# Japan's Period of High Economic Growth and Science and Technology Education: The Role of Higher Education Institutions

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The intent of this paper is to examine quantitative expansion in technology education during the high economic growth period, and its consequences, with a particular focus on the reinforcement of science and technology at institutions of higher education. Over the 1955–1975 period the number of science and technology students nearly quintupled, and the bulk of this growth was the result of three governmental plans to boost student capacity in these fields, which are referred to as "the 8,000-Student Plan," "the 20,000-Student Plan" and "the Rapid Increase Plan." The first two of these were essentially a part of Japan's manpower strategy aimed at achieving economic growth. However, even amid favorable economic conditions the implementation of these plans did not progress smoothly, and in particular it was difficult to regulate the quantitative scale of growth at public (non-national) universities and private universities. For this reason the government was forced to provide massive financial support for these institutions in exchange for cooperation with the plan. Also, while the effort to reinforce science and technology education involved the establishment of a new school format known as "colleges of technology," most of the quantitative expansion during this period took place in the undergraduate faculties of universities. Additionally, these reinforcement efforts were dependent on the strong ambition of private universities to create new faculties and expand existing ones. Amid consistently strong demand for human resources throughout the high economic growth period, the demand for engineers was particularly high during the 1960s, and the reinforcement of science and technology fed this demand. In the 1970s, however, the technical job market grew oversaturated, and graduates branched out into other fields. Through all this, there was only a highly tenuous relationship between science and technology reinforcement measures and Japan's national development plans.

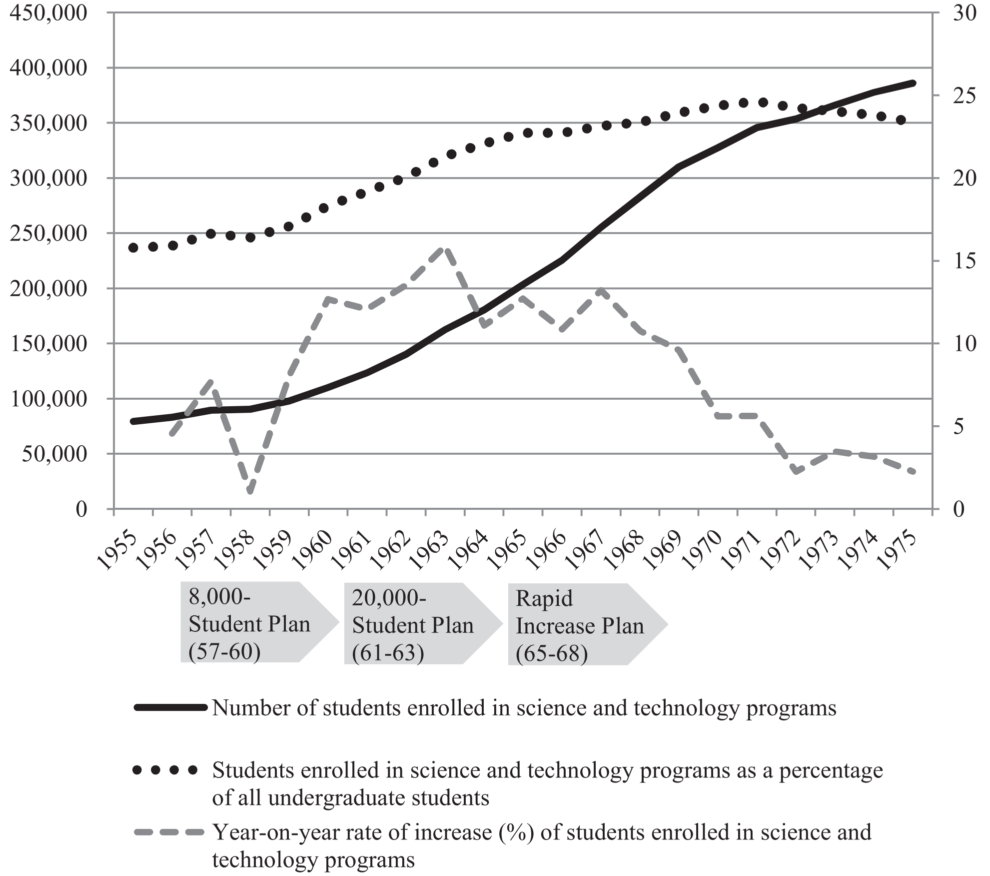
## I. Introduction

In November 1956, the Japan Federation of Employers' Associations (Nikkeiren, the predecessor to the present-day Japan Business Federation or Keidanren) released a statement entitled "Opinions on Technology Education to Meet the Needs of a New Era" (Japan Federation of Employers' Associations 1983). The statement expressed a strong sense of crisis regarding the state of technology education in Japan at the time. It noted that while the Soviet Union, Great Britain and the United States were each "putting intensive efforts into planning the education and training of engineers and technicians," in Japan "the importance of technology education goes virtually unrecognized, and at universities there continues to be a prejudice in favor of law and humanities over science and technology, while in mandatory education as well there are no apparent moves toward emphasizing the sciences or vocational training." At this rate, "we will inevitably lag behind other nations, and fail to fulfill our duty to posterity." The statement strongly urged "the promotion of technology education, which is a pressing task we cannot afford to delay for even one more day," and went on to advocate, in addition to formulation of plans for cultivation of engineers and technicians, "the integration of two-year junior colleges (*tanki daigaku*) and high schools into five-year colleges of technology." Furthermore, to correct the "drastically imbalanced" ratio of science and technology studies to law and humanities studies at four-year universities, Nikkeiren called for "an intentional downsizing of law and humanities studies and a pivot toward science and technology (including at colleges of technology)," as well as reform of technology education at vocational/technical high schools and for working youth, and thorough, effective science education and vocational education at elementary and junior high schools.

What was done to allay the sense of impending crisis expressed in this statement, released right at the beginning of Japan's postwar period of high economic growth? Figure 1 shows the progression of the number of undergraduate students enrolled in faculties of science and technology at universities over the 20 years starting in 1955, which essentially correspond to the high economic growth period (in this paper, "faculty" refers to undergraduate programs at universities.) The number of students enrolled grew at an accelerating pace starting in the late 1950s, and continued rising until the early 1970s. Over this period the number of enrolled students nearly quintupled, swelling from around 80,000 to almost 400,000, and the year-on-year rate of increase stayed above 10% for over 10 years from the end of the 1950s. Of course the number of students attending university in general skyrocketed during this period, the period of greatest quantitative expansion in postwar Japanese university education, but even in this context the percentage of students enrolled in faculties of science and technology rose by nearly 8%. This represented an unprecedented increase in the number of people studying science and technology at university.

The intent of this paper is to examine this quantitative expansion in technology education during the high economic growth period, and its consequences, with a particular focus on the reinforcement of science and technology at institutions of higher education. The reason for focusing on the higher-education level lies in the unprecedented high expectations placed on institutions of higher education during the period, which is evident in the statement released by the Japan Federation of Employers' Associations.

Below, this paper will outline the contents, background and outcomes of three science and technology reinforcement policies implemented from the late 1950s through the 1960s, as well as a new program put in place primarily to cultivate engineers, namely the establishment of the "colleges of technology (*koto senmon gakko*)" system. In addition, this paper will discuss the role of these science and technology reinforcement measures and their relation to Japan's "industrial location policy." Note that in this paper, the term "institutions of higher education" encompasses several categories: colleges and universities (including graduate schools), junior colleges, colleges of technology, and professional training colleges




*Source*: Ministry of Education, Science and Culture, *School Basic Survey Report* and *Ministry of Education, Science and Culture Annual Report* for each year.

Figure 1. Change in the Number of Students Enrolled in Faculties of Science and Technology, and Reinforcement Plans

(*senmon gakko*).

## II. Japan's Science and Technology Reinforcement Policies and Their Background

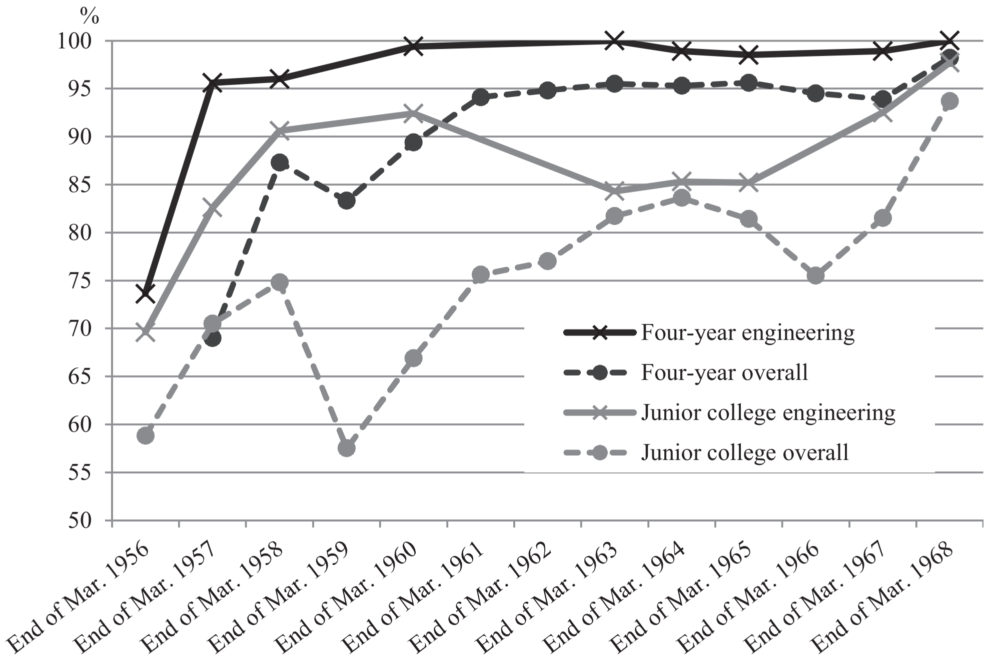
### 1. The Plan for Reinforcement of Training of Scientists and Engineers

With regard to science and technology reinforcement during the high economic growth period, we should first of all examine the three plans for enhancement of higher education that were implemented. The first of these was a plan to boost science and technology student capacity by 8,000 people over four years starting in 1957, which we will refer to as "the 8,000-Student Plan." The second was a plan to increase capacity in the same fields by 20,000 over three years starting in 1961 ("the 20,000-Student Plan"), and the third a four-year plan to drastically expand higher education overall, not only in the science and technology fields, from 1965 onward ("the Rapid Increase Plan.") As we shall see, these three plans were not completely responsible for the increase in the number of science and technology students that took place in Japan during this period, nor were they necessarily consistent with one another. However, it is indisputably true that these plans were the main driving force behind science and technology reinforcement during the high economic growth period.

The 8,000-Student Plan was the first large-scale plan to expand higher education after World War II, and there were various factors contributing to it. First of all, there was the direct impetus provided by public consensus that Japan needed better science and technology education, as illustrated by the statement from the Japan Federation of Employers' Associations quoted above. This consensus was reflected in the formation of public policy. In April 1957, the year following the Japan Federation of Employers' Associations statement, the National Diet (bicameral legislature) passed the Resolution on Improvement and Enhancement of Teacher Training Institutions and Promotion of Education and Research in Science, Mathematics and Natural Sciences (House of Representatives 1957) which included provisions for science and technology reinforcement, and a few days later the Minister of Education, Science and Culture submitted an inquiry entitled "Policies for Promotion of Science and Technology Education" to the Central Education Council (*Chuo Kyoiku Shingikai*) for deliberation, with a report on the Council's findings released in November 1957.

A second factor was the strong demand for science and technology graduates in the workforce, which helped shape the public consensus that Japan needed to promote science and technology more aggressively. Beginning around 1956, there was a rise in the job placement rate of graduates of engineering programs (Figure 2). At first, at least, this stood in great contrast to the job placement rate of humanities graduates, and served to highlight the demand for human resources in the sciences. The consensus was that steps needed to be taken to reinforce the sciences, whereas the humanities were widely viewed as being oversaturated (Itoh 1996). This is reflected in the Japan Federation of Employers' Associations statement, calling for "an intentional downsizing of law and humanities studies" as well as a pivot toward science and technology.

A third factor was the increasingly visible social issue of so-called *juken ronin*, students who had graduated from high school but were as yet unable to enter university because of failing entrance exams (Itoh 1996). Dubbed "masterless samurai," these young people began accounting for an increasing percentage of students entering university from about 1955 onward (Ministry of Education, Science and Culture 1964). Expansion of institutions of higher education came to be advocated as a means of alleviating the difficulty of entering university. Of course, this problem also reflected young people's increasingly strong desire to progress to higher education. Thereafter, throughout the high economic




*Source*: Ministry of Education, Science and Culture, *Annual Report* and *Monthly Journal* for each year/month.

*Note*: The job placement rate is the percentage of job seekers who are hired. However, it does not include students in teacher training, medical, dentistry, or marchant shipping programs. Data has been supplemented for years where data is lacking.

Figure 2. Job Placement Rate for University and Junior College Graduates

growth period, this intense demand for higher education underpinned the ongoing expansion of institutions of higher education.

A fourth factor was the increasingly robust state of the nation's fiscal health. In 1956, government spending began to increase, and would continue to do so throughout the 1960s.[1] 1957 was the height of the *zhinmu keiki* economic boom of 1950s Japan (Asai 2000, 76). Politicians were highly active in mediating on behalf of businesses seeking profits, and threw considerable political muscle behind the policy of constructing new institutions of higher education and expanding existing ones (Pempel 2004).

The 8,000-Student Plan, devised against the above-described backdrop, was characterized by coordination with the New Long-Range Economic Plan proposed by the government around the same time. The 8,000-Student Plan was intended as a means of cultivating the science and technology personnel required for realization of the economic growth called

[1] Ministry of Finance website (http://www.mof.go.jp/budget/reference/statistics/data.htm), accessed February 9, 2013.

Table 1. Contents and Outcomes of the 8,000-Student Plan and 20,000-Student Plan

| | | | Total | National | Public | Private |
|---|---|---|---|---|---|---|
| 8,000-Student Plan | Total (planned) | Number | 8,000 | 4,000 | 1,000 | 3,000 |
| | | % | (100.0) | (50.0) | (12.5) | (37.5) |
| | Total (outcomes) | Number | 7,961 | 4,456 | 125 | 3,380 |
| | | % | (100.0) | (56.0) | (1.6) | (42.5) |
| | Outcomes for each year | 1957 | 1,152 | 647 | 0 | 505 |
| | | 1958 | 2,401 | 1,716 | 0 | 685 |
| | | 1959 | 2,787 | 967 | 40 | 1,780 |
| | | 1960 | 1,621 | 1,126 | 85 | 410 |
| | Success rate | % | 99.5 | 110.9 | 12.5 | 112.7 |
| 2,000-Student Plan | Total (planned) | Number | 20,600 | 11,440 | 760 | 8,400 |
| | | % | (100.0) | (55.5) | (3.7) | (40.8) |
| | Total (outcomes) | Number | 20,663 | 7,140 | 743 | 12,780 |
| | | % | (100.0) | (34.6) | (3.6) | (61.8) |
| | Outcomes for each year | 1961 | 3,220 | 1,790 | 165 | 1,265 |
| | | 1962 | 11,150 | 2,580 | 210 | 8,360 |
| | | 1963 | 6,293 | 2,770 | 368 | 3,155 |
| | Success rate | % | 100.3 | 62.4 | 137.2 | 152.1 |

*Note*: Prepared on the basis of the *1960 and 1962 Annual Report of the Ministry of Education, Science and Culture*. The "success rate" is the actual number as a percentage of the number in the plan. Figures in parentheses indicate share for each category of institution. The fiscal 1963 "outcomes" figures are projections for implementation. Breakdown data for universities, junior colleges, and colleges of technology has been omitted.

for by the New Long-Range Economic Plan. This plan covered the years through fiscal 1962, and it was predicted that 27,500 graduates of science and technology programs would be required that year, but if no steps were taken in the meantime, the number of such graduates would be only 19,500. The goal, therefore, was for national, public, and private universities and junior colleges to recruit the 8,000 students needed to fill the gap. Science and technology reinforcement was viewed as one aspect of a larger economic growth scheme, a phenomenon also seen in the National Income Doubling Plan and the 20,000-Student Plan, to be discussed later.

Table 1 shows the content and outcomes of the 8,000-Student Plan. It was originally a three-year plan covering fiscal 1958 through 1960, but in the final stage of formulation, the start was brought forward a year to 1957 and the overall length extended to four years.[2] I

[2] In October 1959, in the monthly journal of the Ministry of Education, Science and Culture, the ministry authorities refer to the plan as "a three-year plan starting in fiscal 1958" (Moroi 1959, 11), so it is thought that the extension of the plan was decided on after the end of 1959.

have been unable to uncover documentation of why this decision was made, but in any case the plan virtually reached its target, and it is possible that its period was extended when it became evident that it was not going to meet this target otherwise.

The plan succeeded in meeting 99.5% of its target, and the success rate exceeded 100% at national and private universities, but at public (non-national) universities was a mere 12.5%. The overall objective was thus achieved in a patchwork manner. At private universities, the Ministry of Education, Science and Culture (hereinafter referred to as Ministry of Education) subsidized two-thirds of the cost of establishing new faculties and departments of science and technology (Ministry of Education, Science and Culture 1960), but there is no evidence that similar support was provided to public universities. The poor performance of public universities may be due to the lack of such financial incentives. It is possible that there was pressure from the Ministry of Home Affairs, which tended to be reluctant to expand public institutions of higher education for fear of eroding prefectural and municipal finances.[3] In any case, the plan’s outcomes illustrated the limitations of the government’s (Ministry of Education’s) proposed quantitative expansion policy, with neither public nor private universities smoothly following the plan. In other words, gaining the cooperation of educational institutions required sufficient incentives. Be that as it may, it must be noted that the success rates listed above refer to the amount by which *capacity* was increased, and the actual number of enrolled students differed radically. The increase in actual number of enrolled students between 1957 and 1960 was around 140% of the increase in capacity (11,162 students compared to a capacity increase of approximately 8,000) (Arai 1995). The over-capacity students were almost all enrolled at private universities, and it was this private university over-enrollment that enabled the plan to meet its target. Generally, based on the university establishment standards stipulated by the Ministry of Education, if student capacity is increased, there must be a corresponding increase in the number of instructors and facilities. However, with this over-enrollment—admitting a greater number of students while leaving capacity as is—there was no such need. Universities were able to boost the number of students without spending additional funds, which was an extremely appealing prospect especially to private universities that largely rely on income from tuition. The Ministry of Education turned a blind eye to this behavior on the part of private universities.

## 2. The National Income-Doubling Plan and the 20,000-Student Plan

After the 8,000-Student Plan drew to an end, a new proposal for further science and technology reinforcement was made. Demand for engineers was growing even more intense, as illustrated by the nearly 100% job placement rate among graduates from engineering

[3] Overall, the Ministry of Home Affairs tended to believe that establishment of universities was not really the duty of local or regional governments (Takahashi 2009). Later, the ministry communicated to the Ministry of Education that measures to fund public and private universities in connection to the Rapid Increase Plan (Jiji Press Internal/External Education Bulletin 1964).

programs (Figure 2). This time, the primary impetus for formulation of the plan came from outside the Ministry of Education's scope of administration. In October 1960, the Council for Science and Technology (*Kagaku Gijutsu Kaigi*) submitted an inquiry on "Basic Comprehensive Strategy for Promotion of Science and Technology over the Coming Decade," and the following month the Economic Council (*Keizai Shingikai*) submitted the National Income-Doubling Plan for deliberation. This plan was adopted by Cabinet decision the month after that (December 1960). Both the science and technology council's and economic council's proposals strongly emphasized the need for planned cultivation of specialist human resources, particularly engineers. Meanwhile, while these proposals were being deliberated, plans for training of engineers at institutions of higher education were being formulated within the Ministry of Education as well, and in autumn 1960 the ministry set the target of boosting science and technology student capacity by 16,000. Like the 8,000-Student Plan, this plan was linked with a broader economic plan. The number of engineers was predicted to fall 170,000 short of the number needed within the period of the National Income-Doubling Plan, and the idea was to boost science and technology student capacity by 16,000 over the seven years from 1961 to 1967, producing a cumulative total of around 70,000 more graduates during this period (Inumaru 1963).[4]

However, there was strong opposition to this plan within the government. In March 1961, Ikeda Shonosuke, the head of the Science and Technology Agency issued an "Advisory on the Cultivation of Scientists and Engineers" to the Minister of Education, which castigated the Education Ministry for a plan that "would not be able to produce even half the 170,000 additional engineers called for under the National Income-Doubling Plan, and could pose a tremendous risk to the promotion of science and technology in Japan and our nation's economic development." In addition, the advisory noted that not enough scientists and engineers could be trained at national universities alone, and urged reexamination of the role played by private universities, and relaxation of standards and procedures related to the expansion of private universities (Science and Technology Agency 1983, 100–101).

It was extremely unusual for such an advisory to be issued, but in this case there was strong pressure from private university-related individuals behind the scenes (Hashimoto 1996). In the end the Ministry of Education bowed to this pressure and assented to virtually all of the terms of the advisory, and thereafter (until the mid-1970s) there was sustained and unprecedented quantitative expansion of private university education with only limited government interference. Meanwhile, the above-described plan for increasing the number of science and technology students had to be modified, and the Ministry of Education raised its target from a 16,000-person to a 20,000-person capacity increase (this became the "20,000-Student Plan") and shortened its period from seven to four years, 1961 through

[4] According to Hiroshi Kida, then Chief, General Affairs Division of the Ministry of Education, the Ministry attempted to incorporate expansion of medical education into the plan as well, but the Ministry of Welfare and medical organizations fearing a surplus of doctors caused this strategy to be withdrawn (Amagi et al. 1993)

1964. This brought the cumulative number of graduates in these fields during the period to approximately 100,000, an increase of 30,000 from the original plan (Ministry of Education, Science and Culture 1964), the majority of which came out of private universities (Inumaru 1963). To achieve the target, government subsidization of both public and private universities was greatly expanded, as they frequently demanded drastically increased subsidies as a condition for their cooperation with the plan.[5] As a result, in addition to the expanded subsidization of private universities, government financing was applied to the low-interest loans to private universities provided by the Association for the Promotion of Private Schools (*Shiritsu Gakko Shinkokai*) and the scale of these loans was greatly expanded, with a new block of financing set aside for the reinforcement of science and technology. Also, new subsidies for public universities went into effect (Ministry of Education, Science and Culture 1963).

Thanks to all these measures, the 20,000-Student Plan met its target in only three years, a year ahead of schedule (bottom of Table 1). Overall the capacity increase was virtually 100% of the target, with national universities at approximately 60%, public universities around 140%, and private universities about 150% of their respective targets. There is a striking discrepancy between the low rate at national schools and the overachievement at public and private ones. The underperformance of national universities was due in part to budget cuts prompted by assessments by the fiscal authorities, but there were other factors. The 20,000-Student Plan had been expanded in scale due to outside pressure, and the Ministry of Education had never seen it as feasible to meet the target at national universities because of the challenges of training instructors and providing facilities and equipment. Meanwhile the national universities themselves, which tend to be highly concerned with maintaining quality, were not terribly enthusiastic about the plan.[6] By contrast, private universities raised capacity at approximately double the scale of their national counterparts, making up for the latter's underperformance and enabling realization of the overall target. Needless to say, the robust expansion at private universities was given momentum by the advisory from Ikeda Shonosuke (the head of the Science and Technology Agency) and the financial incentives.

As we have seen, these science and technology reinforcement plans implemented in the late 1950s and early 1960s were linked with economic plans and were essentially a part of Japan's manpower strategy, that is, "a policy of developing both quantitatively and quali-

[5] For example, Imazato (1961). However, private schools did not necessarily produce a united front, as outlined by Hashimoto (1996). Also, the expansion of subsidies to private schools was partly derived from concerns about decline in quality of education (ex., the Jiji Press Internal/External Education Bulletin [1961]).

[6] Budget requests for expansion of national universities were frequently slashed by the Ministry of Finance, but it is possible that requests were made with the knowledge that the eventual amount would be lower, so it is difficult to assess the effect of budget cuts. The statement that the Ministry of Education was reluctant to approve the expansion of the plan is based on the Japan Educational Press (1961).

tatively, and utilizing to the greatest extent, the full scope of Japan's manpower, which is the nation's greatest wealth and resource" (Arai 1995, 82). A similar attitude toward manpower was evident during the war (Itoh 1999), but the postwar policy was a much more substantial one. In particular, the National Income-Doubling Plan and the plan that supplemented it, set forth in a 1963 report entitled "Problems and Strategies in Manpower Development during Economic Growth," placed strong emphasis on educational reform, calling it the centerpiece that completed Japan's manpower strategy (Arai 1995). However, as we have already seen, in reality the process of expanding science and technology education in Japan was frequently a matter of piecing together the right numbers, and the Rapid Increase Plan we are about to examine is even further removed from actual manpower strategy.

## 3. Plan to Address a Rapid Increase in the Number of University Applicants

After the conclusion of the 20,000-Student Plan, the government was scheduled to propose a new science and technology reinforcement strategy (Inumaru 1963). However, in 1963, the year the 20,000-Student Plan came to an end, there was a growing problem besides the need for science and technology reinforcement, namely a rapid increase in the number of students applying to enter university. The postwar baby boom generation was poised to enter institutions of higher education in the years 1966 through 1968, and with this looming deadline, science and technology reinforcement was placed on the back burner and the "rapid increase issue" was brought to forefront of public policy.

At the beginning of 1963, the Ministry of Education formed an internal Higher Education Research Group and began deliberating on a strategy. In April of the following year it prepared an initial draft proposal entitled "Plan to Address a Rapid Increase in the Number of University Applicants," which proposed increasing capacity by 100,000 students. It was presented to national, public and private university organizations and the ruling Liberal Democratic Party (LDP), and in response the Japan Association of National Universities generally expressed support, while public and private university-related organizations said they would be unable to go along with the plan unless there were fundamental reforms to central government subsidy programs and the tax system. The LDP's Education Council appears also to have expressed strong concern that boosting capacity by 100,000 students would lower the quality of university education (Itoh 1996).

Based on this feedback, the plan was changed to a 67,500-person capacity increase over the years 1965-1966, laid out in the August 1964 proposal "Expansion and Development of Universities During Periods of Rapid Increase in Applicants" (top of Table 2). The plan was scaled back to about two thirds of the previous year's draft proposal. In terms of expansion plans for specific fields, at national universities the proposal called for "continuing to step up recruiting of science and technology students while expanding recruiting in other fields as well, such as the social sciences, maintaining a balance with science and technology," while at public and private universities no special provisions are mentioned (Higher Education and Science Bureau, University Section 1968, 73).

Table 2. Content and Outcomes of the Rapid Increase Plan (August 1964 and August 1965 Proposals)

(Unit: people)

| | | | | Total | Success rate | National | Success rate | Public | Success rate | Private | Success rate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| August 1964 proposal | FY1965 | Forecast | Capacity | 27,000 | | 4,400 | | 1,600 | | 21,000 | |
| | | Outcome | Capacity | 17,694 | (65.5) | 2,234 | (50.8) | 350 | (21.9) | 15,110 | (72.0) |
| | | | Enrollment | 51,647 | (191.3) | - | - | - | - | 47,274 | (225.1) |
| August 1965 proposal | FY1966 | Forecast | Capacity | 39,000 | | 6,000 | | 2,000 | | 31,000 | |
| | | | Enrollment | 58,220 | | | | | | 50,220 | |
| | | Outcome | Capacity | 33,833 | (86.8) | 4,972 | (82.9) | 1,705 | (85.3) | 27,156 | (87.6) |
| | | | Enrollment | 70,530 | (121.1) | - | - | - | - | 62,870 | (125.2) |
| | FY1967 | Forecast | Capacity | 25,300 | | 4,000 | | 1,300 | | 20,000 | |
| | | | Enrollment | 37,700 | | | | | | 32,400 | |
| | | Outcome | Capacity | 24,240 | (95.8) | 3,985 | (99.6) | 460 | (35.4) | 19,795 | (99.0) |
| | | | Enrollment | 33,162 | (88.0) | - | - | - | - | 29,145 | (90.0) |
| | FY1968 | Forecast | Capacity | 19,000 | | 3,000 | | 1,000 | | 15,000 | |
| | | | Enrollment | 28,300 | | | | | | 24,300 | |
| | | Outcome | Capacity | 18,600 | (97.9) | 2,701 | (90.0) | 390 | (39.0) | 15,509 | (103.4) |
| | | | Enrollment | 24,696 | (87.3) | - | - | - | - | 19,388 | (79.8) |
| | Total (FY1966-68) | Forecast | Capacity | 83,300 | | 17,400 | | 5,900 | | 87,000 | |
| | | | Enrollment | 124,220 | | | | | | 106,920 | |
| | | Outcome | Capacity | 76,673 | (92.0) | 11,658 | (67.0) | 2,555 | (43.3) | 62,460 | (71.8) |
| | | | Enrollment | 128,388 | (103.4) | - | - | - | - | 111,403 | (104.2) |

*Note*: Prepared on the basis of Tables 2 and 4 released by the Higher Education and Science Bureau, University Section. The "success rate" is the actual number as a percentage of the forecast. Forecasts and outcomes for actual enrollment (as opposed to capacity) at national and public universities are not known. The August 1964 proposal was for a two-year plan covering 1965–66, but the actual plan implemented in 1966 was one formulated in August 1965, so the 1964 proposal for 1966 is omitted here.

Despite already being scaled back, the Rapid Increase Plan did not get off to a good start, meeting only 66% of its target for the initial year, fiscal 1965. Universities were cautious about expanding, with national schools having had their budgets cut by the Ministry of Finance, while private ones waited to see how much government funding would be forthcoming (Itoh 1996). As a result, the plan had to be revised again, and a new plan proposed in August 1965 called for a capacity increase of 83,300 and an actual enrollment increase of 124,220 people over the three years from 1966 to 1968 (bottom of Table 2).

A unique aspect of this plan was that unlike previous ones, it took into account the chronic over-enrollment at private universities, and set a target for actual enrollment as well as capacity. This was no doubt due to the realization that it would be difficult to meet targets based on capacity alone, as illustrated by the outcomes shown on Table 2. However, the Ministry of Education was criticized for issuing a plan that depended on over-enrollment at private schools for success, in other words a plan that publicly sanctioned over-enrollment. In addition, the unprecedented scale of the expansion meant that subsidies and loans to public and private universities, particularly private ones, further strained the public coffers (Itoh 1996). Nonetheless, this funding was necessary in order to secure the universities' cooperation (incidentally, this paved the way for the launch of a full-fledged private school subsidization system in the 1970s.) I have been unable to uncover any documentary evidence of concrete expansion targets for specific fields under this plan.

The outcomes of the Rapid Increase Plan, as shown on the bottom of Table 2, were below target in terms of capacity and above target for actual enrollment. Here, as well, the actual enrollment figures at private universities (i.e. over-enrollment) made a major contribution to achievement of the plan.

Now, let us examine the relative weight assigned to science and technology during the Rapid Increase Plan period. Although it is not shown on the table, comparison of the number of students enrolling in science and technology programs between 1965 and 1969 shows an increase of around 25,000 students at universities and junior colleges, accounting for 19.7 (i.e. about one fifth) of the total increase in enrollment across all fields of specialization. This is a bit lower than the corresponding ratio for the 8,000-Student Plan and the 20,000-Student Plan, in which science and technology accounted for 25.4% and 28.9% of the increase respectively. However, the Rapid Increase Plan was large in scope and covered a long period of time, meaning that in terms of raw numbers this plan resulted in a greater increase in science and technology recruitment than the previous two plans had.

At the same time, while the Rapid Increase Plan did indeed produce a sustained increase in the number of science and technology graduates, it could no longer be called either a science and technology reinforcement strategy or a manpower strategy. In reality, as the job placement rates for graduates during this period illustrate, insufficient human resources had become a problem no longer limited to the science and technology fields (Figure 2). While in some quarters there was continued insistence that the number of humanities students was excessive, and this played a role in the downsizing of the Rapid Increase Plan

(Itoh 1996), the unprecedented employment boom meant that the issue of reinforcement of science and technology in particular tended to get lost in the shuffle. When the Rapid Increase Plan was being formulated, the Vice-Director General of the Higher Education and Science Bureau at the Ministry of Education had the following negative assessment of the methods for assessing human resources demand in specific fields, which had been employed in previous science and technology reinforcement strategies:

> ……It does not suffice to interpret society’s needs purely from the vantage point of demand for particular vocations……In opening up the doors to institutions of higher education in response to the baby boom generation’s coming of age, limiting expansion to faculties of science and engineering is not necessarily appropriate in light of the wishes and needs of individuals. (Murayama 1963, 42)

In this context, Japan’s manpower strategy itself was losing a convincing reason for being.

Finally, let us examine science and technology reinforcement measures taken after the Rapid Increase Plan had concluded, through the mid-1970s. The end of the Rapid Increase Plan’s term of implementation coincided with the peak of the campus strife that swept the nation. The number of students enrolling in science and technology programs continued to grow, but over the years from 1967 to 1970 its pace of growth slowed, probably as a result of these campus conflicts. In the 1970s it picked up steam again, but the momentum of expansion was less than it had been during the Rapid Increase Plan, and demand for human resources was showing signs of waning as well. With the coming of the recession in 1974, the era of growth in science and technology education drew to a close.

## 4. Advent of the “College of Technology” System

Here I would like to discuss a reform of the education system that relates closely to the cultivation of technical personnel. The “college of technology” system, established in 1961, had as its primary mission “the training of industrial engineers” (Ministry of Education, Science and Culture 1964, 102). The roots of this idea lay in the postwar educational reforms that united various types of higher education institutions under the old prewar system into all-inclusive “universities,” which caused strong dissatisfaction in the business world, to the effect that the education system (without specialized technical colleges) was no longer producing enough “intermediate-level engineers.” This problem became increasingly intertwined with another one: that of how to deal with junior colleges, a category hastily and provisionally created for institutions from the old system that did not meet the criteria for four-year universities under the new system.

By the late 1950s, the Ministry of Education had decided that it wanted to establish a new type of short-term, two- to three-year institution that emphasized vocational education, and in some cases was combined with high schools and also offered five- or six-year course terms, and to absorb “junior colleges” into this category. This policy was given shape in the “specialized colleges (*senka daigaku*)” bill submitted to the National Diet in 1958. However, this bill met with fierce opposition from junior colleges, with private junior colleges in particular "protesting bitterly" (Kaigo and Terasaki 1969, 249). Not only did those involved in running junior colleges, which had originally been in the same category as four-year universities, consider the idea of being absorbed into a new category unacceptable, the character of this new category, with its emphasis on producing engineers, conflicted with the nature of most private junior colleges, which tended to be humanities-oriented or be women's colleges. In the end, the bill was submitted to the legislature three times but was defeated each time.

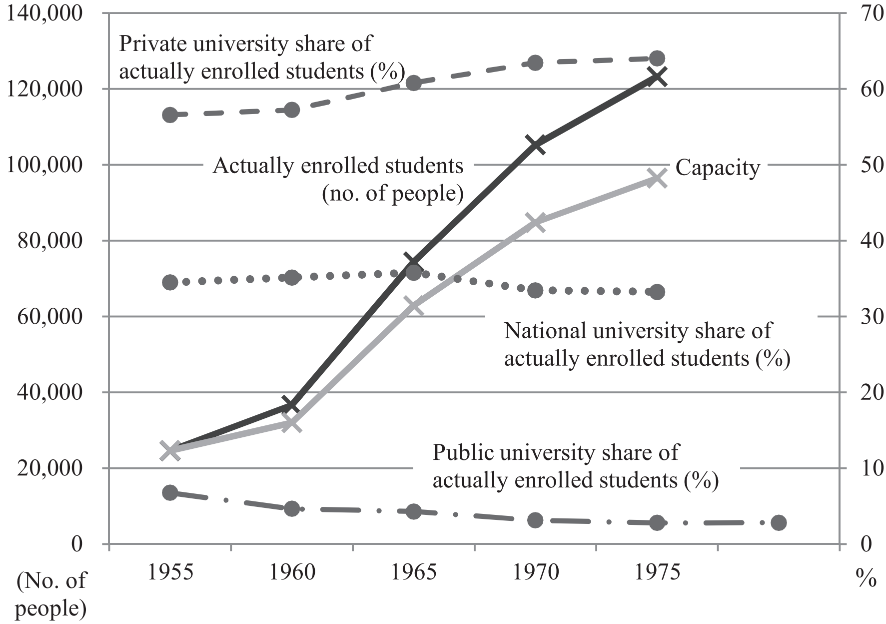
The need to cultivate scientific and technical personnel continued to grow, however, and the Ministry of Education set the issue of junior colleges aside for the time being and focused on the establishment of institutions for training intermediate-level engineers, and the first of the new "colleges of technology" opened in 1962. When the decision to launch the new system was made, nationwide recruitment efforts got underway. Initially things progressed smoothly, with 19 schools opening in the first year, and 16 more the following year (1963). These schools accounted for around one-fifth of the increased capacity achieved under the 20,000-Student Plan, more than twice the share held by junior colleges. However, this momentum did not last long. The number of students enrolled peaked in the early 1970s, and has declined slightly or remained flat ever since.[7] This was not only due to innate structural characteristics not conducive to quantitative expansion, namely specialization in science and technology and combination with a high school course, but also due to the dramatic expansion of four-year universities during the same period, which had the effect of marginalizing colleges of technology in a quantitative sense at least. Meanwhile, by 1964 the junior college system had been converted from its previous provisional status to a permanent one.

## III. The Outcomes of Reinforcement Policies

Now, I will summarize the way higher education in science and technology changed as a result of the reinforcement strategies we have examined. Figure 3 shows the relevant figures for universities' undergraduate programs, junior colleges, and colleges of technology, as well as master's degree programs. While graduate schools were not included in the science and technology reinforcement plans we have discussed, during that period they were expanded considerably with the goal of training university instructors and so forth. In 1960 there were roughly 1,100 people enrolled in master's degree programs in science and technology, but this figure had octupled by 1975.

At higher education institutions overall, over the two decades from 1955 through 1975, capacity grew by a factor of 3.9 and actual number of students enrolled by a factor of

[7] The first through third years of colleges of technology are equivalent to the three years of high school, thus the figures examined ought to be the number of students enrolled from the fourth year onward. However, here the overall number of students enrolled at technical colleges is substituted.




*Source*: Ministry of Education, Science and Culture, *School Basic Survey Report, Universities List, Junior Colleges List* and *University Materials* for each year.

*Note*: As the number of students enrolled in master's degree programs for the 1955 academic year is unknown, actual enrollment figures for that year are not included in calculations. The number of students actually enrolled is probably several hundred to several thousand people higher.

Figure 3. Capacity and Actual Enrollment in Science and Technology Programs, and Share by Category of Institution (Total for Master's Degree Programs, Undergraduate Faculties, Junior Colleges and Colleges of Technology)

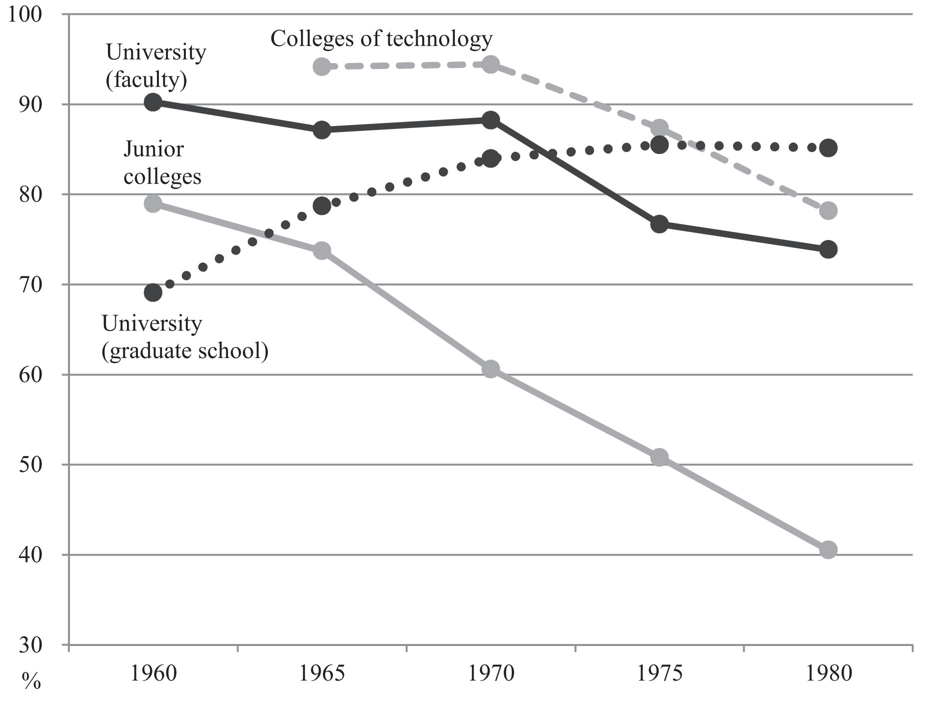
4.9. Over-enrollment at private universities led to a sustained discrepancy between these two figures. It was during the 1960s that growth in enrollment was most pronounced. Examining the breakdown by category of institution, private universities accounted for around 60% of growth and grew in a steady, sustained manner, while national universities accounted for about 35% and showed a slight decline in growth rate over time. Public universities continued to show negligible growth over the period. Though the figures are not shown on the chart, faculties (university undergraduate programs) accounted for an overwhelming share of the growth, though their share was brought down from just under 90% to just under 80% by the introduction of colleges of technology. Junior colleges and colleges of technology accounted for about 10%, though their share declined over time, while graduate programs were in the single-digit percentages but showed sustained growth. In short, faculties at private universities were the linchpin of efforts to reinforce science and technology education. While expansion of capacity and enrollment at national universities was considerable, looking at the big picture, private universities played a central role and their energy drove overall expansion.

Within the fields of science and technology, which specific areas saw expansion? This issue has not been examined thus far, but based on the trends in engineering fields at the undergraduate level examined by Saizu and Yano (1996), there was little change over the 1955–1975 period in the percentage of science and technology student capacity accounted for by the four major engineering fields (mechanical engineering, electrical engineering, construction engineering, and applied chemistry): over 70% at national universities and around 85% at private universities. At national universities, the sciences were compartmentalized in these four categories, while at private ones newly established faculties were primarily in the same four categories. Over the same period, there were four categories that continually dwindled (mining engineering, metallic engineering, textile engineering, and marine engineering), while three new categories saw growth especially from 1960 onward (information engineering, biological engineering, and materials engineering). While this transition occurred, there was little change to the overall structure of specialized fields (Saizu and Yano 1996).

What was the response of the labor market? As previously mentioned, the job market for graduates was astoundingly good. Although it is almost unimaginable considering the situation today, during the 1960s there were many years when the job placement rate for graduates of faculties of engineering was 100% (Figure 2). For graduates of other faculties, the overall job placement rate during the 1960s stayed above 90%, but engineering was a particularly strong field. For graduates of junior colleges, as well, while the overall rate is lower than that of four-year universities, the job placement rate for engineering was particularly high. Though it is not shown on the chart, the job placement rate for college of technology graduates was also extremely high, approaching 100%. Science and technology graduates were avidly embraced by the labor market. In the early 1970s, their employment situation stayed comparatively strong, if not as strong as it had been during the 1960s. It was in 1974 that Japan was suddenly plunged into an employment "ice age."[8]

What percentage of job seekers found jobs as technical personnel? Figure 4 shows the percentage of engineering program graduates that found jobs in fields high in technical personnel, namely manufacturing, construction, transport and communications. Data is provided through 1980 in consideration of year of graduation. With the exception of master's degree recipients, the percentage of people finding jobs in these fields trended downward from the 1970s onward. This trend was particularly pronounced among junior college graduates, and appears earlier. By contrast, the percentage of master's program graduates finding

[8] According to a Nikkeiren survey of companies' plans for hiring of college graduates, carried out every year, the number of people scheduled to be hired dropped for a time in 1972 after economic reforms were instituted by US President Richard Nixon, but temporarily recovered, before being drastically reduced with the advent of the recession in 1974 (Report of the Institute of Labour Administration).

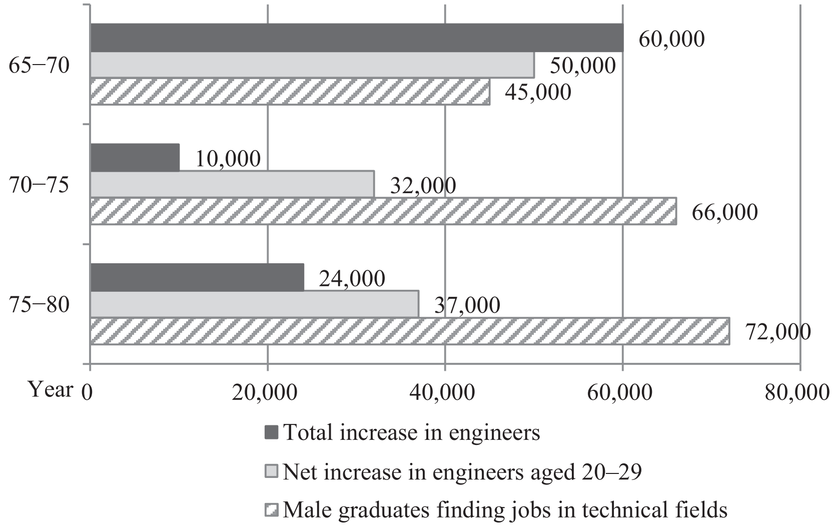



*Source*: Ministry of Education, Science and Culture, *School Basic Survey Report* for each year.

Figure 4. Job Placement Rates in the Manufacturing, Construction, Transport and Communications Fields (Percentage of All Graduates of Engineering Programs)

jobs in manufacturing stayed steady from the 1970s onward, and it is evident that the cultivation of engineers found a stable base in this population.

An analysis of the same subject by Kobayashi (1996) using different data exists. Kobayashi compared the increase in number of engineers (of all ages, and aged 20–29) derived from population censes and the number of male graduates finding jobs in technical fields (Figure 5). First of all, it is evident that over 1965–1970 the majority of growth in the number of engineers consisted of growth among university graduates, and growth in number of engineers can be seen as an outcome of reinforcement of science and technology in higher education. However, from 1970–1975 and from 1975–1980, the rise in overall number of engineers was much smaller, and there was only a pronounced rise among engineers aged 20–29. This means that this increase was the result of demand for young engineers to replace retiring workers, rather than an increase in the number of positions. In addition, the rise in the number of science and technology graduates was much greater than the increase in the number of young engineers, making it likely that there was "an over-supply of university-graduate engineers" (Kobayashi 1996, 246). As we have seen, reinforcement of




*Source*: Kobayashi (1996, 264, fig. 2–6–2). Some data omitted. Original data can be found in the *Population Census* and the *School Basic Survey Report*.
*Note*: "People finding jobs in technical fields" includes jobs in the sciences and agricultural science. Figures are for a period of one year.

Figure 5. Change over Time in Number of Engineers and Number of Persons Finding Employment

science and technology in higher education greatly contributed to swelling the ranks of engineers in the 1960s, but from the 1970s onward, while there was turnover as older engineers retired and new ones were hired, an increasing number of science and technology graduates went on to non-engineer positions.

Finally, let us take a look at the relationship between science and technology reinforcement and Japan's "industrial location policy." As is well documented, during the period of science and technology reinforcement we have been examining, many actions were taken to implement this "industrial location policy." In 1960, the Economic Council designated the "Pacific Belt Zone" as part of the National Income-Doubling Plan, and the 1962 Comprehensive National Development Plan (which can be seen as a revision of the 1960 plan) called for a "growth pole strategy." In these plans there are some references to configuration of departments at institutions of higher education in response to regional needs, and to prevention of over-centralization in urban areas. However, there is little if any evidence that higher education institutions' locations of establishment were clearly linked to national development plans.

However, the prevention of over-concentration of institutions of higher education in cities had been viewed as an issue since before the war, and during the high economic growth period as well, the Law Concerning Restriction on Factories, etc. in Existing Urbanized Areas of the Metropolitan Region (i.e. the Tokyo region) was passed in 1959 and a similar law passed in 1964 with respect to the Kansai region. In these core urban areas, new universities could not be established, and there was a prohibition on constructing classrooms over 1500 square meters in size. However, these restrictions were not limited to the science and technology fields, and the prohibition on large classrooms “had loopholes, as small classrooms could be constructed and meeting rooms, seminar rooms, etc. could be connected to form larger facilities” (Kuroha 1989, 35). It was not until after 1975 that full-fledged decentralization measures were put in effect.

The process of establishing national colleges of technology is perhaps most indicative of the relationship between location policy and institutions of higher education. The 1962 annual report of the Ministry of Education speaks of “petitions for construction of national colleges of technology in 29 locations in 22 prefectures of Japan,” and “based on considerations including industrial location-related conditions, overall regional balance of the nation, measures for securing teaching personnel, and frameworks for regional cooperation, 12 schools will be opened in 1963, and five more in 1964” (page 26). Over the four years after the launch of the system, however, 43 colleges of technology were established in most prefectures, with the exception of those in the vicinity of major cities. Amid fervent demand for opening of new schools, political considerations regarding regional balance won out over the concerns of industrial location. In other words, there is no more than a highly tenuous relationship between science and technology reinforcement measures and the “industrial location policy.”

## IV. Conclusion

In closing, I will enumerate the insights gained from this research.

- The beginning of Japan’s reinforcement of science and technology coincided with the start of the high economic growth period. Naturally, this reinforcement was underpinned by strong demand for human resources accompanying economic growth, and by robust finances, but it was also backed by strong public consensus. Science and technology reinforcement was carried out through three recruitment plans, the 8,000-Student Plan, 20,000-Student Plan, and the Rapid Increase Plan. Of these, the first two were linked to comprehensive national economic plans, and could be described as manpower strategies aimed at achieving economic growth. The Rapid Increase Plan, on the other hand, was not limited to one specific field, but it actually resulted in more pronounced science and technology reinforcement than the earlier two.
- However, none of these plans were implemented smoothly, and the process of shoring up science and technology had complicated aspects. Even amid a period of outstanding economic growth, in some quarters there was a deep-rooted view that the education system was bloated. Also, while things proceeded more or less according to plan at national universities, plans were often rejected by the fiscal authorities, and universities

themselves tended to be reluctant to expand for fear of lowering the quality of education. At the same time, it was extremely difficult for the government to regulate the quantitative scale of public and private universities. Private universities were extremely eager to expand, but unwilling to do so without financial support from the government. The government responded to private universities' frequent tactical maneuvers by providing the support requested, and also turned a blind eye to over-enrollment at private universities, which was a loophole that enabled them to expand without incurring costs. Both of these were necessary in order to achieve the plans' aims.

- It can be said that the success of science and technology reinforcement depended on both private universities' avid desire to expand and on young people's strong desire to progress to higher education. This can be said of postwar higher education in general (Itoh 2013), and science and technology during the high economic growth period were in line with overall trends.
- The issue of science and technology reinforcement was also related to the reform of the higher education system. There were many voices expressing dissatisfaction with the one-track postwar education system and calling for institutions that trained engineers in the manner of prewar professional colleges. However, the colleges of technology eventually established, through a tortuous process, ended up playing only a very minor role from a quantitative standpoint. Despite the above-mentioned debate, it was newly established undergraduate-level faculties of science and technology that played a central role, and junior colleges and colleges of technology were marginalized, quantitatively at least, with the exception of the increasingly prevalent master's degree programs.
- The number of science and technology students approximately quintupled over the years 1955–1975. This growth was primarily driven by private universities, and took place largely at the undergraduate level. Within science and technology overall, the structure of individual fields of specialization remained solid, and there was little change to the major categories that dominated it. Amid consistently strong demand for human resources throughout the high economic growth period, the job placement rate for science and technology program graduates was particularly high, and over the 1960s the reinforcement of science and technology fed demand for engineers. In the 1970s, however, the technical job market grew oversaturated, and graduates branched out into other fields. Through all this, there was only a highly tenuous relationship between science and technology reinforcement measures and the national development plans.

As we have seen, the cultivation of engineers during the high economic growth period can be viewed as a product of the extremely favorable and never-to-be-repeated conditions that prevailed during this period. Today, with higher education, the job market, and Japanese society as a whole radically transformed, what lessons can we derive from the history of the high economic growth period? It is to be hoped that it has practical implications for us today, rather than merely being a segment of history or a snapshot of "the good old days" for us to reminisce on.

One of these implications relates to the difficulty of developing human resources in a planned manner, which the process of science and technology reinforcement we have been examining illustrates extremely clearly. The policy implementation process was made even more complicated by private universities, which in Japan hold a much stronger power than we generally believe. The phenomenon of numerous actors playing intertwining roles in implementing a plan is one that we can see taking place today as well. Another lesson to be learned relates to the high expectations placed on education during the high economic growth period, which today is recurring as Japan faces the need for cultivation of globally viable human resources. In terms of what education can and cannot do to meet the needs of society, there are lessons to be learned from Japan's period of high economic growth.

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