Summary of the White Paper on Monodzukuri 2007

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Ministry of Economy, Trade and Industry (METI)
Ministry of Health, Labour and Welfare (MHLW)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
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—Towards Strengthening of the Supply Chain and Improved Reliability of Manufacturing —

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## Part 2 Measures and Policies Established in 2007 Relating to Promotion of Manufacturing Infrastructure Technology

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The percentages of nominal GDP and number of people employed by the Japanese manufacturing industry have demonstrated a mild, downward trend over the long term, but in recent years, they have shifted to approximately 20%.

Japan, which lacks natural resources, depends on imports from foreign countries for mineral fuel. At the same time, the manufacturing industry such as transportation equipment serves as the main force in exports. Even from an international perspective, Japan’s proportion of industrial products that comprise exports is high.
The production trend of the Japanese manufacturing industry is shifting steadily, in response to healthy exports and brisk capital investments (increased by 7.7% in 2007 as compared to previous year).

However, against the backdrop of the sharp rise in the price of resources such as crude oil, the sense of uncertainty about the future of economic conditions is growing. Variation can be seen according to region, company size, etc. but it is clear that the business conditions diffusion index for small and medium-sized companies is falling into negative territory for the first time in 16 quarters.

Diagram 1-4  Production trend in Japanese manufacturing industry

Diagram 1-5  Balance of trade in Japan

Diagram 1-6  Shifts in business conditions D.I. (manufacturing industry)

Remarks: Seasonally adjusted. 2005=100.
Source: METI “Indices of Industrial Production” and “Factory Construction Site Trend Survey”

Source: Trade Statistics of Japan

Source: Bank of Japan “Short-Term Economic Survey of Enterprises in Japan”
Section 2  Current State of Supply Chain for Manufacturing Industry that Is Expanding Across Asia, and Related Issues

(1) Intensification of international specialization of functions

Against the backdrop of escalating global competition and growth of the Asian region, the Japanese manufacturing industry is building a supply chain (linkage between businesses related to the series of processes, from procurement of raw materials to delivery of products to consumers or customers) on a scale that covers Asia, such as by promoting the development of manufacturing bases in Asia. As a result, production by overseas subsidiaries (in the manufacturing industry) in Asia has exceeded production by subsidiaries in North America in recent years, and the difference in these production levels is likely to continue expanding. The increase in production by these overseas subsidiaries also yields an increase in exports of parts, materials, etc. from Japan to the rest of Asia, and contributes to the activation of the domestic Japanese economy.

Diagram 1-7  Trends in amounts of sales by overseas subsidiaries (manufacturing industry) by region

Diagram 1-8  Overseas presence of subsidiaries (manufacturing industry)
While the percentage of exports to Japan (re-imports) that comprise the sales of overseas subsidiaries (in the manufacturing industry) in Asia remained at 22.1% in 2006, there is an increasing trend in the percentage of local sales. The characteristic of Asian development of the Japanese manufacturing industry as something that incorporates the dynamism of the expanding market has continued to grow stronger over recent years, against the backdrop of high economic growth in Asia.

**Diagram 1-9** Trends in amount of sales by subsidiaries (manufacturing industry) in Asia, by region

While expansion of production bases in Asia continues to become more active, there has also been an increasing trend in the number of production bases in Japan in recent years. In addition to economic recovery in Japan, the background behind this increase also includes the fact that the necessity to shorten the period between comprehending needs to launching products on the market is increasing, due to shortening of the life cycle, as well as the fact that the significance of setting up production bases in Japan is being reevaluated from the perspective of “securing competent human resources” etc.

**Diagram 1-10** Factory location trends in Japan

**Diagram 1-11** Reasons for establishing factories in Japan

Remarks: Preliminary figures are used for 2007.
Source: METI “Factory Construction Site Trend Survey”

Source: Survey by METI (December 2007)
While companies that have already expanded abroad are still producing products that make use of R&D and the latest technology mainly in Japan, such companies are actively making use of foreign bases for commercial production of general-purpose products, etc. While international specialization of functions continues to intensify, it is expected that there will be further advancement of the trend for companies to strategically apply both domestic and foreign management resources in the future.

Diagram 1-12 Orientation of functional specialization in the Japanese manufacturing industry

Diagram 1-13 Supply chain for flat-screen TVs (example of Company A)

While the supply chain is changing, such as by expanding to a scale that covers Asia,

1. Infrastructure industries (machine parts and tooling industries, etc.) that support manufacturing in the midstream of the manufacturing industry’s supply chain are also in competition with those in Asia, and strengthening the management foundation of such companies is important from the perspective of strengthening Japanese manufacturing overall.

2. While the supply chain expands and development of streamlining such as cutting back on inventories becomes linked to competitive strength, the perspective of strengthening a supply chain that includes companies located upstream to downstream, instead of a single company itself, is becoming important, based on the following:
   (1) Impacts in the event that supply is disrupted due to damage
   (2) Risk of technical information being leaked through business partners
   (3) Importance of securing human resources and handing down skills at partner companies, in addition to within one’s own company
While international specialization of functions continues to intensify, the manufacturing infrastructure industry is also exposed to competition with the rest of Asia.

The current evaluation of the technical level of local companies in Asia is low in the automotive field, in which higher precision is desired, and procurement of molds necessary for local production in Asia by Japanese companies, which requires high precision, is dependent on being carried out in Japan. At the same time, in the electromechanical field, evaluation of local companies is relatively high, and there are few technical differences from local Japanese companies. In aspects other than technology, evaluation of local companies is still low compared to the infrastructure industries in Japan and local Japanese companies, in terms of “adhering to the delivery period” and “fast response.”

Diagram 1-14 Technical level of local infrastructure industries

Source: Survey by METI (December 2007)

Diagram 1-15 Procurement of molds for automobiles by local Japanese company in China

– example of Company B

(Example of a standard passenger vehicle)

Source: Created by METI based on hearings with the vehicle manufacturer
However, expansion of manufacturers of assembled products and parts manufacturers into Asia is progressing, and the consolidation of industries in Asia is also adding to this growth. Against the backdrop of an expansion in production by Japanese subsidiaries in Asia (in the manufacturing industry), while the amount of imports of parts and materials from Japan is increasing, the percentage that comprises of procurement overall has been on a decreasing trend in recent years.

**Figure 1-16 Conditions of procurement from Japan by Japanese subsidiaries (manufacturing industry) in Asia**

![Diagram 1-16 Conditions of procurement from Japan by Japanese subsidiaries (manufacturing industry) in Asia](image)

Source: METI “Basic Survey of Overseas Business Activities”

In addition to the increasing trend in the percentage of local procurement of Japanese companies located in Asia, there is also the prospect that competition will increase between manufacturing infrastructure industries in Japan and companies in Asia, as demonstrated by the increase of imports from Asia into Japan of molds in some fields.

**Diagram 1-17 (1) Penetration rate for imports of molds**

![Diagram 1-17 (1) Penetration rate for imports of molds](image)

Source: Survey by METI (December 2007)

**Diagram 1-17 (2) Competition between the Japanese infrastructure industry and Asian companies**

![Diagram 1-17 (2) Competition between the Japanese infrastructure industry and Asian companies](image)

Source: Survey by METI (December 2007)

Remarks: Includes mold components and accessories

Degree of penetration of imports = Amount of imports / (amount of shipments + amount of imports – amount of exports) x 100

Source: METI “Census of Manufactures (Report by Commodity),” Trade Statistics of Japan
Based on the recovery of the economic climate in Japan in recent years, and the trend towards expansion of production of industrial products, there are many companies in the Japanese manufacturing infrastructure industry with improved profit ratios. However, with the current profit ratios, there are very few that can sufficiently implement capital investments, R&D investments, and development of human resources; strengthening of the management foundation is important from the perspective of reinforcing the competitive strength of Japanese manufacturing.

Diagram 1-18 Profit levels of the Japanese infrastructure industry

In order to produce better products, higher added values for the components that make up these products are necessary. Excessive demands by downstream manufacturers to cut down on costs to manufacturing infrastructure industries upstream weaken the manufacturing foundation of these industries, and are also linked to problems with the quality and performance of components and products. There is also a concern that ultimately, such demands trigger a decrease in the competitive strength of downstream manufacturers. From such a perspective, it is important to promote proper subcontracting transactions, and to develop an environment where the manufacturing infrastructure industries can appropriately secure profits.

In addition, rather than depending only on the domestic market in which it is difficult to expect large growth over the medium term, by progressing with exports and expansion abroad, it is important to hold the perspective that incorporating the growing vigor of Asia results in a strengthening of the management foundation in Japan. It is also important to carry out innovation that is based on the needs of downstream companies, establish cooperation between companies of the same and differing industry sectors, and broaden transactions into various fields, including those that are expected to grow in the future such as the airplane and robot industries.

Column: Guideline for Promoting Appropriate Subcontracting Transactions, etc.

(Purpose) To maintain and improve the competitive strength of Japanese industries based on promotion of appropriate transactions (“Win-win” business relationship between the parent company and subcontracting business)

Æ Improve earnings by promoting case examples of “best practice” and by improving trade practices; facilitate R&D and capital investment

Examples of improvements by using guidelines (materials process technology industry)

1. Example where steep rises in the prices of materials were reflected appropriately in transaction prices
   Taking steep rises in material prices into consideration, a meeting on prices was held once every 6 months in the past, but changes were made upon discussion so that there would be an opportunity to present prices once every quarter in the case of a change in prices that exceeds a certain range.

2. Example where the issue of costs for storing molds was improved
   Molds that are not used are now removed after applying for retirement to the partner company once every 6 months and receiving approval and retirement costs from the partner company.

Diagram 1-19 Foreign expansion of medium-sized/small and medium-sized companies

Remarks: Averages for a 5-year period are used for the current profit ratio. Companies indicated here are those that have a subsidiary (manufacturing industry) in Asia, and a capital of 1 billion yen or less.
Source: Reorganized and created based on METI “Basic Survey of Overseas Business Activities” and “Basic Survey of Japanese Business Structure and Activities”
Changes surrounding the supply chain

While global competition is intensifying, the supply chain for Japanese manufacturing industries appears to be expanding toward a scale that covers Asia. At the same time, there is also development in compression of inventories.

Diagram 1-20  Trends in the inventory turnover period for major industry sectors

![Graph showing trends in inventory turnover period for major industry sectors](image)

Source: MOF “Financial Statements Statistics of Corporations by Industry”

While the transaction structure continues to develop into a mesh-type structure, a trend to constructing close relations with suppliers from the design phase, as well as customizing parts and materials for differentiating from rival companies and for realizing different functions and design as well as reductions in size and weight, etc. can be seen in recent years.

Diagram 1-21  Substitutability of procured parts and materials

Diagram 1-22  Changes in the ratio of procured parts and materials that cannot be substituted

Although it is needless to say that promotion of streamlining of the supply chain, such as by reducing inventories, contributes to increased competitive strength, at the same time it has also been pointed out that there is potential vulnerability to unanticipated risks of supply disruption. In the Japanese manufacturing industry, specialization is progressing, and circumstances where halting of production at a business site has a significant impact on other businesses and industries are envisioned. Such an impact may be extremely large in particular for parts, etc. that are difficult to substitute.

Amidst such conditions, the awareness of the Japanese manufacturing industry with regard to supply disruption risks has been increasing, but responses to such risks are still insufficient.

In terms of responses, it is important to review responses that do not jeopardize competitive strength, taking aspects such as the degree of impact in the case that supply disruption occurs, as well as the strengths and weaknesses of a company’s own supply chain into sufficient consideration.

Information management that includes business partners

While globalization of the supply chain, changes in the transaction structure, and fluidization of human resources continue to progress in recent years, responses to the risk of technology leaking by means of products and people are more important than ever. Although it is needless to say that approaches toward reinforcement of in-company management are important, the risk of technical information leaking via business partners cannot be ignored. For example, systems to reduce risks of leakage of technical information, etc., when consigning work, etc., externally are important.

Diagram 1-26 Risk of technology leaks through business partners

<table>
<thead>
<tr>
<th>Risk of technology leaks</th>
<th>Almost no awareness of risk</th>
<th>Aware of risk as being a problem to some extent</th>
<th>Aware of risk as being a large problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>5.6%</td>
<td>32.2%</td>
<td>62.2%</td>
</tr>
</tbody>
</table>

Remarks: Represents large companies that responded that in-company management of technical information is carried out “sufficiently.”


Issues in terms of human resources

Against the backdrop of a large number of baby boomers who are retiring, young people stepping away from manufacturing, and the medium- and long-term decrease in the population, securing and cultivating human resources is becoming more important in Japanese manufacturing. In particular, it is difficult for small and medium-sized companies to secure and keep young human resources in general, and this situation is becoming more serious. Amidst these conditions, many large companies recognize that the risk of inadequate passing on of the skills of their suppliers is a problem, and movements to promote the transmission of skills of suppliers through cooperating with the suppliers themselves are becoming evident.

Diagram 1-27 Approaches for transmission of skills from veteran employees to younger employees (small and medium-sized companies)

<table>
<thead>
<tr>
<th>Approaches for transmission of skills</th>
<th>No approaches are being made</th>
<th>Approaches are being made, successful</th>
<th>Approaches are being made, but not very successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>7.3%</td>
<td>29.4%</td>
<td>62.8%</td>
</tr>
</tbody>
</table>

Remarks: Represents “Companies that are concerned about skills being lost due to veteran employees retiring, etc.”

Source: Japan Finance Corporation for Small and Medium Enterprise Research Institute “Survey of SME Trends”

Diagram 1-28 Risks regarding transmission of skills of suppliers (large companies)

<table>
<thead>
<tr>
<th>Risk of transmission of skills of suppliers</th>
<th>No awareness of risk</th>
<th>Aware of risk as being a problem to some extent</th>
<th>Aware of risk as being a large problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>0.5%</td>
<td>53.3%</td>
<td>21.8%</td>
</tr>
</tbody>
</table>


Column: Risk of technology leaks through business partners

Although semiconductor materials and LCD materials are known as competitive fields where Japanese companies boast overwhelming shares, problems of technology leaks have become evident in recent years. For these functional, chemical materials for which material development is conducted by holding thorough consultations with users, who are the customers, samples as well as testing and evaluation data are provided to customers starting in the development phase, after which commercial production begins. However, the major users of semiconductor chips and LCD panels are now manufacturers from various Asian countries, such as Korea, Taiwan, and China. In these countries, there are many cases where users with large capital possess materials manufacturers themselves as affiliate companies. Based on these circumstances, there are some companies that are concerned that Japan’s expertise in semiconductor materials and LCD materials can easily be leaked via users.
Recently, there has been a sudden increase in the number of product recalls and accident reports. In addition, incidents regarding camouflage of products, such as with recycled paper, are occurring one after another, and trust in manufacturing is waver.
The factors behind these issues cannot be described broadly, but it is considered that one of the factors behind these situations is that streamlining, such as reduction of costs, was prioritized due to intensification of competition, resulting in insufficient approaches toward "safety" and "trust," and little regard for compliance. With respect to product safety, there is also the factor, other than these factors, of manufacturing itself having become more advanced and complex, such as through sophistication and complexity of the manufacturing process and expansion of the use of incorporated software.

In order to reduce product-related accidents in the current state where there is intense competition, initiatives by the management team are essential. In addition, in order to increase the safety of products, approaches that respond to sophistication and the complexity of manufacturing, the state of society, and changes in consumer awareness are desired, and it is important to approach manufacturing by giving sufficient consideration beforehand to predictable mistakes in usage, etc., starting in the design and development phases.

Diagram 1-31  Background behind product-related accidents


Diagram 1-32  Changes in design concepts

Remarks: Represents specific details that were asked of companies that responded that they will respond to the increased number of product-related accidents by "changing the design concept."

The spread of imitation products is a problem not only in terms of economic impact, such as the hitting the profits that the rights holder is entitled to, as well as acting as a brake on corporate innovation and creative motivation, but also in the sense that counterfeiting has in recent years become a problem from the perspective of the health and safety of consumers. If a consumer uses a product without being aware that it is an imitation, it affects the consumer's safety and consequently, there are concerns that this would reduce trust in Japanese manufacturing. Based on such a perspective, further reinforcement of measures against imitation products is desired.

**Diagram 1-33 Problems in terms of safety associated with use of imitation products**

Thermal value is low \( \Rightarrow \) (speed of only approximately 120 to 130 km/h is possible)

If driving at higher speeds continues, there is a large possibility of the plug and engine becoming damaged

<table>
<thead>
<tr>
<th>Condition of plug during driving</th>
</tr>
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<tbody>
<tr>
<td>Heat-resistance limit of plug: 1100°C</td>
</tr>
<tr>
<td>Imitation product</td>
</tr>
<tr>
<td>Genuine product</td>
</tr>
</tbody>
</table>

Large possibility of damage by melting

<table>
<thead>
<tr>
<th>Plug electrode temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Vehicle speed (km/h)</td>
</tr>
<tr>
<td>40</td>
</tr>
</tbody>
</table>

Source: Japan Automobile Manufacturers Association, Inc.

**Column: Framework of Anti-Counterfeiting Trade Agreement (tentative name)**

- Diversity and complexity of diffusion (expansion of sales via the Internet, “international specialization”)
- Economic damage (transaction value of counterfeit goods *yearly average of approx. 80 trillion yen (WCO, ICPO,) approx. 20 trillion yen (based on trade value, OECD))
- Harmful to the health and safety of consumers (brake pads with low durability, etc.)
- Source of income for criminal organizations and terrorist groups (less of an offense than drug dealing, high income)

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**Characteristics of international dispersion of counterfeit products and pirated versions**

- The many international disciplines (WTO/TRIPS, WIPO) represent the minimum standards, and are insufficient for responding to this problem, which continues to become more diverse and complex. **But creation of new rules by the WTO and WIPO are difficult based on the various circumstances.**
  - To build a stronger framework, responses outside of the WTO are necessary.
- Accumulation of bilateral agreements is not enough to prevent international dispersion of counterfeit goods and pirated versions.
  - **Global approaches through a multilateral framework are necessary.**
In recent years, the price of resources has increased sharply and remained high, against the backdrop of an influx of speculative money into the commodities market, in addition to supply risks based on insecurities about the state of countries in which resources are produced and a global increase in demand associated with economic growth of newly industrializing countries such as China and India.

Even for iron and steel, which are important materials in a wide range of industries, such as the construction industry and industries for manufacturing automobiles and ships, the prices of raw materials such as iron ore and metallurgical coal have increased steeply. In addition, the top 3 companies make up more than 70% of the world's iron ore supply, and the top 5 companies make up 60% of the world's metallurgical coal supply. There is growing concern that there will be further sharp increases in the prices of raw materials in the future, caused by an oligopoly of supply.
While Japan’s manufacturing industry faces pressure on profits due to the high prices of resources, there has been a steady performance of business profits as a result of a global economic expansion, etc. However, in the 4th quarter of 2007, business profits entered negative territory (a 4.6% change as compared to the same period the previous year) for the first time in 22 quarters. Looking at this by industry sector, it can be seen that the business profit was mainly dependent on an increase in sales prices in the materials industries and an increase in the sales volume in the processing and assembly industries.

At the same time, the break-even ratio, which has been on a decreasing trend in recent years, has started to increase since 2006 in small and medium-sized companies in particular, against the backdrop of an increase in variable costs resulting from the high prices of resources not having been completely shifted. While the direction of global economy continues to be opaque, if Japan’s manufacturing industry continues to see sluggish growth in sales, the impact on corporate profits may expand even further.

Diagram 1-37 Analysis of factors behind growth rate in business profits
(as compared to same quarter of the previous year)

Diagram 1-38 Shifts in break-even ratios according to company scale

Remarks: (1) The method used for analyzing factors is as follows.
Business profits = Sales – variable costs – fixed costs;
Variable costs = Cost of sales + selling, general and administrative expenses – labour costs – depreciation cost
Fixed costs = Labour costs + depreciation cost
Business profits = (Δ output price x production quantity + output price x Δ output quantity) – (Δ input price x input quantity + input price x Δ input quantity) – labour costs – other costs
[Output price factors] [Input price factors]
Δ output price x output quantity – input price x Δ input quantity
[Unit sales factors] [Labour cost factors] [Other cost factors]

(2) Materials industries refer to pulp/paper/wood products, chemical industries, petroleum products/petroleum product manufacturing industries, ceramic/soil and stone products, the steel industry, and nonferrous metal industries.

(3) Manufacturing and assembly industries refer to metal products industries, general machinery and tools industries, electric machinery and tools industries, transportation equipment and tools industries, and precision instruments and tools industries.

Rare metals are used in a wide range of industrial fields, such as IT and automobiles, and lie at the foundation of Japan's industrial competitiveness. However, as they are extremely scarce and unevenly distributed, the degree of dependency on the partner country with the highest amount of imports of rare metals is high and increasing. Against the backdrop of consumer expansion, etc. in Asian countries such as China, there have been steep increases in the price of rare metals as well as risks in terms of supply, such as changes in resource policies of countries where the rare metals are produced.

Due to these conditions, 60% of companies have recognized in recent years that securing rare metals may become difficult. In addition to progressing with exploration development, etc. through strengthening relations with countries that possess the resources through efforts by both the public and private sectors, it is also a primary task to move forward with approaches to change manufacturing to reduce the amount of rare metals used, by developing 3Rs and alternate resources/materials.

Diagram 1-39 Degree of dependency by Japan on countries that have the highest amount of imports of rare metals

<table>
<thead>
<tr>
<th>Rare earth</th>
<th>Tungsten</th>
<th>Platinum</th>
<th>Indium</th>
<th>Nickel</th>
<th>Molybdenum</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.5% &lt;China&gt;</td>
<td>45.8% &lt;South Africa&gt;</td>
<td>44.8% &lt;Indonesia&gt;</td>
<td>54.3% &lt;France&gt;</td>
<td>28.7% &lt;Indonesia&gt;</td>
<td>40.8% &lt;Chile&gt;</td>
</tr>
<tr>
<td>87.7% &lt;China&gt;</td>
<td>83.2% &lt;China&gt;</td>
<td>55.3% &lt;China&gt;</td>
<td>55.3% &lt;China&gt;</td>
<td>43.1% &lt;Chile&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Remarks: (1) Comparisons were made at 2 points in time of the amount of inputs from partner countries that had the highest amount of imports making up total inputs of each rare metal.

(2) Countries inside the brackets < > represent the partner country with the highest amount of imports.

Source: Created by METI based on Japan Oil, Gas and Metals National Corporation "Collection of Data on Rare Metal Stock."

Diagram 1-40 Awareness regarding the risk that securing the necessary amount of rare metals will become difficult

- Envisioned as a serious risk: 16%
- Envisioned as a risk to some extent: 48%
- Risks where the necessary amount cannot be secured are not envisioned: 36%

Remarks: Represents companies that use rare metals.

Source: Survey by METI (December 2007).

Column: Strengthening of relations with countries that possess resources

To actively promote resource diplomacy and industrial partnerships, Akira Amari, the Minister of Economy, Trade, and Industry, visited the Republic of South Africa and the Republic of Botswana in November 2007, the first Minister of Economy, Trade and Industry to do so.

Agreements were reached in the resources and energy field, starting with rare metals, regarding the building of a win-win relationship that links Japan’s advanced technical strength and Africa's resources, as well as cooperation toward the development of an infrastructure and industrial sophistication.

Meeting with President Mbeki of South Africa

Meeting with President Mogae of Botswana
Japan’s manufacturing industry has made advances with various approaches regarding environmental problems up until now, but the impact of environmental restrictions on corporate management is increasing, due to the intensification of problems with global warming and the strengthening of environmental restrictions in various countries. In particular, emphasis is being placed on elimination, etc. of chemical substances with high risks as conditions for procurement, as a result of reinforcement of international restrictions on chemical substances such as the EU’s RoHS Directive and REACH regulations.

With this as the background, approaches toward environmental restrictions are becoming a problem that affects corporate management, as represented by cases where there is an expansion of transactions for companies that have competent approaches, and halting of transactions for those that do not.

Diagram 1-41 Procurement conditions relating to environmental-friendliness sought by sales destinations

Diagram 1-42 Changes in procurement details resulting from environmental-response conditions of suppliers

Source: Survey by METI (December 2007)

For small and medium-sized companies, which have smaller capital resources compared to large companies, approaches regarding environmental restrictions are more difficult. Consequently, approaches to tackle environmental restrictions through partnerships between large companies and small and medium-sized companies are being promoted.

Diagram 1-43 Biggest issues in proceeding with approaches regarding environmental restrictions

Column: The “domestic credit (CDM) system”

METI is in the process of reviewing the “domestic credit (CDM) system,” which is a framework for promoting reduction of CO₂ emissions by small and medium-sized companies through using the capital and technology of large companies, etc.

In this system, large companies that provide technology and capital to small and medium-sized companies obtain credits equivalent to the amount of CO₂ emissions reduced by small and medium-sized companies. This system is planned on being put into operation as a mechanism that can be used to achieve the goals of voluntary action plans, etc.

Remarks: Small and medium-sized companies refer to companies with less than 300 employees and capital of less than 300 million yen. Large companies refer to companies other than small and medium-sized companies.

Source: Survey by METI (December 2007)
In recent years, increasing importance has been placed in approaches such as streamlining logistics, reducing the amount of resources input, and management of chemical substances through collaborations between upstream and downstream companies, as represented by (1) reinforcement of "regulations for products" starting with regulations on chemical substances in the EU, in addition to "regulations for business sites," and (2) limitations in approaches by individual companies to promote further resource saving under conditions where resource restrictions are increasing.

The heightening of resource and environmental restrictions in recent years is a constraining factor for manufacturing, but at the same time, it also provides a chance to strengthen competitive power, through increasing "environmental power" by applying the superior environmental technology, IT, etc. of Japan.

**Column: Manufacturing that contributes to the reduction of environmental burdens through collaboration between a camera manufacturer and a materials manufacturer**

Upon analyzing the waste in its manufacturing process, Company A discovered that most of the waste was produced in the lens grinding process. By collaborating with a materials manufacturer and improving the method from the conventional one where materials that are hollowed out (Diagram 1) are used, to one where materials that are pressed (Diagram 2) are used, Company A was able to have components that were finished in a configuration that is closer to that of the completed product delivered, thus reducing waste. By including the process carried out by the materials manufacturer, Company A was able to reduce the amount of input materials and the energy amount to 1/7th of the original amounts.

**Diagram 1  Before implementation of approach**

**Diagram 2  After implementation of approach**

**Diagram 1-44 Composition ratio of registered patents/patent applications filed in the environmental field and the energy field according to nationality**

<table>
<thead>
<tr>
<th>Environmental field</th>
<th>Energy field</th>
</tr>
</thead>
<tbody>
<tr>
<td>9,915 patents registered Cumulative total between February 2006 and August 2007</td>
<td>9,430 patents registered Cumulative total between February 2006 and August 2007</td>
</tr>
<tr>
<td>Japanese</td>
<td>American</td>
</tr>
<tr>
<td>67%</td>
<td>20%</td>
</tr>
<tr>
<td>39%</td>
<td>30%</td>
</tr>
</tbody>
</table>

**Remarks:**
(1) The environmental field refers to the environmental fields in the 4 areas that are promoted in a prioritized manner in the Third Science and Technology Basic Plan; the energy field refers to the energy fields in the 4 areas that are promoted.
(2) Patent applications that were registered in Japan, the United States and the EU (including the European Patent Office) were aggregated according to nationality. Others represent the total for applications registered in China, South Korea, and Taiwan.
(3) For fuel cells, the composition ratio is that of patent applications filed according to nationality; for other items, the composition ratio is that of patents registered according to nationality.

Section 1 Current State of Employment/Labour of Manufacturing Workers

- After the second half of 2005, the number of employers in the manufacturing industry has been shifting to a positive tendency on a year-over-year basis.
- When looking at the trend in the excess and deficiency of workers, the excess of shortage in the manufacturing industry was 23 points, indicating that the range of excess of shortage is of a high standard.

Diagram 2-1 Shifts in the number of workers employed, etc. in the manufacturing industry (raw numbers)

Diagram 2-2 Shifts in the condition of excess and deficiency of workers

- The number of new graduates in the manufacturing industry registered an all-time low in 2003, after which there was an increasing trend, but the level has remained low.
- Although the turnover rate of new graduates within 3 years after their employment is low when compared across all industries, it is high on a medium, small, and micro scale, being approximately 50%.

Diagram 2-3 Shifts in the number of new graduates employed in the manufacturing industry

Diagram 2-4 Turnover rate of new graduates employed in 2004 within 3 years after their employment (all industries and manufacturing industry)

Remarks: The broken line represents the percentage (%) when taking the number of people newly employed in 1992, which is the most recent peak, and making it equal 100
Source: Created based on MHLW “Survey on Employment Trends”

Source: MIC “Labour Force Survey”

Source: Created based on MHLW “Survey on Labour Economy Trends”

Source: MHLW “Survey on Labour Economy Trends”

Remarks: The scale on the left represents “Ratio of business that responded as having a deficiency” – “Ratio of business that responded as having an excess.” Surveys were conducted every year in February, May, August, and November.
Source: Created based on MHLW “Survey on Labour Economy Trends”

Source: Survey by MHLW
Section 2  Diversification of Employment Formats at Manufacturing Sites and the Current State of Human Resource Development and Related Issues Associated with this Diversification

1  Changes in the environment for human resource development and diversification of employment formats at manufacturing sites

- While international specialization continues to occur in the manufacturing industry, the importance of "on-site strength" is being reassessed. Regression of production bases back to Japan is arising, and investments in human resources by companies are also shifting toward an upward momentum.

- As business challenges which manufacturing sites are directly faced with, the heaviest emphasis is being placed on "high quality and accuracy," "short delivery periods," and "price competition". In order to respond to these challenges, human resources needs are changing and becoming more advanced, as represented by a creative ability to bring forth improvements in the production system as required by engineers, together with both wide-ranging and specialized knowledge, and the strength to make proposals and execute operations rooted in the manufacturing site that reinforce the business base and that give birth to rationalization and higher added values required by technicians, along with mastery and multiple skills.

Diagram 2-5  Awareness of conditions of changes in business environment/market environment over the past 3 years

Table 2-7  Most important knowledge/skills sought after in regular employees specializing in skills


Diagram 2-6  Most important knowledge/skills sought after in regular employees specializing in technology

Table 2-8  Most important knowledge/skills sought after in regular employees specializing in technology

When looking at the employment structure in the manufacturing industry, characteristics such as the ratio of regular employees being high as compared to other industry sectors, and the ratio of young people such as part-time workers being low can be acknowledged. As a trend in recent years, the number of external workers such as dispatched-workers is expanding. When looking at the number of employed workers in the manufacturing industry, which is affected by these factors, there was an underlying downward trend in both regular employees and part-time workers, despite economic recovery. However, starting in 2006, the number of regular employees has started to increase, followed by an increase in the number of part-time workers in one year later.

Factors behind diversification of employment factors include shortage of labour, price competition and competition with the rest of Asia, and responses to demand fluctuations. Companies are making use of human resources by combining regular employees and workers other than regular employees (including external workers).

There is a trend where, at business sites where the prediction of future production and order volumes is clear, those with a higher percentage of external workers and that make more use of non-regular employees are more likely to be active in recruiting new graduates as regular employees.

Diagram 2-8 Composition of regular employees, non-regular employees, and external workers

Diagram 2-9 Number of employers excluding people of status that do not require them to hold jobs and officials appointed according to age group (non-agricultural industries and manufacturing industry)

Diagram 2-10 Ratio of business sites in the manufacturing industry that make use of dispatched workers and contract-based workers, classified according to whether there was an increase or decrease in the number of workers

Diagram 2-11 Ratio (average value) of number of external personnel for each “expectation of production amount and order volume of major products”
2 Impacts and issues that diversification of employment formats have on production activities, human resources management, and skills development

- At manufacturing sites, workers other than regular employees are engaged not only in work that can be handled through experience and training over a short period of time, but in areas that require expertise and response to changes and that affect the quality of the product itself, such as inspections and tests, and work that requires experience of more than a few years in order to obtain skills as well.
- This may be a new movement characterized by the diffusion of the system for recruiting regular employees.
- When looking at the current state of development of vocational capabilities of regular employees, OFF-JT is implemented at a little less than 80% of business sites, and planned OJT is carried out at approximately 50% of business sites. On the other hand, systems for human resources management and human resource development have not been established, as evident by the fact that there are fewer opportunities for workers other than regular employees to develop vocational capabilities as compared to regular employees.

Diagram 2-12 Operations that regular employees, non-regular employees, and external personnel are in charge of (multiple answers possible)

Diagram 2-13 Conditions regarding recruitment of non-employees and external personnel who work as technicians/engineers as regular employees

Diagram 2-14 State of implementation of OFF-JT and systematic OJT in the manufacturing industry


Source: MHLW "Basic Survey of Human Resources Development" (2008)
Based on such basic issues, the importance of the following is increasing.

- For regular employees, a balance between accumulation of work experience through OJT and acquisition of specialized knowledge through OFF-JT, and building a community and pool of knowledge and values through activation of a network of human resources
- For workers other than regular employees, education and training, an increase in skills, and clarification of career perspectives
- For both regular and non-regular employees, enhancement of rudimentary training that includes safety aspects and development of capability assessment standards, etc.
- In addition, when looking at evaluations of sites with regard to use of non-regular employees, although results such as support of changes in the amount of work and the commitment of regular employees to advanced operations, etc. are found, responses toward increased burdens in terms of human resources management and toward the accumulation and passing down of know-how are sought after.
- From the perspective of contributing to the reinforcement of the foundation for manufacturing sites overall, promotion of the establishment of a human resources management system is important.

Diagram 2-15 Changes and impacts on manufacturing sites due to use of non-regular employees and external personnel (multiple answers possible)

Diagram 2-16 Considerations given to making use of non-regular employees and external employees (multiple answers possible)

With regard to development of advanced engineers as a response to the sophistication of desired skills, support of vocational training and succession of skills are being promoted for employees that are currently employed.

With regard to hands-on human resource development, which serves as the core of manufacturing sites, a "hands-on human resource development system," which consists of vocational training based on practical training at a company and classroom lectures, is growing. For freeters, etc. an expansive way of working is being realized, such as by promoting a "job card system" and employing them as regular employees. Application of this system is also being promoted in the manufacturing industry.

The "International Skills Festival for All," during which both the "International Youth Skills Olympics" and the "International Abilympics" were held simultaneously for the first time in history, was held in Japan. This skills festival produced significant results in terms of fostering momentum for both skills and manufacturing. Through these results, development of the infrastructure for a "manufacturing kingdom" can be further promoted.

Diagram 2-17 Establishment of a “Job Card System”

Diagram 2-18 International Skills Festival for All
Chapter 3 Promotion and R&D of Learning that Support the Manufacturing Infrastructure

Section 1 Challenges by Technical Colleges and Specialized High Schools that Support Tomorrow’s Manufacturing

1. Technical Colleges that Play a Major Role in the Practical and Creative Development of Engineers

- Implementation of practical and creative education that emphasizes experiments and learning consistently for 5 years
- Friendly competition among students through various contests such as the Robot Contest
- Promotion of local collaborations such as through joint research and development with local companies and lectures on demand at elementary and middle schools

Current state of technical colleges (As of 2007)

<table>
<thead>
<tr>
<th></th>
<th>National</th>
<th>Public</th>
<th>Private</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of schools</td>
<td>55</td>
<td>6</td>
<td>3</td>
<td>64</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>242</td>
<td>7</td>
<td>8</td>
<td>257</td>
</tr>
<tr>
<td>Number of classes</td>
<td>242</td>
<td>19</td>
<td>11</td>
<td>272</td>
</tr>
<tr>
<td>Enrollment limit</td>
<td>9,680</td>
<td>760</td>
<td>495</td>
<td>10,935</td>
</tr>
<tr>
<td>Number of students enrolled</td>
<td>52,785</td>
<td>4,025</td>
<td>2,203</td>
<td>59,013</td>
</tr>
</tbody>
</table>

Employment rate and ratio of job offers to applicants over the past 5 years

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of number of job seekers</td>
<td>53.5%</td>
<td>54.1%</td>
<td>53.8%</td>
<td>53.8%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Employment rate</td>
<td>96.5%</td>
<td>98.1%</td>
<td>97.7%</td>
<td>98.7%</td>
<td>98.7%</td>
</tr>
<tr>
<td>Ratio of job offers to applicants</td>
<td>9.8-fold</td>
<td>10.4-fold</td>
<td>12.5-fold</td>
<td>15.6-fold</td>
<td>20.1-fold</td>
</tr>
</tbody>
</table>

Creation of products based on students’ patents

The Tokuyama College of Technology is aiming to increase students’ volition, thinking power, and ability to develop ideas by filing patent applications for ideas that are conjured up by the students. Based on an idea for which a patent was obtained, the students collaborated with an industrial promotion center and a molding manufacturer and succeeded in commercializing a foot mouse. This foot mouse is achieving satisfactory results such as being supplied to hospitals across the nation as well as people who are not able to use their hands.

[Foot mouse]
National College Robot Contest (commonly referred to as “RoboCon”)

Ever since the first contest in 1988, participants have competed, challenging each other with their ideas and technical strengths in accordance with a theme that changes every year. The RoboCon is a nationwide contest where participants experience the joy of “thinking using their own minds, and creating robots with their own hands,” and share the importance of coming up with ideas as well as the enjoyment of manufacturing.

The theme for the 20th RoboCon in 2007 was “Wind, Forest, Fire and Mountain: Calvary Battles Using Robots.” Each team created 2 “cavalry robots,” and the 2 teams—a red team and a white team—competed against each other using their robots. Inside an 8 m square, there were heated matches between a total of 4 robots where each robot fought over a flag.

- Minister of Education, Culture, Sports, Science and Technology Award: Kitakyushu National College of Technology (Tournament winner)
- RoboCon Award: Salesian Polytechnic (Creative and outstanding idea and superior technical strength)

Approaches toward joint research and development with companies

The Tokyo National College of Technology was requested by a local electronic parts manufacturer to develop a product to increase the commercialization value of piezoelectric ceramics (which have the characteristic of generating electricity when tapped and vibrating when electricity flows), which is the manufacturer’s core product. In response to this request, the college proposed “incorporating the ideas of teenage girls and developing new needs,” which marked the start of a joint business between a local company and female students.

The students established themes such as health goods and daily commodities, and came up with ideas for ways of using piezoelectric elements. From among nearly 100 product proposals, the students narrowed the ideas down to 8 product proposals geared towards young females and junior high school students.

The students proposed products such as an "ultrasonic stirrer" that churns dairy products finely inside a cup and makes the taste milder, and headphones that are equipped with a massage function in the cord. These products were evaluated by the electronic parts manufacturer that made the request as being "ideas that reflect the playful spirit of female students, on top of comprehending the characteristics of piezoelectric elements."

Approaches for raising the interest of elementary and junior high school students in manufacturing

At the Miyagi National College of Technology, "Rikaranger," which is mobile science laboratory that was created by modifying a 4-ton truck, is used for carrying out scientific experience classes at the request of elementary and junior high schools. These classes, in which many of the college students participate as assistants for the teachers who are the main people teaching the class, are gathering attention locally such as by being introduced in the mass media as volunteer activities for science education.

These activities do not simply provide an opportunity for showing experiments to young children, but also convey the fun in manufacturing, by sparking scientific curiosity in the children by making use of science shows that place emphasis on actual experience.
2. Specialized High Schools that Play a Major Role in Cultivating Professional People to Support Local Industries

- Promotion of education (Japanese version of a dual system) that upon obtaining cooperation from local companies, combines long-term practical training at companies and classroom lectures at schools
- Active promotion of obtaining qualifications through steady acquisition of practical knowledge and technology
- In advanced courses, implementation of education in which further advanced technology and skills can be obtained while collaborating and cooperating with local companies and universities/technical colleges

Current state of specialized high schools (total of national, public, and private) (May 2007)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Number of students (people)</th>
<th>Number of subjects</th>
<th>Ratio (%)</th>
<th>Independent subjects</th>
<th>Multiple subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated courses</td>
<td>153,583</td>
<td>153</td>
<td>0.4</td>
<td>7 vocational courses + ordinary courses</td>
<td>278,827</td>
</tr>
<tr>
<td>Ordinary courses</td>
<td>2,455,195</td>
<td>4,072</td>
<td>2,771</td>
<td>34</td>
<td>5,313</td>
</tr>
<tr>
<td>Other courses</td>
<td>101,357</td>
<td>9</td>
<td>583</td>
<td>38</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>3,397,735</td>
<td>7,279</td>
<td>5,313</td>
<td>1,534</td>
<td>-</td>
</tr>
</tbody>
</table>

Employment rate, etc., within the last 5 years of new graduates who specialized in industrial courses

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of number of job seekers</td>
<td>49.7%</td>
<td>51.9%</td>
<td>53.9%</td>
<td>57.5%</td>
<td>60.0%</td>
</tr>
<tr>
<td>Employment rate</td>
<td>93.1%</td>
<td>95.1%</td>
<td>96.4%</td>
<td>97.3%</td>
<td>97.5%</td>
</tr>
<tr>
<td>Ratio of job offers to applicants</td>
<td>3.1-fold</td>
<td>3.3-fold</td>
<td>3.7-fold</td>
<td>4.6-fold</td>
<td>5.3-fold</td>
</tr>
</tbody>
</table>
Acquisition of advanced qualifications through using experienced technicians

The Aichi Prefectural Okazaki Technical High School is aiming for acquisition of specialized technology and skills by promoting collaborations with universities and companies. The school is also making approaches toward cultivating manufacturing who have acquired qualifications based on national technical skill tests. In the 8-year period after 2000, 209 students passed the technical skill test (of which 33 passed the Level 2 test), and the school has achieved a pass rate of 83.3%.

Approaches in advanced courses

At the Iwate Prefectural Kurosawaijiri Technical High School, advanced courses for a 2 year program were established. The high school is putting a distinctive manufacturing education into practice, such as by implementing long-term internships, on-demand classes and practical courses using managers of local companies, welcoming lecturers from the Ichinoseki National College of Technology, and having students participate in classes at Iwate University and the Iwate Industrial Technology Junior College. The mechanics course is demonstrating great success—all of the 5 students have passed the Level 2 general lathe skills test, and they have all secured top positions in the preliminary round for Iwate prefecture in the International Youth Skill Olympics.

Manufacturing education in agricultural courses

At the Aichi Prefectural Atsumi Agricultural High School, approaches were made toward developing square melons based on the ideas of students. In 2007 the school obtained a patent for the cultivation method for the square melons through a joint collaboration with the local JA. In addition, through collaborations and cooperation with a technical high school and commercial high school nearby, they were able to produce and commercialize the mold.

Manufacturing education in home economics courses

At the Hyogo Prefectural Nishiwaki High School, production of traditional yarn-dyed fabrics, "banshu-ori," is being incorporated into studies, by making use of fabric supplied by a local trading company. In addition, the classes also touch upon cutting-edge technology and methods for increasing added value through the design and complex texture of "banshu-ori," and incorporate the development of unique designs and new cloth.
1. Manufacturing education in elementary, junior high, and high schools as well as special-needs schools

- Based on the fact that the Amended Fundamental Law on Education newly specifies that relevance to vocation and lifestyle is to be emphasized, and that an attitude that respects labour is to be taken, activities consisting of workplace experience were also newly prescribed in the new education guidelines.
- In addition to implementation of education relating to manufacturing in various subjects, etc. mainly in junior high schools, there is also enrichment of career education such as a workplace experience (the Career Education Project) that lasts for more than 5 days.
- Enrichment of science, technology, and mathematics education such as through the allocation of human resources to support observation and experiments, etc. for science in elementary schools is being carried out, as well as the development of curricula that place emphasis on science and mathematics in high schools.

### Approaches toward education on manufacturing in elementary schools, junior high schools, and high schools

<table>
<thead>
<tr>
<th>Elementary school</th>
<th>Art education</th>
<th>Making boxes, woodworking, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home economics</td>
<td>Making small objects using cloth, etc.</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>Making toys that move, etc.</td>
<td></td>
</tr>
<tr>
<td>Integrated learning time</td>
<td>Making kites, stilts, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Middle school</th>
<th>Technology/home economics</th>
<th>Construction of book stands and benches using wood materials, construction of models for robot contests, making shorts, creating simple programs using computers, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated learning time</td>
<td>Making Japanese paper, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High school</th>
<th>Various specialized subjects (industry, information, etc.)</th>
<th>(Industry) Classes such as machine shop, electric devices, building construction, engineering construction, ceramic chemicals, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special activities</td>
<td>Workplace experience (labor and production activities)</td>
<td></td>
</tr>
</tbody>
</table>

### State of implementation of workplace experience in junior high schools (implementation rate according to period)

- 1day
- 2days
- 3 days
- 4 days
- 5 days
- 6 days or more
Approaches by high schools toward becoming a "super science high school"

At the Tokyo Tech High School of Science and Technology, a robot contest in which 2nd-year students participate is held on campus every year. This contest has been designated by MEXT's "Super Science High School" program, and is carried out as part of practical education in a "science and technology" class, which is a developing subject. Every year, exciting competitions unfold during this contest.

For the students, the contest is a valuable experience in which they can enjoy the feeling of tension characterized by competition, as a preparation for participating in the robot contest when they become 3rd-year students.

Approaches toward operations to allocate people for supporting science at elementary schools

In Osaka, science classes that make use of MEXT's operations to allocate people for supporting science are expanding. In a class on "How Electromagnets Work," 6th-year elementary school students learned from a special lecturer how products that use "electromagnets" that can be found anywhere, such as tape recorders, are created in factories. Afterwards, the students challenged themselves in creating speakers using paper cups.

Approaches toward manufacturing education at special needs schools

At the Hyogo Prefecture Hikami Special Needs School, students with intellectual disabilities are using mill ends and thinned wood that are no longer necessary and supplied from a local lumber mill and carpentry shop to create garden tubs and log chairs.

As there are various kinds of work involved, such as husking wood materials using a chisel and mallet, processing the materials using a saw, and making holes and wood screws using electric tools, and the division of roles is carried out among the students according to the competence of each.
2. Manufacturing Education at Universities and Special Training Schools, Human Resource Development Based on Academia-Industry Partnership

- At universities, educational programs with the purpose of cultivating manufacturing engineers who possess both advanced knowledge and techniques, as well as long-term internships of high quality through academia-industry partnerships, are being promoted.
- At special training schools, practical vocational education is being implemented through collaborations with industry and business in various fields such as manufacturing, dressmaking/housekeeping, and health (food preparation, confectionary production, etc.)

**Approaches at universities**

At the Toyohashi University of Technology, a practical educational program with the theme of creating next-generation robots that can be used in our lives 10 years from now is being promoted, based on collaborations with nearby technical colleges, art universities, and local companies.

Students of various fields, such as integration, mechanism design, information technology, and product design, are working together in a structure where the technical college students and university students receive guidance from graduate students and local engineers, who serve as mentors, to create a prototype for a next-generation robot based on the students' own ideas and plans.

**Approaches at special training schools**

Centering on the Chiba Prefectural Association of Special Training Schools, an experience-oriented curriculum relating to vocational education was established for high school students at various special training schools in Chiba prefecture. Approaches were made to link studies to the development of a sense of working and to expand vocational awareness based on experience in manufacturing, such as development and customization of automobiles, architectural design using CAD, creation of architectural models, web design and programming, making clothes, practical training in sewing, etc.

The students remarked that "modeling and CAD training were fun," "the program got [them] to think about the future," and that "[they were] able to experience technology on-site, through listening to others talk."
3. Activities to Accelerate Understanding of Manufacturing at Social Education Facilities, etc.

| In addition to establishing classes on manufacturing, etc. at social education facilities such as museums, approaches to deepen an understanding of manufacturing are also being implemented through university extension courses and cultural activities, etc. |

**Approaches at social education facilities**

At the Chiba Museum of Science and Industry (Ichikawa city), various classes on industrial art, such as "Children's Classes at the Science Museum" and "Children's Fair at the Science Museum" are being held. In addition, opportunities for children to experience the joy of making objects and to stimulate their interest in science are being made available, through various events such as a "Science Festival for Youngsters," where children can experience industrial art and participate in a wide variety of experience at approximately 60 booths; a "Science Show," "experiment class" and "experience class" conducted through collaborations with companies, schools, and NPOs; "courses" and "lectures" that provide opportunities for students to come in contact with cutting-edge science through collaborations with universities and research institutes, etc.

4. Promotion of Various Activities Relating to Manufacturing Education

| Various approaches to promote manufacturing education are being implemented through various organizations, which are supported by MEXT |

"National Creation and Manufacturing Education Fair for Junior High School Students"

Hosted by the National Japanese Junior High School Technology and Home Economics Education Research Association and other organizations, at the 8th national fair held in January 2008 in Tsukuba, Ibaraki prefecture, contests such as "Go! Woodwork Skills' Champion," which is related to wood processing, the "Creative Ideas Robot Contest" related to electricity, machines, and control, "Ideas for Shorts to Keep for a Long Time," which is related to apparel production, and "Bento Contest For You," related to food preparation were held, and top participants were awarded prizes by the Minister of Education, Culture, Sports, Science and Technology.

In addition, at the venue, a corner for experiencing manufacturing (radio production, stone processing, etc.) and an exhibition booth (exhibition of a robot, etc.) were also set up, with the cooperation of companies and organization that agree with the concept of "manufacturing is people development, country development."
Section 3 Promotion of Research and Development for Strengthening Industrial Power

1. Research and Development of the Basic Infrastructure Relating to Manufacturing

- In order to strengthen the international competitive strength of Japan’s manufacturing industry, and to lead the world through manufacturing technology, research and development of manufacturing infrastructure technology based on science are being promoted.
- As manufacturing technology is inevitably linked to other fields, approaches linked to these fields are being promoted.

Fields promoted and fields promoted with priority in the Third Science and Technology Basic Plan (formulated in March 2006)

**Four priority fields to be promoted**
- Life sciences
- Information communication
- Environment
- Nanotechnology/materials

**Four fields to be promoted**
- Manufacturing technology
- Energy
- Social infrastructure
- Frontiers

Development and application of materials that can withstand ultrahigh temperatures

The National Institute for Materials Science developed material design technology that can predict microstructures and high-temperature characteristics of materials, and succeeded in developing ultra heat-resistance material using this technology. Application to jet engines that are environment-friendly, and high-efficiency power-generating gas turbines that contribute to reducing global greenhouse gases through a high melting point superalloy and a single-crystal superalloy that uses nickel as the main material is being promoted.
2. Promotion of R&D and Learning through the Application of Cooperation Among Industry, Academia, and Government

- In addition to promoting joint research between universities and companies, innovation is being generated through the activation of university intellectual property offices and TLOs as well as support for the formation of university ventures
- By promoting local science and technology and the passing on of research results to society through the construction of a local innovation system, an environment for creating manufacturing infrastructure technology is being developed

**Shifts in the number of joint researches implemented at universities, etc.**

**Shifts in the number of patents established by universities, etc.**

* National universities, etc., only before 2003; national, public, and private universities, etc., starting in 2003

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**Development of a prosthetic hip through joint research between universities and a company**

Based on the results of research by a university professor, Company A developed a prosthetic hip through the “Original Seeds Development Business” program (commissioned development), which was created by conducting alkaline treatment on titanium alloy followed by thermal processing and forming a titanate alkaline salt layer on its surface. It was confirmed in non-clinical studies using animals that when the treated metal is inserted into a living body, it takes in calcium ions and phosphate ions found in body fluids and bonds promptly and strongly with the body's bones.

The prosthetic hip that was developed is expected to contribute to improvements in the quality of lives of many patients who are suffering from hip problems.
Approaches to building local innovation systems (intellectual cluster creation program)

Nagano prefecture as a whole is aiming to form a cluster on a global level, by combining high-precision processing technology, which is the region’s strength, and the nanotechnology that Shinshu University possesses, and by strongly promoting joint research and development between industry, academia, and government through broad and international collaborations.

As one of the results of these efforts, the prefecture succeeded in realizing further high performance of electric double layer capacitors, for which there are high expectations as a means for storing electric energy. As output voltage can be maintained even under conditions where high currents flow through the addition of VGCF® (vapor grown carbon fiber), wide adoption of these capacitors, such as in hybrid vehicles and their use as a response to instantaneous power failures, etc., are expected.
Part 2  Measures and Policies Established in 2007 Relating to Promotion of Manufacturing Infrastructure Technology

1. Matters related to research and development of manufacturing infrastructure technology

Promotion, etc. of research and development relating to manufacturing infrastructure technology

(1) Establishment of an economic growth initiative
    In order to realize the "Japanese-style economic growth model," the "Economic Growth Initiative," which was put together by the government/governing party in July 2006, was revised with regard to measures and policies that should be taken up within the 10 years until the decrease in population becomes full-fledged in 2015. This promotes environmental development and research and development oriented towards the realization of new industries that can also contribute to the sophistication of the parts and materials industries that are necessary for further development of Japanese manufacturing, such as next-generation light-water reactors/the fast breeder reactor cycle, and next-generation environment-friendly aircraft, for which high reliability is desired in extreme situations.

(2) Tax system for promoting research and development (scale of tax cuts: 606 billion yen (in 2007))
    With regard to R&D activities carried out by companies, a tax credit system relating to the total amount of experiment and research costs [8 to 10% of the total amount] and a tax credit system relating to the increased amount of experiment and research costs [5% of increased amount] were established. The upper limit for tax exemptions is set to 20% of the amount of corporate taxes. (*) (1) 12% of special experiment and research costs for small and medium-sized companies and industry-academia-government collaborations, etc.
    (2) For the experiment and research costs that are subject to comparison, the conditions for applicability are such that with the averages of the last 3 fiscal years, the experiment and research costs for the current year are higher than those of the last 2 fiscal years. These are time dependent-measures that are applied for the fiscal year starting in the period up until March 31, 2008.

(3) Formulation of a technology strategy map
    In March 2005, a “technology strategy map” comprised of 20 fields was formulated. Afterwards, expansion of fields and reexamination of each field (rolling) have been carried out every year, and in April 2007, the “Technology Strategy Map 2007” was established in 25 fields.

(4) Consistent promotion of research and development programs (212.9 billion yen)
    In heading towards the realization of “a country founded on science and technology,” the “Research and Development Program” that promotes implementation, diffusion, and support of research and development results in an integrated fashion, centering mainly on life science, information communication, the environment, nanotechnology/materials—Four priority fields to be promoted—has been continued to be implemented, and the creation of innovation based on promotion of science and technology is also being encouraged.

(5) Carrying out thorough management of trade secrets and preventing leakage of technology
    As the contents of the Amended Unfair Competition Prevention Law (strengthening of penalties for encroachment of trade secrets, etc.) that was put into effect in January 2007 should be made widely known, explanatory meetings were held in 15 locations across Japan. In addition, in the “Research Group Concerning Proper Management of Technical Information,” various measures for properly managing technical information, etc. were comprehensively reviewed from the perspectives of maintaining and strengthening industrial competitive power and of safety guarantees.
Collaborations between manufacturing businesses and universities, etc.

(1) Partnership between industry and academia for human resource development

To create a positive growth cycle for collaborations between industry and academia for human resource development in Japan, the “Industry-Academia Partnership for Human Resource Development” was established in 2007, based on a collaboration between MEXT and METI, to provide opportunities for dialogues and actions relating to human resource development for both the academic and the industrial world.

(2) Career Gateway to Asia (3.05 billion yen)

In 2007, the “Career Gateway to Asia” program was initiated in order to promote expansion of opportunities for exceptional foreign students from Asia to find employment in Japan, and to contribute to human resource development on a scale that extends across Asia. Development and implementation support for a human resource development program that supports foreign students who wish to work at Japanese companies, from specialized education to Japanese language education, internships, and employment support, is being carried out through an industry-academia collaboration.

2. Matters related to securing manufacturing workers

Prevention of unemployment and other stabilities in employment

(1) Introduction of the Japanese version of a dual system (7.387 billion yen)

With regard to a Japanese version of a dual system for cultivating full-fledged professionals, approaches for private-sector education and training institutions, etc. were promoted through making a combination of practical training at companies and classroom lectures at education and training institutions that are closely related to these companies available to young people.

Development and improvement of vocational capabilities

(1) Vocational training for displaced workers and people looking to change jobs

While the employment situation continues to remain harsh, vocational training is being implemented by consigning training to various kinds of private-sector education and training institutions, such as special training schools, universities, NPOs, companies seeking workers, etc. in addition to public facilities for the development of vocational capabilities, in order to promote smooth reemployment of workers, including manufacturing workers, who were forced to leave their jobs.

(2) Tax policy that encourages investment in human resources 16 billion yen (in 2007)

With regard to companies that are actively making approaches to educate and train their employees, a measure where they can deduct a fixed percentage of the education and training costs from the amount of corporate taxes was established. Concretely, if the amount of education and training costs increased from the average amount of education and training costs for the previous 2 periods, the amount that is equivalent to 25% of the increased amount can be deducted from the amount of corporate taxes for the current period. For small and medium-sized companies, if the amount of education and training costs increased from the average amount of education and training costs for the previous 2 periods, they can select whether to deduct the amount obtained when multiplying the tax credit ratio (maximum of 20%) equivalent to 1/2 of the increase ratio for the total amount of education and training costs instead.
3. Matters related to cultivation of the manufacturing infrastructure industry

Promotion of Industrial Clusters, etc.

(1) Intellectual cluster creation program (phase I/phase II) (8.9 billion yen)
With an emphasis on the independence of autonomous bodies, approaches toward the creation of bases for research and development capacity (intellectual clusters), where relevant research institutions and R&D-type companies are concentrated around public research institutions, are being supported. In the intellectual cluster creation program (phase II) that started in 2007, the strengthening of the formation of clusters on a global scale is being promoted from the perspective of "selection and concentration."
In addition, support towards joint research with companies participating in METI's industrial cluster plan and universities in the regions in which the intellectual cluster creation program is being implemented was also carried out.

(2) Operation grant program for promoting regional company location (2.1329 billion yen)
Based on Corporate Location Promotion Law, the regions formulated a basic plan taking their own characteristics into consideration, and grants for approaches toward human resource development and activities to attract enterprises to the regions directed toward realizing the basic plan were carried out.

(3) Support related to industrial cluster plan (1.2 billion yen)
The industrial cluster plan outlines the development of a "seed bed" for innovation so that local medium-sized companies and small and medium-sized companies can form a network with universities and public research institutions, etc. and promote the generation of new businesses one after another. Currently, 18 projects are being promoted across Japan. Approximately 10,700 medium-sized/small and medium-sized companies that aim for the global market and approximately 290 universities (including technical colleges) have formed a broad network, and approximately 2,450 institutions and companies all over Japan, including public experiment and research institutions, financial institutions, and trading companies, are supporting the industrial clusters.

Cultivation of small and medium-sized companies

(1) Improvement of subcontracting transactions
i) In order to make subcontracting transactions more effective and efficient, a written survey was conducted for approximately 220,400 new businesses and subcontracting businesses, and on-the-site inspections of approximately 740 new businesses were implemented, based on the "Subcontract Proceeds Law." Taking the results of these surveys into consideration, guidance for improvements were given to approximately 9,600 businesses (of which 8 businesses were admonished) where a breach or possibility of breach of the Subcontract Proceeds Law was found. (The number of businesses indicated here are for those that were surveyed between April and December 2007.)
ii) From the perspective of making the Subcontract Proceeds Law better known, workshops on improving subcontracting transactions were also held for people in charge of outsourcing (procurement) at new businesses and subcontracting businesses.
iii) In addition to the above, the "Guideline for Promoting Appropriate Subcontracting Transactions, etc.," which incorporates examples relating to desired transactions between original contractors and subcontracting businesses, was established for 10 industry sectors in 2007 (including some non-manufacturing industries), in order to improve the productivity of medium and small-sized companies based on the government's "strategy for boosting growth capacity."
4. Matters related to promotion of studies concerning manufacturing infrastructure technology

Manufacturing education in education at schools

(1) Career Education Project (232 million yen)
   In order to cultivate a view of career and work in children, career education was promoted through building a local cooperative structure and implementing “Career Start Week,” a workplace experience project geared for junior high school students lasting for more than 5 days.

(2) Collaboration with specialized high schools and local industries for human resource development in manufacturing (358 million yen)
   MEXT and METI jointly implemented a program for developing human resources that support local manufacturing industries, through long-term training at companies and practical guidance at schools by corporate engineers, based on collaborations between specialized high schools and the local industrial world.

(3) ”Become a specialist (super specialized high schools)” (180 million yen)
   Support was given to specialized high schools promoting distinctive education incorporating the latest technology and skills while forming collaborations with universities and research institutes.

(4) Support for cultivating manufacturing engineers (150 million yen)
   The cultivation of manufacturing engineers who possess both advanced knowledge and technology that can reform the manufacturing field was supported through the development and implementation of educational programs based on a combination of experiments/practical training and lectures in collaboration with the local region and industry, which were made available to universities, junior colleges, and technical colleges.

(5) Plan for promoting vocational education through collaborations with special training schools and technical colleges (147 million yen)
   In addition to providing opportunities for high school students for various kinds of work experience such as through vocational experience workshops and introducing case examples of qualifications, skills, and knowledge related to employment by collaborating with special training schools and technical colleges, job consciousness and the motivation to study technology and skills that contribute to manufacturing were fostered by organizing vocational experience workshops, etc, for cultivating job consciousness in young people in various regions around Japan.

5. Necessary matters related to promoting other manufacturing infrastructure technology

(1) Monozukuri Nippon Grand Award (refer to first batch of attached articles)
   The second Monodzukuri Nippon Grand Award program, in which the Prime Minister hands out awards, was held (on August 10, 2007, 20 projects and 45 people were given awards; on December 17, 18 gold medalists from the International Skills Festival were given awards by the Prime Minister) for mid-level staff responsible for the core of manufacturing, skilled personnel who have supported traditional and cultural “techniques,” young people who are the seeds of future prosperity, and exceptional human resources from all generations, with the purpose of securing and developing human resources who support manufacturing at manufacturing sites and the traditional skills of experts, increasing the motivation of such people, and making their existence be widely known to society. In addition, various PR operations were carried out.