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Study on Method Improvement for Construction Work in Civil Engineering

Tomoji Takatsu
Masashi Nomura
Atushi Sugiyama

Construction Equipment Division
Construction method and Equipment Department
Public Works Research Institute
Ministory of Construction
1-Asahi Tukuba
Ibaraki,Japan 305

ABSTRUCT

Facilitating streamlined and efficient construction works requires the introduction of sophisticated work practices and robotization to what are existing complicated construction processes so as to improve productivity, ensure safety, and further reduce the hard nature of the work by a quantitative method. In other industry, as a part of industrial engineering, various actions that are undertaken have led to good results, while little consideration has been given to such matters in the civil engineering field. Therefore, certain standards must be studied for method improvement for construction work in civil engineering, and construction managers must share a uniform awareness. In this study, authers discuss investigation and analysis methods for coping with these challenges, with actual practical applications taken into consideration.

1.Introduction

With recent remarkable progress in economic standards in society, there are increasing demands to intesify quality of social capital. Therefore, in the construction industry, higher quality and precision works must be impremented. On the other hand, construction industry with its comparatively hard and dangerous has seen its workforce grow older and combined with the lack of experienced workers have a decrease in construcrion labor productivity. Under these circumstances, efficient excution of construction works requires the improvement of not only construction equipment but also new improvement methods which consider the entire excution process.

By the way, the mechanized excution in civil engineering works has been impremented by utilizing hydraulic equipment, developing larger and more high-powered machinery and attachments which are adjusted to various excution processes and sites. As the various construction equipment and excution methods are closely associated, improvement efforts rely on a few experienced workers who can select a single work type, process and machine to

be improved and take required actions. Furthermore, objective evaluation of results can not be expected in most cases, with regard to such efforts for improvement.

Thus, civil engineering works which consist of complicated work processes require analytic, quantitative and objective representation of the problems involved and guidelines for solving such problems. These corrective actions would allow civil engineering works to be mechanized and robotized, and also productive efficiency to be increased, safty to be guaranteed, and the hard nature of work to be allevitated.

2.Direction for Method Improvement

The method improvement for construction work in civil engineering has been made on the basis of the experience and knowledge of exparts but involves the following problems:

①Conventional construction improvement methods requre highly experienced personnel with advanced technical knowledge. Training such experts is not always easy.

②Being based on practical knowledge and experience, such methods are associated with subjective elements.

③With these methods, qualitative improvement is possible but improvement based on quantitative data is difficult to achieve.

Therefore, it is difficult to assign priorities to the problems involved in work improvement efforts, to set targets for such efforts, and to predict and evaluate their efforts. If works can be proved on the basis of quantitative data, the above problems will be solved.

In addition, one of the typical modern quantification methods for civil engineeringwork data is a production rate investigation. This is an investigation methods in which average indices are produced from several hundred data about standard construction units such as work procedures, available resources (workers,equipment and materials),and hours of work. However, these data are not usually adequate for understsnding problems and working out improvement plans to achieve the improvement targets. That is, the production rate investigation aims at average values in terms of the solution of data, relationships between the various opepetions, and handling of the characteristics and conditions of the construction site. And the production rate investigation cannot digitally reproduce the situation of the actually works in question and improve the works objectively usuing this data.

On the other hand, improvement efforts are made on the basis of work data at manufacturing factories. Such quantification and analysis methods are termed as industrial engineering (hereafter referred to as "IE"). The IE concept was established by Tailor. Subsequently, new IE methods have been developed to increase the scope of the concept. Also, IE has an increasing range of applications including not only manufacturing processes but also various management procedures such as office works(ref.figure-1).

The architectural sector introduced IE about 10 to 15 years ago and has largely achieved good results. Such objective method improvement efforts seem to be effective for civil engineering. However, the characteristics of the civil engineering have to be considered to apply this method improvement in civil engineering.

Table-1 lists the characteristics of civil engineering works.

These are due to differences in work analysis levels and analytical objects, and the table also shows that the method improvement in civil engineering requires taking a little different approches other than those related to the method improvement for factories or architectural sector.

3.Applying a Improvement Method for Construction Work in Civil Engineering

Before applying a improvement method, various types of methods must be systematically classified and reviewed to obtain a common standard for civil engineering works. IE mainly aims at the improvement of productivity, but method improvement for civil engineering must also cope with productivity, the hard nature of the work and safty. These days, people tend to avoid being engaged in construction industry which is popularly believed to be hard, dirty and dangerous aspect of the work.

Traditionally, various attempts have been made to increase the efficiency of labor or construction equipment at the site. Some reduces good results, but a great deal attempt ended up producing only casual ideas. Additionally, many investigations which are presented at many lecture meetings or seminars have been made in order to grasp the real situation of a paticular work process and to streamline it. However, some of such investigations do not use appropriate measuring means or handle data properly, so it is difficult to use the findings as a common data source.

Thus , to standardize procedures and methods for work measurements as a common data source to be utilized by persons who plan or manage the work, a manual have been studied.

Figure-2 shows the flow of method improvement in civil engineering. This manual flow is primarily intended for site construction managers, for example, the chief of a work office of regional bureau in the ministry of construction or the construction manager of a private general contructor. The features of it are as follows :

①It contains a flow that proceeds from general concept to the description of the investigation through specific examples (a series of examples are shown at the end.).

②Indices are used if the general concept or investigation section requires specific examples.

These features are probably effective when this manual is actually used. This flow and the ideas involved not only deal with the improvement of constuction equipment but also take the replanning of construction procedures into consideration as described earlier.

However, it is very hard to select evaluation criteria for the hard nature of work and safty. Also, it is desirable to reflect upon the nature of monetary cost, which are not described in detail as an evaluation index, because costs depend highly external factors(shortage of labors, business situation often changes, etc.).

Since it is an urgent present day matter to establish a method improvement for construction work in civil engineering, a foundation for the method can be provided by introducing new ideas, showing planning methods and specific measuring methods, and presenting specific examples(road maintenance and repair work, earthworks, tunnel works, offshore breakwater).

4.Conclusion

In Japan , there has been as yet no attempt to manualize on method improuvement for construction work in civil engineering. Under the guidance of Construction Equipment Division of Public Works Research Institute, Ministory of Construction, the "Subcommittee for studying a manual on Method Improvement for Constructi on Work" has been established at the Advanced Constection TEchnology Center(ACTEC) and a draft is being studied with the end of May 1993 as the target date for its completion.

We hope by utuilizing this manual to standerize the procedure and methods of construction work measurement to a common data source to be utuilized by manement and engineers in charge of constuction planning and which will allow civil engineering to become more efficient.

5.Acknowledgement

We would like to note that we referred to findings from the "Subcommittee for studying a manual on Method Improuvement for Construction Work" (Chairman: Prof. Nobuyasu Miura of Kokushikan University) when writing this article. Also, we would like to express our deep appreciation to Prof. Miura, Dr. Eiji Muro(Vice-chairman of the subcommittee, Takeneka Komuten Technical Laboratory) and other subcommittee members for their kind and helpful advice.

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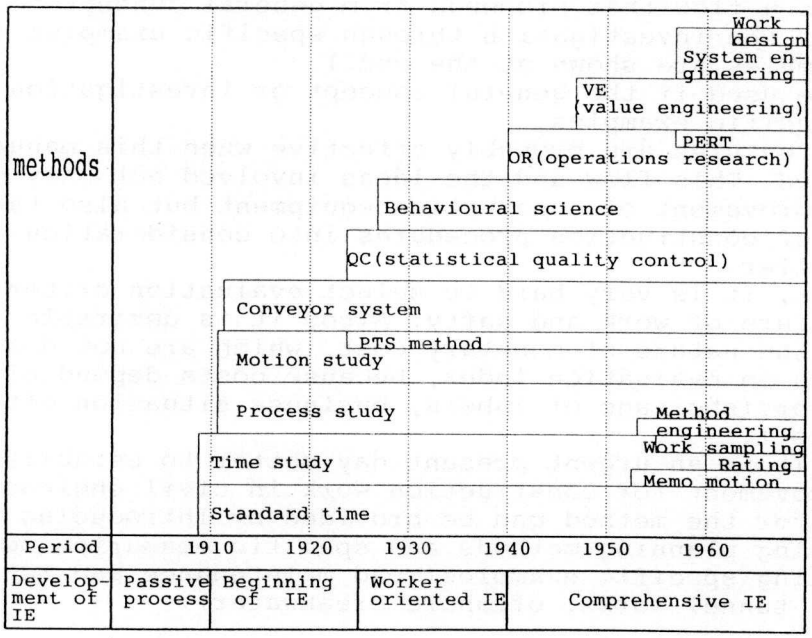

Figure-1 History of IE

Table 1 General Differences between Factories and Construction Sites and Civil Engineering Sites

Comparative items		Factory	Construction site	Civil Engineering site
Personnel	Works with fundamental operations	Few	Many	Many
	(example)	Cutting machine operation	Normal work	Maritime civil engineering work
	Works in which a single person involved	Few	Many	Many
	(example)	Electronic parts mouning	Reinforcing-bar placer	Blockwork
Machinery	Operation skill	Not required greatly	Required	Required
	(example)	NC finishing machine	Crane	Power shovel
	The number of work processes a single machine is responsible for	Constant	Several	Many
	(example)	Cutting machine operation	Crane operation	Power shovel operation
Work place	Range of work	Constant, small	Variable, small	Variable, small
	(example)	Production line of a be-lt conveyor	Reinforcing-bar placer	Tunnel work, Concrete spraying
	Work environment	Constant	Variable	Quite variable
	(example)	Cutting operation	Crane operation	Maritime civil engineering
Characteristic of work	Transfer of personnel	Never	Rare	Frequent
	(example)	Cutting operation	Formwork	Maritime civil engineering, riprap work
	Transfer of machinery	Never	Frequent	Frequent
	(example)	machine tool	Crane	Civil engineering or transport work
	Time period of work unit	Short	Long	Long
	(example)	Automobile parts mounting	Crane operation	Foundation work
	Work procedures	Fixed. Possible to follow them without change	Fixed but sometimes changed	Sometimes fixed but dependent usually on the circumstances
	(example)	Automobile assembly	Reinforcing-bar placer	Tunnel work, chiselling

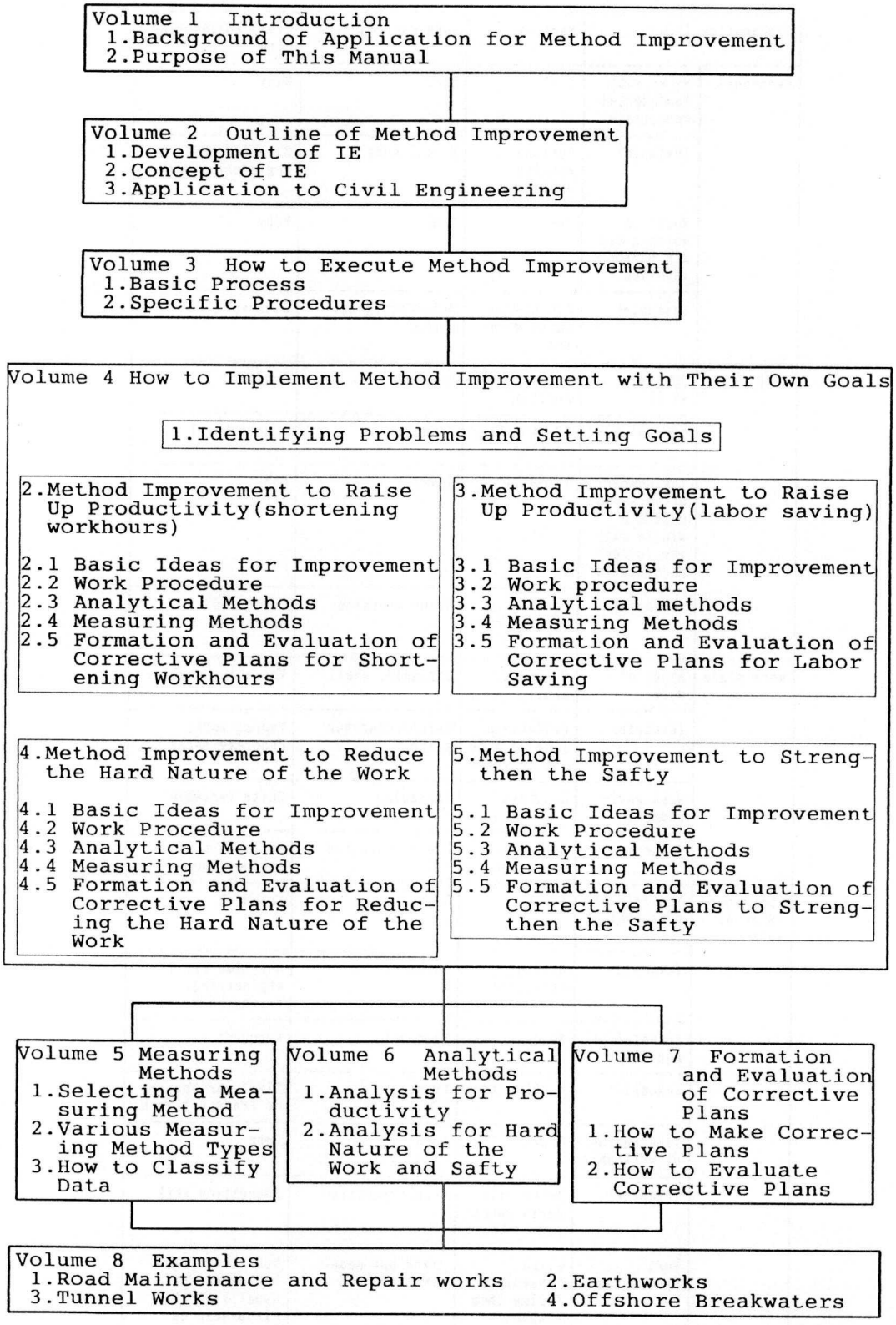

Figure-2 Flow Chart for Method Improvement in Civil Engineering