

# Spirit of Monozukuri: Practical Training Program for Students

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SEI Technical Training Center (TTC), which provides a variety of in-house training programs, has developed a learning course for junior high school students. In this course, they can experience the joy of monozukuri through a “crafting spinning top” competition, a team game of crafting long-spinning tops by using the quality control method. TTC believes that such experience will allow students to become interested in science and manufacturing afterwards, and that cooperation between industry and academia in developing these practical curricula will lay the foundations of competitiveness in Japanese manufacturing industries.

Keywords: monozukuri, training, social contribution

## 1. Introduction

### 1-1 Planning a Hands-on Manufacturing Class

In Japan, the fact that young people are increasingly moving away from science has become a social issue. It is often pointed out that Japan, which is known as a major manufacturing nation, is now in a critical situation due to the rapid growth of emerging nations. Such an environment discourages young people from wanting to become engineers. Children these days have few opportunities to experience the joy of producing things, and so we have been planning in-house training programs to address this.

In October 2008, Sumitomo Electric Industries, Ltd. established the Technical Training Center (TTC) as a manufacturing training facility based on the concept of learning scientific principles using all the senses while touching actual machines and things. Introducing more than 700 items of equipment and training kits, the TTC encourages trainees to learn by trial and error through smells, sounds and sights they cannot experience in the classroom. Students use all of their senses to fully understand principles, such as those underlying equipment failures or the occurrence of defects, and master the common language and knowledge they need for practical work.



Photo 1. The Certificate and the Award for 2010 Excellent Performance Given by JSEE

Using this concept, we have planned and developed a Hands-on Manufacturing Class program for junior high school students, to provide to neighboring schools on a request basis. These days, an increasing number of Japanese companies provide science classes for junior high school students to contribute to the community. By emphasizing the concepts of the TTC and the spirit of social contribution, Sumitomo Electric has produced practical curricula that allow junior high school students to understand manufacturing concepts in general, rather than only those concerning Sumitomo Electric’s products or manufacturing process.

Sumitomo Electric received the Award for 2010 Excellent Performance from the Japanese Society for Engineering Education (JSEE) for this contribution. This article describes the outline of the program and the Sumitomo Electric manufacturing principles that underlie it.

## 2. Our Enthusiasm for Manufacturing

### 2-1 Activities to enhance manufacturing

The Plant & Production Systems Engineering Division is promoting various activities based on the core mission of clarifying the standards of the Sumitomo Electric Group and improving manufacturing. As an example, Sumitomo Electric established the Manufacturing Innovation Committee in 2003 and started group-wide activities to enhance manufacturing, identifying two challenges.

The first challenge was to address changes in market needs. Today, we manufacturers are required to implement high-mix, low-volume manufacturing. However, products manufactured and marketed by Sumitomo Electric are suited for conventional large-sized lot production. Therefore, if we attempt to respond to the demand for a wide variety of products in small quantities without changing this production method, we will have too much inventory. To solve inventory issues and achieve flexibility in product types and volume, while realizing quick delivery, it is not enough to make merely incremental improvements at individual sites. We considered that greater synergy effects

could be produced by restructuring the production system into a group-wide structure. We also explored the idea of creating a universal and sustainable ‘common language’ by systematizing the wide range of manufacturing technologies and know-how that has been accumulated over the 110 years of Sumitomo Electric’s history. This idea eventually led to the creation of the SEI Production System (SEIPS).

### 2-2 SEIPS is an ever-evolving production system

SEIPS classifies Sumitomo Electric products into three types: A (assembly), B (bulk materials), and C (cable), and seeks commonality and competitive production systems in all three. If we have a common production system, we can share technologies and knowledge of improvements and apply them to different final products and to different markets.

This concept was introduced in the training curricula at the SEI University in 2005. More than 2,100 employees from group companies had learned this system by the end of 2009. They began to utilize the system in their workplaces and showed steady progress. What is very important about SEIPS is that it keeps evolving. As a production system that not only solves urgent problems but also enables us to thrive in changing markets by continuously improving our basic capabilities for one or even two decades, SEIPS has continued to grow with consistent standards and direction.

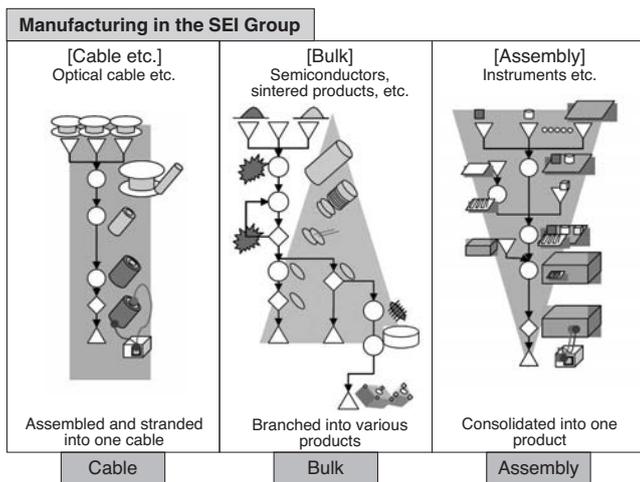


Fig. 1. Sumitomo Electric Products and Process Types

### 2-3 Start of the Faculty of Manufacturing Technology

The second challenge was to address group-wide and global development. Through our experience of manufacturing over 100 years, we now have a wide range of approaches and standards regarding safety, environment and quality. These are common, globally-developing issues to be addressed in every region by our group, which has the same manufacturing target. The TTC was established as an organization to consolidate these concepts into a ‘common language’ and to provide training to all employees. The Sumitomo Electric Group also had (and still has) the SEI University as an education and training system intended for all employees in the group, but in the past, technical

training was done according to programs developed by individual divisions. In October 2008, the TTC was opened at the Itami Works to develop manufacturing personnel who have a full understanding of common manufacturing principles, regardless of region, environment or fluctuations in business.

It is a facility with a ground area of 9,050 m<sup>2</sup> and equipped with various machines such as plating and extrusion lines. A total of 127 training courses focusing on practical skills are held there. These are content-rich programs, including: position-based training, which is given to all employees, particularly young employees; function-based training, which is specialized training for each type of job, such as production engineering and equipment engineering; and needs-based training, which is cross-functional training for unique technologies to be shared throughout the group. We will further enrich the programs by creating new courses based on joint research with universities, for example.



Photo 2. Exterior of the Technical Training Center

### 2-4 Developing leaders for group-wide and global development

Further training to enhance manufacturing capabilities should be considered a mission for manufacturers, because it helps to improve productivity and to reduce losses, and thereby promotes further energy saving. It is time for us to become an even stronger organization by consolidat-



Photo 3. Training at the Technical Training Center

ing the company through fundamental skills training for all employees.

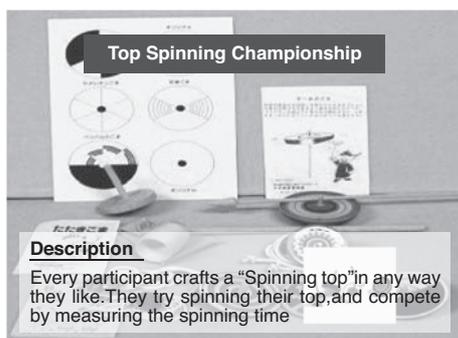
We have also started to create programs with a view to overseas expansion and have started providing some pilot training courses on a request basis. The final goal is to have local staff from overseas affiliates visit the TCC, learn a lot from training, and thereby create a global resource network. However, for the time being, we are developing ideas for overseas branch schools that have the minimum necessary functions.

We are promoting the steady but speedy establishment of a foundation for global manufacturing using programs fully based on the global 'common language.' We will positively and steadily develop these activities as the global manufacturing culture unique to the Sumitomo Electric Group.

### 3. Hands-on Manufacturing Class for Junior High School Students

We believe that we should use the Japanese tradition of manufacturing for education, and we can use the above-mentioned concepts of the TTC for junior high school students to help them learn subjects within organized curricula based on good education methodology. These days, Japanese companies are actively providing classes to junior high school students, and therefore we have developed a program to let junior high school students understand the joy and necessity of manufacturing.

The 'beigoma,' which is a kind of small, Japanese spinning top, is a 'manufactured product' familiar to junior high school students. Our program naturally introduces a process in which students in each team collaborate to design and craft the best performing spinning top in a competition. The best effect of this program is that attending students naturally learn the importance of analyzing results and adopting measures by realizing that how long a top spins, which is an essential property of a good top, differs depending on who makes it. This process leads to self-motivated learning: students recognize again the necessity and effectiveness of the scientific perspective and mathematics. This year, we began developing an environment in which we can provide this class continuously and to a wider range of students, with the help of a board of education.



## 4. Lesson for Making a Spinning Top

### 4-1 Purposes and effects

- The lesson for making a spinning top has three purposes: promoting teamwork, generating ideas and observing facts. It is also expected to produce the following effects:
- 1) Physically understanding the meaning of improvement
  - 2) Understanding the importance of making efforts to show individual ability, originality and ingenuity
  - 3) Understanding the importance of the participation of everyone
  - 4) Mastering the QC story
  - 5) Recognizing the importance of facts and data
  - 6) Realizing the necessity of experiments and verification
  - 7) Learning the importance of preventing recurrence of problems through experience

### 4-2 Procedure and evaluation of the game

STEP 1: Each student crafts a spinning top in any way they like.

Each student crafts a spinning top of the any size they wish using matches, toothpicks, thick paper (selected from diameters of 30 mm, 40 mm and 50 mm) and tape.

STEP 2: Students compete by measuring the spinning time of their tops in each group.

(The First Top Spinning Championship)

Each student tries spinning their top twice and records the longer spinning time. One second is counted as one point and the total points are calculated for each team.

STEP 3: Each team attempts to make improved tops by doing the following:

- 1) Summarizing the results of the First Top Spinning Championship based on facts. (Grasping the conditions)

Fig. 2. Data Summary Sheet based on the Scientific Approach

- 2) Setting a target for the Second Top Spinning Championship. (Target setting)
- 3) Investigating the cause of failure and defects in the spinning tops by using a cause and effect diagram and a relational diagram. (Survey and analysis)
- 4) Considering how to increase top spinning time using measures to counter the cause of failure. (Planning measures)
- 5) Making tops of the specifications agreed together in the group based on the countermeasures taken for improvement. (Effect confirmation)

STEP 4: Students compete by measuring the spinning time of their tops in each group.

(The Second Top Spinning Championship)

In the final match, each student tries spinning their top twice and records the longer spinning time. One second is counted as one point and of the total points is calculated for each team. Each team reports the target value, techniques developed by the members, and the actual results.

#### 4-3 Effects of the championships

This is a very simple way of manufacturing and competing, but junior high school students who attend this class take the work seriously and devote themselves to manufacturing more than we expected them to. At the same time, they realize the importance of observing and analyzing facts. The first championship involves individual matches and shows large variation in top spinning time. We propose a rule that students must set a common target and adopt a final standard design in each team, and this promotes teamwork among the students. In the design stage, in which they determine what kind of top they will make, they have discussions based on facts and principles, verify the design (using trial and error) and finally complete an optimized top. As a result, most groups succeed in increasing the spinning time double to fourfold. In this process, the students naturally develop skills for improving the spinning of tops and make new tops by sharing knowledge on what works. This knowledge is transferred between the students and this is another important factor of this program.

The effects of this program achieved in the first year were recognized by the city board of education. In the second year and later, an increasing number of junior high

schools adopted the program. It is now becoming a regular hands-on class in the summer holidays as one of the formal open classes offered to junior high school students.

## 5. Conclusion

This article introduces our manufacturing training activities at Sumitomo Electric TTC and describes how we developed ways to enable students to learn the importance of manufacturing, teamwork and observation of facts from hands-on learning using a spinning top making competition.

Through this class, students get interested in manufacturing and finding solutions to problems, and they experience the joy of using originality and ingenuity, and the sense of competition between groups. This gives students an experience of the joy of manufacturing, which is an inherent part of human nature. These programs and activities have only just begun. However, through the cooperation of industry and academia, we strongly believe we can support the future Japanese manufacturing industry by further developing systems that enable students from elementary school to university age to experience the joy of manufacturing in steps and in appropriate ways.

#### Technical Term

- \*1 Manufacturing and Monozukuri : In comparison with the word Manufacturing, which is a general English noun meaning the making of products, we use the word Monozukuri to mean various Sumitomo Electric Group activities. These activities are based on the knowledge of technologies and skills that the Sumitomo Electric Group has accumulated, and the expansion of this knowledge is aimed at making our company ever more competitive.

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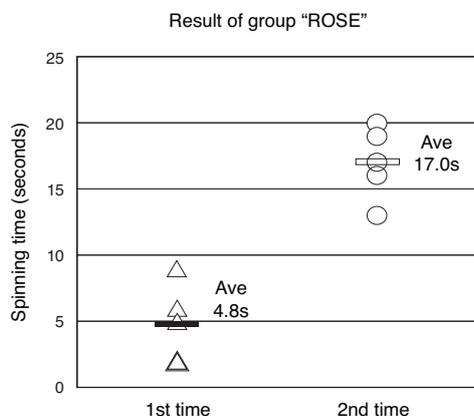


Fig. 3. Effects of the Championships



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