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**PREPARED BY**



RICE

<http://www.rice.or.jp/>

[info@rice.or.jp](mailto:info@rice.or.jp)

RESEARCH INSTITUTE OF CONSTRUCTION AND ECONOMY

NP-Onarimon Building,  
25-33, Nishishinbashi 3-chome,  
Minato-ku, Tokyo 105-0003, Japan  
TEL +81-3-3433-5011  
FAX +81-3-3433-5239

## Improving Productivity in the Construction Industry

### I. Overview

Construction investment in Japan reached ¥84 trillion at its peak in FY 1992, but is expected to fall below ¥50 trillion, less than 60% of the peak figure, in FY 2007 and thereafter. Government construction investment in particular has fallen by more than half from the peak period. Moreover, government policy plans suggest that public investment will continue to experience a 3% to 5% year-on-year decline until FY 2011.

However, adjustment of supply side of construction market has been delaying. While there were about 530,000 licensed construction companies in FY 1992, that number peaked at 600,000 in FY 1999 and then began dropping, falling to around 540,000 in FY 2005. The number of construction industry employees was 6.19 million in FY 1992, reached 6.85 million in FY 1997, and then retreating to the level of about 5.59 million by FY 2006.

In a market characterized by this kind of imbalance between supply and demand, Japan's labor productivity has undergone a considerable decline on per employee basis. This report discusses current productivity in the Japanese construction industry and describes efforts and issues related to improving construction industry productivity from the perspectives of both policy prescriptions and construction production systems.

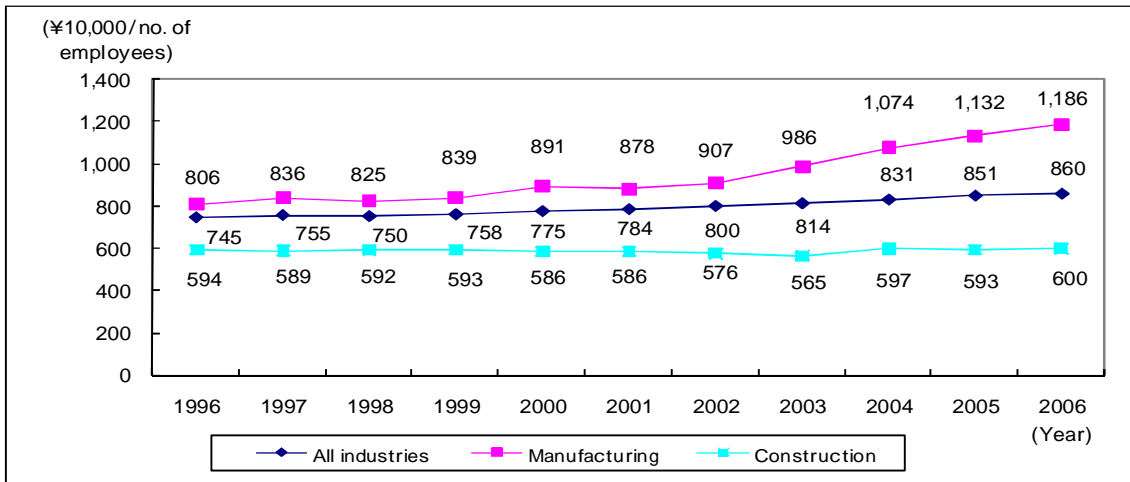
### II. Current Productivity in the Construction Industry

Trends in Japanese labor productivity expressed in the shape of "GDP by economic activity divided by the number of employees engaged in the economic activity" show that all industries was ¥7.45 million at the FY 1996, it had increased to ¥8.60 million at the FY 2006. However, labor productivity in the construction industry was ¥5.94 million at the FY 1996, and it was almost the same level of ¥6.00 million at the FY2006.

The low level of labor productivity in the construction industry versus manufacturing and other industries is largely attributed to macro factors such as declining construction investment and the superfluous workers. However, micro level impediments to productivity also exist at work sites and in companies. The major factors involved are as follows:

- (1) Construction works are outdoor production, single item production and made-to-order. Therefore, productivity improvement in workplace that would bring about major reforms in the production system has not been adequately developed.
- (2) The ratio of employees in back-office section is increasing caused by the decline of order volume for each construction company.
- (3) The state of "too many layers of subcontractors" leads to increase the overhead costs.

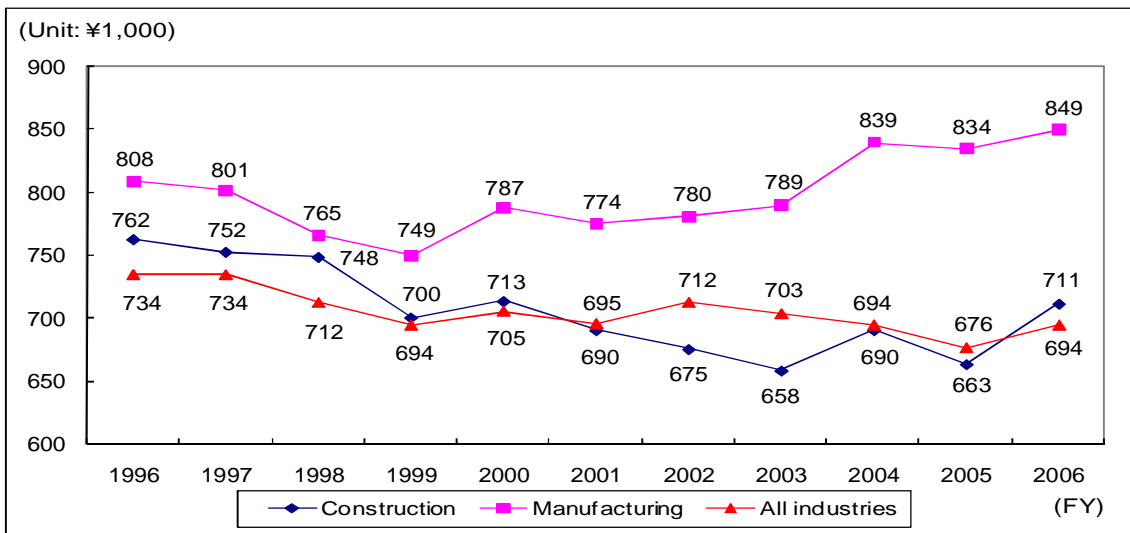
Figure 1 Trends in Real Labor Productivity in the Construction Industry



Source: Annual Report on National Accounts (FY 2008), real prices, base year: 2000, fixed standard year method.

Note: Real labor productivity = GDP by economic activity / no. of employees engaged in each economic activity

Figure 2 Added Value Per Employee



Source: Corporate statistics.

Note: Value added = operating income + personnel expenses + interest expenses/discount expenses + taxes and public fees, etc.

### III. Efforts and Issues Involved in Improving Construction Industry Productivity

#### III - (1) Construction Industry Policies

With construction industry productivity continuing to decline, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has published *Construction Industry Policies 2007*. This document promotes efforts to strengthen the following five construction industry policies, and describes the need to promote “structural reform” in the construction industry.

- (1) Establish a fair competitive base
- (2) Promote reorganizing efforts
- (3) Reform the tender and contract system to promote competition by both technologies and management
- (4) Organize equal and highly transparent construction production systems
- (5) “Human resource development” to sustain the object producing industries

(1) Establish a fair competitive base

Eliminating bid-rigging and other types of misconduct and ensuring full legal compliance are the keys to restoring the trust of citizens and improving the attractiveness of the construction industry. It is of the utmost importance that a fair competitive environment is established in which those who work serious and make a effort do not suffer a loss. This must be done by preventing the burden on subcontractors and workers that result from orders obtained through comprehensive subcontracting and extremely low prices. To achieve this, ensuring legal compliance is a pressing concern, and the government needs to respond forcefully to incidents of legal misconduct.

a) Clarify the rules and ensure legal compliance

- Establish a “Head Office for Construction Industry Legal Compliance Promotion” to strengthen legal compliance promotion systems.
- Prohibit comprehensive subcontracting (Revision of the Construction Business Act) to ensure appropriate construction work execution.

b) Strengthen penalties for legal misconduct

- To abolish bid-rigging, consider extending the business suspension period and extending the maximum suspension period of designation.
- Strengthen penalties for falsifying reports in the Business Evaluation.

c) Provide information to consumers

- Publish negative information on construction companies (supervisory reprimands, suspension of designation, etc.) to strengthen selectivity and monitoring by consumers.
- Disclose profit information by sector (civil engineering division, building division, international division) to ensure appropriate evaluation of business condition.

(2) Promote reorganizing efforts

In the construction industry, further reorganizing and shakeouts are inevitable to correct the excessive supply structure, and efforts must be made to development an environment to promote restructuring. We need to review the obstacles that impede management decisions of individual companies for mergers and other forms of reorganization, and to enact policies to

provide incentives for restructuring.

To support the challenge of companies to move into new markets, such as overseas construction or into upstream or downstream markets, and the fields of agriculture, welfare, and the environment, none of which construction industry have yet extended to in a large scale, helps expand the flexibility of managing of companies. Government needs to cultivate an environment for this challenge, same as for promotion of restructuring.

a) Systems design that do not hinder corporate management decisions

- Create corporate group evaluation systems in the Business Evaluation that promote corporate reorganization.
- Reform the engineer system so that it does not impede the free conduct of corporate business activities.

b) Create incentives for restructuring

- Provide incentives through the use of the Special Measures Law for Industrial Revitalization (revise industry guidelines and ensure flexibility of appliance) to promote corporate restructuring.
- Provide financing support to promote corporate partnerships between small and medium-sized construction companies (mergers, business succession).

c) Support expansions into overseas construction markets

- Develop a database of specialized information to promote overseas expansion, and create an advisor system for providing instruction and advice.
- Strengthen financing support for project formation of infrastructure public-private partnership (PPP) projects.
- Promote measures for active use of Japanese construction technologies in ODA projects.

d) Review the division of roles between the public and private sectors, and expand the sphere of construction industry activities

- Use PFI and the designated administrator system to utilize the funds, technologies and know-how of private companies.
- Promote the use of CM/PM system to expand the market of fee-based business.
- Implement model projects to promote advancement into agriculture and other fields by small and medium-sized companies.

(3) Reform the tender and contract system to promote competition in both technologies and management

It is necessary to create a “virtuous cycle” in which refining technologies and management and doing good work leads to the next job as a basic rule. For this purpose, we need to achieve the highest value for procurements in terms of both cost and quality by introducing a tender and contract system that is fair, transparent, competitive, not contaminated by bid-rigging or other misconduct. To do this, we need to expand the open and competitive bidding system characterized by high competition and transparency, to bolster the comprehensive evaluation system, and to promote the introduction and expansion of bid bonds in order to create the

conditions for achieving these.

As local public authorities expand the range of applicability of the open and competitive bidding system, they need to comprehensively consider their operational structure, the type and scale of construction projects and the characteristics of the construction companies. They also need to create market conditions that promote competition between similarly positioned companies, and to ensure that contributions to the local community are appropriately measured in comprehensive evaluations and qualifications.

a) Promote competition on price and quality, technologies, and management

- Expand open and competitive bidding system and comprehensive evaluation system to develop a competitive environment in which the “companies with the best engineering, execution and management skills” can grow and thrive.
- Promote the introduction of bid bonds to utilize market functions.
- Revise the Business Evaluation to ensure that companies are being fairly evaluated for public works.

b) Revise the tender and contract system responding to local actual conditions

- Establish proper order criteria and bid participation condition to set up markets that are well suited to character and scale of project, and to the feature of construction companies.
- Promote the diffusion of a “Comprehensive Evaluation Manual for Local Public Authorities” for appropriate evaluation of contributions to the local community and so on.

c) Strengthen countermeasures to the low-cost bidding

- Expand comprehensive evaluation system including the evaluation of executing structure to achieve public procurement at high quality and price.
- Promote the introduction and expansion of standards for disqualification in lower limit bid price systems and low bid price investigation systems run by local public authorities.
- Strengthen ties with the Fair Trade Commission.

(4) Organize equal and highly transparent construction production systems

The aim of construction production systems is to provide most valuable service and highest value for money (VFM) to the end users of the construction products, and this goal must be achieved through competition that promotes the survival and growth of companies with the best engineering, execution, and management capabilities.

To achieve this kind of construction production system, based on the “post-collusion era”, we need to establish equal relationships between clients, designers, and builders, clarify the roles and responsibilities of each player, and improve transparency.

a) Use various means of procurement

- Use detailed design contracting system that requires advanced technologies, design-build contracting methods and consortia of construction consultants and construction companies.
- Use proposal method to select the designer.
- Formulation of structure to promote the CM/PM method to supplement client skills and

systems.

b) Clarify roles and responsibilities, improve transparency

- Promote three-party consultation between the client, designer, and builder in order to share design ideas and adapt to changes of conditions.
- Establish the effect of interruption of prescription (revise the Construction Industry Law) in regards to dispute handling within the Committee for Adjustment of Construction Work Disputes to promote simple, prompt, and fair solutions to contract disputes.

c) Build appropriate subcontracting relationships

- Establish the “Head Office for Construction Industry Legal Compliance Promotion” to strengthen legal compliance promotion systems.
- Formulate the Construction Industry Legal Compliance Guidelines to clarify actions that clarify legal misconduct.
- Implement subcontracting safety net debt guarantee programs to facilitate the procurement of funds by subcontractors.

(5) “Human resources development” to sustain the object producing industry

Construction production is an outdoor, single-item, made-to-order production and production success or failure is largely determined by how well engineers and skilled workers demonstrate their engineering capabilities and technical skills under conditions and contexts of execution that differ from project to project. Thus, construction production is a people-based industry, and it is essential to secure, cultivate, and evaluate talented human resources who can sustain the construction industry in order to change the construction industry more attractive. With the population declining and birthrates falling, we need to examine ways to promote the re-employment of baby boomers who are now reaching retirement age in large numbers, to promote the entry of women to the industry, and to utilize foreign worker training programs that are founded on equal treatment of Japanese foreign workers.

Also, improving productivity in the construction industry through supporting standardization that helps introduction of ICT and technological development will enable to prepare for the anticipated decline in the productive age population.

a) Secure and train personnel, improve worker treatment

i) Evaluate engineers and skilled workers, improve treatment

- Proper evaluation of core skilled workers in the Business Evaluation and the comprehensive evaluation system to improve productivity and ensure quality in the construction industry.
- Promote the utilization of the revised Law on the Improvement of Employment for Construction Workers, which makes it possible for construction workers to be temporarily dispatched or hired through business associations.

ii) Improve and transfer technologies and skills

- Support pioneering/leading efforts of business associations to contribute skill-up of young workers guided by experienced workers and veterans.

- Promote the use of cross-industrial training institutions for engineers and skilled workers.
- iii) Strengthen cultivation of future human resources
  - Policies to strengthen the cultivation of future human resources that link vocational high schools with the local construction industry.
  - Policies aimed at actively training and employing women.
  - Use of trainees from other countries.
- b) Promote IT and other technological developments
  - i) Improve networking within the construction industry
    - Promote diffusion of the Construction Industry NETwork (CI-NET) to improve the operational efficiency of construction companies through adoption of electronic systems for exchanging estimates and orders between contractors and subcontractors.
  - ii) Promote technological developments in the private sector.
    - Use the New Technology Information System (NETIS) to collect and share information on new technologies, and induce effective new technologies developed by private companies into public works projects.



### III-(2) Efforts to Improve Productivity Through the Construction Production Systems of Construction Companies

Given its structure of excessive supply, further restructuring and shakeouts in the construction industry are inevitable. In an era characterized by declining construction investment, maintaining steady growth is becoming more difficult than previous eras, when construction investment was rising. As a result, construction companies are striving to strengthen management and engineering capabilities by using new technologies and ICT to achieve greater project efficiency and by shifting their focus from construction project sales to profits. As is happening in other industries, companies are continuing to seek out the optimal business formats for improving productivity, including consideration of mergers and partnerships with other companies, and restructuring.

#### 1. Improve management capabilities

##### (1) Expand sphere of activity

Companies are expanding the sphere of activity of the construction industry, which has thus far been centered around building projects, and are beginning to pursue new business opportunities.

In particular, large and semi-large construction companies are pursuing to move into upstream and downstream markets (such as planning, design, maintenance/repair, and other related fields). These are markets where construction companies can easily leverage the technologies and know-how they have already developed, and they would be attractive markets for construction companies aiming to offer "comprehensive construction services," such as those typified by PFI projects. These are also fields where CM and PM methods are expected to be more actively used as supplementary management systems for the client from the perspective of ensuring transparency and third-party objectivity.

Also, there are an increasing number of construction companies interested in pursuing business opportunities in a broader range of fields, such as development of overseas markets as well as in such new fields as agriculture, the environment, and welfare projects. Many construction companies are citing industries like food production, the environment, energy conservation, disaster reduction, and health/welfare as fields in which the need for construction investment is rising. They are therefore actively establishing offices that specialize in these fields because of their potential for future growth.

Figure 3 Expanding the sphere of activity of construction companies (into upstream and downstream markets)

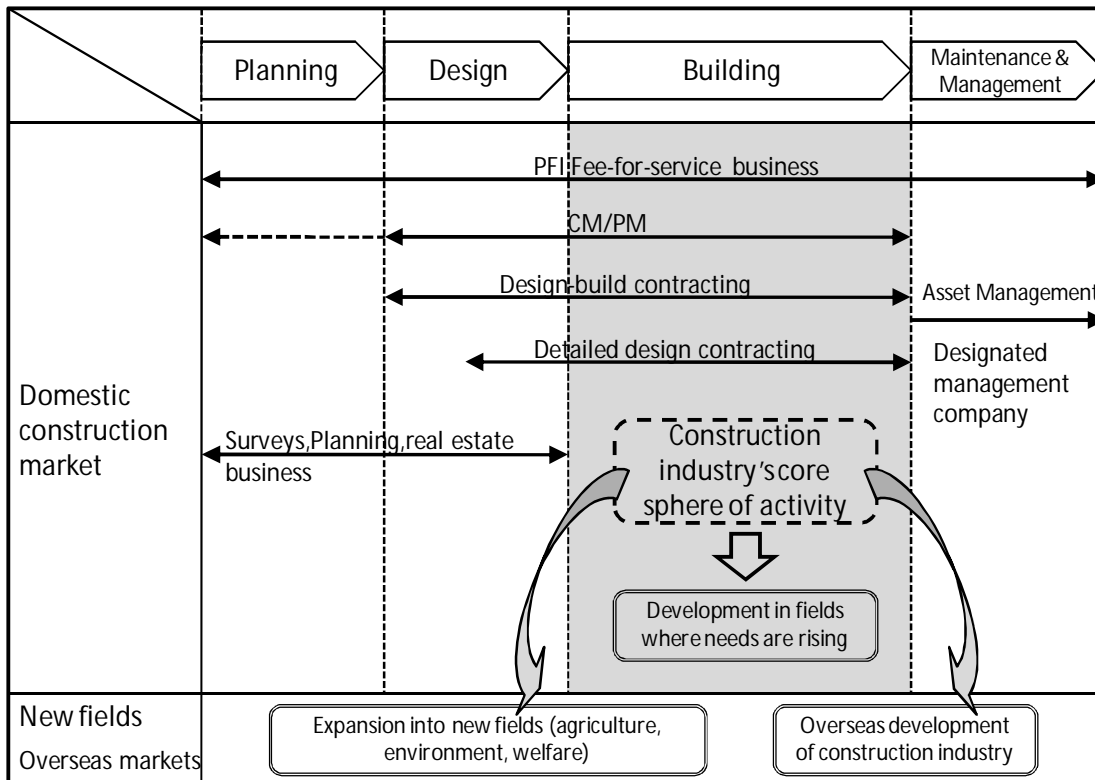


Figure 4 Types of efforts and recent developments

Types of efforts	Recent developments
PFI, fee-for-service business	<ul style="list-style-type: none"> <li>- Most are in the field of education and culture and Most are managed by municipal governments.</li> <li>- Of those projects in which a construction company is the core company, more than half are large or semi-large general contractors.</li> </ul>
CM/PM method	<ul style="list-style-type: none"> <li>- Establishing specialized divisions and offering services.</li> <li>- Construction consultants are also actively involved (CMR).</li> </ul>
Design-build contracting	<ul style="list-style-type: none"> <li>- Upstream strategies are being strengthened, and the ratio of design-build orders is increasing particularly among large and semi-large general contractors.</li> <li>- Strengthens management of proposals incorporating land information from the planning stage. Places priority on project efficiency.</li> </ul>
Asset management	<ul style="list-style-type: none"> <li>- With new demand stagnating, the asset renewal market is attracting attention.</li> <li>- Public authorities that subcontract everything out to construction companies, including bridge pier inspections, repair, and cleaning, are appearing.</li> </ul>
Designated manager system	<ul style="list-style-type: none"> <li>- The number of new entrants is steadily increasing.</li> <li>- The ratio of private companies acting as designated managers was 18.3% in September 2006.</li> </ul>
Expansion into new fields	<ul style="list-style-type: none"> <li>- Small and medium-sized companies are making efforts to expand into new fields, and efforts recognized as model cases should receive support.</li> <li>- Strive to ensure widespread education and outreach. Promote efforts by small and medium-sized</li> </ul>
Overseas developments	<ul style="list-style-type: none"> <li>- Develop an overseas construction project library (database), and provide general information needed for developing overseas.</li> <li>- Strengthen collection of overseas PPP information and establish research associations to support PPP</li> </ul>

## (2) Reorganize construction companies

While the number of licensed companies and employees in the construction industry is falling, construction investment is undergoing an even more dramatic deceleration. As a result, the construction industry continues to be characterized by excess supply. In this environment, individual companies are focusing investment of resources into their particular fields of expertise, and are restructuring their businesses, developing ties with or purchasing other companies to supplement their business activities.

While large and semi-large construction companies are trying to reinforce their businesses by purchasing or forming partnerships with companies in different businesses or different sales regions, some are withdrawing from fields like real estate, where revenues are not expected to increase, and are re-investing their resources in more narrowly focused endeavors.

Small and medium-sized companies, like large and semi-large companies, are engaging in business integration through mergers and the establishment of collaborative unions aimed at strengthening the business base through mutual complementarity. They are also integrating back office departments across companies using ICT, and are collaborating on the procurement and shipment of equipment and materials.

On specialized projects, companies in different industries are forming online networks, establishing groups to engage in joint order acceptance, and engaging in corporate mergers with companies in the same industries, or companies in other industries.

## 2. Improve engineering capabilities

The low level of work site productivity due to the nature of this industry's outdoor, single item, made-to-order production model is an impediment to improving construction industry productivity. To combat this problem, we need to improve engineering capabilities so as to bring about a major transformation in construction production systems, or in other words, to increase the efficiency of site management and project implementation. We also need to increase productivity in response to the decrease in the number of construction industry employees that is expected to occur in the future.

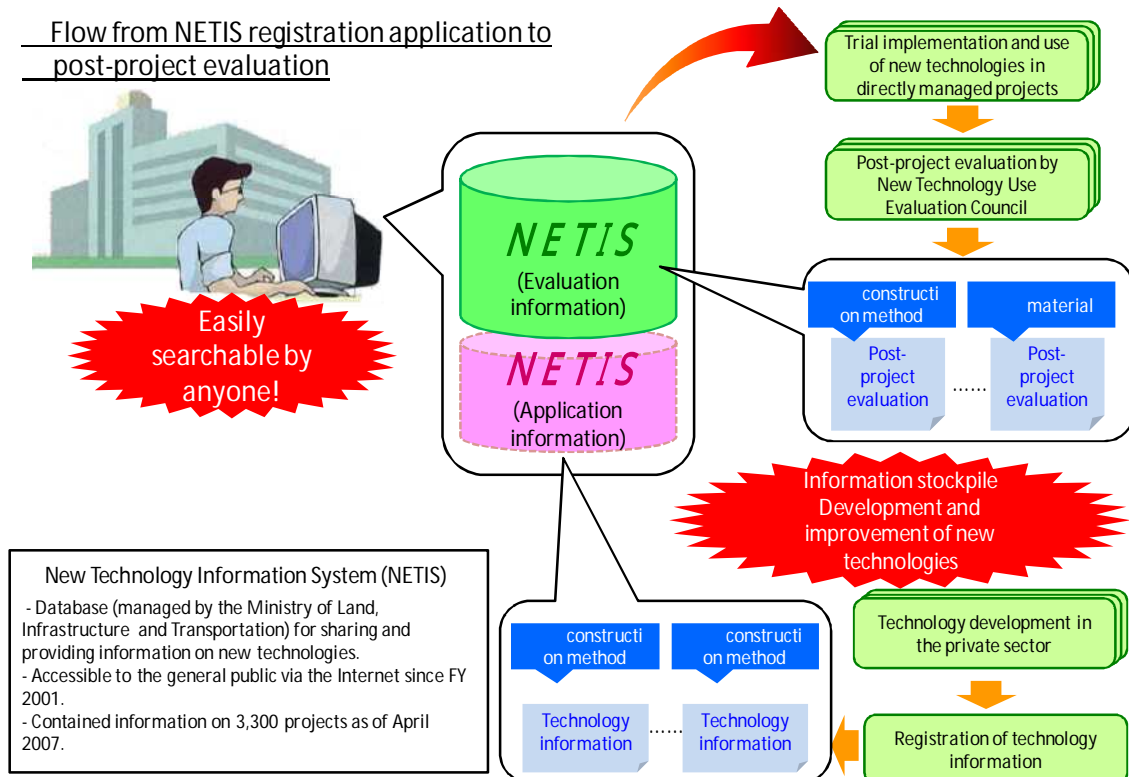
### (1) Use new technologies

Using proven new technologies, such as energy saving measures, is an effective way to increase the efficiency of site management and project implementation.

The New Technology Information System (NETIS) was developed to facilitate the active application of useful new technologies developed by private companies in public works projects. It is being developed and used by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). NETIS collects information on new technologies developed in the private sector, and incorporates it into a single organized database that covers all information on projects directly managed by the MLIT from trial implementation to the evaluation and verification of results. By publicizing information on useful new technologies and new construction methods not only among construction project purchasers, but also among private construction companies, the MLIT is promoting the dissemination of technologies and methods that will help improve

productivity. A system that supplies information on construction technologies, including evaluation results, will not only contribute to the development of the comprehensive evaluation method, but will also increase its importance for improving productivity.

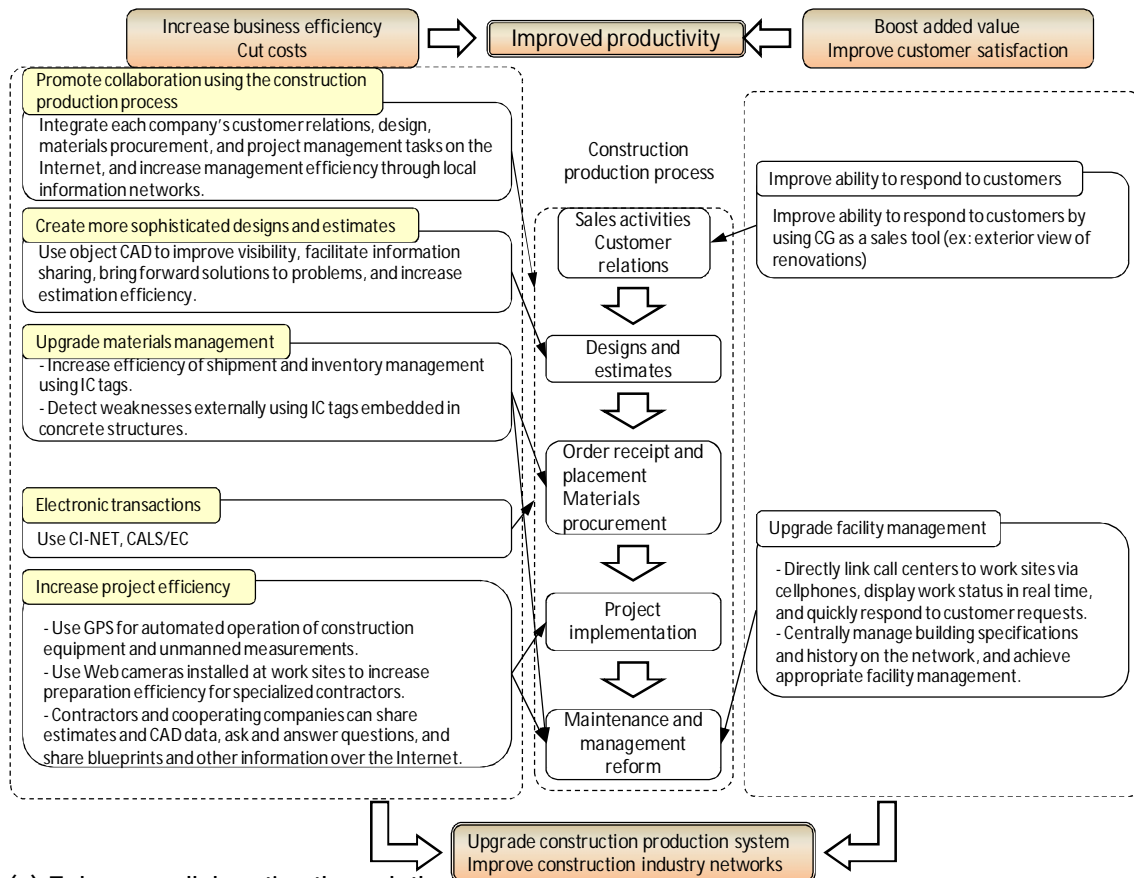
Figure 5 Overview of the New Technology Information System (NETIS)



(2) Use of ICT

ICT is being used in increasingly sophisticated ways in the construction industry. The introduction of ICT by companies in their efforts to increase business efficiency, cut costs, raise added value, and improve customer satisfaction, has thus far largely been based on the independent judgments of individual companies. In recent years, however, efforts have been made to increase efficiency in the construction production process as a whole by creating networks that include clients, cooperating companies, and other relevant parties, and by incorporating ICT into the bidding, delivery, ordering, materials management, and contract management processes. Efforts are also being made to increase the efficiency of construction mechanization by creating networks using CAD systems and ICT equipment.

Figure 6 Use of ICT in the construction industry



(a) Enhance collaboration through the construction production process

Efforts are being made to create an information network among specialized contractors and to facilitate joint construction projects. This makes it possible for the tasks that once would have been managed solely by a general contractor, such as customer relations, estimate preparation, design, subcontracting of specialized contractors, materials procurement, and building project management, to be divided up, and for individual services to be ordered through an information management center. Concentrating all information on an intranet at an information management center makes it possible to confirm workload and material quantities and to consolidate all work and materials orders and project management information. Costs can be kept down by ordering materials in bulk, and accurate information on project progress and labor investments can be obtained. This contributes to improved management efficiency.

(b) Upgrade designs and quantity surveys

Introduction of Building Information Modeling (BIM) using new-generation CAD systems is primarily being promoted in the architecture departments of large construction companies.

Use of new-generation CAD programs makes it possible to seamlessly transmit and share all information related to a project, including quantitative information on the construction product, and to investigate anticipated problems early in the process. As a result, builders have been freed from the time-wasting process of waiting or doing things over again. It is now possible for

labor and materials to be delivered to a worksite in a timely manner, and this has made significant increases in productivity possible. This process not only means shorter construction times for clients, but also helps them engage in effective asset management by using accumulated information as maintenance management information.

For builders, who begin participating in a project early in the process, this system improves their ability to meet their customers' needs.

Figure 7 Comparison of conventional and new-generation CAD systems

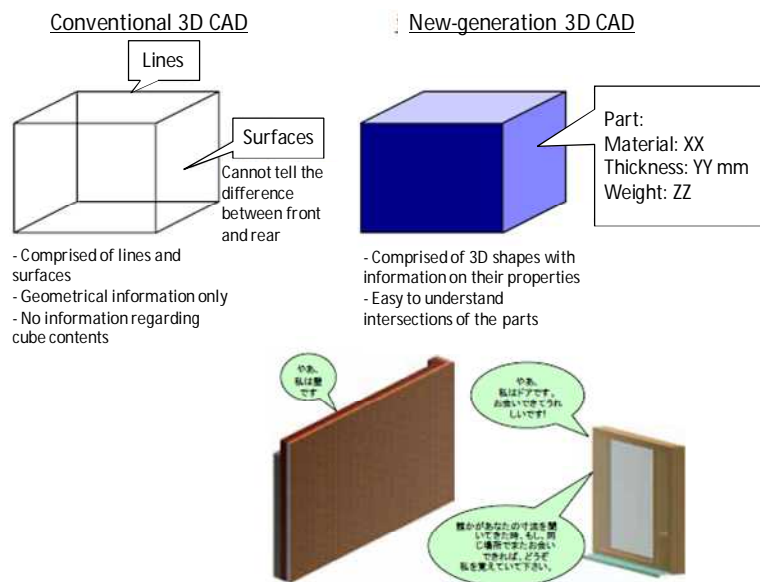
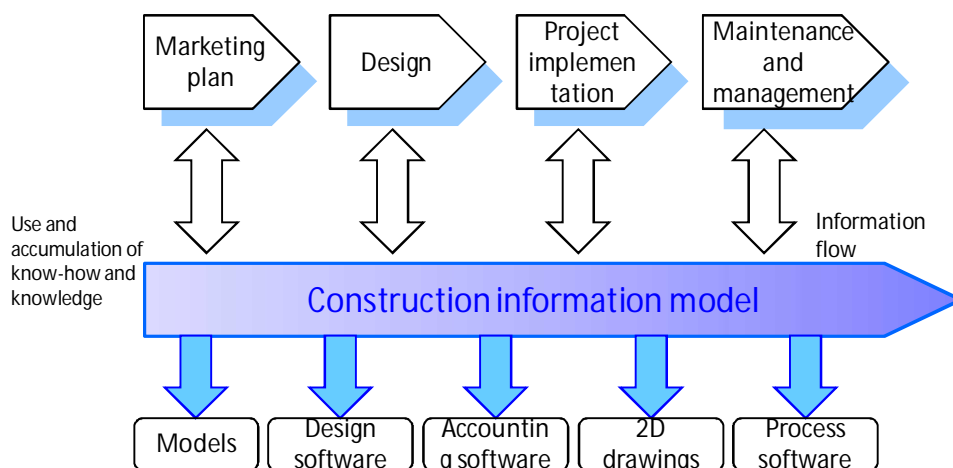


Figure 8 Image of construction production process using BIM

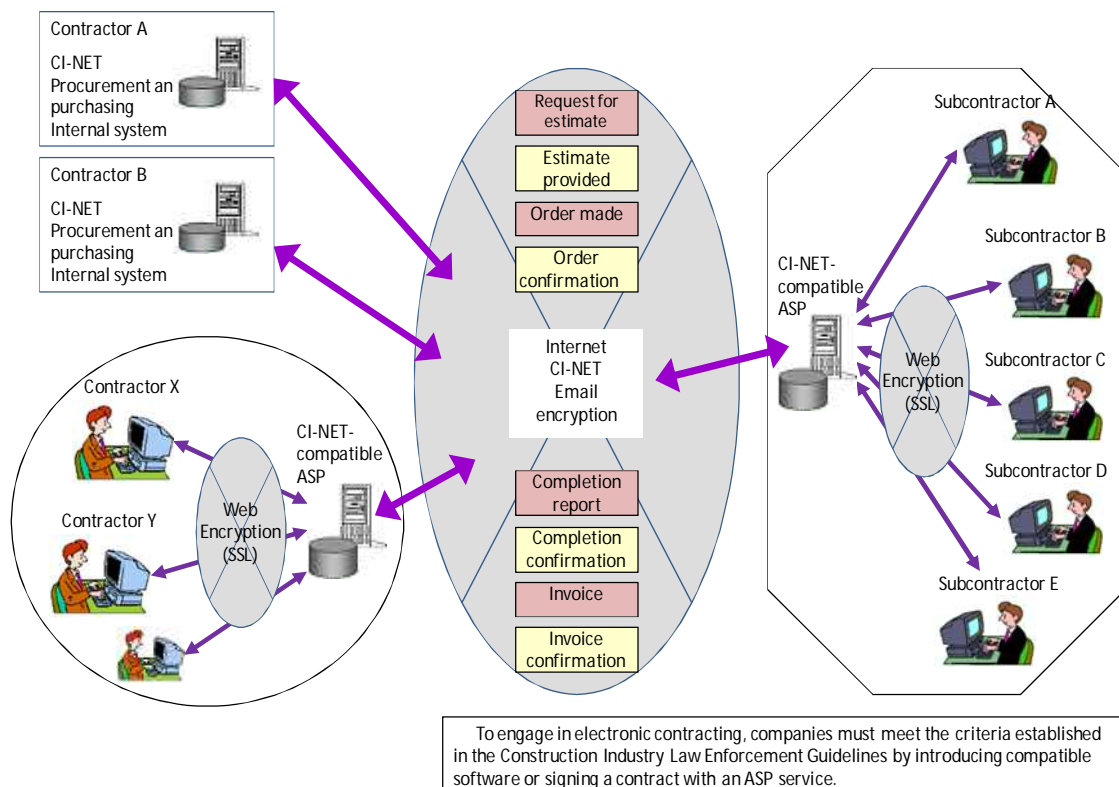


(c) Electronic transactions

Using the Construction Industry NETWORK (CI-NET), private sector contractors and subcontractors can electronically exchange ledger data, such as estimates and purchase orders, and can improve the efficiency of their operations. As of the end of FY 2006, about 8,000 companies were participating in this network.

Meanwhile, use of the Continuous Acquisition and Life-cycle Support/Electronic Commerce (CALs/EC) System by both private and public institutions is also expanding. CALs/EC involves use of digital information technologies related to public works projects for electronic bidding, approval, contracts, and delivery. It aims to increase the efficiency of document and technical information exchange between parties involved in public works projects, and to promote information sharing, as well as to improve the quality of public works projects. Electronic bidding was used in about 90% of the projects directly managed by the MLIT in FY 2006.

Figure 9 CI-NET overview



(d) Increase efficiency through ICT applied project implementation

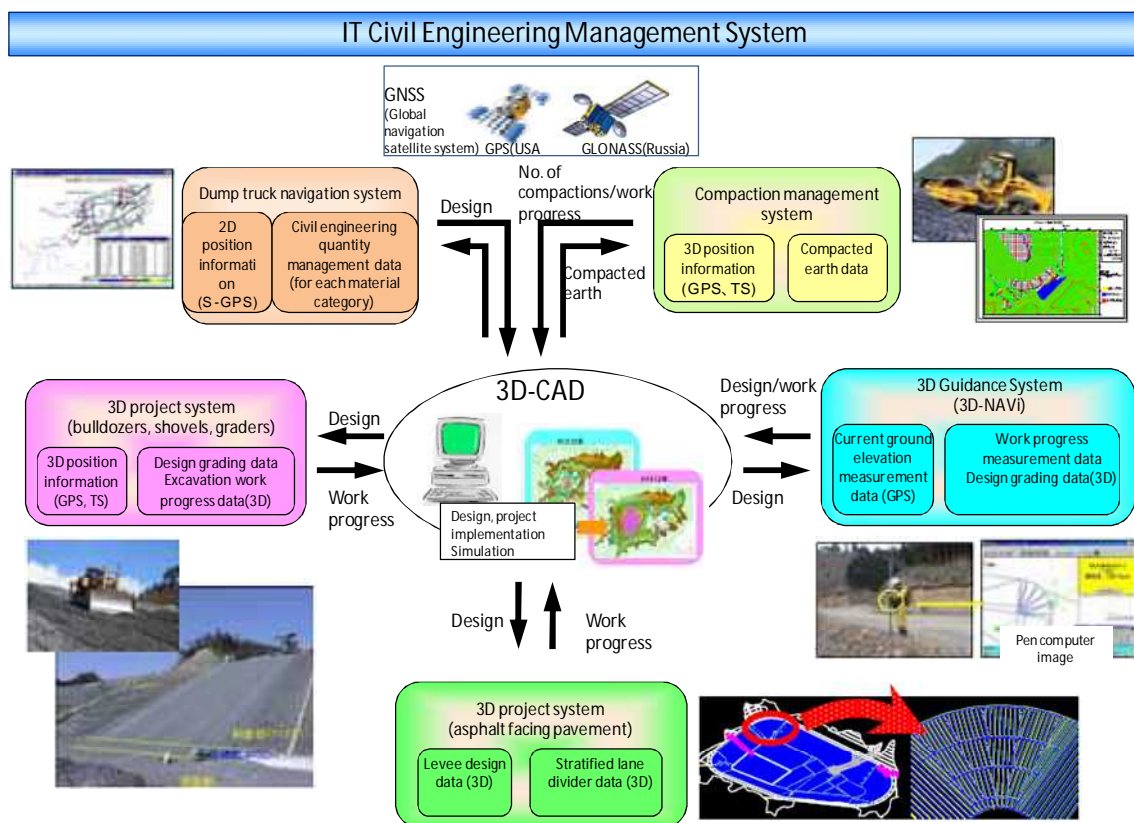
Increasing project efficiency is an effort to simplify project management and quality management through the use of various kinds of information devices that promote mechanization and labor savings. It will also save labor in various construction processes.

For example, construction machinery can be automatically operated using GPS, total stations, and 3D design data made possible by 3D CAD. Because these systems can ascertain height and other positioning information in real time, they eliminate the need for on-site positioning

adjustments and thus save large amounts of labor. Also, because they do not rely on the skill or experience of the operator, they make consistent, highly precise operations possible. By eliminating the need for unnecessary motion and because it can be operated with a minimum number of personnel, it also has the advantage of improving safety.

There are also examples of information networks being used to increase efficiency. Installation of a Web camera at a work site makes it possible to confirm project progress in real time and shortens the amount of time needed by specialized contractors for preparation. Also, the use of cell phones and the ability to communicate information on repairs, building diagnostics, and regular inspection information using digital cameras and computer applications, saves large amounts of labor and cuts down on the use of paper.

Figure 10 Example of IT use in project implementation



#### IV. Conclusions: the Future of the Japanese Construction Industry

The excess supply in the construction industry is casting a long shadow of corporate bankruptcies. Bankruptcies among construction companies in the first half of 2008 (Teikoku Databank, TDB) reached 1,633, a 16.2% increase over the same period last year, particularly among large and medium-sized companies prominent in local areas. These failures can be attributed to a decrease in public works projects, a recent increase in the prices for materials, and the financial collapse of condominium property companies.



Price dumping and bankruptcies due to the imbalance between construction supply and demand are increasing, and the number of construction companies has not declined in conjunction with the decrease in construction investment. These negative impact that subcontractors and workers has been suffered from, has been a factor in reducing productivity in the construction industry. Also, the construction worker population is aging due to overall population decline, and the transmission of technologies and skills to future generations poses a pressing challenge.

Policy efforts include projects to support expansions into new industries, as outlined in the construction industry policy for 2007, "Promoting Restructuring Efforts." MLIT is promoting, under the "Supporting Program for the Construction Industry to Modeling in Expansion into New Fields and Management Reform /in Securing and Training Skilled Construction Worker", the management reform efforts that contribute to productivity improvements being undertaken by local construction companies and efforts to contribute to the recruitment and training of skilled construction workers various companies. MLIT is accepting public proposals that meet certain criteria for projects deemed to be model cases, and highlighting the most progressive cases and widely disseminating information about these cases, The construction industry has contributed to the local community during emergency situations through emergency response and recovery actions in the past. However, as a industry with strong ties with the local communities, it is also expected to be a new player to fulfill the service needs of local government such as public facility maintenance and management, to work in agricultural industry in which human resources are seriously lacking, and to supply public transportation and welfare services in the underpopulated regions.

Utilizing ICT is important in construction production systems. In Japan, high-speed communications networks, including optical fiber networks, have already been developed, and this has allowed the expansion of electronic bidding and electronic delivery. The country is developing an environment in which construction companies can take full advantage of ICT.

CAD technologies are developing from conventional 2D and 3D systems to new-generation object CAD and 4D CAD systems. Object CAD is a technology for sterically creating a design on a computer screen by not only using the shapes of objects (architectural components such as walls, pillars, and fittings), but also by integrating the parts with the information related to their materials, dimensions, shapes, colors, and weights. With the addition of the concept of time, it has become possible to assess the process conditions in four dimensions. As a result, it has become possible to (1) easily transmit and share all information related to a project, including quantitative information, (2) accurately ascertain the content of a project intuitively by improving visibility, and thus to improve customer satisfaction, and (3) use the information entered into CAD programs as maintenance and management information, thereby contributing to appropriate post-project asset management.

Building Information Modeling (BIM) using new-generation CAD systems makes it possible to

link tasks based on the accumulated information once all the necessary information related to the life cycle of the construction product has been entered into the system. BIM is also useful insofar as it shortens project times for both builders and clients, and insofar as it can be used as a tool for asset maintenance and management.

Application of ICT in the construction industry has lagged behind other industries. However, while there is some difference between large companies and their small and medium-sized counterparts in terms of ICT implementation, progress is being made on the adoption of ICT by construction companies as a whole. ICT is now well recognized as an effective way to improve business efficiency and reduce costs.

In the future, companies will need to improve their engineering and management skills if they are to survive in a competitive marketplace, and ICT is sure to be more widely recognized as an effective tool for achieving this.

Construction companies are striving to upgrade the construction production system by working to integrate ICT into the construction industry, and striving to achieve corporate management that takes full advantage of the unique character of the construction industry and its intricate network of clients, designers, and builders.