Meeting the Increasing Need for Internationally Trained Engineers:  
A Review of Technical Japanese Training in the U.S.  

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1. Introduction: the U.S.-Japan Technological Exchange and the Need for Japanese-proficient Technologists
As the world becomes a borderless economy, technological exchange is rapidly increasing among nations, including the exchanges of technical information, technology, and technical specialists. Thus, it is essential for a country to make international exchange as efficient and effective as possible. In this regard, it is particularly important and urgent for the U.S. to improve its ways of importing technical information and technology from Japan and its ways of exporting U.S. products and technology to Japan. To clarify this point, let us examine some statistics concerning technological exchange between the two countries.

(1) High tech product trade
First, let us look at some statistics concerning the trade of high tech products between the U.S. and Japan. As can be seen in Table 1, the U.S. has been the largest buyer of Japan’s high tech products for years.\(^1\) Statistics also show that Japan, in turn, has been the second largest purchaser of U.S. exports (next to Canada), buying $52 billion worth of goods in 1994. Among these purchases, manufacturing goods account for 60%. This includes computers, ICS, aircraft, engines, and measuring and medical equipment.\(^2\) It is evident from these statistics that the U.S. and Japan are heavily dependent on each other for high tech product trade.

<table>
<thead>
<tr>
<th>Products</th>
<th>Total to US (million dollars)</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic Data Processing</td>
<td>16,885</td>
<td>9,270</td>
</tr>
<tr>
<td>Electronic DP Parts &amp; Accessories</td>
<td>9,357</td>
<td>4,400</td>
</tr>
<tr>
<td>Communication</td>
<td>8,119</td>
<td>2,622</td>
</tr>
<tr>
<td>Semiconductors &amp; ICs</td>
<td>15,385</td>
<td>4,573</td>
</tr>
<tr>
<td>Aircraft and Parts</td>
<td>598</td>
<td>492</td>
</tr>
</tbody>
</table>

(Source: Japan Ministry of International Trade and Industry)

(2) Japan’s position in the technological world
Next, let us examine Japan’s position in the world in terms of its technological strength. One thing we can look at for this purpose is Japan’s share of high tech product exports in the world. According to the Japan Science and Technology Agency, Japan’s share in the exporting of high tech products in the world surpassed West Germany’s in 1981 and the U.S.’s in 1983.\(^3\) Table 2 shows the figures for 1992.

Table 2
Exports of High Tech Products from Japan (1992)

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</tbody>
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(Source: Japan Ministry of International Trade and Industry)
Table 2
Shares of High Tech Product Exports in the World (1992)

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>23.5%</td>
</tr>
<tr>
<td>U.S.</td>
<td>18.0%</td>
</tr>
<tr>
<td>Germany</td>
<td>12.5%</td>
</tr>
</tbody>
</table>

(Source: Japan Science and Technology Agency)

Another indicator of a nation’s technological strength can be seen through its share of patents granted by a country in a given year. In America, Japan has been second place to the U.S. for more than a decade. Table 3 shows the top three nations’ shares of patent approvals in the U.S. in 1993.

Table 3

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>54%</td>
</tr>
<tr>
<td>Japan</td>
<td>23%</td>
</tr>
<tr>
<td>Germany</td>
<td>7%</td>
</tr>
</tbody>
</table>

(Source: U.S. Department of Commerce)

A nation’s technological strength can also be seen from the number of scientific and technical papers it publishes. The number of Japanese technology papers published in English has been increasing steadily in the past few years and finally surpassed the U.K. in 1992, as seen in Table 4. (Papers published in Japanese are not included in these statistics.)

Table 4
Scientific and Technical Papers Published in English (1992)

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>36.0%</td>
</tr>
<tr>
<td>Japan</td>
<td>9.6%</td>
</tr>
<tr>
<td>UK</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

(Source: Japan Science and Technology Agency)

From the information in Tables 2-4, it seems safe to say that Japan is the second most influential country in the world in terms of technology.

(3) Technology and human exchange

Despite the fact that the U.S. and Japan are inseparable partners in high tech product trade and the fact that the U.S. and Japan are the top two leaders in technology in the world today, when it comes to technological exchange between them, the gap which exists at present is shockingly large. According to the Japan Science and Technology Agency, technology exports from the U.S. to Japan in 1993 amounted to $2.58 billion, while the exports from Japan to the U.S. in the same year were only $1.19 billion. Here, technology trade includes such items as patents, designs, blueprints, and “know-how.” In terms of human exchange, nearly 12,000 Japanese engineers and scientists came to America in 1993, while fewer than 1,000 Americans went to Japan that year. A key point here is that the Japanese engineers and scientists who were sent to the U.S. were likely to have been proficient in English, especially in reading, whereas it is also likely and unfortunate that most of the American technologists who went to Japan had very limited language knowledge. At present, as America seeks business opportunities in Japan, more and more technical specialists are involved in Japan-related tasks where they struggle with the language and with different business practices. Therefore, it is more than urgent for the U.S. to make every effort to counter this situation.
There are several approaches that can be taken to improve this imbalance. Development of sophisticated Japanese-English machine translation systems is one way. Employing bilingual Japanese engineers and scientists is another. However, as I have discussed elsewhere, there are serious limitations in approaches which depend on translation and on interpreters. I strongly believe that the most direct and effective approach is to train engineers and scientists in Japanese language and culture, and this includes training in Japanese technical language.

2. Japanese Programs for Engineers and Scientists: Three Academic Models

As the need for Japanese-proficient engineers and scientists is recognized, a greater number of engineering and science students are studying Japanese. Opportunities are also increasing for engineering and science majors to go to Japan for either language study or internships. Particularly noteworthy in the U.S.-Japan exchange is the Department of Defense’s initiative called the U.S.-Japan Industry and Technology Management Training Program (JITMT), which has given $50 million over the past five years, supporting twelve university-affiliated centers that train U.S. engineers and scientists in Japanese language, culture, and industry and technology management practices. *

The pool of engineers and scientists who can converse in Japanese in daily settings or read simple Japanese writings is thus rapidly expanding. However, when it comes to reading technical literature or conversing in a technical setting, most are not equipped to do so. This is why we have to consider creating programs which focus on technical Japanese.** In what follows, I will introduce three well-established models for technical Japanese training and discuss some of their merits and disadvantages.

(1) University of Washington’s Technical Japanese Program

The University of Washington’s program is a master’s degree program designed for students who wish to acquire advanced skills in technical Japanese while studying engineering/science subjects in their specialties. For admission, the program requires a minimum two year Japanese background at the college level as well as a B.S. in engineering or science. The program provides two years of advanced-level technical Japanese training which focuses on reading and oral communication. A two-month internship in Japan is also required for the degree. Students who have completed the program can read Japanese technical literature in their fields with speed and accuracy. They can also give and understand technical presentations and discuss technical matters in their fields. A certificate program is available for those who are interested in technical Japanese courses only.

There are a number of merits in this model. I will discuss several here. First, this model integrates engineering education and language training in such a way that students can complete the program without sacrificing their engineering or their language goal. In this program, the engineering segment of the curriculum is individually designed according to the student’s goal before he/she begins the program. Students normally take one technical Japanese course and one or two engineering courses each quarter and can

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**According to the 1994 survey conducted by the University of Washington’s Technical Japanese Program, the following universities offer courses in technical Japanese: Cal-Tech; Georgia Tech; MIT; Stanford U.; U. of California-Berkeley; U. of Michigan; U. of New Mexico; U. of Pittsburgh; U. of Texas-Austin; U. of Washington; U. of Wisconsin-Madison
Second, in this program students can achieve high-level language proficiency in just two years. This is possible for several reasons:
(1) Students have a clear language goal;
(2) Students are committed to the program and therefore highly motivated;
(3) Students have common interests and goals; therefore, it is relatively easy to optimize the curriculum and course content.

Third, this model requires students to do an internship in Japan after the first-year technical Japanese sequence. This enables them not only to accelerate the improvement of their language skills but also to learn Japanese business and engineering practices firsthand. Furthermore, internships in Japan provide students with opportunities to learn about Japan’s recent technological developments.

Although this model has many merits, there are some disadvantages. For example, students need a substantial Japanese background to enter the program. Because of its tough language requirement, the number of potential candidates for the program is quite limited. Another disadvantage of this model is that it cannot accommodate many students without sacrificing the quality of language training. This is because students’ technical fields are usually quite divergent and in order to satisfy each student’s needs and interests, course materials have to be individualized considerably. It is hoped that some kind of computer-assisted instruction system can help in solving this problem.

(2) M.I.T.’s Summer Japanese Program for Engineers and Scientists
This is an eight-week summer intensive program with a primary focus on reading. It requires a three year Japanese background at the college level or equivalent for admission. Currently, two courses are offered simultaneously, one for computer scientists and electrical engineers and another for materials scientists and engineers. Some aspects of oral communication are also taught. Students are introduced to technical databases and other technical information sources in Japan and taught how to use them. A certificate is given at the completion of the program. 6

One of the merits of this model is that the courses are open to non-M.I.T. students and to professionals. In addition, because this is a summer program, students can schedule it around their regular engineering/science studies. Thus, this model allows students to study advanced technical Japanese no matter where they study regularly without affecting their studies at their home institutions.

There are some disadvantages in this model, however. For example, because each course is organized based on a specific technical field, only engineers and scientists in those fields can participate in the program. Another disadvantage is that this program requires a very strong Japanese background for admission. This requirement together with the discipline restriction mentioned above limits the potential candidates substantially. In addition, although the program is open to professionals, the 8-week commitment may not be feasible for them.

(3) University of Wisconsin’s Technical Japanese Program
This program offers three courses in technical Japanese: Basic Technical Japanese (a two-semester sequence), Intermediate Technical Japanese (a two-semester sequence), and Advanced Technical Japanese (a 3-credit course). These courses all focus on reading and translation. (Oral skills are taught in other Japanese courses.) BTJ can be taken by those with no Japanese background. ITJ is for those who have at least one year of Japanese background. ATJ can be taken after finishing BTJ or ITJ. BTJ and ATJ can also be taken off the University of Wisconsin-Madison campus via the audiographic teleconference system developed by the university. Different certificate programs are available for UW-Madison students and professionals. 6

One of the merits of this model is that the program is open to students with no Japanese background. Starting with no knowledge of Japanese, they can acquire the basic knowledge and skills necessary to read
Technical literature in Japanese through the courses this program offers. Thus, for those who do not want to spend time learning conversational Japanese, this model may provide the shortest route to proficiency.

Another merit of this program is that it is available off campus using affordable equipment at the student’s end. With a teleconferencing system, any number of students can take the courses through remote instruction at the same time as students on campus do. In fact, this model can accommodate a large number of students and is therefore highly cost-efficient. Because the program does not require a background in Japanese, and because there is neither a discipline nor a geographical restriction, the number of potential students is also large.

One of the disadvantages here is that in this model spoken Japanese is not integrated into the reading courses; therefore, students who want to learn conversational Japanese must take other courses. This is an extra burden for students. This model also has limitations in terms of the level of the target skills. Although the above-mentioned courses enable students to acquire the basics for reading technical literature, further training is mandatory if students want to read with speed and accuracy.

The three models of technical Japanese training introduced here are offered in quite different settings with different objectives. In this respect, they are not competing programs—but rather they are complementary.

3. Considerations in Offering a Technical Japanese Program
Having viewed three models of technical Japanese training, next I’d like to discuss some considerations in offering a technical Japanese program. More specifically, I’d like to focus on three issues: curricular issues, pedagogical issues, and internship issues.

(1) Curricular issues
One major curricular issue involves designing a curriculum which does not interfere with students’ engineering/science studies but ensures that students can learn the language. In the University of Washington’s model, this problem is solved by creating a new curriculum which combines engineering studies and technical Japanese training. In M.I.T.’s model, this problem is avoided by offering the program in summer. There may be other approaches than these. At any rate, it must be kept in mind that engineering curricula are quite demanding these days and not many students can finish their degrees in four years. In designing a program, therefore, it is important to avoid curriculum overload.

How long the language program should be is another important issue. In my opinion, any serious program should offer at least a one-year sequence of coordinated technical Japanese training. Less training does not seem to achieve any significant goal. Combining this training with regular academic courses and/or internships in Japan can make the program more substantial. To give students an incentive, awarding a degree or certificate seems essential.

(2) Pedagogical issues
Teaching technical Japanese requires special considerations. For example, what skills should be focused on is a very important issue. In my opinion, the target skills should be reading and oral communication because these skills are the most useful ones for engineers and scientists and can be acquired in a relatively short period of time.

Whether those skills should be taught in the same course or in separate courses is also an interesting issue. In general, it is better to teach multiple skills in an integrated fashion. For example, it is more effective to have students read an article and use the same article for oral/aural activities involving the vocabulary in the article than to use different materials for training different skills.

How to satisfy the needs and interests of students in different technical fields is a challenging task. For example, students in bioengineering and those in computer science need to learn different sets of kanji characters and technical terms, and the materials they want to read are likely to be quite different. This
presents a serious pedagogical problem particularly in advanced classes. One solution is to provide individualized assignments; another is to use computer-aided instruction.

(3) **Internship issues**
The merits of integrating internships in Japan into a program cannot be overemphasized. Internships not only enable students to apply their technical knowledge and skills to real jobs but also allow them to use their acquired language skills and culture knowledge in real business and everyday settings, which is one of the most effective ways to learn a language. In fact, if students are sent to Japan with good linguistic and cultural preparation, they can make remarkable progress in the target language even in two months. In addition, internships give students a strong incentive for learning language.

Where the internships fits into the program design is extremely important. From my observation, students should have a minimum of two years of Japanese training before they go to Japan. If the internship period is short, say two or three months, an even stronger language background is desirable. Follow-up training after an internship is important in order to help students with language problems they have encountered during the internship.

4. **Conclusion**
The U.S. and Japan are inseparable partners in the rapidly growing global economy and both countries are experiencing the need for more efficient and effective technological exchange. Especially from the U.S. perspective, the current situation regarding technological exchange between the two countries is far from ideal, largely due to the lack of Japanese-proficient American engineers and scientists. In order to counter this situation, it is both essential and urgent that well-designed academic programs to train engineers and scientists in technical Japanese be created.

**References**


MICHIYO TSUTSUI is the Director of the Technical Japanese Program at the University of Washington and an Associate Professor in the Department of Technical Communication. He has earned a B.S. in naval architecture from Osaka University, and an M.A. and a Ph. D. in linguistics from the University of Illinois at Urbana-Champaign. His publications include *A Dictionary of Basic Japanese Grammar* (The Japan Times).