The 5th International Symposium on Robotics in Construction June 6-8, 1988 Tokyo, Japan

ADMINISTRATIVE MEASURES TO TAKE IN ADVANCEMENT OF ELECTRONICS-ORIENTED BUILDING CONSTRUCTON TECHNOLOGY

Tatsuo Terai, Dr. of Engineering
Senior Researcher
Building Research Institute
Ministry of Construction

Tatehara 1 Tsukuba Ibaraki 305, Japan

ABSTRACT

Several factors concerning to rationalization of building construction technology are dealt with from the administrative point of view, with special stress on utilization of electronics-oriented advanced technology. Once behind other major ministries in connection with this kind of technology, MOC, the Ministry of Construction has been getting more affirmative to its utilization. Two cases are presented for example. The overview of the objectives and results on related national R&D project are described in rather detail.

1. Preface

It is supposed that Japanese beaurocracy system has worked so well that it has contributed to much extent to the amazing economical growth in its postwar period. Governmental officials responsible for setting up relevant policies at individual ministries should therefore have stronger interest and longer sighted prospect on social and technical development in related applicational fields. Good examples are MITI, the Ministry of International Trade and Industry, and MPT, the Ministry of Posts and Telecommunications. They have launched such national projects as Fifth Generation Computer Development Project and Teletopia Project to promote smooth and rapid technical transfer in relevant industries.

As for MOC, however, countermeasures are taken more carefully and deliberately. It has been considered very difficult to drastically rationalize many kinds of construction works especially on site. Construction industry is quite different from production industries and needs much more time and scrutiny to cope with big and comprehensive technical change in proper way.

Circumstances have changed slowly but steadily. They say technical development in Japanese construction industry has long been led by a few biggest general contractors with support of the ministry. Very strict competitive situation in the industry leads them to strive for getting rather high R&D ability and long sight for the future. It can be said that they have shared the role with relevant public bodies to enhance the technical level of the whole industry. It is several years ago that MOC started to put stress upon the necessity to set up some measures as for utilization of high-tech oriented construction technology. In those days, we had come to see relatively many applicational cases of advanced technology mainly in the bigger constructive practices. It is said that the opportunity has matured for the ministry to take some measurs in this field.

2. Administrative measures

Among those which have already taken in the concrete form, most influential ones on construction robotics are the setting up of the minister's advisory meeting for utilization of front edge technology, and the adoption of the R&D issue relating to effective use of electronics in the industry as the main theme of GPTD, General Project for Technical Development.

2.1 Minister's advisory meeting

This advisory meeting had been held from April to November in 1984 to establish an official guideline of the ministry to cope with advanced technical development. It should be noticed that it was the first official announcement concerning to long term policies of the whole ministry. At the meeting, front edge technologies were classified into six fields of application, new media, electronics-oriented mechanization, laser, biotechnology, new materials and advanced site construction technology.

Fundamental issues to be taken notice in affirmative use of front edge technology are reported as follows:

(1) Common recognition as for technical development
- Technology and society should be closely connected as wheels on both sides of one automobile.
- To cope wuth diversified needs of users, construction works have to acquire rather individual and applicational technology than general one.
- Technology has been specialized in accordance with the advancement.

(2) Fundamental requirements in utilization of front edge technology
- It is important to catch relevant needs in ordinary works, for dreams in the earlier can be realized in the contemporary technological situation.
- New technical fields might be born by some combinations of techniques without any roots on front edge technology.
- Dicisions for application of front edge technology should be made timely and carefully in consideration of cost and effect for each technology.
- Interdisciplinary technical development and synthesizing of specialty technology are needed to meet wide and diversified needs of the industry.
- Strict condition not to bring failures should be taken note of especially in public works in such a small country as Japan.
- Technical innovation concerning utilization of front edge technology should be promoted with deep consideration of influences on society and environment.

(3) Else
- Even in construction fields, technical developments such as space and ocean development project should be conducted more affirmatively, for such big projects are strongly influencial in various wide-range technical fields.
- Development of technology applied in developing countries is required in order to cope with internationalization of construction technology.

2.2 General Project for Technical Development.

Another important measure conducted by MOC is an execution of a R&D project called "Development of systems with advanced construction technologies utilizing electronics (code name, ACT, is used in this paper)" as one of the national projects in a series of GPTD. It is noticed that this is also the first R&D project in the series concerning utilization of high technology in construction industry. GPTD series was established in 1972 to cope with very important, comprehensive and nationwide R&D tasks, and is regarded as one of the biggest R&D projects sponsored by MOC.

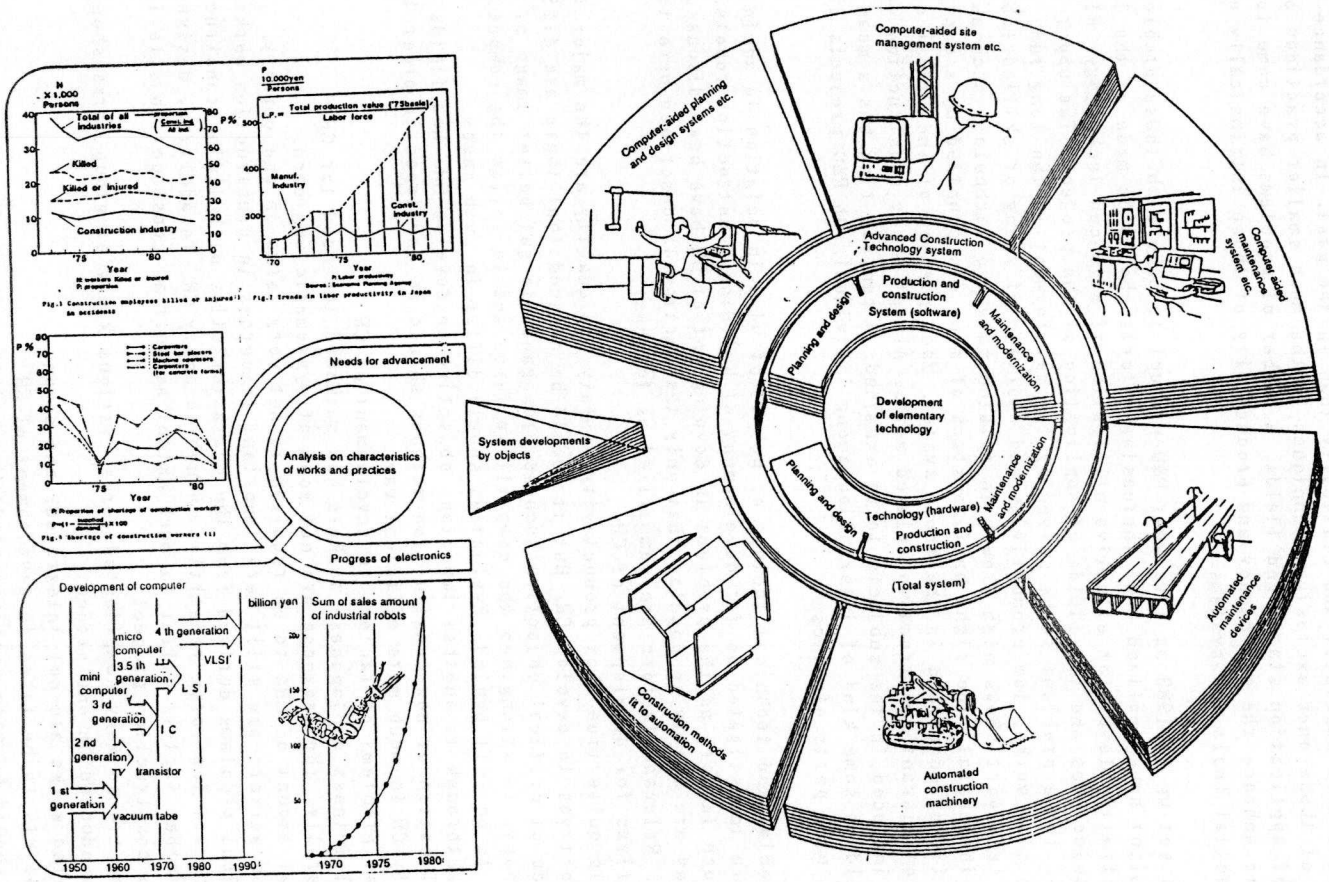

Fig. 1 Diagram of ACT project / Objectives and fields of application

It can be said that Japan is one of the leading countries in utilization of advanced technology in construction activities. Such systems like CAD, construction robot (CR) and construction database service have already lost their novelty in these few years and are now in the proceeding stage to be evaluated their adaptability and cost effectiveness more carefully and critically than in the past. In accordance with the diffusion of those once exclusive techniques to the much smaller practices and the widening of application stages and fields, a number of problems have come to be known in order to enhance the efficiency and productivity of those intrinsically expensive and influential tools and systems.

ACT was set up in 1983 as five year R&D project to cope with these problems. The ministry might have realized that increasing efforts should be made at the industrial or administrative level for effective utilization of advanced technology. FIg. 1 shows the main objectives and the fields of application of the project. The upper left part shows major three problems to be solved by the development in the long run, that is, dangers in site works, low productivity and shortage of young or skilled labourers. The lower left part shows high growth in related advanced technology such as computer and robot in general. The right half, a stack of many discs united by a central ring, shows the fields concerned in the whole system. Each portion of individual disc corresponds to relevant construction-related works. Almost every construction activities are to be included in the subjects to be examined. A central ring has a meaning that there should be some kind of integration among individual sub R&D projects in correspondent to each parts of discs.

Major social and technical factors or points of view in relation to administrative measures are investigated as for development of building construction robots. Although such factors as the problems in development of CR have been discussed in detail, they are mostly so popular that only the portion is described here to exclude redundancy. Relevant factors are summarized as follows;

(1) Objectives for development of CR
- It is quite true that productivity, safety and quality are the major three objectives to develop CR. But it should be noticed that there are different kinds of critical objective such as propaganda to get better image of the company, to strengthen the competitive force and to follow the competitors not to be left behind. Evaluation should differ in such cases.
- Breakthrough is another important objective to develop CR. New fields of application or new construction methods should be developed in order to apply CR in much more efficient way.

(2) General problems or factors in development of CR
- Skillfulness of Japanese workers has weakened the need for CR.
- Generally, the Japanese are not good at systematic approach.
- Total amount of CRs to be required is not very large in one country.
- Human workers are still very important resources in construction works.

(3) Technical problems derived from the characteristics of building construction
- There are few works repetitive enough to apply CR. In addition, design and other factors differ to much extent as well as construction site in each construction project.
- There are so many complicated works. Various kinds of group works should be conducted in one project.
- Related works are not integrated, and so on.

(4) Standpoints to be taken in development of CR
- CRs should be more sophisticated than ordinary production robots (PRs), so that, approach to development of CR is to be different from that of PR. But it is reasonable for CR to utilize PR as basic body, for example.

- Application of CR should follow rationalozation of construction methods. Industrialization is to be the second step to take. The first step is to establish the concrete image of future construction related activities.
- Conventional works are suitable for human workers. New way of work and materials suitable for CR should be devised.
- Comprehensive systematization is required to improve productivity. Partial improvement must be valuable if some kind of quality might be enhanced.
- Completely unmanned construction is not feasible even in the future, so that, it should be very important to optimize man machine interface or relationship
- It is preferable for individual CR to have wide field of application without any overabundance.
- Standardization is one of the critical points to develop useful CRs. It should be undergone both on building construction side and on machinery side.

(5) Subjects to be dealt with by administrative bodies
- evaluation of CRs or relevant systems developed by private companies
- to bring up manufacturers affirmative in development of CR
- measures to urge and support contractors to use CR in individual project, that is, model project, change of design and so on
- financial and taxation measures to accerale development of CR and relevant devices
- reconsideration of legisrations concerning automation of construction works
- development of elemental devices and technologies used in common to develop various kinds of robots
- identification of specifications for relevant elemental items to be aimed and attained in actual development of CR
- identification of CR through wide range and long term prospect, and so on

3. Conclusion

There should be two approaches to cope with technical development on public sectors. One is to establish common base to be able to bring up individual applications, and the other is to develop prototype model to clarify individual specification to be required and demonstrate the possibility of development for much more sophisticated items. In ACT project, R&D study for CR takes the latter approach. To the contrary, R&D study for information oriented technology takes the former one. Fig.2 is one of its results to show standardized information flow through the whole building production process. Study for CR could have taken this kind of approach.

Japanese contractors and manufacturers are competent enough to develop actual CRs, so that, administrative bodies should not develop CR in itself but consolidate background to support practices on private sectors. Next step to take is to carry out the preferable measures listed above.

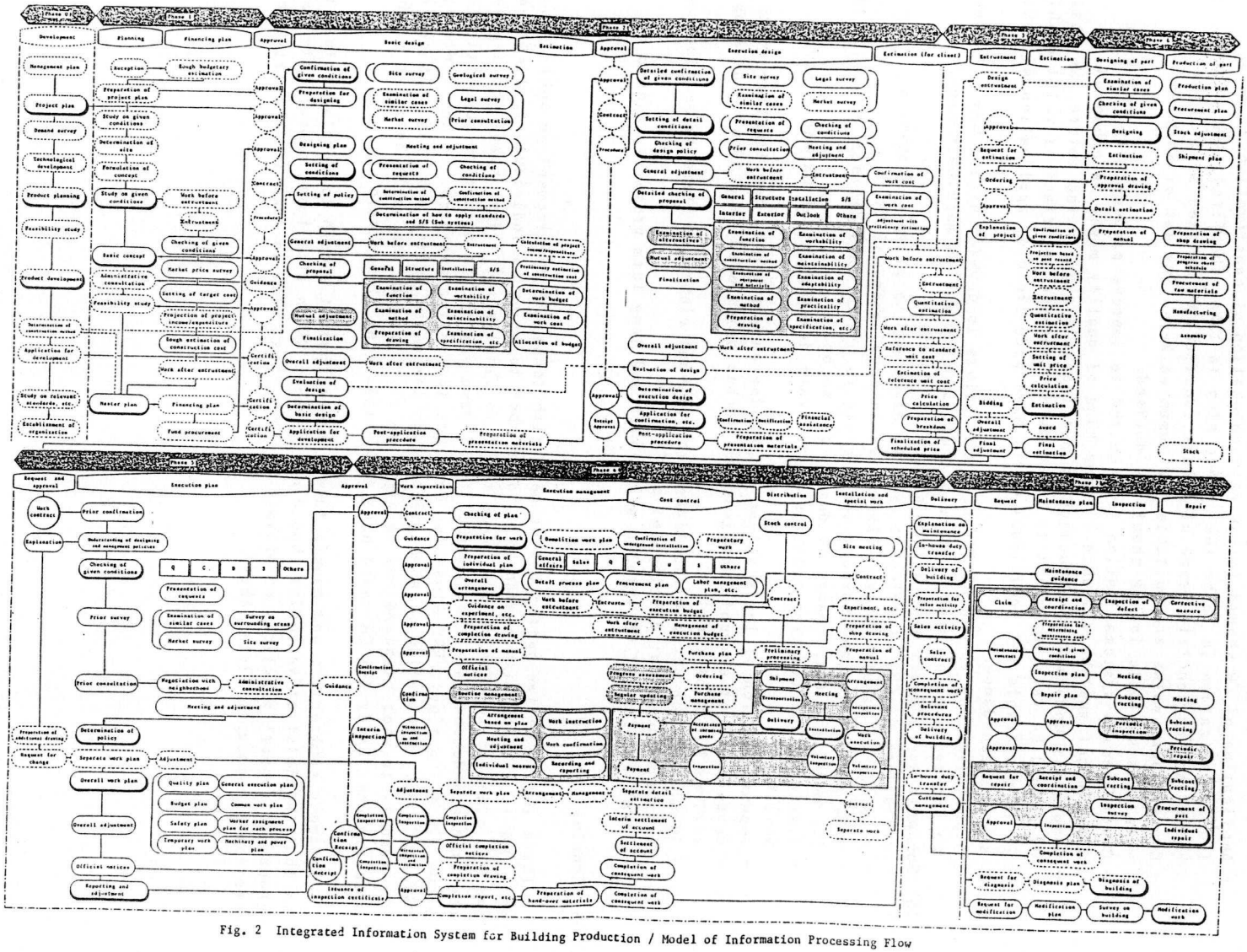

Fig. 2 Integrated Information System for Building Production / Model of Information Processing Flow