

Both the 2011 Off the Pacific Coast of Tohoku Earthquake (that caused the Great East Japan Earthquake Disaster) and the 1995 Southern Hyogo Prefecture Earthquake (that caused the Great Hanshin-Awaji Earthquake Disaster) claimed many lives and caused enormous damage. However, their damage situations are entirely different. The 2011 Off the Pacific Coast of Tohoku Earthquake (hereafter “the 2011 Tohoku Earthquake”) produced catastrophic tsunami damage, but the building damage caused by ground motion was not as serious as that in the 1995 Southern Hyogo Prefecture Earthquake. This was because the ground motion with a period of 1 second or less, which affects buildings little, was predominant in the 2011 Tohoku Earthquake. On the other hand, the ground motion with a period of 1 to 2 seconds, which causes heavy damage to buildings, was predominant in the 1995 Southern Hyogo Prefecture Earthquake (see Figure).

The 2011 Tohoku Earthquake produced “long period ground motion” with a period of 2 seconds or more in the Tokyo metropolitan area and swayed super-high rise buildings heavily. However, there were no serious damages in any super-high rise buildings because they already equipped earthquake-resistant systems such as seismic isolation and vibration damping. In truth, the aftermath of long-continued or repeated long period ground motions on the super-high rise buildings is still unknown and should be studied in the future.

The “slightly short period (1 to 2 sec.) ground motion” and “long period (2 sec. or more) ground motion” could cause damage situations that cannot be truly represented by a single indicator of the current seismic scale. The vibration period of ground motion is considerably affected by not only the hypocenter but also the ground structure and propagation path of seismic waves. Thus, it differs by location even in the same earthquake. Because the slightly short period ground motion damages wooden houses and low- and medium-rise buildings, new evaluation indicators for that may be necessary.

In order to reduce earthquake damage, it is also necessary to achieve mutual collaboration among academic or technological fields, such as seismology, geotechnical engineering, civil engineering, and building engineering, as well as to share and integrate the knowledge in each field, rather than to conduct a study separately in each field.

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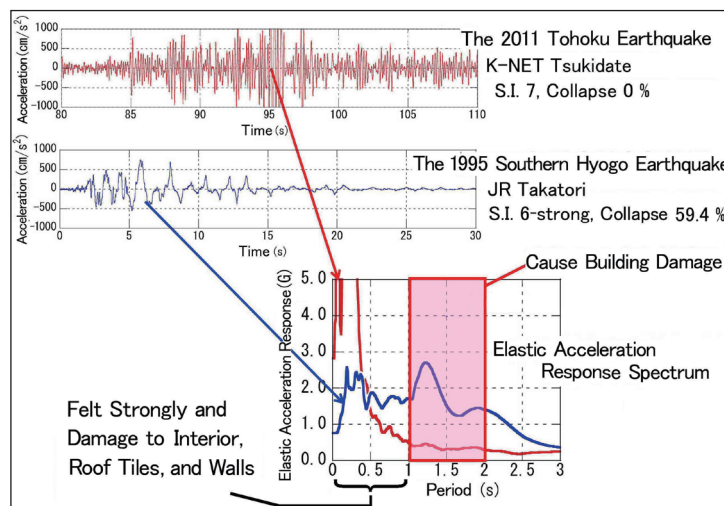


Figure : Comparison of Ground Motions in the 2011 Tohoku Earthquake and the 1995 Southern Hyogo Prefecture Earthquake. (Provided by Y. Sakai)

Design Thinking Education at Universities and Graduate Schools

Toshiaki KUROKAWA
Affiliated Fellow

1 Introduction

We have come to understand very well from various past examples that the products of research in science and technology—research papers, patents and the like—do not on their own bring about outcomes in economies and societies.^[1] New ways of thinking and new approaches are needed in order to link more of the science and technology-related results we create with social and economic results.

The 4th Science and Technology Basic Plan^[2] sets its sights on generating innovation in society by shifting from the conventional focus on individual fields to a concentration on problem-solving and task accomplishment, thus marking a major shift in direction. The Basic Plan employs the word “innovation” in the phrase “implementation of innovation through science and technology” to link the products of science and technology with real-world society and to solve social issues.

The primary fundamental idea concerning action to generate innovation is that humans are the key to bringing it about. Educating innovators (also called “frontier talent” and the like) and utilizing them effectively is essential to innovative action by an organization or society.^[3,4] Furthermore, industry and society as a whole are calling on universities, graduate schools and other institutes of higher education to teach and turn out these sorts of graduates.

Education has always been important in every aspect of science and technology. Everyone has agreed that education is vital for scientific and technological advancements. This journal, *Science and Technology Trends*, has frequently taken up the

subject of education in various fields.^[5] However, these publications have thus far only discussed the topics within the constraints of certain fields and or industries. Their arguments have not gone beyond the paradigm of field-specific discussion to address educational methods that aim to generate innovation which spawns new fields and new industries, rather than adopting the existing field-specific educational practices^[NOTE 1]

General innovation theory observes that creating knowledge by involving multiple perspectives and multiple fields could produce completely different results from those created within conventional specific fields or single industries. However, taking this approach requires a team of individuals other than those with only one area of advanced expertise.^[13] Yet it is quite difficult to form teams of individuals with such qualities via the traditional approach by which we have educated people within certain field, as symbolized by the traditional university structure of undergraduate and graduate school departments.

Thus the “design thinking” approach to education^[11, 18] has garnered attention as a way to educate people who can find solutions to problems straddling multiple fields, as well as discover new problems and assign further tasks to carry out. Numerous universities and graduate schools in countries around the world have begun teaching design thinking.

This paper addresses the questions of what ideas design thinking education is based upon, and how it is actually being conducted at universities and graduate schools, by describing typical examples outside Japan. The list of universities and graduate schools that have begun teaching design thinking is also included.

[NOTE 1] In all fields of study, even older ones, the knowledge and experience outside one's field is effective for generating innovation. For example, for truly advanced ICT experts at the top of the field, in an age when information systems act as the nervous system of society and industry and when IT and management are converging, we need people with T-type and π -type personalities to produce innovation.

2 | The Design Thinking Approach

2-1 What is Design Thinking?

The reason that the design thinking approach is garnering attention is that it has shown that it can find, propose and implement appropriate solutions, even in entirely new fields. For example, there have been cases in which design thinking has offered numerous solutions in areas such as new business ideas for starting up social enterprises or solving problems in developing countries.^[6] And when developing a product in a company, it is extremely difficult for a developer to fathom society's latent needs, no matter how much thought is given to it at the drawing board. Meanwhile if we look at the world at large, we see that smart phone applications and social network services like Facebook and twitter show latent needs that had existed in society, but they have also created new industries that had not existed before. Design thinking education, as explained later in the paper, has a good record of effective outcome in such areas with remarkable changes, and, is recognized as an effective development method, thus becoming more entrenched nowadays. This approach employs a streamlined prototyping process that tests the value of services and applications in the real world and understands the true value through feedback loops.

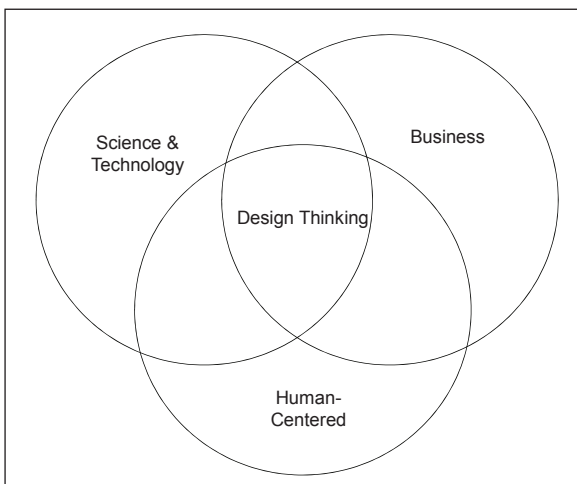


Figure 1 : Three Elements of Design Thinking

Compiled by the Science and Technology Foresight Center

As shown in Figure 1, design thinking, which proceeds towards implementation from concept on through to ideation, is a design approach that combines a trio of human-centered^[NOTE 2], scientific/technical and business elements. The names of the three elements do not contain the word “design” and include one that is “human-centered” to emphasize that the approach is not limited to design in the narrow sense of the word (e.g. industrial design or design technology). If the act of engaging in design thinking is not exclusive to a designer in the narrow sense of the word, then it is in fact not just a recent development.

[NOTE 3]

2-2 The Origin of the Term “Design Thinking”

As an approach that drives innovation, the term “design thinking” came about in 2004 based on a catchword in use at IDEO, a design studio in Palo Alto, California. In 2005, Business Week magazine published a special edition entitled “Design Thinking,”^[8] thus making it a familiar term across the globe.

There are many different explanations of what design thinking is, but we can sum them up as “taking a designer’s approach to try and solve a problem.” However, what sort of person a “designer” refers to or “what to do exactly” is open to interpretation, so it is not easy to tell its common definition. IDEO used to have a Tokyo office, but it has since closed (re-opened in 2011), because an insider story tells it overspecialized in industrial design, which concerns shape and form, and it did not develop a business approach that tackled big issues around design thinking. Design thinking as envisaged by IDEO, the company that coined the term, transforms their own business from pure industrial design into a more influential enterprise that we now call design consulting. However, even IDEO do not have the unique definition. Tim Brown, the current CEO who took over from David Kelley, one of its founders, published a paper on design thinking^[9] in 2008 and a book^[10] in 2009, but even then the wordings are multiple, different words and phrases

[NOTE 2] Although the human-centered element is a basic element of design, here it refers in general to considerations of assessing value for the humans involved, including a product's users. Another term is “human-centered value.”

[NOTE 3] For example, according to Yoshio Murata of Nomura Research Institute, Sony's Walkman was the result of cooperative design thinking between three people: an engineer (Masaru Ibuka), a businessman (Akio Morita) and a performance artist (Norio Ohga). This product fulfilled the three elements shown in Figure 1.

are used to describe design thinking processes and elements. Accordingly, the meaning could undergo a certain degree of further change in the future.

2-3 The Design Thinking Process

The IDEO website (<http://www.ideo.com/about/>) currently has the following paragraph on the design thinking process.

“The design thinking process is best thought of as a system of overlapping spaces rather than a sequence of orderly steps. There are three spaces to keep in mind: inspiration, ideation, and implementation. Inspiration is the problem or opportunity that motivates the search for solutions. Ideation is the process of generating, developing, and testing ideas. Implementation is the path that leads from the project stage into people’s lives.”

This design thinking process can be analyzed and thought of in many ways. For example, the University of Potsdam in Germany, discussed later in this paper, divides the process into six stages: understand, observe, define point of view, ideate, prototype, and test. The most important thing is that these processes do not progress through the steps in one direction in a certain order. Rather, one can go back and forth, or along a spiral line, providing a deeper understanding of an issue to arrive at a more effective result. Figure 2 illustrates this process, with reference to sources such as Reference #9.

2-4 Human-Centered Thinking and Prototyping

The phrase “human-centered” describes one of the three elements in Figure 1, but it is treated as the

core idea of the design thinking approach. People who work in education often use the word “empathy.” As ethnologists often employ the methods for ethnography, empathy has a dormant presence among education professionals that many may not be aware of as they employ the concept in their work. However, understanding essential issues is a pillar of the design thinking approach.

In addition, the connection between the ideation part of the process with the following prototyping is important,^[11] and that prototype must be assessed.^[12] For example, Apple’s strength is said to be that it has the ability to build all of its prototypes in-house, despite not having its own factories or doing its own manufacturing.

We could say that human-centered thinking and prototyping have generally been neglected in traditional research and development.

2-5 π -Type Personalities and Highly Diverse Teamwork

A point emphasized from an education viewpoint is educating T-type personalities who follow a single path and π -type personalities who work in multiple areas of expertise.^[13] The examples of design thinking in practice outside Japan—as discussed later in this paper—involved highly diverse teams comprising students with different majors and backgrounds. Being able to engage in teamwork with people possessing different specializations is essential to design thinking education. This is the way we should be educating students. Accordingly, Figure 3 combines Figures 1 and 2 to form an overview of design thinking education.

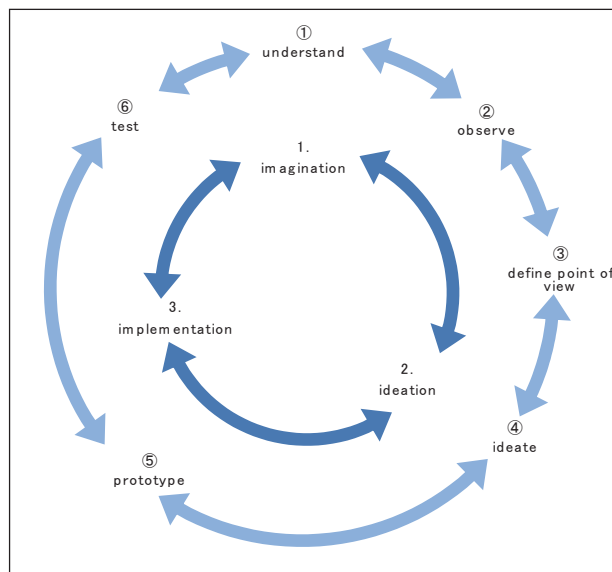


Figure 2 : The Design Thinking Process
Compiled by the Science and Technology Foresight Center

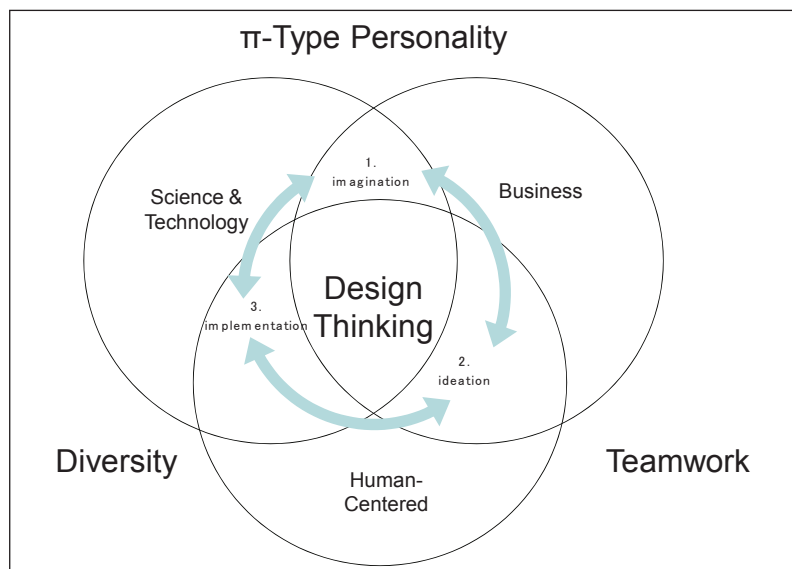


Figure 3 : Design Thinking Education Overview
Compiled by the Science and Technology Foresight Center

3 | Design Thinking Education at Work

3-1 Global Universities and Graduate Schools Engaging Design Thinking

Business Week magazine put together a special edition on design thinking in 2009 that presented the top 32 “World’s Best Design Schools.”^[7] Table 1 shows 33 universities and graduate schools that, as far as the author can confirm, have curriculums associated with design thinking. Some of these overlap with the Business Week ranking.

3-2 Design Thinking Education at Stanford University’s d.school

The author had a chance to see a project, called The Agile Aging project^[13] at Stanford University’s d.school. The school has been a pioneer of design thinking education. We use the project to explain to the reader how this sort of teaching is actually being conducted.

3-2-1 From Issue Comprehension to Prototype Building

The goal for Agile Aging is to make life more comfortable for seniors. A team of students first starts out to thoroughly understand the issue. They take trips off campus to observe elderly people’s lifestyles and hear their complaints and opinions. Rather than staying cloistered away in the university’s

classrooms, they go see what is really happening, come back with the experience and information they each obtained and share with the team. The members, with various majors and backgrounds, bring back each of the experiences and information they obtained individually and get to the root of the problem as a team.

Next, they seek out ideas for a solution, engaging in “brainstorming.” They may need to go back and look again at the background of the problem during this process. In that case, an approach to the issue from a different angle may be suggested to them. However, we should keep in mind that the driving force behind the production of ideas here is individual inspiration.

A variety of methods are employed to obtain a solid understanding of the issue, including ethnographic methodologies. The term “empathy” comes up a lot here. Being able to think about things from another person’s standpoint has the same spirit as the Japanese concept of *sangen shugi* in manufacturing, which refers to the “three actuals” of the actual location, actual component and actual situation.

After generating ideas, the team begins ideation to form a proposed solution. The important thing here is that ideation is done through teamwork rather than being an individual task, and it is a process of visualization that links these ideas with a visual object in the form of a prototype. A prototype can be understood from the phrase “quick and dirty,” meaning that rather than taking the time to build something perfect, one places importance on quickly building something that expresses the key concept.

Table 1 : Examples of Universities & Graduate Schools Implementing Design Thinking Education

Asia-Pacific Region	
Japan	Kyushu University (Graduate School of Design) Kyoto Institute of Technology (Department of Design Engineering & Management) Keio University (Graduate School of Media Design, Graduate School of System Design and Management) Chiba Institute of Technology (Department of Design) Tokyo Institute of Technology (Graduate School of Design Science and Technology) The University of Tokyo (i.school) Tokyo City University (Social Information Department)†
South Korea	KAIST (DESIGN)*
China	Zhejiang University: Communication University of China†
Taiwan	Xue Xue Institute
Singapore	Singapore University of Design and Technology Singapore Polytechnic National University of Singapore
India	National Institute of Design* Indian Institute of Technology
Australia	University of Technology, Sydney
Europe	
United Kingdom	Royal College of Art / Imperial College London*
Italy	Milan Institute of Technology
Netherlands	Delft University of Technology* Technische Universiteit Eindhoven
Denmark	Technical University of Denmark Design Skolen Kolding
Germany	University of Potsdam (HPI d.school)
Finland	Aalto University (IDBM)*
France	The École des Ponts ParisTech (d.thinking)
South America & North America	
Chile	Pontificia Universidad Catolica de Chile
Canada	University of Toronto (Rotman School of Management)*
United States	Stanford University (HPI d.school)* Northwestern University* Massachusetts Institute of Technology (System Design Management) Illinois Institute of Technology(Institute of Design)*

* indicates universities and graduate schools presented by Business Week (2009). † indicates a university/graduate school that will open in the 2013 academic year. The universities and graduate schools in this list are implementing design thinking education to varying degrees.

Furthermore, while attention must be paid to the actual location and ingredients in order to understand the issue, as described above, because a prototype is good enough if it expresses the essential function, it does not necessarily have to be close to the final product at.^[NOTE 4] Recently, students have been creating videos to visualize how their prototypes are used and performing skits to show what settings they will be used in.

3-2-2 Participation by Stakeholders and Short Presentations

In addition, the participation of outsiders who are affected by the issue is encouraged in this process of ideation. In the issue of agile aging used here as an example, seniors joined in evaluating the prototype. In normal pedagogy, children are often forbidden from enlisting the help of others to finish making their work, and from this perspective, the approach at design thinking education may seem to be a form of cheating. However, the goal of this education is to explore any possibilities, try various means and, as quickly as possible, demonstrate an effective path to a real solution for the issue (that being the objective). If the person posing the problem has a solution, then it is okay to hear it. Accordingly, involving the people affected by the issue in the process is recommended as a perfectly natural technique. Design thinking education usually pick up the problems with no final solution is known

Lastly, the team goes before the person posing the problem or other teams' members to give a five-minute presentation. Five minutes seems like a very short time considering all the efforts the students put in until that point. However, because many very important presentations in real life are conducted for incredibly busy leaders, it makes sense that they should be short. Another important element of design thinking education is figuring out how to emphasize the essentials of one's solution in this environment.

3-3 Design Thinking Education's Achievements

The design thinking education process ends with the above-mentioned presentation and feedback from collaborators. Accordingly, the implementation to help those in a predicament—the phase that would follow the formation of ideas and problem-solving—usually does not happen because of time constraints. However, although the university may not officially commit, cases have been reported in which excellent solutions to problems transition to execution and reach the implementation phase.

According to the website for Stanford University's d.school,^[6] ideas from some of the designs proposed there have been adopted in the form of ventures and start-ups, as well as by existing companies. For example, venture firms have been established to sell products and services like the D.Light,^[20] an alternative to conventional oil lamps, and Embrace,^[21] an affordable body warmer for premature babies, in developing countries and elsewhere. Examples of ideas picked up by large firms include Fidelity Investments' remake of its website.^[19]

Like Stanford University, the University of Potsdam also provides a case (albeit not announced in written form) in which a company that put forth a problem hired all the members of a student team who had demonstrated a solution and carried out the project. Joint operation of the project between the company and the university over the next few years then led to successful commercialization. Metro, a major supermarket chain, posed a problem concerning new methods of online shopping. The students then proposed a system by which customers who make a purchase online can receive their products at simple storage sites at train stations or on the street. Metro reportedly commercialized a system based on this proposal.

It is said that at private companies, management needs to commit and make an idea part of the company's business strategy in order to take a result produced by design thinking and carry it to commercialization. Otherwise, its chance of success

[NOTE 4] When the author visited Stanford University in 2008, the students made a prototype of a toilet with fold-up handrails for seniors. This team proposed a new toilet as a solution for the issue of agile aging. They put together cheap pieces of plywood with packing tape and attached aluminum foil to substitute for a mirror, and placed a cushion on a nearby chair to substitute for a toilet. Someone from a Japanese university engineering department or company R&D department may think this looks like mere child's play, but that is fine so long as it clearly expresses the concept.

is low.^[18] Management needs to be involved for the industry to utilize design thinking.

3-4 Design Thinking Education's Goals

However, the end goal of design thinking education is not the aforementioned implementation, but rather the education of innovators called “design thinkers.” Also, design thinking education teaches people to deal with real world problems by forming teams with people from other fields and working on projects to demonstrate solutions, it does not intend to produce individuals but teams and cooperative network of people.

A key aspect of design thinking, which is probably not emphasized so much because it is so apparent, is that “learning from anything” is essential. However, teamwork is also important. In the above-mentioned university program, students are not given grades or certificates of completion. This is because the design thinking approach recognizes that assigning individual grades to members who made various contributions to their team would wreck that teamwork. However, this does not mean a lack of assessment for their results. It is essential to receive evaluations of the solution from the people who posed the problem. They carefully inquire into whether the solution will help and whether it is meaningful. However, this is different from giving grades to individual students; it is an assessment of the team's proposal.

4 | Design Thinking Education Administration

Let us look again at the examples of Stanford University and the University of Potsdam to see how exactly design thinking education should be administered.

4-1 The d.school's Administration

Stanford University's d.school is a department within the Hasso Plattner Institute (HPI), created in 2005 within Stanford University with funding personally provided by Hasso Plattner, a one of the founders of SAP AG. Although the school is affiliated with the university, its administration is kept separate. Administration funding comes from the HPI fund, other individual and organizational contributions, as well as selling educational services to companies and other means. The school receives no financial

support whatsoever from the university. Unlike typical university schools, no credits are earned for completing the program, no transcript or diploma certifying academic credit is issued and, naturally, students do not receive report cards.

HPI created the University of Potsdam's d.school in 2007 as a place for design thinking education in Germany. At that time it began with the same kind of facilities and administration as the Stanford University d school, but its approach is to gradually introduce successful elements while making its own improvements.

4-2 Student Screening: Ensuring Diversity

The Stanford University d.school and University of Potsdam d.school annually recruit around 350 and 120 people, respectively, during recruitment drives each semester. Both are very popular and attract many applicants. At Stanford's d.school, admission is limited to students enrolled at one of the university's graduate schools. At the University of Potsdam, the German education system allows any graduate students in the Berlin and Potsdam areas to apply, no matter what university they are attending. Many foreign students come to Germany for applications as of late key report in June, 2012.

Student screening considers not only applicants' compatibility with design thinking and their skills, but also ensuring diversity within teams. In other words, the process considers how to build teams composed of members from as diverse a range of majors and backgrounds as possible. What should be emphasized is that the screening gives thorough consideration to individual students' expertise and backgrounds. Teaching π -type personalities is based on solid specializations and demands that individual students already have expertise at the undergraduate level. Education for π -type personalities does not refute specialization, but liberate from “confining oneself within a specialty.” Thus, it in fact assumes a high level of specialized education among individuals and a diversity of those specializations.

4-3 Coursework Schedule

The core of the curriculum at each university's d.school is a 12-week series of classes, the main part of which is a workshop. Stanford University offers classes on many topics three times a year: fall, winter and spring. Students can examine the content of the

classes prior to applying. The University of Potsdam recruits students every winter and spring semester. The basic course is a nine-week workshop, after which students can take an advanced course up through the twelfth week.

In the workshops, students go through the process described earlier to examine an issue stemming from a real-world problem, build a prototype, and finally present a solution to those who posed the problem and have it evaluated. Students go off-campus to understand their issue, even traveling overseas if necessary. For example, students at the University of Potsdam's d.school came to Japan to study the country's advanced cat litter boxes. However, many prototypes make do with readily available materials and students usually do not seek them out from elsewhere. Some teams also produce video effects to present via video and other media a virtual setting in which their prototype would be used.

4-4 Team Structure and Work Settings

Workshop teams are comprised of a few to 10 or so students, to which two or three facilitators are assigned. A full-time instructor will direct multiple teams as they cover a certain topic. Teams are allocated separate desks and corners to work at. Until the project is completed, the team members can come and go as they progress with their work (see Figure 4). Of course it is standard for team members and facilitators to gather and work during scheduled class hours, but their time is not managed like a typical lecture course, in which everyone assembles at the start time and finishes their work by the end time. And the classroom for lectures is a corner of a design

studio with sofas, chairs, tables, whiteboards and other furnishings that students are free to rearrange. Stanford University's d.school makes major changes to the layout and facilities each time its building moves to a new location. Since 2010 it has taken the form of a "War Room" prepared by IDEO and other companies, where student groups can work on each project.

4-5 Faculty

In addition to full-time staff, schools enlist the help of part-time experts in various fields as facilitators. These instructors assist student groups with their projects. Stanford University's d.school has around 70 facilitators and the University of Potsdam's has around 40. The instructors are distinguished by their rich diversity as they come from various fields, specializations and backgrounds. At Stanford University, many alumni, including former executives, help with the program.

The most intriguing thing with the faculty is that the instructors themselves have also learned much from the interaction and tried to incorporate ideas for improvement right away. For example, faculty at Stanford University's d.school line up their desks together with the administrative staff's in a layout designed to improve work efficiency. At the University of Potsdam's d.school, rather than sitting to deliberate and work, they find that standing is more efficient, so they started using desks designed to facilitate this style (see Figure 4.). Now they even have licensed promotions for this kind of desks.



Figure 4 : University of Potsdam Student Team Corner

Source: University of Potsdam HPI d.school

4-6 Facilitators

Facilitators are staff members who take care of the teams. Facilitators found come from various fields and possess diverse backgrounds and skills. Facilitators would include alumni and people working in the local area. One facilitator said, “We are not teaching. We watch over the students as they go through a trial-and-error process, make mistakes and run into dead ends. We just help these men and women reach a solution.”

Facilitators’ education is itself a critical element. Some think that popularizing design thinking education is difficult due to a lack of facilitators. However, IDEO General Manager Tom Kelley said, “Where design thinking is taught, facilitators also learn and grow, so there’s no reason to worry about facilitator shortage.”

4-7 External Linkages and Ecosystem

As described earlier, although Stanford University’s d.school receives administrative funding from the Hasso Plattner Institute (HPI), to which it belongs, this financial support is limited to a few years and the school is transitioning to an independent status. Naturally, in order to do so the school is building up its outside financing, thus developing its external links and ecosystem. This kind of independent status was made with Mr. Plattner, from the beginning of the Stanford d.school.

The University of Potsdam’s d.school is also administered with financial assistance from HPI, but there seems no deadline to make the school independent. However, the University of Potsdam’s d.school was established along with a venture incubation center at HPI and recently numerous venture capital, have been joining in design thinking education presentations and the like. Rather than being a scheme to secure outside funding, this can be thought of as setting up an environment conducive to turning good proposals into start-ups.

Both schools are also actively engaged in design thinking education for companies and working adults, not just graduate students. Individual companies have ways to contact and make requests to both schools. In addition, Stanford University has created the Stanford Executive Program run five times a year, in which individuals and small teams of people from outside the university can participate. The program consists of a three-day introductory course that costs US\$9,500 to take. The University of Potsdam runs

a three-day course any time of the year in an open course format, which costs 2,750 euros (before tax) to join. The University of Potsdam also limits individual applications, but does offer the Design Thinking for Professionals program that mixes working adults with students.

5 | Examples of Other Universities and Graduate Schools outside Japan

This section will introduce design thinking education at universities and graduate schools other than those already discussed (see Table 1). Many universities and graduate schools have begun using design thinking as a slogan in recent years. But they are not specifying what design thinking is. Rather, they are teaching to instill the same kind of thinking. And while some universities and graduate schools are running legitimate programs, and some programs are being set up at universities that already specialized in design or had a design department, much of this design thinking education is happening at business schools.

5-1 European Universities and Graduate Schools

In Europe, the Ecole des Ponts, ParisTech (the National School of Bridges and Roads) set up a d.thinking course in 2009, which unabashedly advocates design thinking. At Finland’s Aalto University, created through a 2010 merger of three universities (Helsinki University of Technology, Helsinki School of Economics, and University of Art and Design Helsinki), the International Design Business Management (IDBM) program has a tradition dating back to 1995, before the merger.

The Innovation Design Engineering (IDE) program has been offered at the Royal College of Arts in the United Kingdom as a design thinking-equivalent two-year program since 1995. Currently, according to Miles Pennington, the head of the department, the program gathers diverse students from as many different regions and majors as possible, and aims to teach by inducing a “chemical reaction” between students to find various problems and propose solutions to them so that there is no syllabus. Design London, an organization created in 2007, offers business funding for prize-winning student work at the Royal College of Arts and Imperial College

London. Design London was disbanded in fiscal 2011 and merged with the InnovationRCA business incubator in April 2012.

Other European universities and graduate schools teaching design thinking can be found in the Netherlands, Italy, Denmark and elsewhere (see Table 1). In Denmark, Design Skolen Kolding is at the heart of the D-City Plan, a local cluster project.

5-2 North & South American Universities and Graduate Schools

In North America, since 2005 the Rotman School of Management at the University of Toronto, Canada has run two design thinking courses: Business Design and Integrative Thinking. Here, Dean Roger Martin encourages design thinking from a business school perspective, and he has written numerous articles on design thinking. In the United States, MIT's School of Engineering and Sloan School of Management jointly run the System and Design Management program, which incorporates design thinking. In Chicago, the Illinois Institute of Technology's Institute of Design is conducting a similar program. Although the business school programs at Northwestern University, led by Donald Norman, are not officially termed design thinking programs, they include observational visits to real hospitals and automotive design projects, which makes them equivalent to design thinking education.

In South America, Chile also has a program at the Pontificia Universidad Catolica de Chile (Pontifical Catholic University of Chile).

5-3 Asia-Pacific Region Universities and Graduate Schools

Singapore is probably the most active country in Asia when it comes to design thinking education. The Singapore University of Design and Technology began teaching design thinking in 2009 in the form of a joint program with MIT and Zhejiang University (China). The Design Singapore Council, set up by the government, established a university-equivalent educational institute in 2010 called the Design Thinking and Innovation Academy, which began teaching design thinking, including knowledge creation elements. The SP School of Design is also teaching design thinking at Singapore Polytechnic. At the National University of Singapore (NUS), the School of Engineering has established a graduate program for Integrative Design Thinking. The

university is also promoting design thinking education at the NUS Business School, which has created a Design Thinking & Business Innovation program.

Strong demand by industry in South Korea, China and other countries in the region has led institutes in those countries to begin teaching design thinking. In South Korea, where industry places importance on design in general, the Department of Industrial Design at the Korea Advanced Institute of Science and Technology (KAIST) is heavily promoting design thinking education. Professor Kun Pyo Lee, who played a central role at KAIST, has garnered much attention after transferring from the university to a position as vice president of design at LG Electronics. That fact alone provides the links with industry in this area. In 2012, Communication University of China in Beijing created a department with a focus on design thinking. Professor Weinberg of the University of Potsdam's d.school is involved. Numerous inquiries have already come in from Chinese companies and foreign companies. Taiwanese industry also has a great interest in design, and the Xue Xue Institute in Taipei plans to incorporate design thinking.

India's National Institute of Design (NID) was founded in 1961, but it began devoting efforts to design thinking in 2007,^[14] when India's government formulated its National Design Policy.^[22] In response, the India Institute of Technology (IIT) later created its own design thinking program. There is also deep interest in design thinking in other countries such as Malaysia and Indonesia.

In Australia, the University of Technology, Sydney is also teaching these concepts.

6 Japanese Universities and Graduate Schools Teaching Design Thinking

There are few curriculums in Japan that use the term "design thinking." However, the author believes that programs with the same content have been present.

The University of Tokyo's i.school, started up in 2009, is probably the closest thing to the aforementioned d.schools in Japanese education. It has attracted much attention for being very different from the program at other Japanese universities, in that the school seeks corporate donations and runs project-style workshops.^[15] The basics of the program are that it recruits ten graduate students and holds five workshops each academic year.

Of those, students must join three designated workshops to receive a certificate of completion. However, the certificate does not count toward academic credit. The school does not have its own building or rooms. It has held joint workshops outside Japan with South Korea's KAIST, India's IIT and others. Moreover, open workshops allow employees of partner companies and students from other universities to participate as well. At first the i.school mainly targeted graduate students, but since the 2011 academic year it has run programs for freshman and sophomore undergrads at its Komaba campus. i.school alumni, so to speak, has begun u.school^[17] for junior high and high school students and others to experience the i.school style workshop for themselves.

Starting in the 2000s, much of what the D. Think Lab at Keio University's Graduate School of Media Design does falls along the lines of design thinking education. In 2008, Keio University created the Graduate School of System Design and Management at the Hiyoshi Campus. This school also includes design thinking in its curriculum. However, neither of these schools are recruiting students from all the university's schools. Their design workshops are regular coursework. A Keio University professor told us that the intent in establishing the Shonan Fujisawa Campus was to break down existing academic departments, and is equivalent to an effort to promote design thinking.

Design schools like the Graduate School of Design at Kyushu University, the Department of Design at the Chiba Institute of Technology and the Department of Design Engineering & Management at the Kyoto Institute of Technology are also teaching design thinking, but like Keio University, they are not actively trying to mix students from other and different disciplines.

In 2011, Tokyo Institute of Technology, Associate Professor Hiroyuki Umemuro began teaching a Design Thinking course at the Graduate School of Design Science and Technology. Its purpose is to study what exactly design thinking is and it is a half-year program that students from all the university's schools can join. Tokyo City University plans to start a semester-long Design Thinking course for freshmen in the Social Information Department starting in 2013. Meanwhile, the Graduate School of International Corporate Strategy at Hitotsubashi University has been running a Design and Creativity program since

2005. This, too, is very similar to design thinking education.

Although not a permanent program, Kyoto University organized the Kyoto University Design School workshop in September 2011 and March 2012. A number of the university's schools, including the GCOE Informatics Education and Research Center for Knowledge-Circulating Society, the Graduate School of Informatics, the Graduate School of Management, the Graduate School of Engineering and the Academic Center for Computing and Media Studies, collaborated to hold the workshop and recruited participants from outside the university.^[16] The International School of Asia, Karuizawa, runs a workshop as a summer school program for junior high school students from around the world.

Japanese companies are also interested in workers with design thinking capabilities and are beginning to hire students who have experienced its concepts as described above. Toshiba Corporation is recruiting students who have completed the University of Tokyo's i.school program and graduates of non-Japanese universities such as KAIST in order to acquire workers the company needs for its infrastructure business. Meanwhile, Nomura Research Institute, Ltd. and the NTT Data Institute of Management Consulting, Inc., seeing a limit to the software contracting business and its traditional business model, are building the Future Center, which will comprise a corps of employees specializing in design thinking.

7 | Conclusion

While there is some variation to how the term, design thinking, an education approach, is used and the content of design thinking programs, it is in the process of spreading and growing worldwide. The traditional approach to education, premised on the assumption that acquiring the latest knowledge and skills in a specific field or industry will lead to innovation, is becoming obsolete. It can be expressed by a phrase often used by the Japanese media: "Japan is winning with technology, and losing in business."

Meanwhile, universities and graduate schools across the globe are beginning to incorporate design thinking education and praising it as an educational method that will produce results to address the wide-ranging and spanning from social problems to the future problems—including those in as yet unknown

fields—by forming teams comprising members with various specialties.

And as like many other educational and training approaches, design thinking is not a cure-all that “can make anyone into an innovator.” And there is no fast and easy way to learn design thinking. As of now, there is no certificate we can issue that says someone has “acquired” design thinking. Accordingly, the author believes that taking the simple step of “setting up design thinking departments at many universities and graduate schools” would not be effective.

Finding a way to promote the spread of design thinking education may itself be an issue that we should work out with a design thinking approach. For example, there is not yet any place in Japan that is teaching design thinking like predecessors elsewhere in the world. Thus, it may be effective for Japan if educators promoting design thinking were to experiment in new ways by collaborating in a utilization of applicable settings, equipment, tools and the like.

Even in Japan, some universities and graduate schools are already starting to teach something thought to be near design thinking education. There is no standard teaching process, so the author believes that each university and graduate school should move forward in its own way. However, none of them has a program that properly shares its students' results with the outside world when they find an area for improvement. Accordingly, these programs are not producing meaningful results for society. We could think of new methods in addition to a framework for sharing results, producing videos and publications or even collaborating in running design thinking programs. Improving on those kinds of areas would lead to praise for the results produced by this form of education.

Naturally, in addition to instructors and facilitators capable of teaching people innovation, we also need people who can correctly assess innovators and who are working out in the world.^[4] This is why one way to expand design thinking education is to cast a wide international network to collect innovative ideas and to share the various efforts being made in Japan with educators overseas.

However, an important thing to do first is to not get caught up in a traditional paradigm, but rather to understand the intent of design thinking and to foster a mentality of actively supporting these initiatives.

In addition, if we set up places where the public can experience an embodiment of this approach and focus on relationships outside academia, it will probably lead to change in education ever in gradual, incremental manner.

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Profiles



Toshiaki KUROKAWA

Science and Technology Foresight Center, Affiliated Fellow
SCSK Corporation, SCSK Fellow (at the writing, now with Kanazawa Institute of Technology)

<http://www.linkedin.com/profile/view?id=16047089>

Mr. Kurokawa worked at Toshiba, IBM and (formerly) CSK before M&Aed as SCSK Corporation, and now at Intellectual Property Science Laboratory of Kanazawa Institute of Technology. He has worked on the standardization of programming languages, object orientation, metadata and more. Mr. Kurokawa is also interested in system development methodology, service science, science and technology communities, cloud computing technology and crowd sourcing.

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