Summary of the White Paper on Manufacturing Industries
(Monodzukuri)

June 2014

Ministry of Economy, Trade and Industry (METI)
Ministry of Health, Labour and Welfare (MHLW)
Ministry of Education, Culture, Sports, Science and Technology (MEXT)
<Contents>

Part I  Current Status and Challenges of Manufacturing Infrastructure Technology

Chapter 1  Challenges that Japan’s Manufacturing Industry Faces and its Future [P 5]

Section 1  Current Status of Japan’s Manufacturing Industry

Section 2  Toward Strengthening the Competitiveness of Japan’s Manufacturing Industry

Section 3  Improvement of Earning Power Despite Changes in the Business Environment
Chapter 2  Fostering and Securing Manufacturing Human Resources which Support the Growth Strategy [p. 22]

Section 1  Challenges and Measures for Fostering and Securing Manufacturing Human Resources which Support the Growth Strategy

Section 2  Efforts for Fostering Manufacturing Human Resources which Support the Growth Strategy
Chapter 3  Education, Research and Development to Support the Foundations of Japan’s Manufacturing Industries [p. 35]

Section 1  Efforts by Universities (engineering), Colleges of Technology, Specialized Upper Secondary Schools, and Specialized Training Colleges to Foster Manufacturing Human Resources

Section 2  Enhancement of Japan’s Educational/Cultural Capacity to Foster Manufacturing Human Resources

Section 3  Promotion of Research and Development (R&D) to Enhance Industrial Strength
(i) Improvement of business performance in Japan’s manufacturing industry

- Compared with 2012, stock prices are rising, corporate profits are improving, and there is a growing movement towards raising wages. (trends towards a virtuous economic cycle) (Fig. 1).
- Production is expanding in tandem with the economic recovery. SMEs are also showing signs of improvement in their businesses (Fig. 2). The positive effects of Abenomics have been permeating into Japan’s manufacturing industry, which had long been forced into fierce competition.

[Fig. 1: Operating Profits of Major Companies]

<table>
<thead>
<tr>
<th></th>
<th>Consolidated operating profit (billions of yen)</th>
<th>Wage raise</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 automobile companies</td>
<td>1,632.9</td>
<td>3,230.2</td>
</tr>
<tr>
<td>4 electric companies</td>
<td>416.5</td>
<td>721.3</td>
</tr>
</tbody>
</table>

[Figure 2: Changes in Business Conditions by Company Size]

- EIKO Engineering Co., Ltd. (Kadoma City, Osaka) is a small company with only 11 employees (spring manufacturer).
- The company expanded its sales channel to automobile manufacturers and has successfully increased its business performance.
- At present, springs for automobiles sell well and the company decided to raise wages at the end of 2013 in order to properly share its profits with employees.
In the meantime, the surplus in the current account has continued to decrease for three consecutive years (Fig. 1). In particular, the largest ever trade deficit was recorded due to such reasons as an increase in imports of fossil fuels (Fig. 2).

The trade surplus of electrical equipment (the electronics industry) has decreased by around 80% since 2005. This is mainly due to the expansion of imports of communications equipment (especially mobile phones) and solar cells (Figs. 3 and 4).
Transport equipment (automobiles, etc.) maintains a trade surplus of around 14 trillion yen but falls short of making up for the diminished surplus in the electronics industry and expanding energy-related deficits (Fig. 1).

The yen is becoming weaker, but neither price reduction nor growth of export volume are notable (Fig. 2). Rather, automobile companies seem to secure profits by maintaining export prices of high-price models, which are expected to sell well irrespective of price levels.

Local production for local consumption has been advanced for low-price models and manufacturing bases have been relocated overseas. The number of low-price models to be exported is likely to decline in the future. In the meantime, the export of mid-price models has remained flat. It is expected that automobile companies would adopt a strategy to manufacture high-price models in Japan and expand exports thereof to developed markets (Fig. 3).

The export of automobiles with small engine capacity (mainly low-price models) has decreased.
There is a possibility that a weaker yen will not directly increase exports partly due to the negative effect of the overseas relocation of manufacturing bases (Fig. 1). However, exports are generally expected to increase in the future on such grounds as the recovery of overseas demand and the cultivation of new customers (Fig. 2).

There are further concerns over the possible shrinking of the domestic market, a decrease in the working-age population and labor shortage due to population decline from a falling birth rate (Fig. 3). It is hoped that the manufacturing industry will maintain its bases in Japan, increase per capita productivity, and manufacture high value-added products, thereby increasing earnings both inside and outside of Japan.

---

**Fig. 1: Changes in Ratios of Overseas Capital Investment**

<table>
<thead>
<tr>
<th>Year</th>
<th>General machinery</th>
<th>Electrical machinery</th>
<th>Transportation equipment</th>
<th>Iron and steel</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>55.9</td>
<td>50.8</td>
<td>44.4</td>
<td>42.1</td>
<td>50.4</td>
</tr>
<tr>
<td>2004</td>
<td>50.8</td>
<td>42.1</td>
<td>39.3</td>
<td>37.1</td>
<td>40.7</td>
</tr>
<tr>
<td>2005</td>
<td>40.7</td>
<td>37.1</td>
<td>39.3</td>
<td>39.1</td>
<td>44.4</td>
</tr>
<tr>
<td>2006</td>
<td>39.3</td>
<td>34.7</td>
<td>34.7</td>
<td>40.4</td>
<td>39.1</td>
</tr>
<tr>
<td>2007</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2008</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2009</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2010</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2011</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2012</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
<tr>
<td>2013</td>
<td>34.7</td>
<td>34.7</td>
<td>34.7</td>
<td>39.1</td>
<td>40.4</td>
</tr>
</tbody>
</table>

**Fig. 2: Forecast for Exports in the Coming Three Years**

- Decrease: 7.0, 9.9, 14.8
- Unchanged: 55.9, 50.8, 44.4
- Increase: 15.8, 42.1, 50.4

**Fig. 3: Changes in Labor Productivity in Major Industries**

* Per capita GDP by industry
Section 2  Toward Strengthening the Competitiveness of Japan’s Manufacturing Industry

(a) Improving and maintaining domestic production bases that support exports

- Triggered by increases in personnel costs in some emerging countries (such as China and Thailand) (Fig. 1), the significance of maintaining domestic manufacturing activities has come to be reevaluated.
- Companies have been showing their willingness to increase their domestic manufacturing capacity and otherwise expand domestic investment (Fig. 2).

**[Fig. 1: Concerns regarding Business in China]**

- Increase of labor cost
- Fierce competition with competitors
- Lack of legislative transparency
- Insufficient protection of intellectual property rights
- Uncertainties in public order and social conditions

**[Fig. 2: Forecast for Domestic Capital Investments in the Coming Three Years]**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>General Machinery</th>
<th>Electrical Machinery</th>
<th>Transportation Equipment</th>
<th>Iron and Steel</th>
<th>Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last fiscal year</td>
<td>(n=478)</td>
<td>(n=556)</td>
<td>(n=390)</td>
<td>(n=108)</td>
<td>(n=178)</td>
</tr>
<tr>
<td>This fiscal year</td>
<td>(n=503)</td>
<td>(n=524)</td>
<td>(n=444)</td>
<td>(n=125)</td>
<td>(n=195)</td>
</tr>
<tr>
<td>Increase</td>
<td>47.5</td>
<td>44.1</td>
<td>43.2</td>
<td>43.8</td>
<td>50.8</td>
</tr>
<tr>
<td>Unchanged</td>
<td>42.8</td>
<td>39.3</td>
<td>32.9</td>
<td>43.8</td>
<td>38.5</td>
</tr>
<tr>
<td>Decrease</td>
<td>29.3</td>
<td>17.7</td>
<td>17.9</td>
<td>43.2</td>
<td>18.0</td>
</tr>
</tbody>
</table>

* Last fiscal year: As of January 2013
This fiscal year: As of January 2014
While overseas business expansion is being promoted mainly for commodity items, the international division of labor is progressing, with the development and manufacturing of high value-added products being conducted at domestic bases and the development and manufacturing of commodity items at overseas bases (Fig. 1 and Fig. 2).

At domestic bases, high value-added products are manufactured and overwhelming productivity has been achieved (upgrading of domestic bases) through such means as (i) the optimal division of roles and cooperation between people and leading-edge equipment (such as robots), (ii) the utilization of industrial clusters in Japan, (iii) ensuring of proximity to the most advanced R&D functions, and (iv) early delivery in response to diverse customer needs (Fig. 3 on the following page).

---

**Honda Motor Co., Ltd.**: Established the world’s top class energy saving plant under the concept of “producing the world’s eco-friendliest products at the world’s friendliest plant” (Yorii-machi, Osato-gun, Saitama Prefecture). The plant started operation in July 2013.

**Olympus Corporation**: In December 2013, the company decided to invest a total of some 19.7 billion yen by FY2016 to expand the existing plant, with the aim of achieving a 30% increase in its production capacity of endoscopes, for which the company holds the top share in the global market.

**Japan Display Inc.**: The company has made a capital investment totaling some 200 billion yen to double the capacity of its major Mobara Plant (Mobara City, Chiba Prefecture) to manufacture high-performance, high-quality display for smartphones and tablet computers that are becoming widely used.

**Toshiba Corporation**: The company is planning to expand its Yokkaichi Plant (Yokkaichi City, Mie Prefecture) to increase production of NAND flash memory-related products for smartphones and tablet computers.
**Production base boasting overwhelming productivity achieved by innovation of processes**

<Glory Ltd.>* Manufacturer of money handling machines and systems

- The company established a **high-variety low-volume production** system under which people and compact **humanoid robots cooperate with each other**, achieving 80% automation and nearly quintupling labor productivity.
- Cross-trained workers are **adopted in high-mix low-volume assembly lines**, where slowness in operation is ignored.

**R&D base that is expected to create ripple effects on domestic and overseas bases**

<Komatsu Ltd.>

- In October 2013, the company established the Production Technology Development Center at its Osaka Plant, with the aim of **developing and improving production technology based on an optimal division of labor between machinery and people**, while promoting collaboration with the design department and the production site within the premises, and spreading the results thereof to **other domestic and overseas bases**.
- The company is making efforts for the development of welding robots and simulation technology for heat treatment and processing, which will contribute to the reduction of cost and time.

**Manufacturing in cooperation with suppliers in peripheral industries**

<Daikin Industries, Ltd.>

- Although the air conditioner sector has been facing difficulties in continuing domestic production, the company aims to develop overseas markets and is successfully **manufacturing high value-added products at a low cost by taking advantage of the industrial clusters in Japan and involving suppliers in various industrial sectors**.

**Early delivery in response to diverse customer needs**

<Fujitsu Limited>

- Shimane Fujitsu, which produces two million PCs annually, takes advantage of its **high productivity, high quality and quick delivery times** and endeavors to respond to **diverse customer needs** under its **high-variety low-volume production** system.
- The company has moved toward greater automation by utilizing general-purpose robots, while aiming to achieve collaboration between people and machinery, and has succeeded in **reducing the number of personnel for production to one-tenth** of that in China.
In order to secure such positive trends as the expansion of domestic investment and efforts for upgrading domestic production bases, it is required to create new markets (such as a market for robots that are expected to be utilized broadly in industries and in the medical/nursing care and other wide-ranging fields, and a market for regenerative medicine whose commercialization is highly expected) and to improve Japan’s competitiveness in attracting business.

Furthermore, (i) measures against relatively high energy costs, (ii) the promotion of economic partnerships, and (iii) discussions on the issue of effective corporate tax rates (Fig. 1) are required.

[Column] Assistance for energy-intensive industries that have supported the foundation of manufacturing in Japan

Kokoku Steel Casting Co., Ltd. (Yodogawa Ward, Osaka) is a steel casting manufacturer founded in 1941. The company has obtained trust with its capability to manufacture tough steel castings of diversified complicated configurations and achieve quick delivery thereof.

At present, the company faces the issue of high electricity costs, which account for 10% or more of total sales.

Measures to reduce energy costs need to be taken in order to assist such SMEs that, like this company, possess high levels of skills and have long bolstered the foundation of manufacturing in Japan.

The government will offer support also for small-scale investments that are expected to attain high energy saving effects so that SMEs can proactively invest in energy saving equipment.

---

[Fig. 1: International Standards of Effective Corporate Tax Rates]

<table>
<thead>
<tr>
<th>Corporate tax rates</th>
<th>2000</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>Approx. 33%</td>
<td>25.32%</td>
</tr>
<tr>
<td>Asia</td>
<td>Approx. 28%</td>
<td>22.47%</td>
</tr>
<tr>
<td>Japan</td>
<td>42%</td>
<td>38.01% – 35.64% (April 2014–)</td>
</tr>
</tbody>
</table>


“Based on the Outline of the 2014 Tax Reform Proposals released by the ruling parties on December 12, 2013, we will discuss means to secure revenues through the expansion of the taxation base and revenue increases from other tax items, verify policy effects such as the correlation between corporate activities and the reduction of effective corporate tax rates amid changes in industrial structures and the business environment, from the perspective of ensuring the neutrality of the tax system and achieving sound public finance as part of measures for improving Japan’s economic competitiveness. At the same time, we will discuss the issue of effective corporate tax rates in collaboration with the Tax Commission.”
(b) Fostering new exporters

- In Germany, SMEs are contributing to exports significantly (the percentage of SMEs exporting goods or services is about 3% in Japan, but about 19% in Germany). Japan also needs to encourage a broader range of companies, not limited to large companies, to earn profits through exporting goods or services.
- The government has to offer support to companies at the top of the global niche markets that focus on export but also needs to broadly cover domestic supply chains (Fig. 1), and to assist in the creation and development of venture companies in the manufacturing industry (Fig. 2), for the benefit of the whole nation, including local economies, targeting small business operators, medium-sized companies, and SMEs as well.

[Fig. 1: New Exporters (i)
(companies at the top of global niche markets)]

[Characteristics of companies at the top of global niche markets]
(i) Large share in global markets in specialized fields: Global market share is 59.6% on average.
(ii) High profitability: Average operating profit on sales is 10.7% on average (the average for the manufacturing industry as a whole is 2.9%).
(iii) Strategic business operations: Capture information on customer needs through joint development with customers and strategically utilize intellectual property, such as patents.
(iv) Internationalism: Foreign sales ratio is 45.1% on average.

<Spiber Inc. (Tsuruoka City, Yamagata)>
- A bio-venture company started at Keio University’s Institute for Advanced Biosciences
- The company also collaborates with auto-parts manufacturers outside the region, with the aim of promoting the utilization of a synthetic fiber it has developed based on the composition of spider silk.
- The new fiber is lightweight but strong, and is more elastic than nylon.

[Fig. 2: New Exporters (ii)
(venture companies in the manufacturing industry)]

<Spiber Inc. (Tsuruoka City, Yamagata)>
- A bio-venture company started at Keio University’s Institute for Advanced Biosciences
- The company also collaborates with auto-parts manufacturers outside the region, with the aim of promoting the utilization of a synthetic fiber it has developed based on the composition of spider silk.
- The new fiber is lightweight but strong, and is more elastic than nylon.

Challenges faced by venture companies in the manufacturing industry
- Personnel: Lack of challenging personnel and managerial personnel who manage risks and make business judgments
- Funds: Shortage of direct finance to take risks in the medium and long terms
- Collaboration: Need to make collaboration with large companies, etc. to make up for a low profile, etc.

<Koyo Engineering Co., Ltd. (Sakai City, Osaka)>
- Ratchet gears for legless chairs and sofas
- The company manufactures ratchet gears that make it possible to freely adjust the angle of the back of a legless chair or sofa (global market share: 30%). The company obtained an international patent with its core technology and has strictly fought against infringement of the patent right by foreign counterfeit products.

Challenges faced by companies at the top of global niche markets
Lack of personnel for cultivating sales channels, securing of funds for R&D activities, and countermeasures against counterfeit products

[Column] Venture home appliance company competing in global niche markets
- Cerevo Inc. is a venture home appliance company with 13 employees. The company develops core components for satisfying customer needs, while procuring general components from other companies.
- The company ascertains global niche markets through the use of SNS and promptly launches products with functions focusing on niche-market needs in various countries.
(c) Bringing in global demand and promoting the capitalization of earnings from overseas in order to maintain the current balance

- The flow of investment and production overseas is inevitable mainly for mass production models (such as general purpose home appliances and motorbikes) for the volume zone in order to acquire emerging markets.
- It is also necessary to increase the surplus in the current account by decreasing the deficit in the services account through the expansion of the surplus in the income account (Fig. 1) and through an increase in investment earnings (Fig. 2) as a result of overseas business expansion in the manufacturing industry.

[Fig. 1: Changes in Income Balance]

Overseas business investments are expanding.

[Fig. 2: Changes in Loyalty Earnings from Intellectual Property Rights, etc.]

<table>
<thead>
<tr>
<th>Column</th>
<th>Risks involved in overseas business operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMEs are also expanding business overseas, however, they need to be aware of risks unique to foreign countries, such as upsurge of personnel costs and the emergence of counterfeit products.</td>
</tr>
<tr>
<td></td>
<td>There is also a risk of withdrawal, the possibility of which is not usually taken into account at the time of commencing business overseas. It is important, for example, to prepare a business plan that clarifies conditions for withdrawal in advance and review it on an ongoing basis.</td>
</tr>
</tbody>
</table>

<Case where withdrawal caused large expenses>
A plant closure triggered a strike and the company ended up in paying a large amount of retirement allowances. Furthermore, the company was forced to undergo investigations on overtime pay and taxes by the tax authorities and it took one year to settle everything after withdrawal.

<Case where a company gave up withdrawal due to the high transfer price>
Although the company intended to transfer its subsidiary to a third party, the transfer price became too expensive due to high retained earnings of the subsidiary and the company could not find a purchaser.

[Fig. 3: Barriers Hindering Return of Profits to Japan]

- The public and private sectors need to cooperate to eliminate various barriers, such as regulations and tax systems in foreign countries, so as to ensure that wealth acquired through accelerating overseas business expansion will reliably return to Japan for domestic investment (Fig. 3).

- China and Thailand are typical examples of a country with barriers that hinder Japanese companies from bringing back their profits to Japan.
- Major causes are strict regulations on money transfer and royalties.
(a) Building profitable business models

- There is a possibility that supply chains may change due to the introduction of new digital manufacturing methods (such as 3D printers) and the advancement of modularization. Polarization between high value-added fields and low value-added fields is observed. There is also a move to facilitate connection among companies in supply chains.
- New digital manufacturing methods (Fig. 1) are being introduced. At present, development of samples and other prototypes is highlighted, but it is expected that this technology will be utilized broadly in medical fields and aircraft-related fields in the future.
- This technology is expected to (i) make it possible to reduce the time required for trial production (innovation in processes) and to form complicated objects (innovation in products), and to (ii) enable a wider range of entities, including individuals, to manufacture goods.
- However, at present, Japan lags behind Western countries in this field (Fig. 2). We need to foster personnel and promote development of fundamental technology integrating hardware, software, and raw materials.

[Fig. 1: Economic Ripple Effect from the Introduction of Digital Manufacturing Methods (3D Printers, etc.)]

Direct markets for devices, raw materials, etc. [1.0 trillion yen]

Related markets [10.7 trillion yen]: Markets for products manufactured using additive manufacturing technology

Innovation in productivity [10.1 trillion yen]: Streamlining manufacturing processes, etc. using additive manufacturing technology

[Fig. 2: Global Market Share Based on Cumulative Shipments of 3D Printers]

Global Market Share Based on Cumulative Shipments of 3D Printers

<table>
<thead>
<tr>
<th>Country</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>71.2%</td>
</tr>
<tr>
<td>Japan</td>
<td>3.3%</td>
</tr>
<tr>
<td>Europe</td>
<td>11.5%</td>
</tr>
<tr>
<td>China</td>
<td>3.5%</td>
</tr>
<tr>
<td>Israel</td>
<td>10.0%</td>
</tr>
<tr>
<td>Others</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Share based on cumulative shipments (1988 to 2012) of 3D printers whose sales prices are no less than US$5,000 (Source) Wohlers Report 2013

[Column] Complicated objects formed with 3D printers (heart simulator)

- Cross Effect Inc. (Kyoto City, Kyoto) has developed a precision heart simulator with realistic texture and strength in medicinal-engineering field collaboration.
- Three-dimensional heart models created with 3D printers are made of ultra-soft resin and can be used for surgery training for cardiac surgeons. Highly-accurate pre-surgery simulation has become possible and it significantly contributes to the success of extremely difficult surgeries.
- This is an ideal example of an SME succeeding in advancing into the high value-added medical field by utilizing 3D printers.
Changes in business styles mainly in the automobile industry are leading to the advancement of modularization in fields unrelated to brand value. These moves have been caused by the need to achieve diversification of models and cost reduction at the same time under intensifying global competition and by an increase of the ratio of electronic components (Fig. 1), and may change the structure of supply chains.

In modularized sectors, individual lot orders of components will become larger and this may facilitate the emergence of mega component suppliers. Therefore, companies need to properly select sectors to be modularized and those not, while assessing investment risks, etc. (Fig. 2).

Advantage of modularization
(i) The number of types of components decreases and efficient multiproduct production will become possible beyond brands and classes.
(ii) As components are made common, plant lines and fixtures can be shared for manufacturing multiple types of products.

Disadvantage of modularization
(i) As components are made common, order lots become larger and orders are intensively placed with mega suppliers, which may intensify price competition among suppliers.
(ii) When there is any defect in a specific component, the number of products to be recalled may become tremendous.
(iii) Differentiation of completed products may become difficult.
Amid structural changes in supply chains, Japan should create more profitable supply chains, while maintaining a solid, productive base of SMEs and leading medium-sized enterprises that constitute Japan’s fundamental driving force of manufacturing.

For that purpose, the development of infrastructure to offer support (support for overseas business expansion with an eye on enhancement of collaboration within supply chains and strengthening of export capacity) is required. Japan needs to shift from the conventional practice under which large companies in the downstream industry basically foster companies in their supply chains and public support organizations offer support to make up for deficiencies.

<table>
<thead>
<tr>
<th>Changes in environment faced by companies</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overseas business expansion of major manufacturers of finished products and changes in product specifications</td>
<td>Shift to, or commencement of business in different or new fields</td>
</tr>
<tr>
<td>Advancement for responding to changes in the environment</td>
<td>Enhancement of added value</td>
</tr>
</tbody>
</table>

### Industry-academic-government R&D assistance for recognizing needs of downstream companies

**<Hiroshima Industrial Promotion Organization>**

In response to the advancement of electronics in the automobile industry, Hiroshima prefectural government has taken the initiative in fostering core Tier 1 companies (primary subcontractors) and assisting their matching with Tier 2 companies (secondary subcontractors) or others as well as with universities. Furthermore, the prefectural government assists business expansion outside of Hiroshima Prefecture or to industries other than the automobile industry.

### Achieved a breakthrough as a company in the prototyping industry, which does not depend on downstream industries

**<Kyoto Prototyping Platform>**

Achieved a breakthrough as a company in the prototyping industry, which does not depend on downstream industries. SMEs gather and cooperate to provide prototyping services at overwhelming speed by taking advantage of processing technologies, such as pressing and sheet metal forming, resin treatment, and surface treatment, that each enterprise possesses. Small enterprises also participate in prototyping services for medical equipment components and this platform succeeded in expanding sales channels.

### Foster human resources required for new business fields

**<Hamamatsu Embedded System Technology Consortium (Hamamatsu City, Shizuoka)>**

Shizuoka University and Hamamatsu City cooperate to provide education on software engineering and control engineering to employees of local companies, including small business operators, and have produced engineers in these fields.

### Established a global brand

**<Shikoku Towel Industrial Association and Imabari Chamber of Commerce>**

Against increased import of cheap towels from China, the association commenced Imabari Towel Project, under which they established quality standards and are carrying out media promotion and training of personnel who can advertise the quality of Imabari towels to consumers, and has successfully expanded sales channels to European and other foreign countries.

---

**[Fig. 1: Response to Structural Changes of Supply Chains]**

<table>
<thead>
<tr>
<th>Changes in environment faced by companies</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overseas business expansion of major manufacturers of finished products and changes in product specifications</td>
<td>Shift to, or commencement of business in different or new fields</td>
</tr>
<tr>
<td>Advancement for responding to changes in the environment</td>
<td>Enhancement of added value</td>
</tr>
</tbody>
</table>
With products themselves losing added value (Fig. 1), there is a limit to business depending only on the manufacturing of goods. It is necessary to build a profitable business model (Fig. 2) from the perspectives of taking measures within supply chains and responding to consumers, such as through combining manufacturing with the provision of services or implementing joint development activities with consumers, in order to ensure sources of value creation. An intellectual property strategy, such as the open/close strategy to tactfully disclose intellectual property (opening) or keep it confidential and claim rights thereon (closing), is also important in devising new business models (Fig. 3).

**[Fig. 1: Manufacturing Competitiveness Index]**

* Calculated together with profit ratios and sales amount shares
(Source) Japan Machinery Center for Trade and Investment

**[Fig. 2: Examples of the Classification of Business Models]**

<table>
<thead>
<tr>
<th>Increase added value of conventional products</th>
<th>Acquire market needs and seeds of new technology through reform of the design process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enhance conventional products by integrating new technology fields</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increase added value by adopting new sales methods</th>
<th>Provide a new platform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expand customer targets, change the conventional sales form, and adopt a branding strategy</td>
</tr>
</tbody>
</table>

**Innovative production method in response to market needs**

**<YSP Inc.>**
The company is small, with only 12 employees, but has developed an innovative soy milk and tofu processing machine, which can produce high value-added products while reducing production time to 20 minutes, less than one-twentieth of the time previously required.

**Advancement of business systemization and packaging in emerging countries**

**<Olympus Medical Systems Corp.>**
With the aim of domestically manufacturing endoscopes that are less of a strain on patients during surgery and marketing them in emerging countries, the company established a training center for local doctors and technicians in Beijing and Shanghai to sell equipment and offer services in an integrated manner.

**Branding strategy**

**<Fukuda Metal Foil & Powder Co. Ltd.>**
The company was founded as a gold and silver foil and powder wholesaler in 1700 and has achieved growth by utilizing its specialized manufacturing technology based on traditional arts in new fields of the day. At present, metal foil and powder produced by the company are indispensable as functional materials in a wide range of industries, such as for producing electronic equipment and batteries, etc.

**[Fig. 3: Open/Close Strategy]**

A digital camera manufacturer has standardized file formats, etc., thereby increasing consumer convenience. In the meantime, the company conceals its superior technologies for image processing circuits, lenses and other parts, and has successfully increased production volumes and maintained its world market share.
It is indispensable for relevant ministries and agencies to cooperate to train human resources broadly not limited to conventional sites of manufacturing. It is necessary to train and ensure sufficient numbers of (i) personnel who lead innovation in such areas as production techniques and market strategies, (ii) skilled workers working with a proper division of roles between machinery and people, and (iii) managerial personnel (executives) who can enhance corporate value through overseas business expansion and M&As and in other ways, depending on the aptitude of each individual.

**Fig. 1: Relevant Ministries and Agencies Jointly Train Personnel to be Engaged in Manufacturing**

<table>
<thead>
<tr>
<th>Elementary and secondary education</th>
<th>Higher education</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEXT</strong></td>
<td><strong>MEXT</strong></td>
<td><strong>MEXT</strong></td>
</tr>
<tr>
<td><strong>Specialized upper secondary schools</strong></td>
<td>Universities (engineering)</td>
<td><strong>MEXT</strong></td>
</tr>
<tr>
<td>- Mainly in science, technology and home economics, education on manufacturing is provided based on the characteristics of each subject.</td>
<td>- Practical engineering education is provided in collaboration with industry.</td>
<td></td>
</tr>
<tr>
<td><strong>Colleges of technology</strong></td>
<td><strong>MEXT</strong></td>
<td><strong>MEXT</strong></td>
</tr>
<tr>
<td>- Professional and practical technology education is provided in five-year courses prioritizing experiments and practices.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Specialized training colleges</strong></td>
<td><strong>MEXT</strong></td>
<td><strong>MEXT</strong></td>
</tr>
<tr>
<td>- Efforts are being made to improve students’ practical and professional knowledge and skills in collaboration with local industry.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Training for graduates (Polytechnic Universities, etc.)</strong></td>
<td><strong>MHLW</strong></td>
<td><strong>MHLW</strong></td>
</tr>
<tr>
<td>- Foster technician engineers who have advanced knowledge and skills/technologies sufficient for responding to technological innovation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Foster future leaders of production technology and production management sectors who can develop new products and build new production processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Career education</strong></td>
<td><strong>MEXT</strong></td>
<td><strong>MHLW</strong></td>
</tr>
<tr>
<td>- Education to develop each student’s basic ability and attitude necessary for achieving social and vocational independence, thereby encouraging career development</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vocational education</strong></td>
<td><strong>MEXT</strong></td>
<td><strong>MHLW</strong></td>
</tr>
<tr>
<td>- Education to develop each student’s knowledge, skills, ability and attitude necessary for engaging in certain or specific vocation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Monodzukuri Meister System</strong></td>
<td><strong>MHLW</strong></td>
<td><strong>MHLW</strong></td>
</tr>
<tr>
<td>- Practical instruction, etc. is provided to young skilled workers and students at SMEs and lower secondary or industrial high schools, with the aim of handing down skills effectively and fostering successors in manufacturing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Monodzukuri Nippon Grand Award</strong></td>
<td><strong>MHLW</strong></td>
<td><strong>MHLW</strong></td>
</tr>
<tr>
<td>- This award is to recognize outstanding individuals in various generations engaged in monodzukuri (manufacturing), such as core personnel who are playing central roles in production sites, highly skilled personnel who have supported traditional and cultural skills, and young personnel who are expected to lead the future.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Retraining for adults**
- Universities, graduate schools, professional training colleges, etc. cooperate with industry and develop and implement custom-made vocational education programs with the aim of fostering professional personnel and core personnel.
- Scholarship systems are flexibly operated for assisting the retraining of young people and adults.
- Enhanced education/training benefits are granted for education and training that may contribute to medium- and long-term career development of workers, such as young non-regular workers (since October 2014).

**Public vocational training (Polytechnic Centers, etc.)**
- Training in the field of manufacturing that will be helpful for re-employment is provided to displaced workers.
- For those working at present, advanced training in the field of manufacturing is provided so that they can acquire specialized knowledge and skills/technologies for responding to diversification and advancement of their duties.

**Accredited vocational training**
- A small and medium-sized business operator that provides vocational training accredited by the relevant prefectural governor as satisfying certain standards is eligible to receive subsidies when it provides such training satisfying the relevant standards.

**The Career Development Promotion Subsidy**
- (Training for dealing with policy issues: HRD for skilled workers or skill’s inheritance Course)
  - Subsidies are granted for accredited vocational training and other vocational training for strengthening skilled workers’ leadership and for handing down skills.

**National Trade Skill Test System**
- This is a system to examine and certify workers’ skills based on certain criteria and has worked to motivate workers to acquire higher skills in various fields, including manufacturing.

**Efforts to convey the attractiveness of manufacturing (promotion of skills)**
- Efforts are being made to raise the general public’s awareness to respect skills through granting awards to excellent skilled workers and holding competitions for various skills.
Enhanced utilization of women and elderly people is important under circumstances where population aging and birthrate decline are expected to progress steadily and productive population will further decrease.

[Column] Introduction of IT and standardization enable female workers without specialized knowledge to play active roles in the workplace

- Iguchi Issei Co., Ltd. (Chiyoda Ward, Tokyo), which processes components of office automation equipment, has established a standardized production system utilizing IT.

- For example, the company clarified the implicit knowledge of skilled engineers, and taking into account accumulated processing technology, it built a database on the physical properties of materials. Thanks to such efforts, even female workers without specialized knowledge now can operate processing machines.

[Column] Retired personnel play active roles in SMEs that expand business overseas

- JETRO dispatches, as specialists, people who have retired from large enterprises or other experienced personnel to SMEs that plan to expand business in emerging countries, and have them support SMEs’ establishment of local bases.

- Retired personnel with experience and human networks, mainly those previously engaged in the manufacturing industry, have been dispatched to companies intending to start business in such countries as Thailand, Viet Nam, and Indonesia (165 people were dispatched in FY2012).

[Column] Create roles for women to help them work comfortably

- Tenhiko Industrial Co., Ltd. (Suminoe Ward, Osaka City) is a small and medium-sized enterprise with 39 employees that engages in processing and sale of special steel.

- The company formulated an online international sales team consisting of female workers, “Tenhiko Web Sales (TWS),” with the aim of offering opportunities for female workers with good English communication skills after returning from childcare leave. Thanks to the team, overseas sales doubled in two years.

- Male workers offer full support to female workers who lack sales experience, with regard to transaction rules and knowledge on special steel.

- [Pie chart showing age distribution of the workforce.]

- [Pie chart showing industry distribution of the workforce.]

- [Pie chart showing gender distribution of the workforce.]

- [Pie chart showing education distribution of the workforce.]

- [Pie chart showing occupation distribution of the workforce.]

- [Pie chart showing marital status distribution of the workforce.]

- [Pie chart showing employment status distribution of the workforce.]
As global competition has been intensifying, Japanese industry needs to enhance productivity by effectively utilizing managerial resources in the economic society of the nation as a whole. In order to deal with these issues flexibly, it is indispensable to visualize changes in the value chain (a flow to generate added value consisting of such processes as development, manufacturing, sales and services) and develop infrastructure that enables flexible recombination of limited managerial resources. The introduction of IT not only increases the efficiency of managerial resources but also maximizes their effect (Fig. 1). Business restructuring is a means to utilize managerial resources effectively among companies (Fig. 2).

![Fig. 1: Objectives of IT Investment](image)

**Objectives are mainly cost reduction and streamlining. Companies are relatively less aware of the use of IT for providing high value-added products.**

![Fig. 2: Important Issues Before and After M&A](image)

**Table: Important Issues Before and After M&A**

<table>
<thead>
<tr>
<th>Important issues before M&amp;A</th>
<th>Important issues after M&amp;A</th>
</tr>
</thead>
<tbody>
<tr>
<td>・Decision making and managerial judgments by the top management</td>
<td>・Consolidation of corporate cultures</td>
</tr>
<tr>
<td>・Establishment of visions and strategies for M&amp;A</td>
<td>・Consolidation of personnel systems, wage systems and other organizational structures</td>
</tr>
<tr>
<td>・Shortage of personnel and lack of organizational system for promoting M&amp;A</td>
<td></td>
</tr>
</tbody>
</table>

![Column] Business restructuring by integrating the strengths of different companies

◆ In February 2014, Mitsubishi Heavy Industries, Ltd. and Hitachi Ltd. established a new company by merging their power generation-related business, which was one of their major business sectors whose sales accounted for over 80% and 60% of the total, respectively.

◆ They integrated the strengths of different companies, that is, Mitsubishi’s sales channel for large turbines in Southeast Asia and Hitachi’s sales channel for mid and small turbines in Europe, etc.

◆ They utilized the tax breaks for promoting business restructuring.
Section 1 Challenges and Measures for Fostering and Securing Manufacturing Human Resources which Support the Growth Strategy

1. Necessity of Manufacturing Human Resources which Support the Growth Strategy

In order to realize a virtuous economic cycle led by the growth strategy, both companies and workers need to adapt to structural changes.

(a) It is important for companies in the manufacturing industry to advance into growth fields and for manufacturing workers to strive to enhance their capacities by acquiring new skills.

(b) The manufacturing industry is prone to concentration in certain regions, but it is losing workers. For the purpose of supporting the growth strategy, it is important for manufacturing industries to foster local human resources (Fig. 2-1 and Fig. 2-2).

[Fig. 2-1: Number of Employees Engaged in Manufacturing]

[Fig. 2-2: Changes in Knowledge and Abilities that are Considered Important]

Source: “Labour Force Survey,” Ministry of Internal Affairs and Communications

(Sources) “Survey on New Business and Human Resource Development in the Monodzukuri (Manufacturing) Industry,” conducted by the Japan Institute for Labour Policy and Training (2013) (All graphs in this Chapter are extracted from this survey.)
According to a recent survey, around 45% of manufacturing companies with 30 or more employees are trying to develop new lines of business (this includes companies that have made such efforts previously and those merely considering the possibility; the same applies hereinafter) (Fig. 2-3). These companies are developing new lines of business in new fields, such as new energy and environmental technology, health, medicine, or welfare, or next-generation automobiles, in accordance with the growth strategy (Fig. 2-4).

(i) Details and fields of new lines of business

Around 65% of companies developing new lines of business have experienced significant technological changes (Fig. 2-5).

They are making various efforts to integrate and apply new technologies through learning at in-house study sessions, partnerships with academia or involvement with research institutions (Fig. 2-6).
Many companies developing new lines of business consider training for acquiring broad knowledge concerning multiple technologies and skills, training for acquiring specialized knowledge corresponding to new technologies, and training for acquiring skills necessary for processing new products to be necessary for full-time technical employees. However, they often fail to provide this training despite their awareness of its necessity (Fig. 2-7).

The most common issue in developing new lines of business is difficulty in finding personnel capable of managing the new businesses (Fig. 2-8).

### Fig. 2-7: Required Training and Training Actually Provided (multiple answers)

<table>
<thead>
<tr>
<th>Training Type</th>
<th>Required</th>
<th>Actually Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training for acquiring broad knowledge of multiple technologies and skills</td>
<td>44.5</td>
<td>57.0</td>
</tr>
<tr>
<td>Training for acquiring specialized knowledge concerning new technologies</td>
<td>43.5</td>
<td>30.2</td>
</tr>
<tr>
<td>Training for acquiring skills necessary for processing new products</td>
<td>32.5</td>
<td>24.3</td>
</tr>
<tr>
<td>Training for acquiring knowledge and capacity for streamlining production processes</td>
<td>39.4</td>
<td>14.2</td>
</tr>
<tr>
<td>Training concerning the operation of newly introduced manufacturing equipment</td>
<td>31.6</td>
<td>25.7</td>
</tr>
<tr>
<td>Training for cultivating communication skills</td>
<td>20.9</td>
<td>7.8</td>
</tr>
<tr>
<td>Training for acquiring capacity for designing and development</td>
<td>26.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Training for cultivating leadership at workplaces</td>
<td>22.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Other</td>
<td>0.9</td>
<td>8.9</td>
</tr>
<tr>
<td>There is no training required in particular</td>
<td>1.0</td>
<td>6.0</td>
</tr>
<tr>
<td>No answer</td>
<td>5.9</td>
<td>5.9</td>
</tr>
</tbody>
</table>

### Fig. 2-8: Issues in Developing New Businesses (multiple answers)

<table>
<thead>
<tr>
<th>Issue</th>
<th>Required</th>
<th>Actually Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty in finding prospective businesses</td>
<td>40.7</td>
<td>23.3</td>
</tr>
<tr>
<td>Lack of ability to gather information</td>
<td>23.3</td>
<td>35.3</td>
</tr>
<tr>
<td>Lack of product development/planning capability</td>
<td>7.7</td>
<td>15.6</td>
</tr>
<tr>
<td>Difficulty in securing business tie-up partners</td>
<td>15.6</td>
<td>32.5</td>
</tr>
<tr>
<td>Risk of being distracted from existing businesses</td>
<td>16.6</td>
<td>41.2</td>
</tr>
<tr>
<td>Lack of knowledge and know-how concerning the operation of new businesses</td>
<td>10.6</td>
<td>22.4</td>
</tr>
<tr>
<td>Difficulty in securing personnel who take charge of new businesses</td>
<td>4.8</td>
<td>9.7</td>
</tr>
<tr>
<td>Lack of fund</td>
<td>16.6</td>
<td>No answer</td>
</tr>
<tr>
<td>Difficulty in raising of fund</td>
<td>9.7</td>
<td>No answer</td>
</tr>
<tr>
<td>Difficulty in cultivating and securing purchasers</td>
<td>22.4</td>
<td>No answer</td>
</tr>
<tr>
<td>Difficulty in securing stable suppliers</td>
<td>6.2</td>
<td>No answer</td>
</tr>
<tr>
<td>Barrier to entry into new business fields</td>
<td>6.1</td>
<td>No answer</td>
</tr>
<tr>
<td>Other</td>
<td>2.1</td>
<td>No answer</td>
</tr>
<tr>
<td>There is no problem in particular</td>
<td>10.6</td>
<td>4.8</td>
</tr>
<tr>
<td>No answer</td>
<td>4.8</td>
<td></td>
</tr>
</tbody>
</table>
Such policies may include the following.

(a) Enhanced training subsidies for business operators
   Under The Career Development Promotion Subsidy, subsidies are granted to business operators who have provided training to foster human resources in growth fields, such as health and environmental technology. Further efforts for publicizing this subsidy are required.

(b) Promotion of skill transfer from skilled workers to young technicians
   Under the Monodzukuri Meister System, skilled workers (Meisters) are dispatched to train young workers. The system must be improved by registering a larger number of Meisters.

(c) Training which responds to the needs of companies developing new lines of business
   The vocational training provided by Polytechnic Centers and other entities needs to be improved by enhancing the curricula in response to various needs.

(d) Improvement of vocational ability evaluation, which is significant in fostering human resources
   It is necessary to review and improve the current National Trade Skill Test System.

[Column] Advancing into growth fields – commencement of the development and manufacturing of medical equipment –
The major products of Nakashima Medical Co., Ltd. are joint prostheses. Its predecessor, Nakashima Propeller Co., Ltd., began manufacturing joint prostheses as a new line of business in around 1980.
In order to obtain the knowledge and know-how necessary to manufacture joint prostheses, product designers offered assistance to medical colleges and learned a great deal from clinical practice. Personnel responsible for processing and polishing utilized the experience and skill they had accumulated through manufacturing propellers, and worked to learn new techniques and know-how to manufacture joint prostheses through trial and error.
The company also encouraged employees to enroll in medical or engineering colleges for training. It also hosted workshops in cooperation with medical colleges and public research institutions, etc. to promote partnerships with academia and address gaps in information and technology.
Mr. “K,” assistant chief of manufacturing, said: “We did not have sufficient funds and had no choice but to train personnel on our own. It took us years to gain the ability to respond to various requests from hospitals.” Patiently trained, carefully educated personnel have bolstered the company’s expansion into the medical field.
3. Fostering Human Resources which Support the Growth Strategy through Regional Collaborative Efforts

(i) Partners and details of collaboration to collect information on business activities or acquire new technologies

- More than half of companies surveyed have collaborated or are considering collaboration with other companies or local organizations to collect information on business activities or acquire new technologies (Fig. 2-9).
- In particular, many companies cited universities or other public educational or research institutions as collaboration partners (Fig. 2-10).
- More than half of companies surveyed responded that they had collaborated with public vocational training institutions to receive or provide training or seminars or for recruitment activities (Fig. 2-11).

(ii) Efforts necessary and issues in enhancing capacity through regional collaboration

- Efforts cited as necessary to enhance the capacity of full-time technical employees through regional collaboration include preparation of vocational training courses corresponding to company needs and invitation of skilled workers to lecture at company training sessions (Fig. 2-12).
- The most commonly cited issue in advancing regional collaborative efforts is the difficulty in finding appropriate partner companies or local organizations (Fig. 2-13).
(iii) Possible measures for fostering manufacturing human resources in local communities

- Such policies may include the following.
  
  (a) **Strengthening information provision concerning local training resources**
      
      Actively provide information on training, etc. available in local areas and on collaboration between Polytechnic Centers, etc. and prefectures
  
  (b) **Support by Polytechnic Centers and Polytechnic Colleges**
      
      Enhance training for working people in response to the needs of local companies and provide information on training provided by Polytechnic Centers, etc. to local companies
  
  (c) **Development of training courses in cooperation with relevant local organizations (local consortiums)**
      
      Develop vocational training courses to increase employment opportunities, in cooperation with companies, industrial organizations, private educational training institutions and administrative agencies

---

**Fig. 2-12: Efforts Necessary to Enhance Capacity through Regional Collaborative Efforts (multiple answers)**

- Preparation of vocational training courses corresponding to company needs: 40%
- Provision of practical training with the cooperation of local companies: 13%
- Invitation of skilled workers to lecture at company training sessions: 20%
- Building of mechanisms to establish a human resources agency which registers skilled workers and facilitates their use: 12%
- Invitation of local companies to participate in hierarchical training programs and seminar activities: 11%
- Developing human resources in collaboration with local companies and administrative agencies: 7%
- Provision of instruction in training courses: 4%
- Compilation of processing technology into databases or manuals: 1%
- Other: 0%

**Fig. 2-13: Issues in Enhancing Capacity through Local Collaboration (multiple answers)**

- Difficulty in finding time to collaborate with other companies or local organizations: 24.9%
- Difficulty in finding appropriate partner companies or local organizations that satisfy company needs: 35.6%
- Difficulty in obtaining appropriate information concerning the activities of other companies or local organizations: 20.1%
- Difficulty in adjusting interests with other companies or local organizations: 17.5%
- Difficulty in achieving results as satisfactory as expected: 17.9%
- Other: 1.1%
- No particular problems: 18.9%
- No answer: 7.3%

(n=2,059)
[Column] Fostering manufacturing human resources in industrial clusters

Sagamihara City established a municipal ordinance to attract factories in 1955 and has long worked to promote industry. As a result, the city has developed into an inland industrial cluster for the machinery manufacturing and metalworking industries. However, in recent years, factories have been relocated overseas and to more rural areas, and the number of industrial establishments in the city has decreased, from 1,477 in 1990 to 1,000 in 2011. The hollowing-out of industry is ongoing. In 2013, the city responded to these circumstances with training to foster human resources with the cooperation of large companies in the city to encourage SMEs to enhance their technical capabilities.

This training is offered at the existing training facilities of large companies in the city and uses their curricula, conserving travel time and expenses. It also aims to enhance local manufacturing through personnel exchanges among employees of companies in the city which do not ordinarily have business relationships with each other. Large companies that offer their facilities for training can not only make contributions to local communities but will also benefit from an increase in the number of suppliers of high quality components resulting from the improved technical capabilities of local SMEs.

One responsible city official said that fostering human resources is the first step toward the revitalization of the local economy, declaring, “We will fully staff companies in Sagamihara with workers fostered in Sagamihara.”

4. Future Direction of the Program to Foster Human Resources which Support the Growth Strategy

The government is currently shifting away from its conventional policy, which prioritizes employment maintenance, to a new policy which supports labor mobility. This includes capacity development to enable individuals to smoothly change jobs, fully utilize their abilities, and play relevant roles in the Japanese economy.

(i) It will be important to offer public support so that workers can develop their capacities while manufacturing shifts from mature industries and advances into growth industries.

(ii) In response to these changes in the manufacturing industry, the provision of information and support for collaboration needs to be promoted in line with company needs so that local communities can foster manufacturing human resources necessary to the communities.
Section 2  Efforts for Fostering Manufacturing Human Resources which Support the Growth Strategy

1. More Effective Manufacturing Training

(a) Training in response to the needs of growth fields

In addition to conventional training to acquire welding skills or skills to handle lathes or milling machines, training relevant to growth industries, such as environmental technology and energy, has been increased in recent years.

(b) Effective review of training fields.

The Polytechnic University conducts surveys to ascertain companies’ human resource needs. Based on the survey results, training curricula for the Polytechnic Centers and Polytechnic Colleges are reviewed.

(c) Provision of effective training for specific locations

Polytechnic Centers, etc. provide training which responds to the needs of specific locations, and also provide special training in response to the needs of specific companies.

[Column] Collaboration between manufacturing companies and vocational training facilities

Polytechnic Centers nationwide are public facilities that provide vocational training to job seekers and working people. In order to provide proper, effective training, Polytechnic Centers conduct surveys by visiting local employers’ organizations and trying to ascertain their human resource needs.

The Kanto Polytechnic Center in Kanagawa prefecture reviews training classes and courses based on around 400 pieces of information collected from surveys and consultations with employers, etc., and it also provides customized capacity development seminars, etc. depending on each company’s needs. One example is a special seminar concerning design development provided last year in response to a request by Company A, a machinery tool manufacturer that has a production base within the prefecture.

Company A was aware of the necessity of having its employees acquire the ability to respond to diversified needs and obtain knowledge of new design development specifications, etc., and had been considering means of strengthening its design ability as one measure. The company decided to request that the Kanto Polytechnic Center conduct a seminar due to its ability to respond to requests of this sort. The Kanto Polytechnic Center responded to Company A’s request by establishing an original curriculum teaching specific workplace skills, such as cultivating the ability to extrapolate three-dimensional images of complicated tool configurations from two-dimensional diagrams, the ability to generate drawings based on knowledge of new JIS schemes, etc., and an understanding of overall production processes. It also conducted a seminar for the company’s design development employees.
2. To Improve Private Sector Vocational Training

(a) Subsidies for private companies for voluntary vocational training

The Career Development Promotion Subsidy and The Career Development Promotion Subsidy are granted to support efforts by employers to further their employees’ career development.

(b) Accredited vocational training by employers’ organizations

Assistance is provided to owners of SMEs that conduct vocational training accredited to meet specific standards by the competent prefectural governor.

(c) Improvement of training quality

In December 2011, the Guidelines for Vocational Training Services at Private Educational Training Institutions were established to improve the quality of private educational training institutions. Efforts are being made to ensure that the guidelines are widely known and understood.

[Column] Foster professionals specialized in surface treatment techniques under the systematic human development system

Surface treatment techniques are indispensable for advanced technologies such as semiconductors, next-generation energy and environmental technology. Mitsuya Co., Ltd., a plating company with around 300 employees, was facing a multitude of new challenges from customers requiring very advanced surface treatment techniques. The company needed to train technicians and sales personnel able to make proper proposals in response to diversifying and increasingly sophisticated customer requests and accelerating technological development. It therefore created a career matrix to help its employees to develop their career into professionals specialized in surface treatment techniques.

The company requested that employees formulate personal career development plans based on this career matrix, and built a system to foster human resources in a planned manner via a staged training system and a quality certification system. The company also requires that employees attend specific training sessions before they are promoted to supervisory positions. The company applied for The Career Development Promotion Subsidy, which provides financial support to cover the expenses of companies related to planned vocational training and human resources development and employees’ wages during training. Via this subsidy system, Mitsuya Co., Ltd. has been able to develop many first- and second-class plating technicians. Furthermore, the company affords employees responsible for technological development the opportunity to study at graduate schools, thereby steadily fostering core personnel with strong theoretical foundations able to respond to customers’ future requests with flexible, new ideas.

Technical staff discussing means of solving a new challenge
3. Measures to Cope with the Reluctance of Young People to Engage in Manufacturing

(a) Training for high school graduates by Polytechnic Colleges, etc.
   • Polytechnic Colleges and other educational institutions nationwide provide manufacturing training for high school graduates, etc.
   • They collaborate with industrial high schools, etc. by dispatching vocational training instructors, etc.

(b) Transfer of skills to young people
   • Skilled workers with high-level manufacturing skills are certified as Monodzukuri Meisters and dispatched to companies, etc. to provide practical training (Monodzukuri Meister System).
   • From FY2014, Monodzukuri Meisters will also be dispatched to elementary schools and junior high schools to demonstrate manufacturing processes.

(c) Communicating the attractiveness of manufacturing
   Through various awards for skilled workers and competitions (National Skills Competition, WorldSkills International Competition and National Abilympics), efforts have been made to foster a skill-oriented mindset widely in society.

(d) Regional Youth Support Stations
   NPOs and other organizations established and are operating Regional Youth Support Stations to provide employment support (such as consultations with career consultants and provision of work experience) to so-called NEETs and other young people.

[Column] Example of the Monodzukuri Meister System – practical training (lathe work) at Nakamura Electric MFG. Co., Ltd. –
Nakamura Electric MFG. Co., Ltd. seeks to foster young skilled workers by providing them with practical training under the Monodzukuri Meister System.
Practical training was provided to two of the company’s young skilled workers from basic skills to application thereof in general lathe work. The goal was to improve their skills to a level equivalent to that of the second class of the National Trade Skill Test through 20 training sessions over approximately six months.

The Monodzukuri Meister commented, “I taught them more than simply practical skills. On the very first day of the training, I told them the ideal attitude they should have toward machinery as a skilled manufacturer. In order to make them understand how to face their work, I guided them to always think about the next step while remaining aware of issues in the current stage. I am impressed with their diligence and willingness to learn new skills.”
At the 42nd WorldSkills International Competition in Leipzig, Germany, Japanese competitors all did a great job in the 40 areas in which they participated, winning five gold medals. In particular, Mr. Shinpei Utsunomiya (Kinden Corporation) participated in the Information Network Cabling sector and became the first Japanese winner of the Albert Vidal Award, granted to the person who receives the highest score among all competitors.

Mr. Utsunomiya had already taken first prize in the National Skills Competition in both 2011 and 2012. He was selected to represent Japan in the Information Network Cabling section, in which Japanese competitors have won the gold medal every year since 2005. He originally wanted to be an electrical engineer, but the company recognized his superior aptitude for detailed work. The Information Network Cabling section requires competitors to handle a bundle of approximately 100 delicate optical fibers contained in a single cable. He worked hard in national and international competitions.

At the WorldSkills International Competition, the Information Network Cabling sector involves five challenges over four days (totaling nearly 17 hours), covering skills such as the installation of optical fiber in facilities. Competitors are not only required to be skilled, but must also be physically and mentally strong and able to concentrate for many hours. Looking back on the grueling experience and the persistent efforts it required, Mr. Utsunomiya commented, “I was bewildered by the many alterations in the tasks during the competition days, but I was able to leverage the abilities I learned through difficult training.”

He further stated, “I will not remain satisfied with my past international competition results and will continue work day in, day out.” It is expected that he will play an active role in his daily workplace duties and that his junior fellows will also work hard to participate in national and international competitions.
4. Support for Fostering Skilled Female Workers

(a) Communication of the attractiveness of manufacturing to women
The government decided to provide women with opportunities to attend open campus events or hear about the personal experiences of female trainees and prepare and deliver leaflets for women explaining the attractiveness of manufacturing starting in FY2014.

(b) Promotion of the employment of women in manufacturing
The government also decided to consider support measures for capacity building for women depending on their life stages, by, for example, developing and providing manufacturing-related courses for women and improving day nursery services during vocational training to enable women to find jobs and continue working in the manufacturing industry.

[Column] Opinion of a female student of a Polytechnic College

Q: Why did you choose this college?
A: This college is well-equipped and provides a favorable environment for studying.
   Its high placement rate is also an advantage.
Q: What are you studying at present?
A: I am studying various subjects to become a broadly qualified engineer able to handle everything at a manufacturing site, such as machine processing, machine design and electrical circuit assembly.
Q: What do you enjoy about your studies, if anything?
A: I can design, process and make adjustments to products by myself.
Q: What are your future goals?
A: I would like to make the most of what I learn at this school and actively incorporate new knowledge to become a trusted engineer.

[Column] National Skills Competition (interview with the winner of the 51st National Skills Competition)

Ladies’ Dressmaking: Ms. Asami Kaminaka (Wayo Gakuen Fashion College)

● Ladies’ Dressmaking
Q: Please tell me what attracted you to dressmaking.
A: Combining pieces and making three-dimensional dresses while considering who will wear them is a great pleasure.
Q: What skill do you think is most necessary in dressmaking?
A: The ability to work steadily and never give up.
Q: What motivated you to work hard and participate in the competition?
A: I learned that senior students from my school had participated in the competition, and I was inclined to take on the challenge.

Q: What did you do and how much time did you spend to train for the competition?
A: For three months after the task was determined, I measured the time I spent on each process and repeated exercises to finish processes within the prescribed time limit.

Q: How do you intend to leverage your experience in winning the competition in the future?
A: I would like to make an earnest effort in everything I do.

5. Career Development Support

(a) Career consulting services
A system to promote career consulting services is being developed to enable individuals to make their own vocational life plans in accordance with their competence and vocational experience, and to select jobs or receive vocational training to develop their vocational abilities in an effective manner based on such plans.

(b) Utilization of the Job Card system
Efforts are being made to further promote the Job Card system to provide practical vocational training by combining internships and classroom lectures to help participants find stable employment.

6. Creation of a Socially Acceptable Ability Evaluation System

(a) National Trade Skill Test System
The system to evaluate and authenticate the skills of workers based on certain criteria plays an important role in encouraging workers, including manufacturing workers, to acquire skills and enhances their position in society (skill tests are available for 128 job categories as of April 1, 2014, and there are now approximately 5.19 million Certified Skilled Workers).

(b) Vocational Ability Evaluation Standards
Based on an analysis of detailed industry surveys, the Vocational Ability Evaluation Standards were established by compiling and systematizing vocational abilities and knowledge necessary to perform the duties of personnel of all levels, from rank-and-file workers to superintendents responsible for an organization or department. These standards are intended to create an ability-oriented labor market for 50 business areas, including the manufacture of electrical machinery and equipment.
Universities (engineering) provide practical engineering education in collaboration with industry. Colleges of technology provide experience-oriented specialized education, through a five-year course starting after graduation from elementary school, with a focus on experiments and practical training sessions. Specialized upper secondary schools work on various projects to support local traditional industries and specialized training colleges strive to enhance practical and professional knowledge and technology in collaboration with local industries. The unique vocational education provided at each type of school has played a significant role in fostering manufacturing human resources in Japan. The Minister of Education, Culture, Sports, Science and Technology certifies and promotes vocational and practical courses in professional training colleges that aim to systematically ensure the quality of more practical vocational education - a pioneering trial in providing advanced education programs at specialized training colleges to enable students to obtain state-of-the-art practical knowledge with the cooperation of companies.

[Efforts at a university — Yokohama National University — ]

The Yokohama National University Graduate School of Engineering has been promoting an original education program called the “Pi-type Engineering Degree,” which won the Kanto Society for Engineering Education Award in 2013. Under this degree Program, students do not belong to any specific university laboratory and instead participate in project-specific laboratory training sessions, seminars and practicums (including long-term internships). For example, students learn how to use the latest software and experience implementing simplified software to deepen their understanding of the underlying theories of digital engineering through a laboratory training session on the design and manufacturing of aluminum wheels. Such education has been rated as very helpful in the real world by students.

The final qualifying examination is based on students’ portfolios, aggregating all of their academic achievements, rather than requiring them to submit a master’s thesis. This is an effort to foster pragmatic engineers and researchers able to solve diverse and increasingly sophisticated modern industrial issues.

[Efforts at colleges of technology — Robot Contest of the National Colleges of Technology]

The “Competition of Ideas – Robot Contest of the National Colleges of Technology” is held every year as an educational event in which students of colleges of technology nationwide freely and independently design and build robots under annually changing rules, thereby cultivating originality and a shared interest in manufacturing. The 26th contest in FY2013 was entitled “Shall We Jump?” and required participants to create a variety of animal robots able to swing a jump rope over which other robots would jump. Participating students competed with regard to the time required to jump a prescribed number of times and the number of jumps their robots could perform.

Around 4,000 people visited the Ryogoku Kokugikan to cheer on the heated competition among students with highly original robots incorporating the advanced technology they learned about in school. The grand prize for the team with the best concept went to the Toyama National College of Technology team for its robot, “SuLuMe,” whose unique design, with a large balloon on its head, captivated the audience.

[Chart 3-1: Scene of the Competition]
MEXT has been offering intensive support to universities that promote internationalization, as one of its initiatives to foster global human resources. In addition, colleges of technology are carrying out overseas internship programs with the cooperation of companies with international business operations.

Since FY2012, METI has been offering internship programs to foster industry-ready global workers. It provides young adults and students with opportunities for internships lasting several months in developing countries, with the aim of fostering young global human resources, facilitating the business expansion of SMEs, and generating opportunities for infrastructure businesses.
The Courses of Study (school curriculum guidelines) provide that manufacturing education should be provided mainly in science, technology and home economics, on the characteristics of each subject. The government offers support to female researchers and encourages female lower and upper secondary school students to take science courses, while endeavoring to foster future global human resources specialized in science and technology and to enhance science and mathematics education that will bolster Japan’s science and technology.

The government has been promoting Internship programs to enhance elementary and secondary school career and vocational education, and has been developing a system which helps students to be socially and vocationally independent at the higher education phases. Additionally, universities, etc. are working with industry to assist in the re-training of young people.

The National Museum of Emerging Science and Innovation (Miraikan) holds various science experiment classes and events to convey the enjoyment of manufacturing, while endeavoring to increase people’s understanding of advanced science and technology. Community centers and other social educational facilities are also endeavoring to enhance children’s interest in manufacturing and breathe life into local communities.

The government has been endeavoring to transmit manufacturing traditions to future generations by fostering successors to important intangible cultural properties, protecting selected conservation techniques, etc.

[Assistance for women in scientific fields]
The assistance provided to women in scientific fields includes projects supporting research by female researchers by helping universities develop environments favorable to balancing research activities and family life, such as the responsibilities of childbearing, child rearing and providing care to elderly family members, and a program encouraging female lower and upper secondary school students to take science courses by providing them with opportunities to interact with prominent female researchers and university students in scientific fields, offering them science experiment classes and having them attend lectures.

[Promoting regional development using loquat, a local specialty, at the Inabu Fureai-kan in Nankoku city, Kochi prefecture]
The Nankoku City Board of Education has been trying to promote regional development using a local specialty, loquat, at a city facility, the Inabu Fureai-kan. Inabu Elementary School - the regional learning center - and the community center have long been cooperating closely in relation to this, and decided that the community center would take the initiative with local residents in promoting the development of regional products using loquat. These products had historically been promoted by the Inabu loquat study group, which is comprised of local residents.

Under a project entitled “creation of a loquat-colored village,” they organize lectures by university specialists, etc. and publish a local magazine to develop new regional products.
The government has promoted the development of cutting-edge measurement and analysis techniques/equipment, which is expected to improve diagnostic technology, alleviate the suffering of patients, and reduce medical costs.

Shared use of the large-scale synchrotron radiation facility (Spring-8), the X-ray free electron laser facility (SACLA), and the large-scale proton accelerator facility (J-PARC) are promoted to support research and development in manufacturing industries by utilizing quantum beam and photon science and technology.

SACLA allows the observation of shapes and the behavior of substances below the nano level. Studying the destruction of substances using such equipment is expected to provide useful knowledge about manufactured goods. The RIKEN SPring-8 Center provides technologies which allow substances to be visualized at the atomic or molecular level using radiation and/or an x-ray free-electron laser. It seeks to understand fatigue, aging and destruction at the atomic level based on this visual information. If the phenomena of aging and fatigue in organisms can be understood at the nano level, it may be possible to find means of controlling aging or of effectively reducing fatigue. These may help elderly people maintain vitality and continue contributing to an aging society. Understanding the phenomena of aging and fatigue in functional substances and devices at the nano level may create a foundation for new manufacturing techniques designed to control destruction.
Joint use of the super computer “K computer,” which has the world’s highest level computation performance, started shared operations for researchers and engineers from the end of September 2012. The government has also been promoting research and development through the full utilization of the innovative High Performance Computing Infrastructure (HPCI), which establishes an innovative computing environment in response to diverse user needs by linking super computers at universities, etc. in Japan via a high-speed network.

In response to societal needs, research and development on materials, including new nanoscale material creation and structural control, has been conducted.

[Fig. 3-9: The K Computer]

In FY2013, six research subjects were adopted for the project related to developing pioneering applied research to strengthen industrial competitiveness. Three research subjects were adopted for the project relating to fundamental technology, under which research and development to increase the number of users, including industries, has been carried out.

[Pioneering applied research based on the integration and combination of optical technology and quantum beam technology –Photon and Quantum Basic Research Coordinated Development Program–]

The Photon and Quantum Basic Research Coordinated Development Program, which commenced in FY2013, aims to facilitate the combination of optical technology and quantum beam technology and to promote pioneering research utilizing facilities and equipment across the nation in an interdisciplinary manner and to promote the development of fundamental technology, thereby strengthening research and development, resolving issues, returning outcomes to society and laying the groundwork for the future utilization of research. Under this program, two projects, titled 1) “research on the interdisciplinary utilization of multiple optical and quantum beam technologies” and 2) “development of fundamental technology to facilitate the integration and combination of optimal technology and quantum beam technology,” have been established. The former project aims to achieve innovative outcomes, such as development of novel materials and new drugs based on new methodologies, in three to five years through interdisciplinary utilization of multiple optical and quantum beam technologies, including radiation, neutron beams and lasers. The latter project aims to conduct research and development in order to further advance and miniaturize accelerators and other devices, facilitating the integration and combination of optical technology and quantum beam technology within three to five years, thereby contributing to building a research base to generate innovation.

In FY2013, six research subjects were adopted for the project related to developing pioneering applied research to strengthen industrial competitiveness. Three research subjects were adopted for the project relating to fundamental technology, under which research and development to increase the number of users, including industries, has been carried out.
(ii) Promotion of research and development based on collaboration between the government, industry, and academia

- The government promotes the development of a system to facilitate collaboration between the government, universities, industry and academia, and research and development to commercialize research results, and offers support for the utilization of intellectual property, such as filing foreign patent applications.
- Since FY2012, the government has been carrying out initiatives to startup companies, which can lead the global market, using inventions (patents) and know-how produced in universities.

[Fig. 3-11: Collaboration between the Government, Universities and Academia]

[Fig. 3-12: Total Number of University Ventures]

40

* Data are for public and private universities (including junior colleges), public and private colleges of technology, and inter-university research institute corporations.

* As amounts less than a million yen are rounded off, the total does not always match the sum of the amounts for each school category.

* Part of the line graph is dotted, as the method used to tabulate the number of cases in which patent rights have been exercised was altered in FY2012.

(Source) “Status of Partnerships between Industry and Universities, etc. in FY2012,” MEXT

(Reference) http://www.mext.go.jp/a_menu/shinkou/sangaku/1342314.htm (in Japanese)
The government has been carrying out initiatives to establish innovation platforms in which universities, public research institutions and industries collaborate to operate internationally competitive R&D. Under the initiatives, participants focus on intensive R&D activities to commercialize outcomes of industry-university cooperation, aiming at generating disruptive innovations and new industries.

Under the Regional Innovation Strategy Support Programs, support is being offered for various initiatives to generate innovation in local regions, including disaster-affected areas.

**Fig. 3-13: Regional Innovation Strategy Support Programs**

- **Regions focused on strengthening international competitiveness**
  - Regions focused on strengthening international competitiveness.
- **Regions with internationally superior technological seeds at universities or with industrial concentrations with the strong potential to attract people, goods, and money from overseas**
  - Regions with internationally superior technological seeds at universities or with industrial concentrations with the strong potential to attract people, goods, and money from overseas.
- **Regions focused on advancement of research functions / industrial concentrations**
  - Regions focused on advancement of research functions / industrial concentrations.
- **Regions where innovation leveraging regional characteristics is expected to be achieved and with the potential to succeed in overseas markets in the future**
  - Regions where innovation leveraging regional characteristics is expected to be achieved and with the potential to succeed in overseas markets in the future.

- **Areas adopted in FY2011**
  - Areas adopted in FY2011.
- **Areas adopted in FY2012**
  - Areas adopted in FY2012.
- **Areas adopted in FY2013**
  - Areas adopted in FY2013.