

# Knowledge management system for Universal Design training

- Attempt on a special subsidiary company as a facility for learning about technicians -

## **Seiichiro Miura†**

Department of Mechanical and Electrical Engineering  
National Institute of College of Technology, Tokuyama College, Yamaguchi, Japan  
Tel: +81-(0)834-29-6288, Email: miura@tokuyama.ac.jp

## **Sakiko Ogoshi**

Department of Electrical Engineering and Computer Science  
National Institute of Technology, Fukui College, Fukui, Japan  
Tel: +81-(0)778-62-8280, Email:ogoshi@fukui-nct.ac.jp

## **Yasuhiro Ogoshi**

Graduate School of Engineering, University of Fukui, Fukui, Japan  
Tel: +81-(0)776-27-9703, Email: y-ogoshi@u-fukui.ac.jp

## **Naohiro Hayashi**

Mechanical and System Engineering,  
Graduate school, Kyoto Institute of Technology, Kyoto, Japan  
Tel: +81-(0)75-724-7300, Email: hayashi.naohiro@kit.ac.jp

## **Takashi Yoshioka**

Former OMRON KYOTO TAIYO Co Ltd, Kyoto, Japan  
Tel: +81-(0)75-672-0911, Email: takashi\_yoshioka@omron.co.jp

## **Yutaka Yamaguchi**

OMRON KYOTO TAIYO Co Ltd, Kyoto, Japan  
Tel: +81-(0)75-672-0911, Email: yutaka\_yamaguchi@ktaiyo.omron.co.jp

## **Hitoshi Nishi**

Department of Electrical Engineering and Computer Science  
National Institute of Technology, Fukui College, Fukui, Japan  
Tel: +81-(0)778-62-8273, Email:nishi@fukui-nct.ac.jp

**Abstract.** Mature society of economy and welfare in which individual advocacy is generally accepted, along with movements for individualization. At this society, providing opportunities to learn techniques is important to support a person with disability for engineering students. In order to touch welfare situations for students, we have tackled development of an internship program with a special subsidiary company (SSC). The SSC employs not only many persons with disabilities but also experienced engineers, and has various universal design environments. We found that the student learned relations between major subjects at engineering and production techniques through the interview survey. In addition, we also considered that the program was related to Nonaka's knowledge management model. Reporting the internship experience meant Combination process in the model had a good influence on other students, other faculty members and the other SSCs. As a result, there were spread for students joined the SSC internship program and SSCs accepted the internship program. These considerations suggest that the internship program with a special subsidiary company is one possible way for growing universal design mind engineers.

**Keywords:** Educational Design for Engineers, Assistive Technology, Knowledge Management

## 1. Introduction

In an increasingly globalized world, we need to realize an inclusive society in which individuals can improve the ability and can demonstrate the ability. In order to persons with disabilities to demonstrate their abilities, it is necessary to implement systems to support them and fostering scientists and engineers in such fields as welfare and medical care. In the future the support and agency to technology for the functions impaired mind and body will become more diverse in need. By a support technology being used for such an individual treatment, it is hoped that it leads to the switch of the economic structure to the sustainable direction.

Therefore, we think that providing opportunities to learn techniques is important to support a person with disability for engineering students. As one of opportunities, an internship program in companies gives various experiences and identity construction to students. To educate an engineer with a universal and an inclusive design in mind, a special subsidiary company (SSC) is one of the best companies, because it employ not only many persons with disabilities but also experienced engineers, and has various universal design environments. The company is a practice unknown to other countries, and is unique to Japanese welfare system. We attempted to perform a company tour as an educational method to foster inclusively minded engineers.

"National Institute of Technology, Japan" called KOSEN, is also unique educational organization which five-year engineering education from 15 years old students. In Japanese school system, the KOSEN covers high school level education and the first-two-years curriculum of the university. In order to provide high-quality early technical education, the students generally have equal or higher ability compared with university students. And then, it has two-year course where higher education in engineering is conducted. Most graduates in the course receive bachelor's degrees from the National Institution for Academic Degrees and University Evaluation. Having graduated from college, each alumnus started individually working at a company, or proceeding with two-year advanced courses program at college, or transferring to a university as a third-year student. In present, the number of graduates of engineering as whole higher education in Japan is about 390,000 included 51,000 KOSEN graduates by a year. We introduce in this paper the internship program with the company for a sixth grade student and consider its effect through several surveys of students.

In addition, the number of students studying in engineering fields in Japan is about 410,000 students within 51,000 KOSEN students. So, the KOSEN trains ov

er ten percent engineers in Japan. Thus, the development of new engineering education method at KOSEN may have an impact on university engineering education.

In this report, we introduce our second approach to an education model of the internship program with the company for engineering students. And we also consider its qualitative evaluation with Nonaka's SECI model.

## 2. Content of the Internship Program with SSC

The special subsidiary company system was established to facilitate the hiring of handicapped people as part of the Welfare Employment System of Japan since 1976. A company having more than 50 employees is required by law to employ at least 2.0% handicapped persons. Alternatively, the company is allowed to establish a SSC for handicapped persons, employing them at this subsidiary instead at the parent company or corporate group. As of May 2015, there are 421 SSCs in Japan. We collaborated with OMRON KYOTO TAIYO Co. Ltd. which established as a joint venture company of OMRON Corporation and the Social Welfare Organization Japan Sun Industries in 1985, allowing our student to participate in the internship. Japan Sun Industries has been providing jobs for people with disabilities by Dr. Yutaka Nakamura since 1965. OMRON KYOTO TAIYO Co. Ltd. has 167 employees of which 127 are disabled and produces industrial machinery products such as sockets, sensors, relays, health equipment and PLC power supply units. There is also an Engineering Division (ED) adapting each machine to compensate for lost physical functions of a worker. During a two-month internship, it was required to design and develop a solution for one of the ED's annual improvement projects. While the subject was assigned by the company, the student was expected to independently carry out almost all the design. Of course, a student could consult with a technical director at the ED when necessary. Furthermore, the budget for a two-month internship was less than 100,000 JPY, in addition to using the facilities of OMRON KYOTO TAIYO Co. Ltd.

## 3. Result of the Internship Program with SSC

The student who participated as the first in the internship program, tackled with developing a packing case machine that was modified such that a hearing impaired worker would not forget to affix tape to the packing case (Figure 1). To examine educational effects of the internship, we interviewed the student. It was found that the student acquired tacit knowledge of elements of fluid mechanics, industrial mechanics, mechanical design theory, programming, machining practices, sequence programming, Productive technologie

s and how to use air cylinders. The greatest insight indicated by the student was the concept of the operator's safety and work environment being the maximum priority. The student also developed the vision of a manufacturing engineer as a person who is helpful to other people. Note that the student learned sign language voluntarily to contact the hearing impaired operator. The student then reported that he felt "joy to work" and "pleasure in helping society" as an engineer. In addition, this program has been also beneficial for the company.

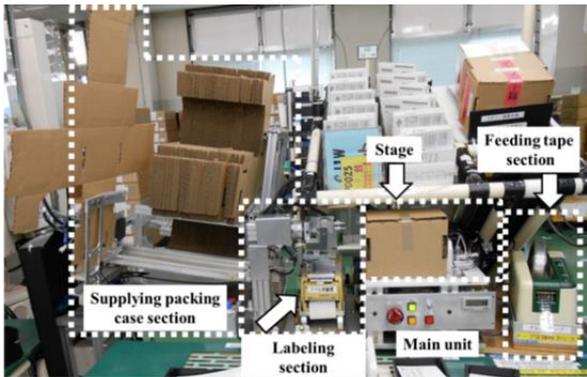


Figure 1: A packing case machine

#### 4. Apply SECI Model to the Internship Program

Nonaka's Innovation theory has been implemented by various companies and has had a positive impact. The SECI model maintains that tacit knowledge and explicit knowledge are not separate but mutually complementary entities (Figure 2). They interact with each other in the creative activities of human beings. An interaction between tacit and explicit is called the knowledge conversion

process. This process consists of four stages: Socialization, Externalization, Combination and Internalization. We found that the SECI model describes accurately a knowledge-creating system to aid the support of people with disorders.

The first stage, Socialization (tacit to tacit), explains social interaction as tacit to tacit knowledge transfer, sharing tacit knowledge face-to-face or through experiences or know-how. At this stage, the student has learned through workers with disabilities and experienced engineers.

The second stage, Externalization (tacit to explicit), embeds the combined tacit knowledge which enable its communication. At this stage, the student writes daily report during the internship.

The third stage, Combination (explicit to explicit), combines different types of explicit knowledge like building prototypes. Explicit knowledge is collected from inside or outside the organization and then combined, edited or processed to form new knowledge. The student reports to other persons, for example at conferences, about what he or she has learned during the internship.

The fourth stage, Internalization (explicit to tacit), is realized by learning and doing; on the other hand, explicit knowledge becomes part of an individual's knowledge and will be assets for an organization. The fact that the student has felt "joy to work" and "pleasure in helping societies" when he or she developed assistive equipment, is as such an asset for the SSC.

In addition, the student also gets some feedback for himself. Within the KOSEN education, internship programs have been prepared for all students. Eventually, through a phenomenon called "knowledge spiral", knowledge creation and sharing becomes part of the culture of an organization.

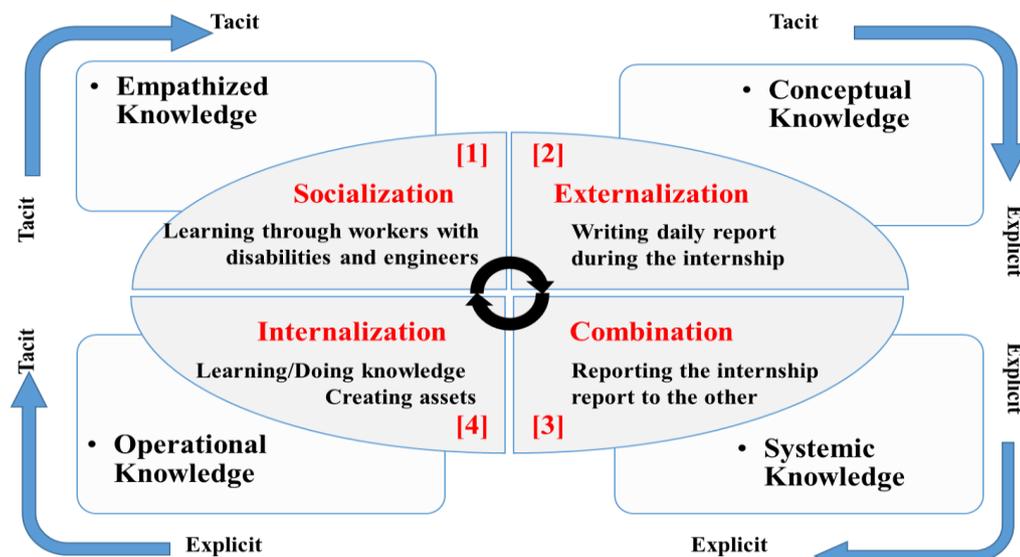


Figure 2: Schematic of the SECI model of the internship program

## 5. Effect of the Internship Program

As result of the internship program, we had several presentations for other students and other SSCs. It was correspond to Combination process of SECI model.

Our presentations made a big opportunity for increasing SSC's internship programs in which KOSEN students can participate. Table 1 shows SSCs' accepting of the internship program, the periods of it, grades of students and accepting numbers of students. The detail of each internship program is now progress. New internship programs will be held in summer vacation term from end of August to middle of September respectively.

As these behaviors, we considered that students and SSCs found their own new values and resources through the internship program.

Table 1: New plans of internship programs

Names	Periods	Grades	Numbers
OMRON	2 weeks	4	1
TAIYO	2 month	Adv.1	2
OMRON	3 days	4	1
KYOTO	2 weeks	4	1
TAIYO	1 month	Adv.1	1
Sony Taiyo	2 weeks	4	1
OKI Work Well	2 weeks	all	During the adjustment

## 6. Conclusions and Outlook

Mature society of economy and welfare is any individual advocacy is generally accepted, along with movements for individualization. At this society, providing opportunities to learn techniques is important to support a person with disability for engineering students. In order to touch welfare situations for students, we introduced an internship program with a special subsidiary company to grow universal and inclusive minded engineers. This has made great contributions to understanding of an inclusive mind for the student. The result indicates that the internship program with SSC is one possible way for the students to arise an inclusive mind.

The learning process of the internship program can apply to the SECI model. Especially, Combination process means the student and faculty members spread the internship experience over other persons and other SSCs, is effective to know the values of the internship program. In addition, students and the internship program give positive influence on SSCs. Through the internship program, SSCs have started to notice their own values and resources. This result suggests that the internship program with a special subsidiary company is one possible way for growing universal design mind e

ngineers. We have been already engaged in developing a quantitative assessment method of the program and expanding the program in cooperation with SSCs.

## Acknowledgments

We would like to thank member of Employment Support Technology Research Association who provided carefully considered feedback and valuable comments.

We would like to thank KAKENHI (Grants-in Aid for Scientific Research: 16K04250) that made it possible to complete this study. And, this study was partially supported by Watanabe memorial foundation for the advancement of new technology (H26-364).

## References

- National Institute of technology, Japan (2008), <http://www.kosen-k.go.jp/>
- OMRON TAIYO Co. Ltd., (2007), <http://www.omron-taiyo.com/en/>
- OMRON KYOTO TAIYO Co. Ltd., (2013), <http://www.kyoto-taiyo.omron.co.jp/>
- Sony/Taiyo Corporation., (2016), <http://www.sony-taiyo.co.jp/> (In Japanese)
- Social Welfare Organization Japan Sun Industries (2002), <http://www.taiyonoie.or.jp/english/>
- Oki Workwel Co., Ltd. (2004), <http://www.okiworkwel.co.jp/> (In Japanese)
- Seiichiro Miura, Naohiro Hayashi, Sakiko Ogoshi, Hitoshi Nishi, Takashi Yoshioka, Yutaka Yamaguchi, Yasuhiro Ogoshi, (2016) *Fostering the Development of Inclusively Minded Engineers : Computers Helping People with Special Needs*, Volume 9758 of the series *Lecture Notes in Computer Science*, 113-116
- National Disability Authority, (2012), <http://universaldesign.ie/What-is-Universal-Design/The-7-Principles/>, Retrieved 2014-10-14.
- Paul Harpur (2013), *From universal exclusion to universal equality: Regulating Ableism in a Digital Age*, 40 *Northern Kentucky Law Review* 3, 529-565
- Ronald L. Mace, Ronald L. Mace on NC State University, College of Design., [Design.ncsu.edu.](http://Design.ncsu.edu/), Retrieved 2014-06-18.
- Nonaka. I. and Takeuchi, H. (1996), *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press.
- Nonaka, I. and Konno, N. (1998), *The concept of 'Ba': Building a foundation for knowledge creation*, *California Management Review*, 40(3), 1-15.
- Nonaka, I. and Takeuchi, T. (1995), *The Knowledge-Creation Company*, Oxford University Press.