In the outside we have the society, the industry. So basically the university is required to serve the society, getting help from the industries in order to develop and eventually come up with commercialized products that can be investable products for the investors. Here we start a triangle partnership with the university, the society, and the industry. Once we identify the need from the society, we form this triangle partnership. We ask one of our specialized knowledge development centers to collaborate with the industry and the society, to come up with innovative products. Once they innovate under the supervision of the innovation center, we have innovation centers that have different units in various colleges, we have 12 innovation centers in the university, and those centers supervise the innovation processes. Once we come up with a product we evaluate it, then we protect that product through IP Registration office, we have an office here called IPTL, which is Intellectual Property Technology Licensing office. They are responsible for registering the product and also negotiating the possibility of licensing the technology to a third party. Then it comes to the incubation stage, we have an incubation center that can help the incubatee in order for it to be commercialized. Then we have the investors who should be able to invest in our product. Having this process make it easier for the investor to invest in a guaranteed product that is based on the real need by the society and also utilizing the experience of the industry. Normally the industry will be very keen to invest in that product. So basically our processes go like this. We explore the needs, we innovate, evaluate the innovation, then we protect it through our IPTL office, we commercialize it with the help of the incubator and invest in it.

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In order to facilitate this, we came up with the innovation center as I mentioned before. It is responsible for helping the innovators to grow up their invention. Basically the center was established in 2008. We are planning to have 12 innovation units. Currently we have 3 units in the engineering colleges, and the medical colleges and also for the female section. Recently they have achieved a number of international awards from different international exhibitions. And also during these exhibitions we have the interest of some international investors in our inventions.

Also we have IPTL as I mentioned. They are responsible for registering the university owned IPs. And also we encourage external inventors to come and register their inventions with our university as part of our community services. And also the center negotiates with the investor in order to license the technology owned and developed by the university. We have registered so far more than 550 patents, 40% of which are registered in the U.S. Recently we have been awarded the certificate. We are among the best 100 international universities registered in the U.S. patent office.

Also the incubation, we celebrated some time ago, the establishment of a startup company with one of our students or graduates, and he is now commercializing his products.
Finally we expect from our guests our colleagues from the Japanese side to help us with activate this triangle of partnership with the university and the Industry and society as a focal point for this partnership. I know the Japanese side has excellent and successful experience with bringing those 3 partners together.
With this I would like to end my presentation. Thank you for listening.

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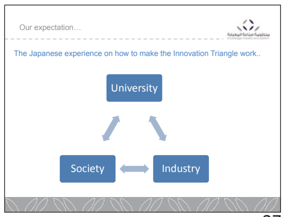

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Opening Remarks

Prof. Ahmed Al-Aameri

KSU Vice Rector, GS & SR

I would like to welcome our distinguished guests from Japan.
And we are celebrating the constructive, effective and great relationship between Japan and Saudi Arabia. And we the Kingdom of Saudi Arabia appreciate this relationship and we admire what our friends in Japan have accomplished in terms of the advancement of technology and science and also helping the humanity. And we would like to strengthen this relationship. Between the government and people of Japan and Saudi Arabia we have a very good relationship, and we hope to extend this relationship to be more scientific in terms of transferring the knowledge, and how we can construct a relationship between KSU and Japanese universities, companies of Japan with companies here. I understand that there is a great opportunity here to have a constructive relationship.

We think we have the ability to really make a good relationship between Japanese Industries, Japanese universities and those of Saudi Arabia. I'm sure that my colleagues here and KSU really want to strengthen the relationship with our friends in Japan.
My colleagues are very enthusiastic, we talk about how we can strengthen this relationship.

But we need to transfer this talking into real, actual relationship.
We at KSU are looking forward to seeing this in reality. I hope you enjoy your visit to KSU.
I would also like to thank you for the presentation that you will be giving. And I am sure that our colleagues here will be very cooperative and also effective in terms of making decisions.

We hope you enjoy the nice weather that we have today in Riyadh. And I'm sure that we have good weather compared to Japan. I know that now it is very cold there. So please enjoy your stay and make yourselves at home. Thank you for coming and participating with us. And I hope that we can continue to meet in the future.

Session 1:
Industrial and Human Development

Dr. Fumio Kodama
Professor Emeritus, The University of Tokyo

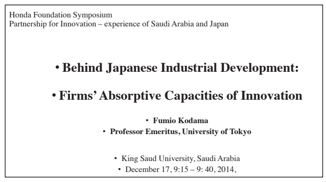
Mr. Satoshi Okumura
Advisor, Furukawa Co., Ltd.

Session 1: Industrial and Human Development

Behind Japanese Industrial Development: Firms' Absorptive Capacities of Innovation

Dr. Fumio Kodama
Professor Emeritus, The University of Tokyo

Thank you very much for the invitation. I was told that I should talk about Industrial development of Japan. My main title is "Behind Japanese Industrial Development" and what was behind that. And the answer is that there was absorptive capacity of innovation at firms' level. I will go in detail and I bring new perspectives of learning and innovation.



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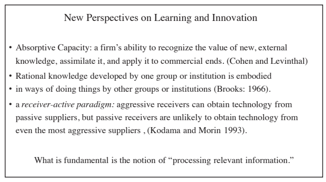
Here we have a well-cited concept of absorptive capacity by Cohen and Levinthal around 1990 which is defined as a firm's ability to recognize the value of new external knowledge, assimilate it, and apply it to commercial ends. But I bring some other more challenging and sort of provocative argument about technology transfer in particular.



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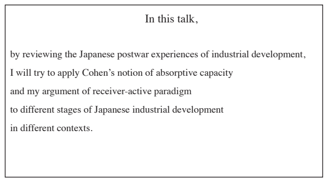
That is quotation by Brooks of Harvard University in 1966. He says that rational knowledge developed by one group or institution is embodied in ways of doing things by other groups or institutions. It is old citation but it makes more sense to me because it implies there is a supplier of knowledge and also a receiver of knowledge. My argument is that technology transfer is more analyzed as a receiver active paradigm rather than supplier active. Aggressive receivers can obtain technology from even passive suppliers, but passive receivers are unlikely to obtain technology from even the most aggressive suppliers. What this is all about is the fundamental notion of processing relevant information. In this talk by reviewing Japanese postwar experiences of industrial development, I will try to apply Cohen's notion of absorptive capacity and my argument of how receiver was active to different stages of industrial development in different contexts.



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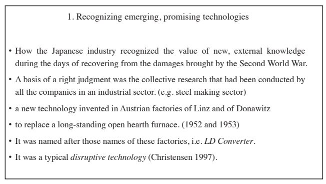
The first item of Cohen's absorptive capacity is recognizing emerging and promising technologies. Then I will talk about how the Japanese industry recognized the value of new, external knowledge during the days of recovering from the damages brought by the Second World War. It is the story about how Japanese were active in making right judgment of the best technology in the world. This is an example of the steel industry. The basis of right judgment on the choice of the technology was a collective research that had been conducted by all the companies in an



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industrial sector. I am talking about the steel-making sector. That was a very drastic technology invented in Austrian factories Linz and Donawits, which was to replace a long-standing open-hearth furnace technology. It was invented in 1952 and 1953. And it was named as LD (Linz and Donawits) Converter. And there is a recent more important concept developed by Christensen of Harvard called a disruptive technology. But this was a brand new technology so there were many problems to overcome otherwise you cannot use that technology.

First, the limitations in applicability to different kinds of steel, the low-yield due to splash, and dust problems. There was no consensus that this technology would become a mainstream of steel making. In order to make a judgment, all the Japanese steel companies conducted a collective research by mobilizing all the competences owned by those companies. And for this a committee for LD converter was established during 1958 to 1966. And the investigations made by that Committee had resulted in developing various problem-solving technologies. These were exhausted gas recovery, the nozzle of multi-holes, and the bottom blown converter. US steel companies were greater at that time. However US steel companies were hesitant to adopt this uncertain technology. So as a result the diffusion curves of adoption of this LD converter of several countries are as shown in Figure 1.

The thing that should be noted in this LD committee is that they had their rule in which all the information will be available for free to every member of the committee without respect to whether the information is patented or not. Indeed out of 111 intellectual property rights applied by steel companies, 51 patents had been publicized for free among the members. This is a more detailed chart. There is the patent rights, utility model rights, total property rights, subtotal of free charge and so on. So we can generalize this experience that the demands for newly emerging technologies were articulated, and by collective research these articulated technological problems were solved collectively. So this successful experience put the Japanese steel industry into a leadership position in the world in the following years, and it is still valid.

This second story has something to do with Honda. This is technological profiting in new industry. As a technology diffuses throughout society, its widespread use may surpass a certain threshold of environmental capacity. The government enacts new regulations, changing the rules of competition. That may give newcomers an opportunity, like Honda at that time, if they are aggressive enough technologically. When diffusion rate of cars surpasses one car per two persons in the US, people began to recognize a societal disadvantage of car usage – pollution. The Japanese contribution to develop this kind of technology is obvious.

Then this is an interview I had with Mr. Soichiro Honda. He said there are two sides of the same coin. That is two oil crises made society become aware of another disadvantage beside pollution -- the waste of precious

there existed many problems to be overcome:

- the limitations in applicability to different kinds of steel;
- the low-yield due to splash; and,
- the dust problems (Nishigata and Kodama, 1999).

No consensus: this technology would become a mainstream of steel-making.
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A committee for LD converter was established during 1958 - 1966.

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The investigations made by the *LD Committee* had resulted in

developing various problem-solving technologies:
exhausted gas recovery,
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the bottom blown converter.

- US steel companies hesitant to adopt this uncertain technology.
- The diffusion curves of several countries are in **Figure 1**.

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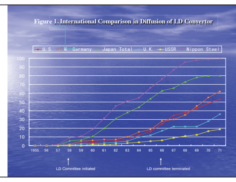

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What should be noted in this LD committee

- is their rule in which all the information will be available
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- Out of 111 intellectual property rights applied by steel companies,
- 51 patents had been publicized for free among the members.

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Table 1. Intellectual Properties Applied by Largest 7 Companies and Free Charged

	Patent Rights	Utility Model Rights	Total Property Rights	Subtotal of Free Charge	Ingot Steel	Nozzle Lance	Brick Wall	Exhaust Gas	Others
Nippon K.	33	3	36	24	23	3	3	3	3
Yahata	32	13	45	9	9	5	1	21	9
Fuji	14	6	20	9	7	5	1	5	2
Kawasaki	1	1	2	1	0	0	0	0	2
Sumitomo	1	1	2	2	1	0	1	0	0
Kobe	1	3	4	4	3	0	0	1	0
Taiheiyo	2	0	2	2	1	0	0	0	1
Total	84	27	111	51					

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We can generalize this experience as follows:

- the demands for newly-emerging technologies were articulated
- by the collective research, and these articulated technical problems
- were solved collectively. Thus, this successful experience
- put the Japanese steel industry into a leadership position
- in the following years in 1970s and 1980s.
- And it is still valid at the present time.

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2. Technological Profiting and New Industry Creation

- As a technology diffuses throughout society, its widespread use
- may surpass a certain threshold of environmental capacity.
- Government enact new regulations, changing the rules of competition.
- This may give newcomers an opportunity,
- if they are aggressive enough technologically (Kodama, 1984).
- When the diffusion rate of cars surpassed one car per two persons,
- people began to recognize a societal disadvantage of car usage -- pollution.
- The Japanese contributions to develop this kind of technology are obvious.

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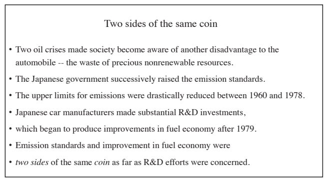
nonrenewable resources. The Japanese government successively raised the emission standards. The upper limits for emissions were drastically reduced in 1970s. And Japanese car manufacturers made substantial R&D effort, and began to produce improvements in fuel economy after 1979. Emission standards and improvement in fuel economy were different, or that is two sides of the same coin as far as R&D efforts were concerned. That is in what I interviewed with Mr. Honda when he came to our university, graduate school of policy sciences of Saitama University at that time. Mr. Honda directed the company's researchers to focus on a deeper understanding of the burning processes of fuel inside the cylinder. It resulted in the invention of CVCC. In hindsight, burning fuel cleanly is technologically equivalent to burning it efficiently. So newcomers really take benefit or technological profit from that kind of changes in situation.



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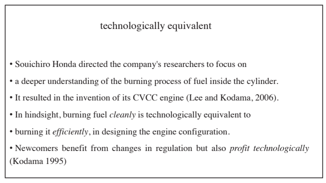

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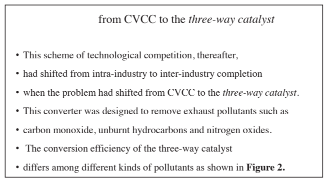
But then from CVCC to the three-way catalyst, the scheme of technological competition, thereafter, had shifted from intra-industry to inter-industry competition when the problem had shifted from CVCC to the three-way catalyst. The converter was designed to remove exhaust pollutants such as those (on the screen). And the conversion efficiency of the tree-way catalyst differs among the different kinds of pollutants. I got some data from Nissan and this is conversion efficiency. In this area, the conversion efficiency is quite high. Why don't you just control in this narrow range? The auto industry thought that they could do this control by electronics.



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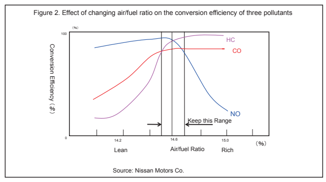

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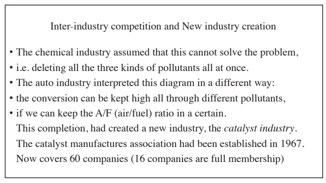
Anyway the chemical industry assumed that this couldn't solve the problem, by deleting all three kinds of pollutants all at once. But the auto industry interpreted this diagram in a different way. The conversion can be kept high all through different pollutants, if we can keep the air/ fuel ratio in a certain range, this catalyst should work well. This competition that is inter-industry, has created a new industry, called the *catalyst* industry. In fact the catalyst manufactures association was established in 1969 and now covers 60 companies in the membership.



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Anyway the third subject is more related to science. That is technological platform for assimilating new science. Reflecting the intensified US-Japan trade friction in the 1980s, the government announced that they are trying to change themselves from the "technology-based nation" to "science-based nation". It's okay but it's very difficult. This concept is so subtle that the science-technology interaction is very much incomprehensible to government as well as to corporate managers.

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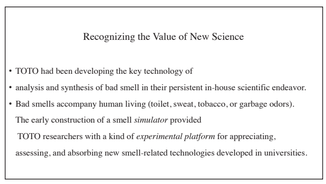
So here I explain a case of TOTO, a Japanese manufacturer of sanitary ware, provides us with an excellent example of how the ability of new sciences regenerated its main business, and also how the science-technology interaction is reciprocal, not only from university to industry, but industry get back something new to the university. Then how to realize the value of new science? TOTO had been aware of that. The water flow in the toilet was their main concern. This is different from a



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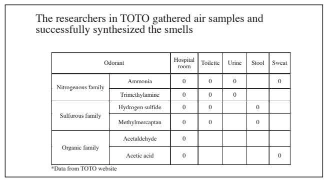
toilet producer that is derived only from the tile producer. They were more interested in synthesis and analysis of bad smells. And bad smells come from human living especially toilet. And at an early stage TOTO constructed a smell simulator that provided an experimental platform for appreciating every kind of related technologies developed in the university.

And two major inventions were made in photo catalyst.
Fujishima, at University of Tokyo discovered the photo-catalytic properties of titanium dioxide, and it was published on Nature magazine in 1972. And also Kawai, another researcher published on Nature.
This is an efficient oxidizer of organic matter. Fujishima is more interested in producing hydrogen. And TOTO at this stage developed photo-catalytic tiles coated with titanium oxide, and in 1994 it was introduced into market. But as you know that oxidizer property is not enough. They needed a new property, another quite unique property that is the photo-induced super-hydrophilic property, which means water-friendly. That was again a brand-new independent scientific finding that was published in 1997 on Nature with collaboration with TOTO researcher. This property has been further exploited by the auto industry and construction industry. With the auto industry it has been used for anti-fogging of side mirrors. With the construction industry it is used for hydraulic nature of glass of buildings.

For the concluding remarks, I have demonstrated that our absorptive capacities have been upgraded from the simple acquisition of foreign technology, to the response to the enforced environmental regulation, and then proactive exploitation of the emerging scientific discovery. Finally, this is a little bit of commercial advertisement of our research, more MOT (management of technology) is needed. The valuable information can be obtained through scientific understandings of the experiences of the advanced countries, not through repeating what we have done but through what was essential. We need to research on that and only with scientific understanding we can transfer our experience, so a joint research might be most effective. Thank you very much.


The researchers in TOTO gathered air samples and successfully synthesized the smells

Odorant		Hospital room	Toilette	Urine	Stool	Sweat
Nitrogenous family	Ammonia	0	0	0		0
	Trimethylamine	0	0	0		
Sulfurous family	Hydrogen sulfide	0	0		0	
	Methylmercaptan	0	0		0	
Organic family	Acetaldehyde	0				
	Acetic acid	0				0

*Data from TOTO website

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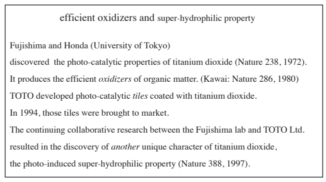

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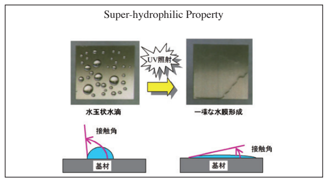

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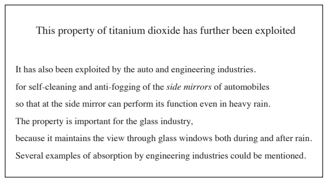

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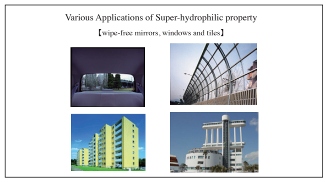

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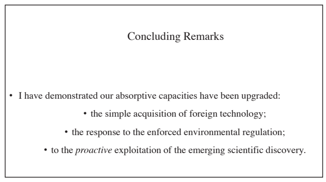

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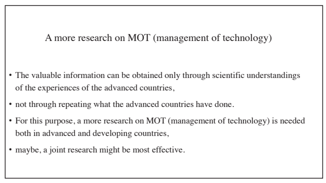

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Session 1: Industrial and Human Development

Mining and Japanese Industry

Mr. Satoshi Okumura

Advisor, Furukawa Co., Ltd.

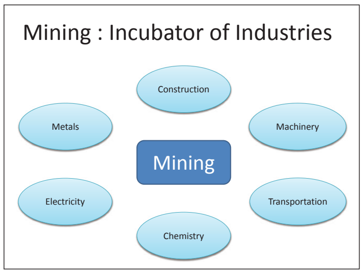
Good morning. Today I would like to talk about our experiences on mining and Japanese industry. I visited this country for the first time in 1976 almost 40 years ago. I was a government official at that time working on a corporation project, which later grew into a big petrochemical project in Japan. At that time I was much younger than I am now. But Saudi's counterpart people were also young and enthusiastic to change the Saudi economy from oil-monoculture to broader-based industry. Later I joined private companies. Among them two are mining related companies. One is JFU and the other is Furukawa, which now I belong to as an advisor. And before I came to Furukawa I was the managing director of STBC, which is the Japanese counterpart company of SABIC, jointly operating SHARQ. And I was also a board member of SHARQ.

I think I might be able to talk about some experiences of Japanese mining companies, which definitely provided broad bases of Japanese industries. Mining technology is not just about digging ores and extracting minerals. Mining is a huge civil engineering field with various kinds of machineries. Transportation is a key factor. It's also a chemical plant to handle hazardous byproducts. All the electricity needed for these activities should be supplied. And very often, it has to operate a whole town by itself. Mining is nothing but one category of industries, yet it includes various industries within itself. Thus, mining will provide ideal conditions as an incubator.

Let me show you some examples. Furukawa is manufacturing various machines. These are the photos that Furukawa machines were used for land elevation of a city that was completely swept away by the tsunami caused by the huge earthquake 3 years ago.

Furukawa was established in 1875 as a mining company, at the early stage of Japanese industrialization. The main mine was Ashio copper mine whose peak production was as much as 40% of total Japanese production. That mine was exhausted and closed already. But based on the mining experiences, Furukawa now is producing various machines and materials. Also, Furukawa made many subsidiary companies.

01



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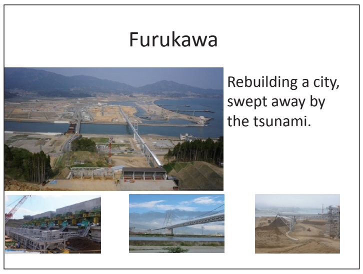

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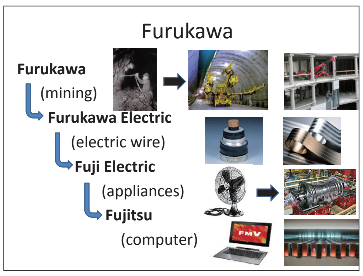
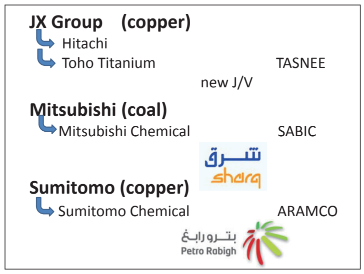


04

One of them was Furukawa Electric Company, which started as a refinery and soon began to produce electrical wire. And its subsidiary was Fuji Electric to produce electric appliances. And its subsidiary again was Fujitsu, engaged in information technologies and producing one of the fastest computers in the world. And if you don't mind, FANAC, a leading company of manufacturing robot, is also a subsidiary of Fujitsu.
You can see a good example that the original mining industry has spread to related industries.

As for JX Nikko-Nisseki, important origin was also copper mine. JX itself is importing oil from Saudi Arabia. And its repair shop grew into Hitachi, one of the major companies in heavy industries. Another subsidiary company, Toho Titanium is now constructing a titanium sponge plant in Saudi Arabia with Tasnee.
The origin of Mitsubishi was marine transportation. However, in order to supply fuels, it soon entered into coal mining operation. In order to process coal tar, a chemical company was established. It grew into Mitsubishi Chemical Co., which is the main company supporting Japanese SPDC, jointly operating SHARQ with SABIC. Sumitomo again originated in a copper mine. It was established to make use of acid byproduct at the smelting plant. That was the origin of Sumitomo Chemicals Co., which is now operating Petro Rabigh with Saudi Aramco. These examples indicate that mining is an ideal incubator for other industries. Mining utilizes a wide range of technologies and each technology spread to related fields, making broad base of industries. But just importing original technologies is not enough for industrialization. Let us see how Japan absorbed advanced western technologies.



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Meiji Restoration took place around 150 years ago. Before was the era of Japanese worriers, Samurai. Japanese Samurai government virtually closed our country border; so, we had very limited information about the Industrial Revolution. We were still living in handicraft manufacturing industry. But such technologies were supposed to be in rather high level. For instance, production of Japanese copper was considered to be the largest in the world in the late 17th century. The famous economist Adam Smith wrote about the influence of Japanese copper production in his book "The Wealth of Nations", published in 1776. Meiji Restoration was really a kind of revolution in Japan. The main driving force was the pressure from industrialized Western countries. Japan was really at the risk of independence. The new Japanese government decided to open its door and introduced almost entire system, from advanced technology to legislative system to catch up the advanced countries. Hundreds of foreign experts were hired directly by Japanese government or private sector at a high salary. They provided a broad basis for the modernization of Japan.

Meiji Restoration

(Before)
Close Door Policy
Traditional Handicraft Industry

(After)
Open Door Policy
Introduction of Entire System
Foreign Experts

06

But, soon the process of "Japanization" began, the struggle to adapt those technologies to fit for Japan.
One of the priority areas to introduce western technologies was education. The Japanese government founded national universities and invited many foreigners as teachers. Those universities provided many talented people needed to lead the time. Soon, these educated people began to teach the next generation. The time of foreign experts ended within 30 years, rather a short time. By that time, Japan became self-sufficient. Traditional industry was also a key factor in introducing advanced technologies. In Japan, the accumulation of techniques of traditional handicraft manufacturing directly contributed in applying new technologies. Also, Japanese traditional industries provided an important base for supporting industries. Mining was a good example. Traditional mining masters were incorporated into new mining industry. Thus, new technology and traditional industries became mutually complementary. Many engineers educated in the universities were put into the mines. The role of engineers at the early stage was to bridge western technologies to traditional Japanese mining masters. Soon, the role changed more to improve those technologies, as frequent modifications or new applications were needed in the mine, to cope with the change of natural environment. But in either case, their main work field was on the site, not in the office. It is considered to be unique that Japanese engineers tend to stay on the site rather than in the office. I know that there are merit and demerit for this kind of "On-Site-ism", but it is absolutely important in manufacturing to keep plant in best condition and further to improve it. Later, at the beginning stage of SHARQ, we invited all the Saudi engineers and trained them of this "On-Site-ism". I think SHARQ is still keeping this asset.

JAPANIZATION

Education
- Self-sufficient Education
- Application on the Site

Traditional Industry
- Integration with New Industry
- Formation of Supporting Industry

07

One more difficult job was the involvement of common people in the process of industrialization. Fortunately, the literacy rate was very high in Japan. Virtually 100% of Samurai class can read and write, and even in a common class, around 50% of male as an average can read or write, or as high as 80% in metropolitan area. Compare 30% in London or 10% in Paris at the same time, it is exceptionally high. This high literacy rate enabled Japan to absorb the new technologies and to supply qualified workers. In order to realize such a rapid modernization, it was also important that all the people understand and participate. Many of the western knowledge and its cultural background were translated into Japanese, so that ordinary people could read. It became a common knowledge. These translated knowledge, along with the high literacy rate, enabled those common people to become qualified workers.
At the same time, to keep the traditional identity became a very important issue. Western culture was quite different from Japanese one. We did not deny nor select them, but accepted them rather freely. Then we modified them to fit for our culture. "Wakon Yosai", which means "Japanese Spirit, Western Knowledge", was a slogan at that time.
Let me talk about the Japanese industrialization from a different aspect, population problem. In the second half of the 19th century,

Involvement of Common People

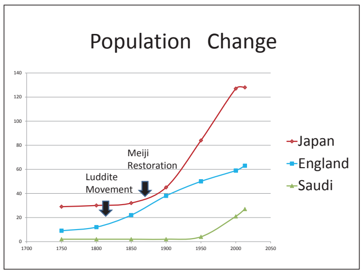
High Literacy Rate
➡ Qualified Labor

Diffusion of Knowledge through Translation
➡ Common Knowledge

Identity Problem
➡ 和魂洋才
Wakon Yosai
(Japanese Spirit, Western Knowledge)

08

Japanese population was around 30 million, almost the same number as England at that time. But England increased its number gradually, utilizing the fruits of the Industrial Revolution. Even so, England had to suffer from severe unemployment problems such as the Luddite movement. Japan was forced to face a sudden competition from outside. Japan could not let her people lose their jobs. To make those people participate in the Japanese industrialization was the best and only solution at that time.



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So, what kind of suggestions can we have from those experiences? One of the important things is the higher education focused on basic principle. This would become a solid foundation of future applications and the key to the technological independence. The other thing which I think very important is the education of the common people. If you see any country, most of the people are within the range of one sigma or two. How to utilize those average people is quite important. It will have two positive effects. One is to strengthen the basis of whole industries including supporting industries which are vital for future Saudi economies. And the other is to help Saudi young generations to have their own jobs. But in order to bring out those common people, say, as the masters of techniques, there should be a common perception within the society that they are to be respected. One last thing I would like to say is the "On-Site-ism", participation of engineers on the manufacturing site. When Mrs. Margaret Thatcher came to Japan, she visited a factory and surprised that many university graduates were working on the site of the factory. It is quite important if you want to make an improvement, especially in the manufacturing industry. Improvement is a key factor of competitiveness. I think each country would have a different path for its development, based on the different environment. But I will be very happy if you extract some principles from our experiences and modify them to fit in your country. Thank you very much.

Suggestions

(1) Higher Education

(2) Education of Common People

(3) On-Site-ism

10

Session 1: Industrial and Human Development

Q & A

Kodama I would like to add one thing. I forgot to mention Honda Foundation' s contribution in awarding the three-way catalyst inventor. As you know Honda made a breakthrough with the CVCC and then technology changed from CVCC to three-way catalyst. And in 2002, the British inventor Cooper was awarded by Honda Foundation.

Q **Ohayougozaimasu. I have a one quick question for the first speaker. A very interesting story about the comeback of the steel industry. But you mentioned that 50% of the patents were shared. So what were the criteria for the company to share or not share the patents with others?**

Kodama Well, it was a special arrangement at that time. The objective was to make a right judgment on the emerging technology. The LD converter, the world didn't not know whether it was going to be a mainstream technology in steel making or not. They established a community to evaluate and solve the problem. And then when that committee expanded, all the patent they owned or half of that was shared. The point is the purpose at that time was to diffuse the most efficient technology throughout the Japanese steel industry. Not to compete with each other and hide it. As you know the US did not find this interesting.

Q **Yes but why half of them? Why not all of them?**

Kodama I don't know. You have to check the details. But I think 50% is good. 100% means everything open. And maybe not all patents were valuable. The research is to evaluate the emerging technology, or technology that did not exist before.

Q **I am an associate professor of cyber security. I have a question for the first speaker about the excellent knowledge. Are you referring to open innovation? And secondly you spoke about sharing knowledge and patent without licensing. Is this to open information so society can benefit from whatever intellectual property was there?**

Kodama Yes, I talked about the three stages of development. And patent issue of steel companies was the first stage, and also that was a collective research. Every company joined in the research. So as I said, diffusing was the important aspect. The basic spirit of patent is diffusion. Then second stage for example CVCC is a patent and could not be free for other

Kodama | companies. And the technology was later inter-competition rather than intra-competition. So the patent was very important. TOTO patented a lot I think. But think about some other use of that super-hydro property. It's beyond the visional domain of TOTO, which is sanitary product manufacturing. I think they organized some association for that technology and they tried to diffuse more through different industries. Of course patents are important. So the talk about free use of patents is in the first stage.

Q | **But what about open source or open innovation?**

Kodama | Open innovation is how to use patents in a wider way, without releasing them to other companies. How to use and exploit for many different use. That is the idea of open innovation. And that is a new argument. Around 1950 there wasn't such an argument.

Session 2:

Innovation, Culture and Spirits

Mr. Takeo Fukui
Advisor, Honda Motor Co., Ltd.

Dr. Eng. Essam Bukhary
Cultural Attaché, Royal Embassy of Saudi Arabia

Session 2: Innovation, Culture and Spirits

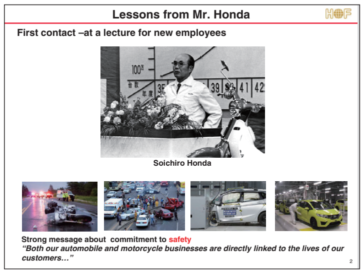
Advancing Corporate Culture to the Next Generation

Mr. Takeo Fukui
Advisor, Honda Motor Co., Ltd.

Good morning. It is my great honor to have this special occasion to speak in front of the people of Saudi Arabia.

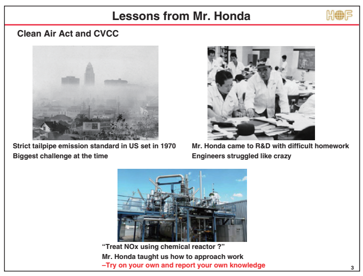
01

It has been 23 years since the founder of Honda Motor, Mr. Soichiro Honda, passed away. However, Mr. Honda's way of working and way of thinking have become the corporate culture of Honda. I am a member of the last generation of Honda associates who directly inherited the spirit of Mr. Honda. Today, I would like to explain what I learned from him, how I pursued it and how a corporate philosophy can be passed down to future generations.



02

I met Mr. Honda for the first time in 1969, at a meeting for new employees after I joined the company. I had admired Mr. Honda for a long time, and there he was giving a lecture to his new associates. He said something that left a strong impression on me: "Both our automobile and motorcycle businesses are directly linked to the lives of our customers," Mr. Honda said. "Those of you who cannot take responsibility for your own actions can quit Honda right here and now and go home." I was struck deeply by Mr. Honda's strong message about our commitment to safety. And I communicated the same message to other young associates from time to time during my career.



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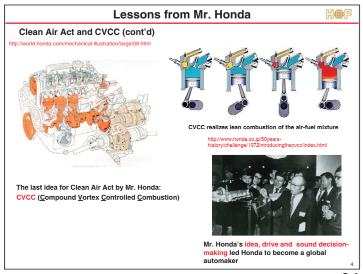
In 1970, an amendment to the U.S. Clean Air Act, known as the Muskie Act, set strict new standards for tailpipe emissions. The standard seemed impossible to meet. But without doing it, we could not have succeeded with our automobile business. So, meeting the standards of the Muskie Act was our biggest challenge. Mr. Honda was the president of the company at the time, and he came to the R&D center almost every day. He would give us difficult homework and return the next day.
If we hadn't solved the problem, he would yell: "Are you still doing that? Knucklehead!"
We struggled like crazy every day. One day, my boss said to me:
"Mr. Honda is asking if it is possible to treat Nitrogen Oxide using chemical reactors. Can you try that?" Then he added: "Mr. Honda is coming tomorrow!" I was, in fact, a chemistry major and I had studied in

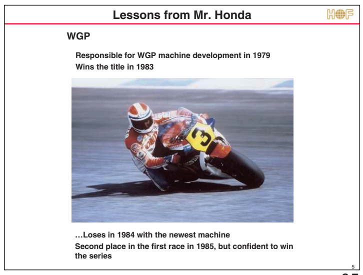
the area of exhaust gas emissions during my college days. So, I thought 'Mr. Honda has an interesting idea.' But I had only one day!
I conducted every possible experiment without sleeping. But I could not come up with a practical solution. Mr. Honda came the next day.
And my boss asked me, a rookie engineer, to explain the result to Mr. Honda. I spoke with caution: "It is possible to treat Nitrogen Oxide with a chemical reactor," I said. "But, according to my calculations, the equipment will be too big to put in a car."
Mr. Honda said, "Oh, OK." That was it. I think he saw how exhausted I looked and trusted that I tried everything possible. And he never mentioned this research issue again. Mr. Honda wanted to see if people were making a genuine effort. He could recognize right away if we depended on someone else's research. He would go crazy! He made sure that we tried on our own and reported our own knowledge. This is how Mr. Honda taught us to approach our work.

The last idea Mr. Honda came up with for the Clean Air Act was the Compound Vortex Controlled Combustion, or CVCC technology. This realized lean combustion of the air-fuel mixture. We developed CVCC engine just two years after the Muskie Act became law.
It became the world's first engine to meet the 1970 Clean Air Act. It went on sale in the Honda Civic in Japan in 1973 -- and in the U.S. in 1975.
We looked at this challenge as an opportunity. Our success was due mainly to Mr. Honda's idea, his drive and his sound decision-making.
The CVCC technology was key to Honda's leap as a global automaker.



04

Among the many contacts I had with Mr. Honda, the strongest memory involved motorcycle racing. In 1979, I became responsible for developing a race motorcycle for the World Grand Prix, now known as MotoGP motorcycle road racing. I had no experience in this area.
Honda was a dominant force in motorcycle racing in the 1960s. However, we withdrew from racing for a time. After we returned, we won the WGP title in 1983. But in the following 1984 season, our newest machine did not do well. And we missed the title in the main 500cc class.
We badly wanted to regain the title.
In 1985, Honda introduced another new machine to make a comeback. But in the first race, we finished in second place. After analyzing why we lost, we were confident we could make the adjustments needed to win the series. But when we returned to Japan, Mr. Honda came to the R&D center and asked me about the race. I said: "We finished second."



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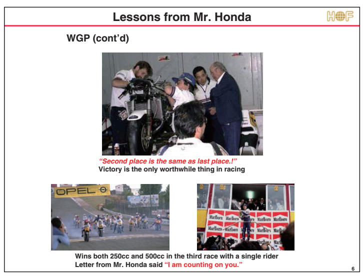
The next thing I heard was the ear-splitting voice of Mr. Honda. "Damn you! Second place is the same as last place." I almost told him, "Second place and last place are not the same!" But I bit my tongue and listened to him for one hour. Mr. Honda wanted me to understand his strong belief that victory is the only worthwhile thing in racing.
Our team set a challenge that year that had never been done before -- to win the double title in both the 500 and 250cc class with a single rider.
In the 3 rd race of the year we won both classes. Then we received a box



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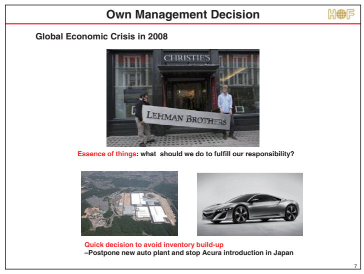
of treats and a letter from Mr. Honda. He wrote: "Keep up the good work. I am counting on you." I still treasure that letter. And at the end of the season, we won the first double title in Grand Prix history.

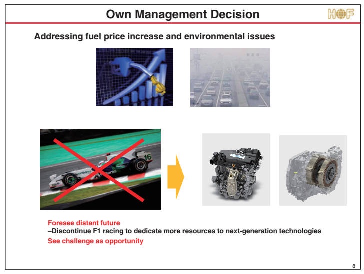
These lessons and way of thinking are what I learned from the founder of the company. The philosophy of Honda would serve as an important foundation later, when I made management decisions as the president of the company. For example, the global economic crisis that began in 2008 became a major turning point for our company. We had to revisit the way we built automobiles while preventing the major decline in sales from having a big impact on our financial results. Honda was facing the biggest crisis since its foundation.



07

As president, I looked deeply into the essence of things. I read again a number of books written by our founder. And I thought about how we should maintain a stable business to fulfill our responsibility as a good corporate citizen. In November of that year, we opened a new auto plant in the U.S. However, our business environment was getting worse by the minute. For a maker of expensive products like automobiles, too much inventory can be deadly. So, I made quick decisions to postpone the start-up of a new auto plant in Japan and stopped a plan to introduce the Acura luxury brand in Japan.

Even when taking quick actions to cope with current challenges, it is very important to foresee the distant future, 50 or even 100 years from now. Fuel prices were increasing. And there was a growing need to address environmental issues. So, electric powertrains emerged as the future direction of the automobile. Thinking ahead, I had to decide where to invest our resources for the post-recession era. I discontinued F1 racing activities so that we could dedicate more R&D resources to next-generation automotive technologies and powertrains.

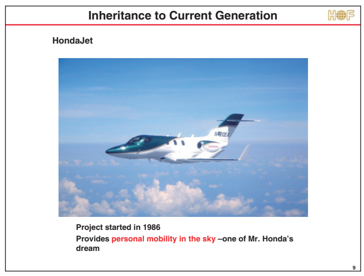


08

Just like when we met the challenge of the Clean Air Act, we worked with a positive spirit. We saw this big challenge facing the auto industry as our opportunity.

Now, let me explain how the current generation of Honda associates is utilizing this corporate culture and spirit. Honda makes many different kinds of products, but the core direction is personal mobility.

In 1986, Honda began several new fundamental research projects – including aviation and humanoid robotics.



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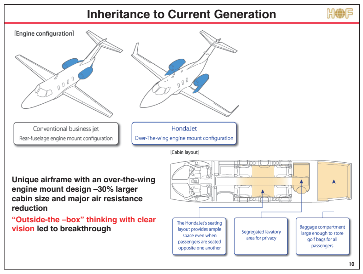
One result is the development of the HondaJet. The first customer delivery will take place next year. This small-sized jet provides personal mobility in the sky—something that was always one of Mr. Honda's dreams.

Our engineers adopted a unique airframe with an over-the-wing engine mount design. A conventional small jet has the engines attached on both sides of the fuselage. Honda's over-the-wing engine design eliminates the supporting structure inside the fuselage—which increases the cabin size by 30%.

When other companies tried this engine layout in the past, the air resistance increased. So, the conventional thinking was that the layout didn't make sense. But Honda engineers never gave up. They conducted experiments over and over again. Finally, they found a "sweet spot" where the engine can be mounted over the wing with a major reduction in air resistance.

Honda is a company that pursues the essence of things even when our ideas do not fit with conventional wisdom. The engineers who developed HondaJet were thinking outside-the-box. They had a breakthrough because they had a clear vision of what a small business jet must achieve.



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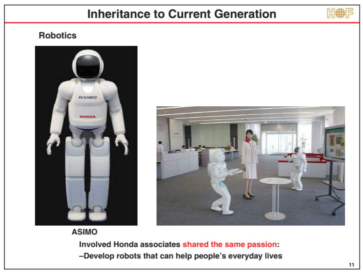
In a similar way, Honda has been striving to develop humanoid robots that can be useful in society by having our engineers pursue the essence of things. All Honda associates involved in this project share the same passion. They want to develop robots—like ASIMO—that can help people's everyday lives.



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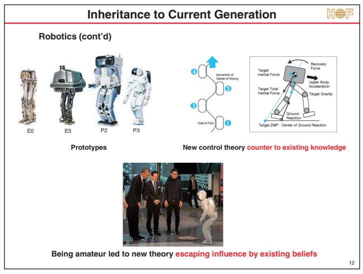
It was an accepted idea that robots would never be able to walk smoothly like people. But our development team studied how people walk. They analyzed what theories were needed to replicate human walking. Based on these studies, Honda developed a new control theory which was counter to the existing knowledge in the academic community. We established a new direction for humanoid robotics. In this way, we overcame the doubts of many people, including in government, who didn't believe it was possible. Being a complete amateur in this area worked in Honda's favor. It enabled the team to establish new control theory without being influenced by existing beliefs.



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Today, I have talked about the essence of what I learned from Mr. Soichiro Honda. I have explained how these values have been passed down and applied by the current generation of Honda associates. Mr. Honda wanted all Honda associates to understand that the purpose of technology is to serve people. What Mr. Honda said at my new-employee orientation, which I mentioned at the beginning, all comes down to respecting and cherishing human beings.

Another aspect of how we work at Honda is what we call our "challenging spirit." Even when people think something is impossible, we look deeply into the essence of things. This can lead to a new way of thinking or breakthrough to overcome a difficult challenge. New products and technologies created this way tend to be more innovative and create new value.

What is important is the effort to confirm the truth in the real world, with real things. Based on the theory we conceive, we create and test with our own hands. And if we fail, we re-think and we try again.

13

By repeating this process "at the spot," we are able to overcome challenges and maintain a creative way of working.
Mr. Honda once said: "Action without philosophy is a deadly weapon, and philosophy without action is worthless." These great words of wisdom state very simply the importance of thinking deeply and taking action as two sides of the same coin.
I believe we can bear the pains of giving birth to new ideas only when we have a strong passion and take initiative toward what we want to do.
Just as Mr. Honda did when I joined the company, I remember speaking at a welcome ceremony for new Honda associates. I told them "It is great to learn the Honda Way. But there will be no future for Honda unless you bring something new to the company or do something new at the company. Our value depends on how we can change Honda. If you are thinking that you are going to work for Honda, you are already not in line with the "Honda Way." Why do people work? We work not for the company but for ourselves. That is a universal truth at any time and anywhere in the world."
This was my true feeling and it was also what Mr. Honda was thinking. Enjoying our jobs will ultimately help the company and contribute to society.

But the world changes ... and the business environment changes along with it. No matter how great the founder of any company, there is no corporate philosophy that can be an absolute truth across time and space. Rather, it is the great responsibility of succeeding generations not simply to inherit the corporate culture, philosophy and spirit, but to determine how to apply it to a changing society and the current times.

Today, I hope I have been able to explain just a small portion of what Mr. Soichiro Honda demonstrated through his life and how it still lives on as the spirit and corporate philosophy of Honda.
Thank you for your attention.

Session 2: Innovation, Culture and Spirits

Challenges of innovation and Future Design in Saudi Arabia and Japan

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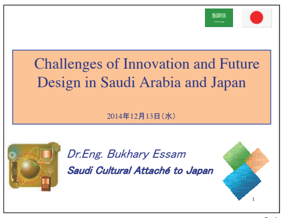
Good morning ladies and gentlemen. It's my great honor to talk to you today. I first of all would like to express my gratitude and appreciation to the foundation and King Saud University for convening this symposium today.

I would like to begin by having everyone look at this world map. This is how we look at the world from the point of view of Saudi Arabia. However, this is how our friends in Japan look at the world. We are here, while Japan is here at the center of the world. Our friends in the US, they believe that THEY are at the center of the world. Our friends in Australia believe that they are in the North and we are in the South. And this is the world from the North Pole, and the world from the South Pole.

What I am trying to say is that, even if we have this one material thing, our planet, we can have various points of view. We can look and deal with the same problem from different aspects. I think this is a key to a nation or an organization, or even a person, who would like to be innovative in facing changes. By the way, this is how we look at our planet from the moon, and this is a little bit far from outside the solar system.

In the previous slides, we were looking at our planet from the place, but now, I would like to change the time. This is how our planet looked 152 million years ago. I don't think Japan and Saudi Arabia were around at that time. This is how our planet looked 90 million years ago. And this is how we look currently at night. So we can see Japan, Saudi Arabia, Riyadh, the Eastern Province, the Western Province are lighting. We can see the situation on the ground—for example Africa and the South America. We have more ways to see our planet. This is how the world map will look based on the economic power.



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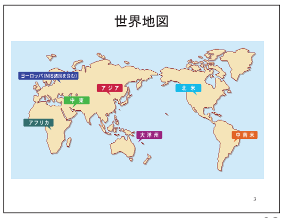

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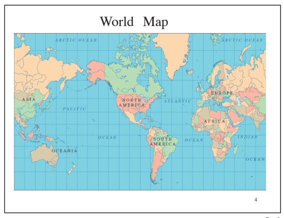

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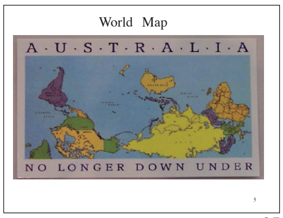

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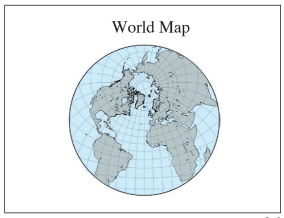

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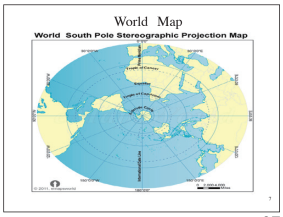

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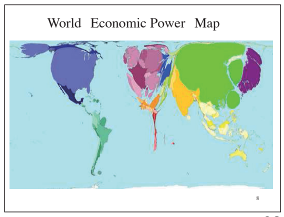

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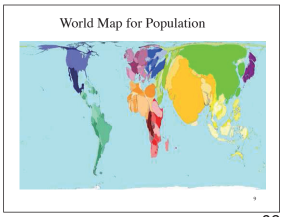
We can see how Japan is very huge, and how Africa is shrinking. Australia here. South America here.

This is a world map based on population. We can see how China and India are occupying almost a third of the world's population. This is the world economy in 2050. In 2050, it is expected that China or even India will be the biggest economy in the world, with US third, Brazil fourth and Japan fifth. Saudi Arabia will be 18th, and hopefully in 2090, we will be in a better position. But what I am trying to say is, the world is changing.



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PPP 2009 Rank	Country	GDP at PPP*	PPP 2050 Rank	Country	Projected GDP at PPP*
1	US	14256	1	China	59475
2	China	8888	2	India	43180
3	Japan	4138	3	US	37876
4	India	3752	4	Brazil	9762
5	Germany	2984	5	Japan	7664
6	Russia	2687	6	Russia	7559
7	UK	2257	7	Mexico	6682
8	France	2172	8	Indonesia	6205
9	Brazil	2020	9	Germany	5707
10	Italy	1922	10	UK	5628
11	Mexico	1540	11	France	5344
12	Spain	1496	12	Turkey	5298
13	South Korea	1324	13	Nigeria	4530
14	Canada	1280	14	Vietnam	3939
15	Turkey	1040	15	Italy	3798
16	Indonesia	967	16	Canada	3322
17	Australia	858	17	South Korea	3258
18	Saudi Arabia	595	18	Spain	3195
19	Argentina	586	19	Saudi Arabia	3039
20	South Africa	508	20	Argentina	2549

*(constant 2009 US$bn)
Source : World Bank estimates for 2009, PwC model estimates for 2050

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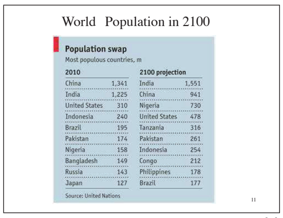
So let's look at the population of the world in 2100. Again, in 2100 India will be first, China, Nigeria, the United States, Tanzania, Pakistan, Indonesia, Congo, the Philippines, Brazil, and Japan is not even in the top 10, unfortunately.



2010		2100 projection	
China	1,341	India	1,551
India	1,225	China	941
United States	310	Nigeria	730
Indonesia	240	United States	478
Brazil	195	Tanzania	316
Pakistan	174	Pakistan	261
Nigeria	158	Indonesia	254
Bangladesh	149	Congo	212
Russia	143	Philippines	178
Japan	127	Brazil	177

Source: United Nations
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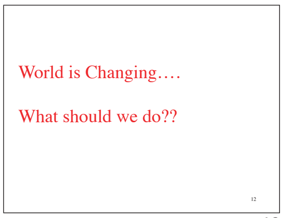
So as Fukui Sensei mentioned, the world is changing, and the biggest problem is, 'what should we do?' How we should deal with those changes. Here I would like to quote the comments of Shigetaka Komori, the CEO of Fujifilm. He says that there are three levels of dealing with changes. The first is reacting after the change. For example, the IT bubble happened in the end of the 1990s, and a lot of companies started to change their philosophy after that from being concerned with just mechanics to digital equipment. The second is predicting the change and preparing for it, and this is what happened to Fujifilm. Fujifilm and Kodak were the strongest two companies in the camera field; however, Fujifilm predicted that the world would become increasingly digitized, and they invested in R&D and changed their business style to digital cameras and smart printers. However, Kodak no longer exists.



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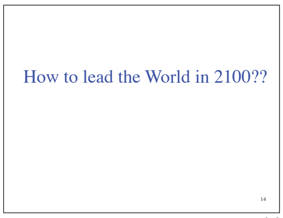
The third stage, which is the best approach, is making the change. In other words, to be proactive, not to be reactive. This is what's happening with Google, with Facebook and with Apple, and with a lot of Japanese companies in the 1950s and 1960s. So what I am proposing here is the importance of designing the future. We should not wait for the change to happen; we should take the initiative to change and design the future.

How can we lead the world in 2100? I once attended a lecture in Japan, and the Japanese professor was mentioning that they had a lot of scenarios to predict the world's environment in 2100. In one of the results, they found that the USA, Europe and Japan will be deserts, and the Arabian peninsula will be full of rivers and green



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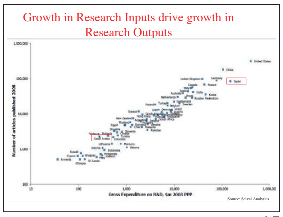
spaces. The professor was also mentioning that who has the water at that time can lead the world. However, there is a very important condition, which is you should have a very qualified leader —in economy, in science, in technology, in planning, in ICT. So, here we start the calculations—let's assume that the people who will be the leaders in various fields in 2100 are 50 years old. It means that they will be born in 2050. When they are 20 years old—in 2070—they will be in their second year in university, hopefully King Saud University, and other universities as well. To have a good, qualified leader, they should have a good education and they should have qualified educators. So let's assume that the educators in 2070 are 50 years old, that means they will be born in 2020. To prepare for the leaders in year 2100, we should have qualified educators, and to have qualified educators, we should have qualified educators of the educators. And if we ask ourselves, who are the educators of the educators, it is you and I and the distinguished guests here. We must start now.

This graph shows us the expenditure on R&D, and the number of articles published in 2008. As you can see, the position of Japan and the position of Saudi Arabia, recently, Saudi performance of R&D expenditure is getting better. However, this is the global situation of R&D as you can see. This is a global collaboration map. We can see the USA in the center. The bigger the letters, the more publications. So, we can see the USA, Germany, China, Japan, and here is Saudi Arabia. Something to mention here is that the strongest country for R&D collaboration with Saudi Arabia is Egypt.

Let's have a look at innovation in Saudi Arabia. The expenditure on R&D grew from 0.05% in 2007 to 1% in 2012. This is a very huge change. And our national plan for science and technology is aiming to have 1.6% in 2020, and 2% in 2025. This is a summary of performance in publications and citations, and one thing to mention here is that among G20 countries, Saudi Arabia recorded the highest growth rate in publications. For international ranking we are not in the top; however, our growth rate is recognized to be high. These are the core competencies for Saudi Arabia—chemistry, engineering and medicine, in terms of publications. Here are our competencies in science and technology. Those are the best organizations that publish papers: for the national level, you can see King Saud University, King Abdul Aziz, KFUPM, KAUST, King Faisal Hospital, King Khalid and other universities.



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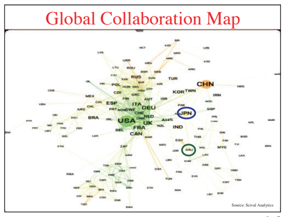

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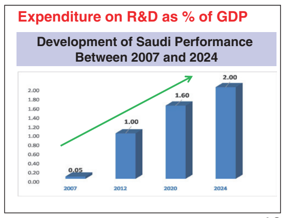

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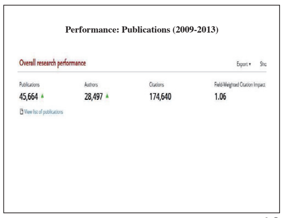

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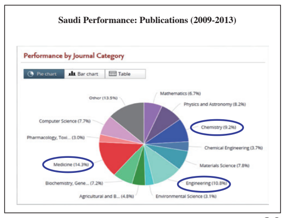

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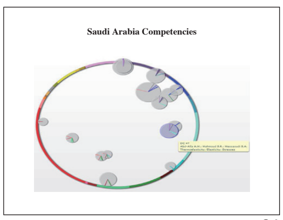

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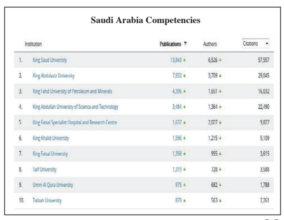

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This is the academic ranking. Saudi universities are very high ranking, while India and Russia have only two universities in this ranking.

So what are the challenges to envisioning a system for Saudi Arabia? In my belief most researchers are theoretical, or let's say, not applied, or are not transferred into industry. So why is that? Because there is a lack of strong industry-academic collaboration. And why is that? Because the lead expenditure of Saudi private sectors is in R&D. And why is that? Because of the absence of Saudi firms in high-tech industries.

However our universities are investing in R&D, however much we publish, if we do not have Saudi firms in high-tech industry, we will not be able to market our technologies. The other approach will be marketing those technologies, globally, unhindered.

This graph shows investment intensity and profitability from investment in R&D. Let's have a look at all the graphs. This is the main investment of our country. We can understand here that, even if you are not investing too much in oil and gas you can have very high profit. It doesn't mean that I think to invest in something that brings no profits.

What about petrochemicals? Consider SABIC, where you have more R&D but less profit comparing to oil and gas. So what we should do is, as we move from only oil and gas into petrochemicals, we have to move into technology hardware, electronics, automobiles etc. Of course, the best scenario is to have Saudi leading companies, software and fixed-line telecoms perform the work.

Some would say: 'We have huge companies in telecommunications, but why are we not investing there?' Because, most of our economies are technology consumers, not -technology innovators. We have to change that. So how can we build Saudi firms into high-tech industries? I believe in M&A—acquisitioning others. There are examples of Korean companies—LG, Samsung, Hyundai—most of those companies acquired other companies in order to build their indigenous technological capabilities. For example, Samsung acquired a company with microwave and semiconductor technologies—those technologies are essential now for Samsung smartphones.

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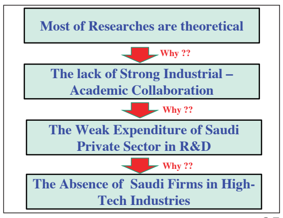

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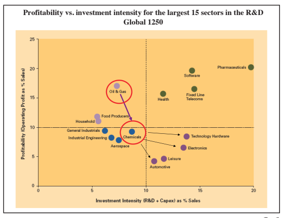

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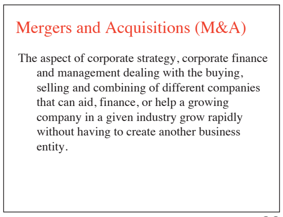

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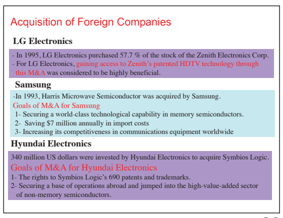

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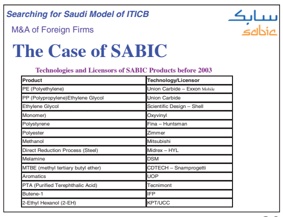
So what about Saudi Arabia? Let's have a look at SABIC. I believe my colleague will have a presentation later. In 2003, when SABIC started by joint ventures with a lot of companies, they had licenses for many technologies. At one stage, when SABIC became a global competitor, and other companies feared that SABIC would occupy their positions, and they began to set difficult conditions for SABIC, such as withholding licenses. What SABIC did was acquire a scientific design company in 2003, so now it is a part of SABIC. In 2007, SABIC acquired a plastic industry company.

This is what we are talking about. To go from petrochemicals to the plastic industry, this might be the pace for coming Saudi firms to move into a high-tech industry.



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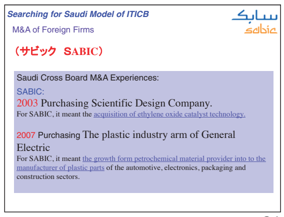

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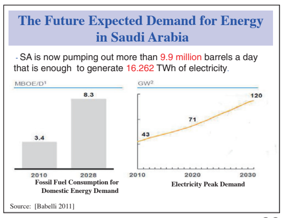
Here is one simple example: this is our fuel consumption in Saudi Arabia—in 2010 we used the equivalent of 3.4 million barrels of oil everyday, if we kept this consumption rate, by 2028, we will use daily 8.3 million barrels of oil. This is a very challenging subject.

So what can we do? One approach is solar energy. We can see that Saudi Arabia is in a very good position in terms of solar radiation.



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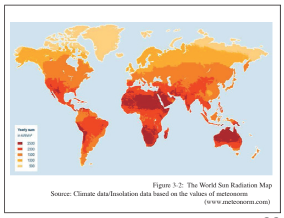

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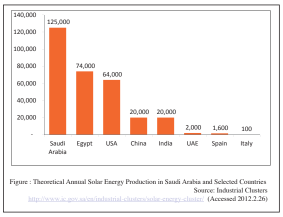
This is the theoretical analog of solar energy production in Saudi Arabia compared to other countries. So, compare Saudi Arabia to Spain, the leading country in Europe in the solar industry. For example now in the Saudi market we have Solar Frontier, which is a Japanese company under Showa Shell, and Aramco has around 15% of stake in Solar Frontier. Consider BP Solar Arabia was a branch of BP Solar; however, British Petroleum stopped all its projects in solar and they started to focus more on wind engineering, so now they don't have any technological capabilities. Most of those solar companies are contractors—they do not have real technological capabilities. For National Solar System they do have operational capabilities and they started to develop and customise a number of products, but still limited.

What we should do when we start and open this sector is to set conditions, such as using local materials and components in addition to human resource development and technology transfer.

We can have those fields to develop our national companies into high-technology area.



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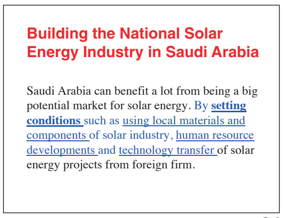

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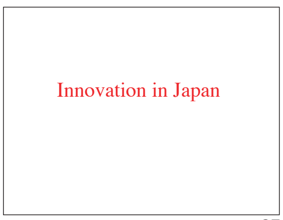

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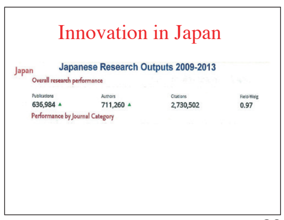

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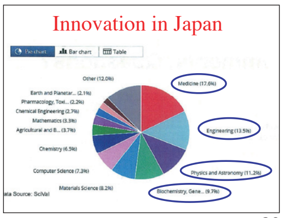
This is the performance of Japan. Very high, of course. Japan is very strong in medicine, engineering, physics, biochemistry. Between 1996 and 2007, this was the growth rate of R&D expenditure. Yes, Japan was not as high as other countries, but let's remember that Japan has invested a huge amount since the 1970s and 80s compared to those other countries.

So what are the challenges we can envision facing Japan? There are many, but I'll pick up two today: international cooperation and ageing society. So let's start with international cooperation. We can see the United States in the center of co-author-patterns of publications in the world and China is in the new center, and you can see Germany and the United Kingdom. Those are the centers among the G8 in publications. Japan, South Korea, Brazil, India does have a kind of collaboration, but not that much compared to the others. This is the number of papers co-authorized between Japan and the US, China and the US, the EU and the US, and you can see that there are a lot of other areas compared to Japan.
One approach is enhancing global cooperation within Asia. This is the example of Europe. We can see how they are collaborating with each other. Raising the number of foreign students, foreign faculties at universities, and enhancing R&D activities for Japanese industry and academia. We have many good projects between Japanese industries and Saudi universities. Today's symposium is a good example. We do have Fujitsu, working with King Abdulaziz University in developing a super PC. Hitachi is also working on water distillation. We have companies working with KAUS on solar energy. We have Yokogawa denki building and R&D center in King Fahd University.

So next is the aging society.
This is the population of Japan. We can see how it was rising until 2005 and then the decline started. So this will affect Japanese competencies. So what are the solutions? Foreign workers? A workforce of women?
We do have more innovative solutions. Robotics. Here we can have ASIMO of Honda and Pepper of SoftBank. What I am explaining to you today is quoted from Mr. Son Masayoshi the president of SoftBank. What he says that a human can work for 8 hours a day, while a robot can work for 24 hours. In other words, one robot can work as three persons. What does that mean?
If we assume that we have 30 million robots in Japan —so 10 million humans plus 90 million robots it would equal 100 million workers. Compared to 70 million in China, and 10 million in the US and India.



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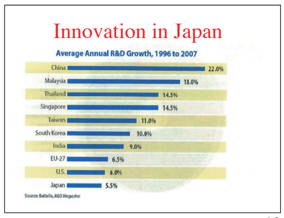

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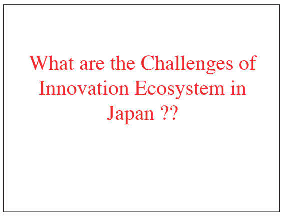

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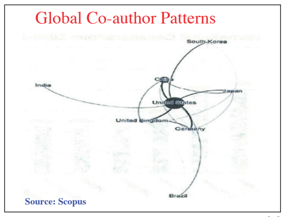

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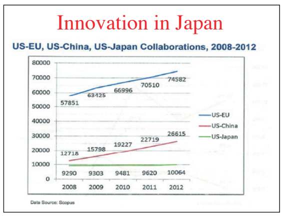

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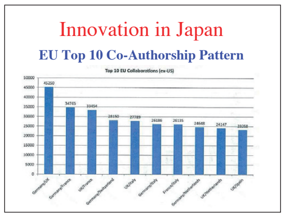

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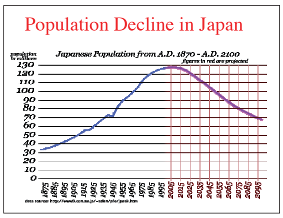

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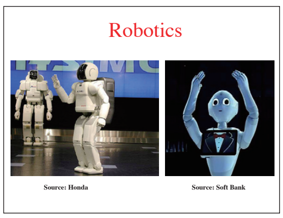

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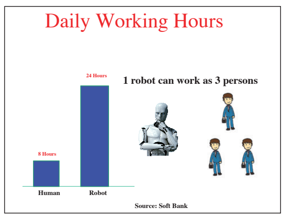

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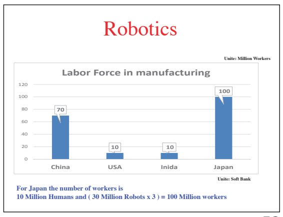
For the average monthly salary, in the US it is 3300 US dollars, Japan $2500, China $700, $300 in India, and only 170 US Dollars for robots. Very cheap labor force

So we have this famous equation: productivity multiplied by labour force population equals core competency of a country. This is the scenario. This is if you were to go normally without using robotics, and this is what would happen if Japan applied the use of robotics in industry—Japan would become #1 in industry by 2050.

So at the end, as we are celebrating the 60th anniversary of relations between Saudi Arabia and Japan, we mentioned that we have new challenges and the world is changing. For the Saudi-Japanese relations it was oil for goods. we exported oil and we imported automobiles and electronics; however, we have to change. We should not be win-and-win. Now we should be partners—strategic partners: partners of investment, industry, human resources development and innovation. And the most important point is that we are not playing a match. It's not win- lose, or win-win. It's happy- happy. Our objective is the happiness and peace for all humanity. Thank you for your time.



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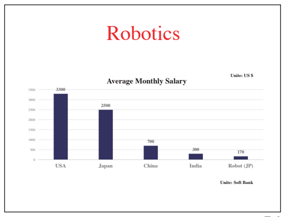

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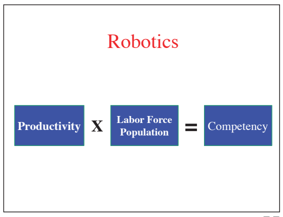

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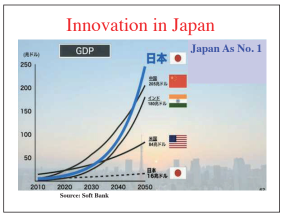

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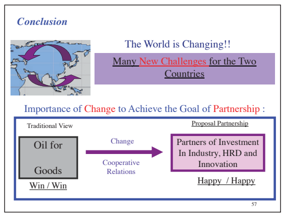

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Session 3:
University-Industry-Government Collaboration

Dr. Hirohisa Uchida
Professor, School of Engineering, Tokai University

Eng. Fuad Mosa
General Manger Technology KSA & Emerging Economies, SABIC

Dr. Kazuko Matsumoto
Senior Director, R&D, Vision Development Co. Ltd.

Session 3: University-Industry-Government Collaboration

University-Industry-Government Cooperation and Industrial Innovation

Dr. Hirohisa Uchida

Professor, School of Engineering, Tokai University

Good afternoon. My name is Uchida and I'm going to talk about University-Industry-Government Cooperation and Industrial Innovation. And I'll begin my talk by asking first: What is innovation? Professor Kodama explained already about innovation. Therefore, I won't be explaining much about this. Rather, I'll look at examples of innovation in Japanese University-Industry-Government Collaboration, focused on the case of Tokai University. Then I'll look at Kanagawa Science Park, founded for knowledge based R&D and industrial innovation. Then, I'll give some concluding remarks.

As you well know, Schumpeter said that innovation is not a simple invention, but induces "discontinuous and revolutionary changes of a society." And the center of economic change causes gales of "creative destruction". I'll give you some examples. For example, materials. Iron: since we've discovered iron, we've had tools for agriculture and civil engineering. Another case would be coal. Using coal has allowed for iron manufacturing and the steel industry to develop. Then railway and mass production proceeded. And, of course we extended markets and information from that.

We've also discovered semiconductors. Semiconductors led to transistors. From this came IC and LSI, and from this we have computers and smartphones. And now we have a global communication network as well.
And, LED—light-emitting diode. An invention of blue LED as you may know well, is by professors Akasaki, Amano and Nakamura—the three Nobel Prize laureates—was just one or two weeks ago. Why is blue LED so important? And why did they received this Nobel Prize?. Now that we have green, blue and red LEDs, we can use them to make a white LED. That is important.

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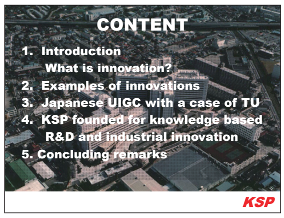

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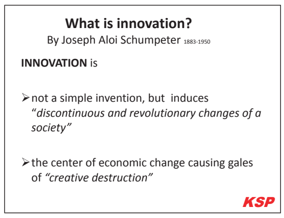

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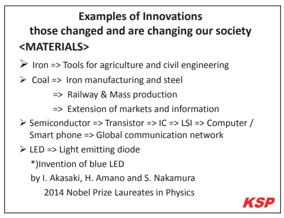

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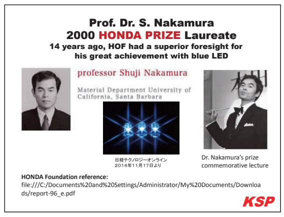
But, please remember this fact: the Honda Foundation already gave the Honda Prize to Professor Nakamura 14 years ago. We had such good foresight. This is a fact,
and a very nice case.

And, of course, an example of innovation for energy is fossil fuels for automobiles which have created our present traffic society. Uranium fission and hydrogen fusion is, as Einstein found this relation, a very small portion of mass change releases a huge amount of energy. We now apply this reaction to nuclear power generation, nuclear weapons,
and applications of radiation to medical treatment, industrial processes, and agriculture, as well as space technology.

And, hydrogen. This is my own field. Hydrogen is a nice and fundamental element. Hydrogen is being applied to fuel cell technology and combined with renewable energy as an alternative to fossil fuels, which is also very important one.
Just yesterday, or the day before yesterday, Toyota just started to sell the Mirai fuel cell vehicle at a price of 70,000 US dollars. Now this is still very expensive, but the Japanese automobile industry—both Toyota and Honda—will be expanding these hydrogen vehicles very extensively in the world.
Of course, this is the Honda concept car you'll see in 2015. If you have this car at home, you can utilize this car as a generator, too. Honda is showcasing this combination—you can see here this unit, is a power exporter. If you have this kind of car, you can supply electricity for one week to your family.
This is Honda's Solar-Hydrogen-Fuel Cell Vehicle System. This is Honda's environmentally-conscious technology—eco technology that Honda has had this technology patented for a long time. It has photovoltaic energy which can decompose water into hydrogen and oxygen, and you can directly supply 35Mpa hydrogen to this FCV. This is an example of nice technology from Honda.
And recently, in September, Honda announced this new very small hydrogen-supply system. This all fits in 7.8m2, and this is very important for Japan with its small space.
This is very nice technology for the future.

HONDA’s tackling on innovative Environment Conscious Technology—so-called 'eco technology'—started already in the 70s. Mr. Fukui already mentioned this.
Here is the Honda Civic with its CVCC engine. This was really innovative for the combustion engine at that time. Honda was the only company that succeeded with this at that time—no other company could make this type of engine at that time. The air was very dirty at that time and the Honda CVCC engine emissions were quite clean. This technology was transferred to other companies through reverse-engineering at that time.



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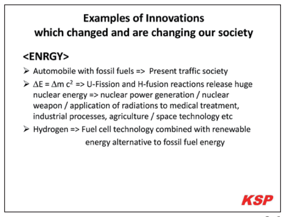

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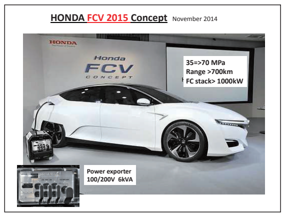

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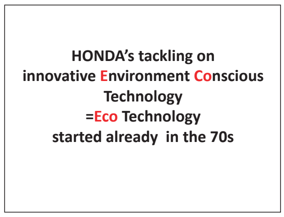

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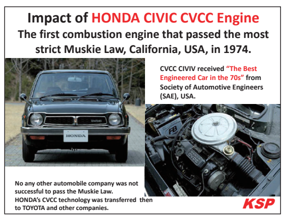

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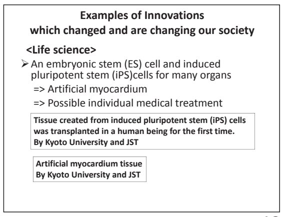
Another case of innovation is in the life sciences. The so-called ES cells or iPS cells. They're dreaming very big dreams for us—for example, artificial myocardium, or individual medical treatment may be possible.



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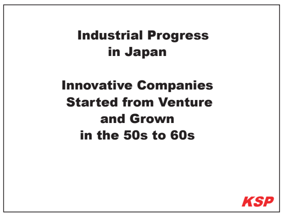

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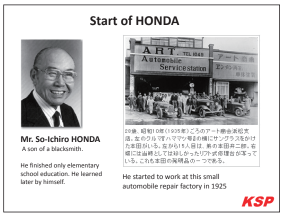
Now, I'll briefly tell you about industrial progress in Japan. I'll give you an example of innovative companies. Sony started with a tape recorder or a small transistor radio or a small transistor TV as a venture company called Tokyo Tsushin Kogyo, and now it has become a very big one. And then there was Mr. Matsushita who manufactured a very small lamp for a bicycle. That was the start of Matsushita Electric. Another case is Hayakawa Denki—this is Sharp. He manufactured this mechanical pencil. We call it a Sharp pencil. That was his invention. And based on this he invented the first TV, the first radio, the first cassette stereo recorder. These were great innovations.



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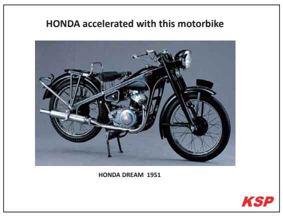

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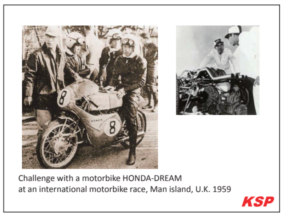
This is the case of Mr. Soichiro Honda. He worked in a very small repair factory in Shizuoka Prefecture. That was the start for him. And then, this motorbike, the Honda Dream, really accelerated the expansion of Honda. Mr. Fukui already told you of this motorbike challenge with the Honda Dream. And this is the air-cooled engine series, which was a special property of Honda's products. They took the original technology from their bike and applied it to their cars.



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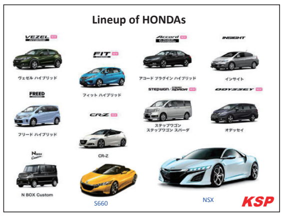
This is the line-up of cars from Honda. And this is the development of a humanoid robot by Honda. This is an example of Honda's spirit for innovation. "Challenge yourself, and catch your dreams!" Also, as Mr. Fukui mentioned, the Honda jet was also a result of Honda's "challenge yourself, and catch your dreams."



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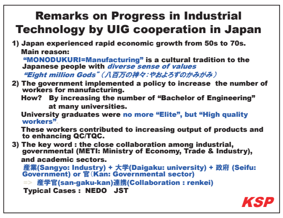
Now, I'd like to make a few brief remarks on the progress in industrial technology by university-industry-government collaboration in Japan. Japan experienced rapid economic growth from 50s to 70s. The main reason is 'MONOZUKURI=Manufacturing' is a cultural tradition to the Japanese people with a diverse sense of values. For example, in Japan we say we have 8 million gods. Even in the family, we say we have an extra god—wife—in Japan we say wife is also a god and we have an anxiety. Why do we have 8 million gods? Why such a concept? Because we find so many different nature. We see so many interesting, diverse things in nature. That was the thinking behind why we have a concept of 8 million gods.



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The second main reason is that the government implemented a policy to increase the number of workers for manufacturing. How? They increased the number of Bachelors of Engineering at many universities. These university graduates were no longer 'Elites', but 'High-quality workers'. They work in front, on site by soiling their fingers, which was very important to increase QC/TQC, too. The key point is the close collaboration among industrial, governmental, and academic sectors. These are really important relations. I will tell you more details later. I'll just tell you the example of what Tokai University, a private university, did. Since I was involved in the university-industry-government collaboration at this university, I can tell you that the research contracts increased by 1000 per year, and we introduced about 20 million US dollars per year. Except for the medical school. This is the actual data for intellectual property rights for Tokai University. At least until 2 years ago, it was the top data in Japan.

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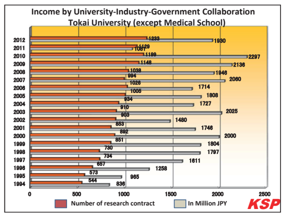

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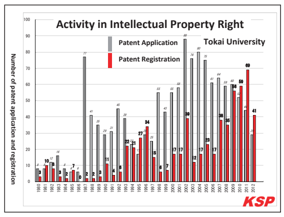

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I was appointed as a representative member to the UNESCO International Committee on University-Industry-Government Collaboration, and we published this manual book just for developing countries who want to start such a system.

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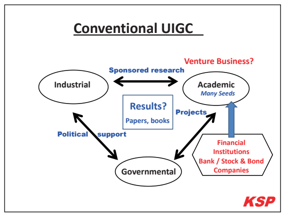
This is a very conventional university-industry-government collaboration system. This is a very typical triangle with the industrial, academic and governmental sectors. And between the industrial sector and academic sector is the university, which have very nice relations. I, myself, have had a very nice experience with industry. Between government and industry there are many national projects as well. Between government and university there are, of course, many projects as well. But it is thought that the research results of most university professors are just academic papers or books. And at that time scientific education did not accept patents as a result or academic achievements. Outside of this triangle, financial institutions—banks, stock & bond companies—are just waiting. There are so many interesting results, but they cannot convert these interesting results to money or on the market. That remains a big problem.



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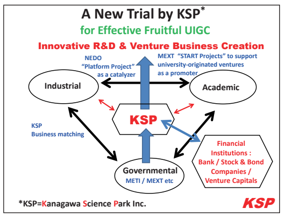
Kanagawa Science Park is the first science park in Japan. Now we are doing just as you see we are doing here. We are supporting NEDO as a 'Platform Project' as catalyzer. Or we are supporting the Ministry of Education as a 'START Projects' promoter. We are bringing support to companies that ask, but this is not easy. But we are trying actively, and we have already developed a long-connection with financial institutions, like banks and stock & bond companies. We totally combine these relations to these areas.



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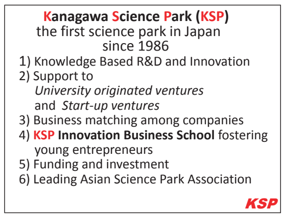

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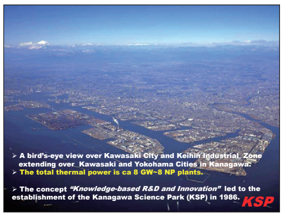
Kanagawa Science Park was established based on knowledge from R&D and innovation. We offer support to university ventures and start-up ventures. We also make business matching among companies. We also have the KSP Innovation Business School, which fosters young entrepreneurs. We also carry out funding and investment. We are also leading the Asian Science Park Association. This is a view of Mt. Fuji. This is Kanagawa Prefecture, especially Yokohama and Kawasaki area. Our Science Park is just located here. We can use the large potential with industry and academic institutions in this Keihin area. In 1986 Kanagawa Prefecture and Kawasaki City invested and opened this Kanagawa Science Park.
It is quite near to Tokyo.



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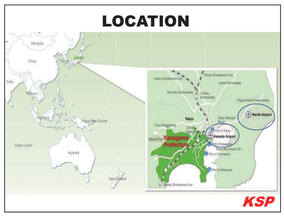

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This is our complex. This is the business park. This is our laboratory here and R&D Business Park Building. There are around 120 companies working. Among them 50 are venture companies and 70 are major enterprises. And around 5,300 people work there everyday. We have hotels, stores, restaurants—it's like a small town. We also have domestic and international companies.
We have investment funds. Companies give back money by a factor of 2 to 4 to the investor. We are now raising the number of funds to four.

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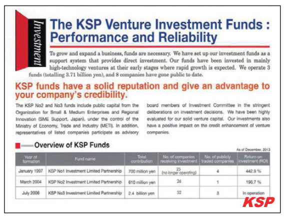
This is a chart of the last 10 years for the IPO performance at the Science Park.
We are also leading the Asian Science Park Association with 37 nations and 60 science technology parks. We act as a global platform for these science and technology centers.



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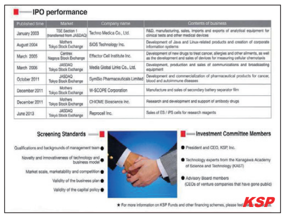

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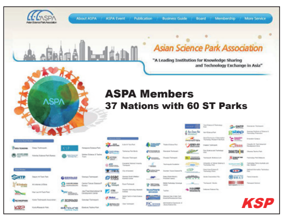

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These are pictures of the special courses for Saudi Arabian students. We've had this special course now three times. These students are starting to learn about Japanese university and they have a good understanding of Japanese.

This is our latest one—the KSP Innovation Business School with the Saudi Arabian Embassy in November. That was a very nice one.

We also have MOUs with the Prince Salman Youth Center in Saudi Arabia. We had a very nice time discussing matters with young leaders there.

The crucial word is 'global diversity'. This is the key for our future business and innovation. As Dr. Bukhary said before my lecture, because we have a diversity of ideas, we can find new ideas and business. We should respect these differences in each other. This is very important. Next year, we will hold an international conference in Kanagawa Science Park with the theme STPs towards Global Platforms for Sustainable Development by Human Eco Networks. Human networks—I think this is the most fundamental fact to maintain sustainable development for us. Thank you very much.

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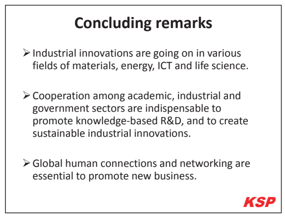

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Session 3: University-Industry-Government Collaboration

Toward Productive Collaboration between Universities and Industry

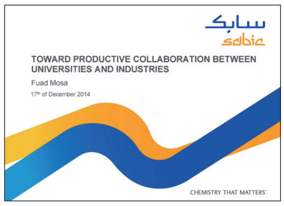
Eng. Fuad Mosa

General Manger Technology KSA & Emerging Economies, SABIC

Good afternoon everybody. It's my pleasure to represent here the industrial part of KSA. I'll give you a brief message about what SABIC is and what the industry around SABIC is trying to do in the knowledge ecosystem here within Saudi Arabia. I'll start by giving you some high-level information about SABIC. SABIC started, as most of you know, around 35 to 40 years ago. We were trying to devise flare gases and make it as a real product. If we look at SABIC and where we have come in 40 years, we have become the second largest, diversified chemical company in the world. We are the 88th largest public company in the world. I believe those two numbers haven't come only from efforts SABIC is doing now, but they came from the strategic vision SABIC had 40 years ago. Mr. Bukhary just highlighted the vision of the SABIC founders. We partner with the most competitive companies in the world in order to master manufacturing, which was the most important requirement at that time for SABIC.

Later on in the last 10 years, SABIC moved its strategic goal from mastering manufacturing to begin looking for another competitive edge, which requires a lot of innovation, a lot of research and development. We tried to hasten our approach through mergers and acquisition, which is something that has helped SABIC achieve these numbers. We now operate everywhere in the world, in 40 countries. From east to west. We work in most of the chemical downstream business required, and we believe that if we continue now as we are, we will soon become number one.

This is how SABIC operates. We have 45 sites distributed all over the world, as I said in 40 countries. We are producing 70 million tons per year. This is distributed between commodities and speciality products. Our customers also distribute all over the world. So, we have customer in most of the countries, which are countries working in industry. Our products are distributed to different businesses, and these are data about those businesses. Most of the numbers, which are important for us and we are proud of it, were number one now in a very important product, which is helping the world. Mono-ethylene glycol, MTBE, polycarbonate,



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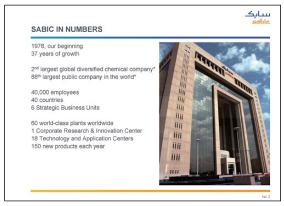

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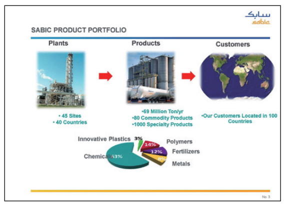

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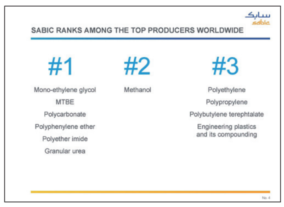

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polyphenylene ether, polyether imide, granular urea. We're number 2 now worldwide in methanol production. We're number 3 in polyethylene, polypropylene, and engineering plastics. We're distributing ourselves to different strategic businesses units, in order to be able to manage our business, to manage our product, to grow continuously.
Those are the six main business unit which SABIC concentrates. As you can see almost everything is touching the human beings, starting from chemicals, which was the initial power of SABIC, going to performance chemicals, metals, fertilizers, polymers and later we came with innovative plastics after acquisition of General Electric Those business units you see some products which we are showing here, most of products have so many grades and those grades going to everything. I believe, that anyone sitting here has definitely something coming from SABIC products.

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As all previous presentations said, the world is changing. If you would only like to manufacture, this will not be enough for you to compete. So Japan started with manufacturing. Then later on they started to innovate something, China, they are copying, but now they are number one or two or three in innovation. We are number two, but only with manufacturing. Insourcing technology will never allow us to continue as number two. So for us innovation, research and development are very crucial. We started 15 or 20 years ago for building the infrastructure of SABIC research and development. We believe that now we have reached a level of maturity that can help us in the future, with the help of lots of partners, which we will indicate later to go toward megatrends which is very obvious to everybody. There have been a lot of changes in the megatrends from the last 50 years, last 30 years, and last 10 years. In the next 10 years, 30 years, 50 years there will show many changes and those changes will bring different markets and different market focus. We believe, at SABIC, that those are some of the most important market focuses in the future. We are building our infrastructure, our footprint, worldwide in order to be able to compete on those areas which will assure us that if we are not number 2 in the next 50 years, we will be number 1.

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So now I will talk about how SABIC moved from manufacturing to be a technology and innovation company. This is just a main highlight of SABIC regarding technology and innovation. We have globally 2,000 researchers, these are researchers that come from different countries with different educational backgrounds. We were able in the past 15 to 20 years to come up with 10,000 global patents, good amount of this 10,000 patents are already upheld for our products and technology which SABIC are currently operating in different countries. We have now, based on SABIC, our mergers and acquisitions, 19 technology and innovation centers, from the US all the way to Japan. We are everywhere. If we saw all numbers of those countries now, we would see that they are the leaders in innovation research. We are currently attached to every country that is leading innovation and technological development.

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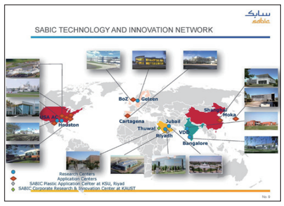
This is another picture that shows our networking—where we are exactly. We have many centers in the US and some in Europe. We also have many centers here in our home country. And we are in India, in China, in Japan. We are also looking to be wherever we feel that it will enhance and help us t to grow our research and development.



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This is a description of how we are distributing our products because it's not about matter of having many centers in the world. Although I am happy that we have 19 centers, the most important thing is how you can leverage those 19 centers to help innovation, research, and productivity.

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So what we did was we made a center of excellence. Each country has its own edge from application point of view or feed stock engineering or different angle of R&D requirement and competency. So what we did is to have center of excellence which we can support our ongoing plan and also try to leverage the availability of good chemist, good process engineer. At India and Europe also, we try to leverage competency same in US, China and Japan. This, we believe, helped us move from 1,000 patents from 50 years ago to 10,000 patents now. If you see the rate, for company, like SABIC moving from manufacturing to innovation, this increase in number can be huge, even compared with all our competitors except Chinese because Chinese are doing something amazing.

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One thing which we didn't talk about regarding our footprint is our 19 centers. Two of our 19 centers are currently located in the campuses of two leading universities in KSA. One of them is our SABIC application center in KSU, and the second one is in the industrial park of KAUST. We believe that our partnership, and our competitors, they value that their research and development are affected a lot, by our connectivity with universities. If you would like to come up with a technology—a constructive innovation—you need to be very strong in fundamental.

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The fundamental knowledge is available in the university. So if you have a strong university, like our competitors who have cutting-edge technology because they are receiving help from a strong university like MIT, then you will be able to be an innovative company. We believe that we will be able to be a strongly innovative company if we have a good partner, and we believe there is strength in our collaboration with our university. This is one of the reasons why we are there. We are seeing a little benefit currently, because there are all newly built, but in the next five years, if I come back here I can tell you a lot about how we have made it and how we have developed from it.

So now I will give some brief success stories which will give you an indication about SABIC and innovation. I will talk about a major technology, which SABIC developed. This technology produces acetic acid from methane. Methane is a valuable fuel, which was largely available in the Persian Gulf, but now less available. Where highly available now is in US. SABIC has the only technology in the world which can make acetic

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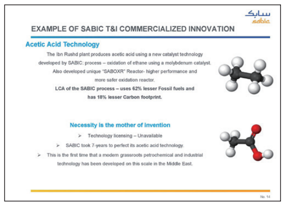
acid, which is an important product made from methane. The second one is linear alpha olefins, and linear alpha olefins are family products. It is used to make plastics, lubricant. It is used to make additives. Three companies worldwide—Shell, Amocco etc.--are monopolizing this technology for more than 30 years. SABIC tried to license this, because this is a very strategic product for us. But they refused. We decided in the 1990s that we should not continue to look after those people and we should do it ourselves. We were able to, by the middle of 2004-2005, get a technology which was better than how the big companies do it. Most of those large companies produce this under very high operating conditions—300bar, 200 degree C. We were able to make the same product with 50bar and 60 degree C. I know this because I was leading this technology. In the first presentation I gave in 2006, they were all sitting like you, and after I finished they came up to me to say that you are dream maker. And now, 5 years later, we have 150,000 KTA plants with engineers, and I can advise you all to come see it. It is a technology that we made and we are proud of because it shows that we can make it by ourselves.



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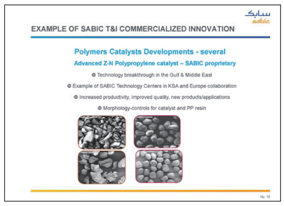
One more effect on our industry is the catalyst. In the catalyst, we are doing lots of work and we became able to produce our own advanced Z-N. We used to use Z-N of Exon Mobile for 30years.



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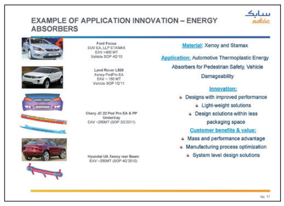
We are also proud, because we not only had our own catalyst, but polymer which we are producing from this catalyst is better than what we were getting from Mobil. With a change, you have to start changing. You have to go more downstream to see what is affecting the world. One thing is pollution. Pollution comes mainly from cars. All countries now are pushing for a reduction in energy consumption, which means reducing pollution. The only way to reduce this is by changing the material. What we are using now to build cannot help us so we need to change this. We are lucky at SABIC that we have the material which we can use to help those to change some of their parts. If they change their parts, they will reduce their weight, and if they reduce the weight they will reduce energy. So SABIC now is working with Ford, Land Rover, and many other car manufacturers. I think some of your cars already have SABIC parts in them without even noticing. Something which is also surprising, is that companies like Samsung have lighter and lighter mobiles. SABIC is one of the major players that is now offering lighter materials to company like Samsung. Also SABIC had a big role to play with the iPhone 5.



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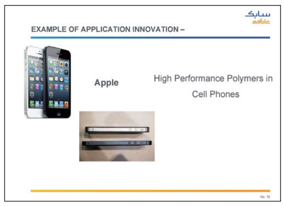

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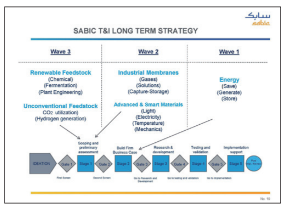
We are now trying to move into the future. In the future, SABIC has already set a new long term strategy. SABIC would like to work in energy in the future. Many presentations have covered energy already—the generation of energy, the storing of energy. Moving away from fossil fuels requires utilizing technology to reduce energy consumption and habits. Smart materials will allow you to have information through your glasses that you currently get through your mobile device. We believe that the advance of smart materials is very important.



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I would like to quickly talk about our collaboration with universities. We have two different collaboration directions. There is the old one, that SABIC would lead the collaboration. We knew that the local infrastructure of universities is not as we would like to have in order to compete. So we began to push universities in different angle, with building centers, adding research grant and faculty enrichment programs in order to build infrastructure. But, last year, we believe that since we have done this for the past 10 o 15 years, it is sufficient. We will continue with this slightly, but we plan to move from just helping to build infrastructure to enhancing productivity. Enhancing productivity means that we need to start developing technology. Eventually we will build technologies through collaboration with universities and other institutions. We would like to move forward our collaboration from the first dimension to the second dimension, where we can be proud of our productivity of all our universities which is pushing industry toward right direction. We have collaborations with other institutions in order to help local resource and know-how to maximize and go to the next step.

Finally, I would like to highlight that even though we are working in two dimensions, it does not mean that we were not able to come up with something. We were able to have good projects with most of our universities. Regarding research in Acetic Acid, we had 5 percent of our work done in KSU. Also we have other activities with KFUPM and King Abdulaziz University which are small projects, but we would like to enhance them through communication. Eventually, we would like to provide hundreds of those examples with 50/50 collaboration. I would like just to say that we are committed. We know it is very important for our future success that we have a strong university. We are communicating with universities now about how they can help us, and how we can help them. We believe that if we have Cambridge in Saudi Arabia, Tokyo University in Saudi Arabia, and MIT in Saudi Arabia, then SABIC would be number one globally in everything we are working in. Thank you very much.

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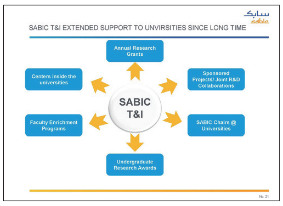

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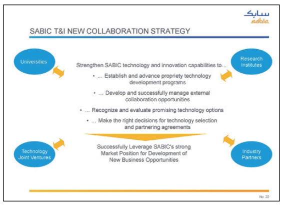

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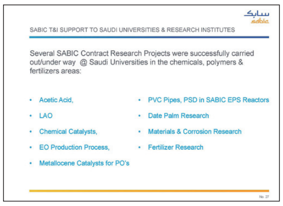

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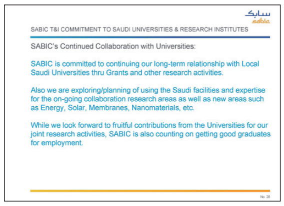

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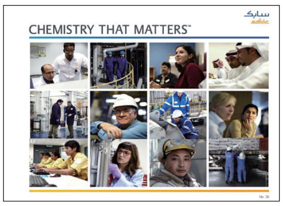

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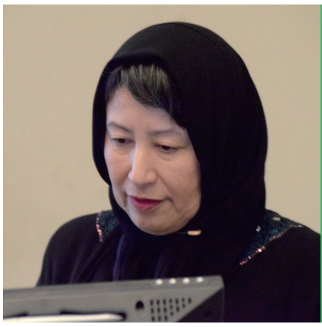
Session 3: University-Industry-Government Collaboration



Saudi Arabia and Japan Cooperation in Science and Technology: from Universities to Industries

Dr. Kazuko Matsumoto

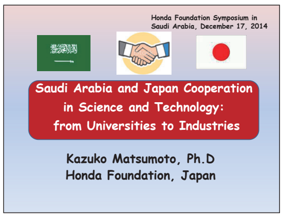
Senior Director, R&D, Vision Development Co. Ltd.

It is my pleasure and honor to have this opportunity to talk about Saudi Arabia-Japan Cooperation in Science and Technology from universities to industries. The outline of my talk will be to first talk about the recent Japanese atmosphere of industry-university-government cooperation to grow innovative technology and to empower venture business. Secondly, I will show you a successful example of university-based venture company 'Euglena' in Japan. Thirdly, I will speak about my experience as a chemistry professor at Waseda University and cooperation with industries at that time. Finally, I will show you Japan-Saudi Arabia exchanges relating to Japanese technology on several companies' occasion.

The recent trends of industry support to universities in Japan are the following: Japanese industries increase funding support to university projects clearly focused on more practical targets than before. More rapid and competitive commercialization is requested to industry-university cooperation. So, both industries who support universities and university itself feel some burden because their surrounding atmosphere is more requesting to them to practical commercialization.

This is the statistics of the top ten universities in Japan. Top ten means their fund amount receiving from industries. Kyoto University is the top, receiving 43 million US dollars this year.. If you compare 2013 to 2014, mostly the research amount doesn't change much, but Kyoto University increases its funding amount appreciably.

This is the data of operational grants from government to national universities. As you can see here, the statistics show that for the past 10years, the total amount of grant continued decreasing, but in 2014, it slightly increases again. The top university in government funding is the University of Tokyo. This data shows that the ratio of funds from industry and government to each university is 1: 20 at University of Tokyo, 1 comes from industries and 20 come from the government. But, the ratio is 1:10 to 1:15 at other universities. This means that the University of Tokyo receives an outstandingly large ratio of funding from the government. In our system, all professors receive a small research



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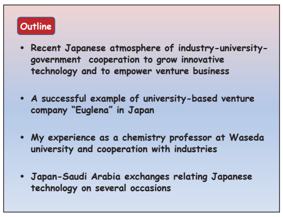

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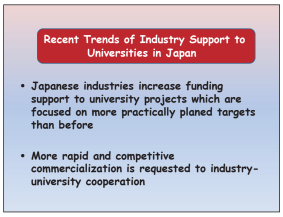

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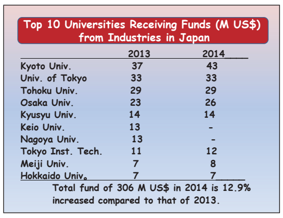

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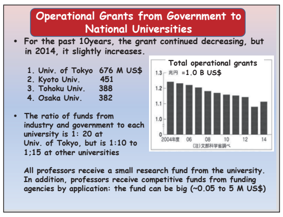

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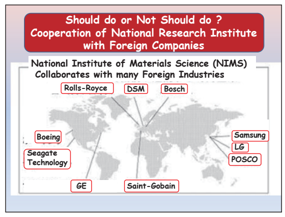
fund from the university, it means from the government without any application. This research funding is very small, so professors must apply to other competitive funds. If their application is very well planned and target is highly appreciated, he can receive the fund that can be very big, sometimes of 0.05 to 5 Million US dollars. So research funding depends on the professor. There is a big difference now.

If you look at national research institutes like RIKEN or AIST and several others, there is an argument about whether national institutes should cooperate with foreign companies. It is because for instance, the National Institute of Material Science which is called NIMS currently collaborates with many foreign industries. This map shows the partners of foreign companies. Since this national research institute is fully-funded by the government, the government expects the institute to contribute to create new technologies and industries within Japan, not for foreign companies. So there is an argument whether this research institute should collaborate with foreign companies. But for the past 10 years, government gradually approved such international collaborations and many other national institutes are starting to collaborate with foreign companies.



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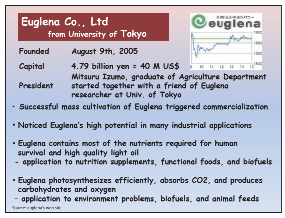
I will take this company as an example of venture company starting from my university's research seed. The name of the company is Euglena, which began from the research results of the University of Tokyo. The company was founded in 2005, and capital is now 40 million US dollars this year. The founder is Mr. Mitsuru Izumo, graduate of Agriculture Department of the University of Tokyo, and he started it together with his friend, who is a euglena researcher at the University of Tokyo. Euglena is the name of the merchandise which this company sells. Euglena is also the academic name of the green algae that the company sells. This is the stock price of this company from 2009 to 2014. The price is continuing to increase, so you can see how successful this company is doing from the beginning.



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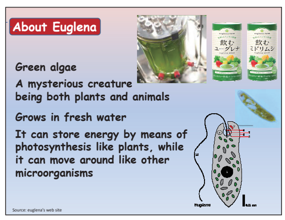
The feature of this company activity is to develop successful mass cultivation method of Euglena, which triggered commercialization of the product. The company noticed, from the very early stages, that Euglena has high potential in many industrial applications. Euglena contains most of the nutrients required for human survival and high quality light oil. This features is suitable for application to nutritional supplements, functional foods and biofuels. Euglena photosynthesizes efficiently, absorbs CO_2 and produces carbohydrates and oxygen. This feature is suitable for environmental problems since CO_2 will be absorbed and this anticipates photosynthesis. It is also suitable for biofuels. The residue is oil distraction which is rich in various proteins amino acid suitable for animal feeds.



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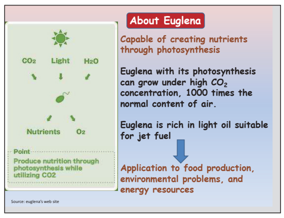
This is a picture of the cultivation tank of Euglena. It is green algae. It is a mysterious creature being both a plant and an animal. It grows in fresh water. And, it can store energy by means of photosynthesis like plants, while it can move around like other microorganisms. This is a picture, and this is the enlarged structure of this algae. Its size is about 50 micrometers. It consists of only a single cell. This is a rather primitive creature. This green solution contains a lot of nutrients, so it is now commercialized as a supplement drink for human health.

Euglena is capable of creating nutrients through photosynthesis. Euglena and its photosynthesis can grow under high CO2 concentration; it is so strong against high CO2 concentration that it can endure 1000 times the normal content of air. So it is expected to absorb a lot of CO2 and can clean the environment. Euglena is rich in light oil suitable for jet fuel, application to food production, environmental problems, and energy resources.



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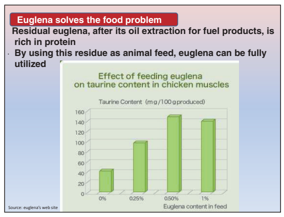
This graph shows the taurine content of chicken muscles. If chicken is raised with Euglena feed, chicken muscle contains more taurine. So it is effective as animal feed.



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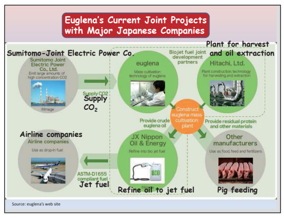
This is the final slide about Euglena. This shows several joint projects currently being carried out by Euglena. Sumitomo-Joint Electric Power supplies CO2 from their plant to Euglena, and Hitachi makes the plant for harvest and oil extraction. Euglena uses this plant and extract CO2.



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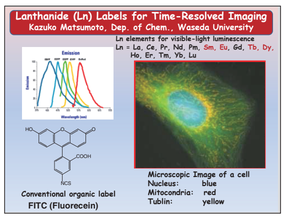
After the extraction of oil, that oil is sent to JX Nippon Oil & Energy which refines the oil to jet fuel. In the future it is expected that the refined oil will go to airline companies. On the other hand, the oil residue is good for feeding pigs and chickens. So this is a grand design, full of dreams. The government is supporting this project, and we expect this company to grow further and larger. I would like to emphasize that even though the company is small like Euglena, if the company has a good plan, a good idea, and a good design project, the company can collaborate with big companies, like Hitachi, JX Nippon Oil & Energy Company, Sumitomo Joint Electric Power Company, and airline companies in the future. This is a system of very successful example of a Japanese venture company.

In the next slide, I will talk about my research which was carried almost 15years ago in Waseda University. I am still now a researcher of lanthanide luminescence for time-resolved imaging. Usually, in bio-technology, many organic luminescence materials are used for staining, for observing with microscopy to see the structure of a cell. For example, this is such a structure. The blue one is the nuclear. The yellow is the tublin. The red ones although it is not obvious, are the mitochondria. All of these structures are stained, and color is specific to each component. And usually, fluorescein and several other organic dyes are used for staining these structures.



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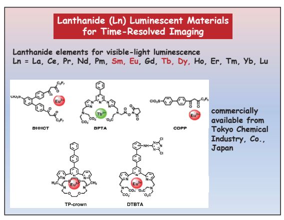
Different from those organic labels, I synthesized lanthanide complexes that are strongly luminescent. For instance, europium or terbium give red and blue color, these europium complexes give strong luminescence.



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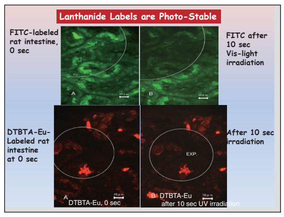
Some of these are compounds commercially available from Tokyo Chemical Industry in Japan.

One of the advantages of using lanthanide as photo label is photo stable compared to conventional FITC, like fluorescein. This is a microscopic picture of a rat intensive labelled with fluorescein at 0 seconds. Usually in microscopic imaging, a strong laser is used and if you keep irradiating this area for 10 seconds, the images decompose. That means the fluorescence is photo disruptive. When researchers use organic fluorescence or luminescence, photo-bleaching is a big problem. But if you use DTBTA europium or lanthanide label for the same experiment, you can see that even after 10 seconds of irradiation you can clearly see the stained image with lanthanide. So this is the typical advantage of lanthanide labels.



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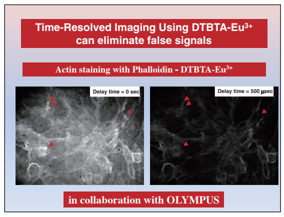
This is another example of using lanthanide. This is irradiation time at 0 seconds, and this is irradiation at 500 microseconds. Usually, if you use fluorescein, you can have this image. But, after 10 microseconds, because of the light radiation, the whole image is weakened, and you'll get this kind of image. But using europium you can still see the structure of the tissues, but at the same time, you will notice that these strong spots that appear at 0 seconds totally disappear after 500 microseconds. This means that this spot is considered a false signal. So by using europium labels, we can distinguish false from true signals. That is the advantage of this europium.



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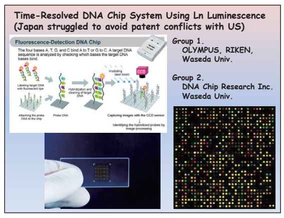
We constructed a special time-resolved imaging microscopic system with collaboration with Olympus company.

Almost 15 years ago, we started two groups to develop a DNA chip analyzer by using europium luminescent labels. One group consisted of Olympus and RIKEN and my university, Waseda University and the other was the DNA Chip Research Corporation. This was a venture business at that time supported by Hitachi. Both targeted the same DNA chip system with lanthanide luminescence, but their systems of instruments were different. This is a DNA chip and this is a man's finger. If it is enlarged you can see the structure. Each luminescence and color signifies information about DNA. Each spot corresponds to different DNAs. So we have to read the color and intensity of each spot in a very rapid way. We were successful in developing a good system for this DNA chip analyzer; but, there was actually one drawback compared to US systems. That was the reading speed. It was not very competitive with the US system, so we gave up after 5 years of development to commercialize this system. The group two DNA chip research gave up at a relatively early stage of the development to construct a new depiction system. But this company still survives today, because the company changed their policy from being a technology-development company to a DNA-analysis company.



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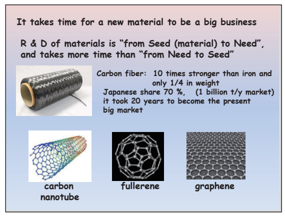
So this company now has tens of instruments. They bought a USF system, and they now have a lot of analytical instruments. They received many samples from customers, analyzed them and reported the DNA information to the customers. So they have totally changed, but they are still doing very well.



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In this slide, it is a different subject, but there is a picture of carbon fiber. Carbon fiber has very strong background. Actually 3 big Japanese textile companies, Toray, Teijin, and Mitsubishi Rayon have a 70% share in the world. The total market is 1 billion tons per year. Carbon fiber features 10 times stronger than iron and 1/4 in weight. It is now used in aircraft bodies, car bodies, windmills, power generators and many other applications. But, actually, it took 20 years to develop the current large market. So you have to be very patient, and you have to keep making efforts very hard to realize really applicable market. We have also many companies who developed manufacturing technology for carbon nanotube, fullerene, graphene and several other carbon materials. Chemistry is a field of industry that is very strong in Japan, and we expect in the next 10 years or 20 years, we will have several other carbon nanomaterials which will be applicable to industrial products.

This is another example. Perhaps this will interest women students. Spash is a registered name, and it is a packaging film that seals in freshness. This is Japanese sushi. It is raw fish, and that raw fish must be very fresh. If it is not fresh, it doesn't taste good. So, if you use this Spash film to retain the freshness, it is very effective. This film was developed by the Mitsui Chemicals Tohcello Company. This is a subsidiary company of Mitsui Chemicals. The effect of this Spash film is shown here. If you wrap spinach with another company's film, 5 days later the spinach is degraded. But, if you wrap the spinach with Spash film, it will keep its freshness.

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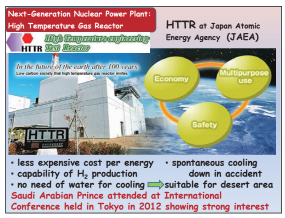
I will show you a fruit grocery store in Tokyo. Its name is Senbikiya. This is longest-established fruit grocer on the most expensive street in Tokyo. They sell only the highest quality fruits. For example their strawberries cost five US dollars. An apple costs 12 US dollars. This company is very proud of this. The company told me that a few years ago, that some rich or high-ranking people from Saudi Arabia visited this company and they bought a lot of fruit. This fruit has Spash wrapping, and they know that they can keep freshness and beautiful appearance.



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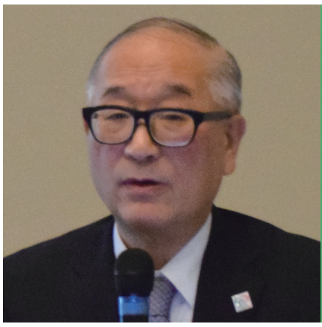
This is the final slide. This is a next-generation nuclear power plant, which is called High-Temperature Gas Reactor. And this is a picture of the high temperature engineering test reactor, and it is installed at the Japan Atomic Energy Agency (JAEA). This is a new nuclear power reactor, and it features less expensive cost for energy or capability of H2 production. It doesn't need water for cooling. This fact suggests that this system is suitable for desert areas. This system has a spontaneous cooling function should an accident occur. So because of these good features, many countries are paying attention to this on-going experiment at JAEA. Japan hosted a big international conference in Tokyo in 2012, and the Japanese people there were surprised to see that a Saudi Arabian prince attended that conference, and he asked many questions. So, he seemed to have a strong interest in this system. We hope that this will become a big industry for the Japanese economy.

I hope that you enjoyed my talk. If you have any ideas about how Japanese industry and universities can collaborate together, it would be my pleasure to hear your thoughts. Thank you for your time.

Closing Remarks

Dr. Hiroto Ishida
President, Honda Foundation

Closing Remarks



Dr. Hiroto Ishida

President, Honda Foundation

Good afternoon, Thank you for so many people attending this symposium.
Representing Honda Foundation, I would like to thank King Saud University for its tremendous efforts to prepare this symposium, and it was our greatest honor to co-host the event at this glamorous and prestigious academic institute.

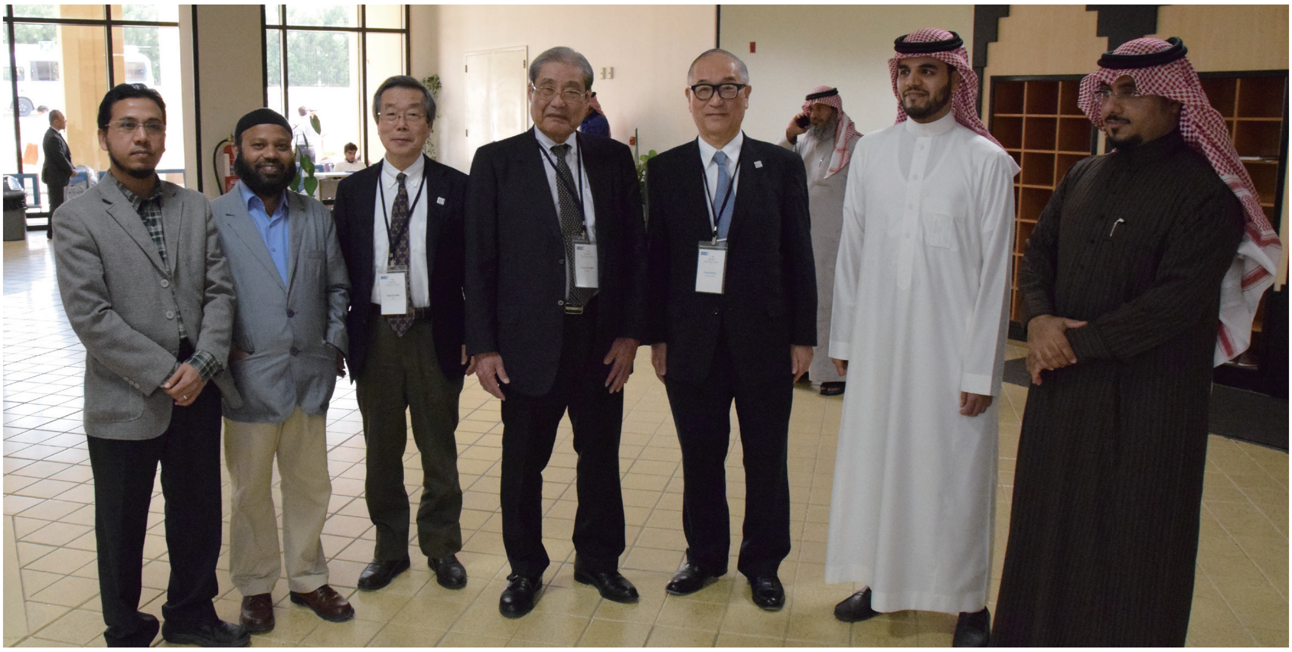
The project started with a call from Dr. Bukhari, who is present today from the Embassy of Saudi Arabia in Tokyo. The goal we initially set was to discuss how to draw a roadmap towards a bright future of Saudi Arabia, and how Japan can be supportive in this context.
In today's program, we reviewed the history of industry development in Japan to look for some lessons to be shared, talked about innovations backed by corporate culture and spirits, and discussed how the collaboration among various sectors should work.
It is necessary to establish an appropriate vehicle such as a scheme for industry-academia collaboration to foster innovation. But that itself does not guarantee any technological advancement or economic development.
I would dare say, the more important thing is that how the people involved in such scheme are motivated, spirited and eager to improve. The people and their mindset are the most deciding factor for building the future of a nation.

The next year, 2015 marks the 60th anniversary since the Kingdom of Saudi Arabia and Japan have established their diplomatic relationship in 1955. The relationship between the two countries is indispensable and very strong. For Japan, we import the largest amount of oil from Saudi Arabia among other countries, and we received significant goodwill support from Saudi Arabia with deepest gratitude, money and other things for the reconstruction from the disastrous earthquake in 2011. Now we hope Japan can further contribute to the development of your country through cooperating for accelerating human resource development as well as diversifying the industry.

I would like to say that the Japan side has learned much from the symposium, and I would like to say heartfelt appreciation to presentations of Saudi Arabian side speakers.

At Honda Foundation, our founding prospectus which was stipulated by the leadership of Mr. Soichiro Honda and his younger brother, Mr. Benjiro Honda defines that our mission is to contribute to "creating truly humane civilization." I hope today's discussions will contribute to a brilliant future for the people of Saudi Arabia, thus approaching toward realization of truly humane society in the country.

I was deeply impressed with the praying (by the people in Saudi Arabia). At the end of my remarks, I would like to offer a prayer for the future of Saudi Arabia and Japan with a part of a Noh song from Japan. (Dr. Ishida chants a Noh song.)
Thank you very much.





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The experience of Saudi Arabia and Japan