



## Engineering construction project site logistics management

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### ABSTRACT

The engineering construction project logistics management is the plan, the organization, coordinated and the control carries on to the logistics activity, from the function angle minute, may divide into the engineering construction project physical distribution the supply physical distribution and the scene physical distribution, through the analysis engineering construction project physical distribution's characteristic, elaborated with emphasis the scene physical distribution's key question is the information flow optimizes, the plan to formulate and to control, the scene arrangement, the owner, the design business and contractor's tertiary role, has carried on the preliminary discussion to it. And proposed that the establishment special physical distribution management group management engineering items of basic construction physical distribution, guarantees the physical distribution effective operation. Finally, it distinguishes the key responsibility of logistics management owners, designers, main contractors and specialist contractors and manufacturers, suppliers and vendors.

**Key words:** transportation engineering construction project; logistics management; site logistics

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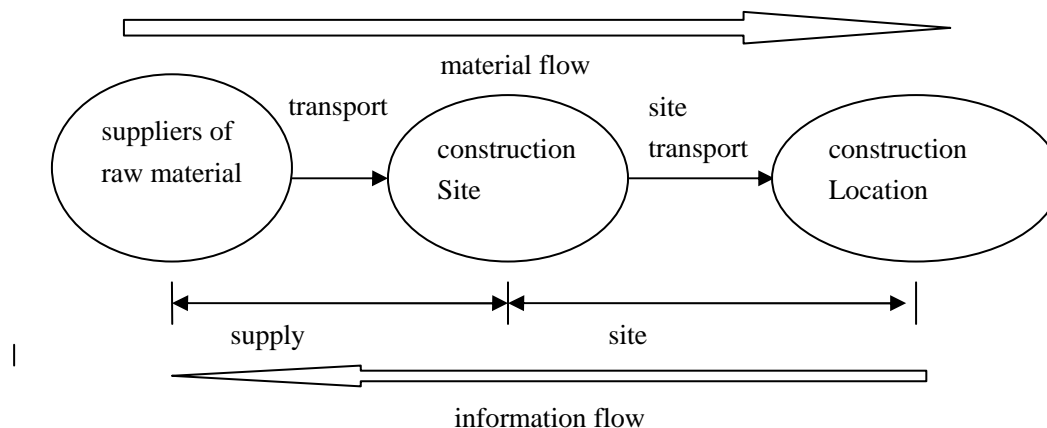
### INTRODUCTION

The engineering construction project's investment is quite generally big, particularly the big-scale work items of basic construction, usually the investment cost reaches as high as above several billions Yuan. The investigation showed that the material cost will probably occupy the engineering project construction cost 60%~70%, but the delivery service expense will account for the material cost about 17%, i.e., the physical distribution expense will approximately compose the engineering project construction cost 10%~11%, obviously physical distribution activity in engineering construction project important economic impac<sup>[1-3]</sup>. But in reality, the engineering construction profession far has not given regarding delivery service's value proper takes seriously, therefore, enhances the engineering construction project the physical distribution management level, to excavates the project delivery service the value fountainhead and the promotion entire engineering construction project benefit has the vital role.

### THE CHARACTERISTICS OF THE LOGISTICS OF CONSTRUCTION PROJECTS

#### A. The meaning of the logistics of construction projects

The engineering construction project physical distribution is a multi-disciplinary process, including all materials, fitting, commodity concretes, equipment and so on purchase, transportation, warehousing, loading and unloading, transporting, packing, allocation, information processing and so on entire process<sup>[4]</sup>. During this process, before construction activity and in the construction active procedure's plan, the organization, command control, seeks in the appropriate time, the correct position, by the inexpensive cost and the high quality, guaranteed: Material supply (including material purchase and transportation), memory, processing, scene material management, scene infrastructure, scene arrangement, machinery, supply of equipment, plan control, labor force supply, as well as all and physical distribution and service class related information<sup>[5]</sup>. The processes of the engineering construction project logistics was shown in Fig. 1.



**Fig. 1: Logistics Process of Construction Project**

The engineering construction project physical distribution management is the plan, the organization, coordinated and the control carries on to the physical distribution activity<sup>[6]</sup>. It is for the purpose of making the project process to be easier and quickly, simultaneously obviously and controllable.

In view of the fact that the engineering construction project physical distribution constructs scene the physical distribution cost to account for the entire project physical distribution cost the very major part, says from the function angle, may divide into the engineering construction project physical distribution the supply physical distribution (or is called the exterior physical distribution) and the scene physical distribution (or is called internal physical distribution). The supply physical distribution and in the production process circulates the work activity related, the basic activity includes: Definite resources (material, equipment and man-power) specification, supply plan, resources purchase, storage control, ex works. Scene physical distribution and in scene production process material plan, organization, direction with control related, including: The scene transportation and the delivery, the field processing, the scene operating system management, the safety equipment, the site layout, the work order's arrangement, as well as between various engineer brigades conflicts solution measure.

#### B. Characteristics of construction projects of Logistics

Compared with traditional logistics, from the structure and function point of view, the logistics of construction projects has the following characteristics:

**The gathering logistics:** It is one unidirectional, the gathering physical distribution, all materials, the equipment are transported finally to construct the scene, and completes the product with these materials. Constructs the factory to establish regarding this sole product<sup>[7]</sup>. The owner or the investor are consumers, usually before the construction process started already to determine, the construction completed the construction product through the quality testing department and so on examination, is considered qualified, indicated the project to be completed, items of basic construction on reassignment for the first party or owner, expression entire physical distribution process conclusion. Therefore, usually only then the material inflow physical distribution actually does not have the product to flow out the physical distribution or sells the physical distribution. This forms the contrast with the general Industrial enterprise's production physical distribution. Generally Industrial enterprise's production physical distribution not only includes the material the inflow, but also includes the product outflow, each product through the plant production, assigns for many customers or the downstream producer. Some also have the recycling physical distribution, therefore, the physical distribution activity circulation carries on.

**Logistics plans major uncertainty:** The engineering project production process and the transportation process's nonuniformity, has various project change frequently, causes the resources the demand and supplies non-uniform, in addition the massive uncertainty factor, causes the resources the variety and the amount of use in the construction process the large scale fluctuation. The construction process uncertainty is big, the delivery service place's mobility, the perfect forecast demand, the plan change is with difficulty frequent, causes the material demand uncertainty to be high, the very difficult elephant Traditional enterprise such to form the accurate material detailed list, simultaneously, is also not easy to control the stock. The physical distribution plan receives the external factor influence to need frequently to carry on the revision.

**The complexity of logistics management:** The engineering project construction is typical face the order form production process. According to the contract provision, in certain investment quota, the stipulation time disposable

completes the project the function goal and the quality objectives. Therefore needs the resources, the time, as well as the project function and the quality objectives has the explicit restraint. The physical distribution management's complexity and constructs the process by supplier's dispersivity the parallel decision<sup>[8-10]</sup>. And with the physical distribution related design, the processing and so on is in the different enterprise and the scene separately; Physical distribution supplier's raw material, the outsourcing supply transport network also distributes in each region. The engineering construction project and various sub-items project are parallel carry on from the design to construction each link. These request the physical distribution system strictly according to the plan coordination dispatch movement. To these behavior's management and the control are an engineering construction project physical distribution management big difficulty.

Service mode more flexible, diverse: Construction materials required for the project a wide range of diverse nature. Bulk materials including steel, cement, sand, etc., with big, wide covering the characteristics, needs large-scale logistics facilities and equipment to complete loading and unloading, and need more space storage. Some materials must be provided not with the supply off so that the normal operation of the construction. Some materials require special packaging, transport and storage and warehousing methods. These factors greatly increased construction projects logistics warehousing, packaging, transportation and other sectors of the technical requirements, increasing the difficulty of logistics to make it more diverse and complex, on the logistics of construction projects put forward higher requirements.

Storage costs highly: Construction site storage is limited, high cost, especially for tight urban construction site. Warehouse construction site is usually temporary built, with the completion of the project, are generally removed. So not only is very limited, and the amortized cost of major. Make on-site storage costs particularly high<sup>[11]</sup>.

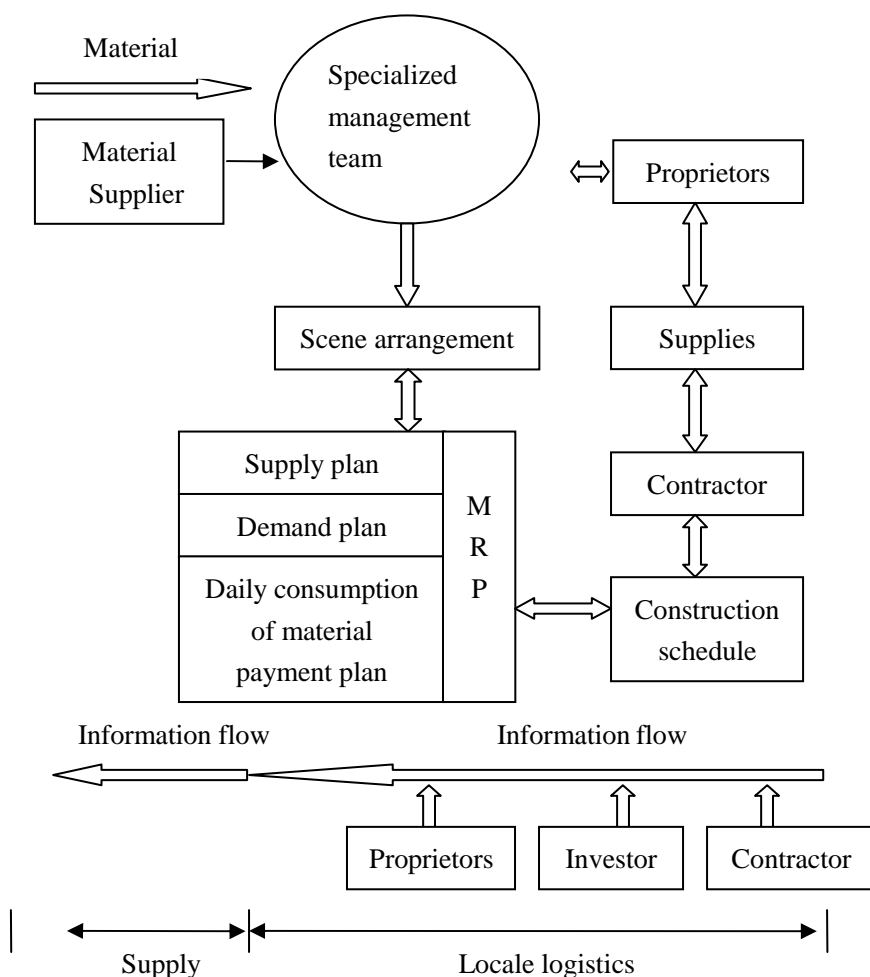


Fig.2: Logistics Management Framework Model of Construction Project

### THE MAIN CONTENT OF THE SUPPLY LOGISTICS MANAGEMENT FOR ENGINEERING CONSTRUCTION PROJECTS

There are variety problems what about the supply of building materials in construction, these problems could be a great impact on their productivity. Logistics management is vital management tool if focus on the process of building from the logistics point. This management should be a whole strategy that ensures the flow of material. Fig.2 shows the model of project logistics management. To improve the spot organization and the whole construction process through control the material flow which from supplies to construction site and internal construction site.

The supply logistics management of engineering construction is similar as the traditional engineering construction. However, although there has lots of researches for traditional engineering construction, this essay would introduce from the interface between the field of logistics and supply logistics, which is suppliers' delivery.

This article divided three levels for material requirements planning, which are supply plan, demand plan and daily consumption material delivery plan. The suppliers would clearly understand these three plans in the early design process and the local area network or the Internet as understanding the needs to delivery of the material. Hence, they could actively tell the project's managers about the potential problems in delivery. The project's managers should change the production plan, according to the material which had been found problem. This method could give suppliers deliver the responsibility of the materials needed to each work.

This essay would take the frequently parameter, which is time buffers, for the actively delivery to make sure that the materials for some projects would arrive on time. Hence, the suppliers delivered the materials, according to the material requirements planning and buffer days. As shown in Fig. 3, is a single item of projects as a week plan. Assume that the project time buffer for 2 days, suppliers' delivery needed time for reinforcement is two days. Another supplier delivery time is a day of the brick. Therefore, steel suppliers should be started in the job four days before the delivery, and brick supplier should be three days in advance shipment for the work on Friday.

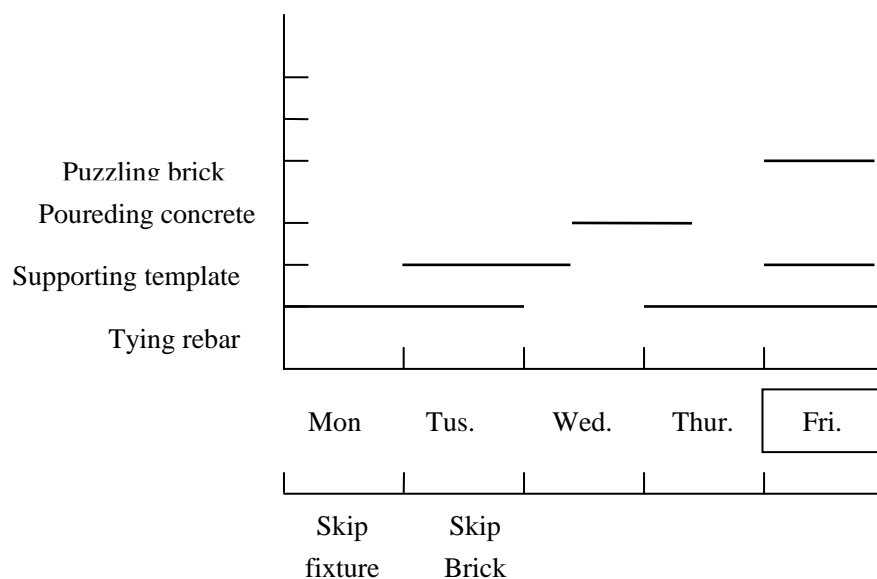


Fig.3: Suppliers' Pro-active Delivery

### ENGINEERING CONSTRUCTION PROJECT SCENE LOGISTICS MANAGEMENT PRIMARY COVERAGE

Logistics management is an important management tool to ensure the flow of production materials, the overall strategy. Construction project management and supply logistics similar to the traditional logistics management<sup>[12]</sup>. The traditional theory of logistics management is more and more mature, in order to avoid repeat, this paper described only from the on-site logistics management.

Construction project site logistics is an important part of logistics. Logistics management requires accurate delivery date material plans to suit the actual site plan and storage arrangements. Otherwise, it will lead to the construction schedule delays and interruptions, or resulted in the storage, handling and transportation process a waste of

resources. The scene logistics management's main challenge is the information prompt transmission, works out the multi-level dynamic plans, to determine that the scene arrangement, through the perfect material tracking system determination work level material as well as the stock, the change tradition's architecture industry interior cooperation's pattern and so on, lays the solid foundation for the precise acquisition of material and the payment.

#### A. Information flow optimization

Information is the basis of logistics, the information is not accurate and delays directly affect the success or failure of logistics. The items of basic construction information content is big, the great variety, from the decision-making, the design and the construction and so on each stage as well as the owner, the investor, the chief contractor, divides the contractor, the design side and so on each participant, and needs each participant's centralized decision-making. Moreover, the items of basic construction information along with the project progress, the field condition changes unceasingly changes<sup>[13]</sup>. Constructs the scene usually to have the massive design alteration and the scene instruction, needs to hand in the application, after obtaining the project management side and owner's authorization, only then may do the work, afterward will change the result and the instruction rear-drive gives various requesters in the verification. These changes and the modification of orders have needed each material, the equipment and the construction machinery, have the direct influence to the material flowing. Therefore, the information real-time, transmits accurately for needs the essence one by one in order to makes the response and the revision is the physical distribution smooth operation guarantee promptly, thus causes to use each advanced method and the information technology optimization information flow is especially important.

#### B. Plans to develop and control

From the operational point of view, affect the efficiency of the supply of logistics management is an important aspect of the production plan. The construction process there are many uncertainties in making accurate planning more complex. Three commonly used levels of material requirements planning method, which supply planning, demand planning and delivery of programs on material consumption. According to the characteristics of construction projects and the actual situation, material requirements planning in the construction schedule based on the build. Therefore, the construction schedule of the controls will directly affect the accuracy of material requirements planning.

The supply plan refers to the entire project to need the material, the fitting, the equipment and so on plan payment date, and explained in detail with each supplier, divides contractor's material coordination. This plan in detailed design stage formulation, and which independent working procedure can relate in detail the material to belong. When formulation plan, the designer, the contractor and the supplier must clasp. Therefore, the supplier should carry on the participation in the design stage, with the aim of choosing the appropriate material, the formulation appropriate plan. At the same time, as a result of seller participation as soon as possible, may provide the preferential benefit the price and the better payment provision.

Demand planning is to supply the detailed version of the materials needed to predict the near future. This program requires all subcontractors to develop cooperation in the drafting. During the construction phase, contractors, suppliers, logistics and materials management group administrator week between the regular meeting held on material control. Representatives of the parties to identify in advance the supply of materials three weeks, two weeks in advance to determine the exact demand, supply of materials a week ahead of the application, and prediction can be divided according to weeks to identify the materials required for each day. At the next regular meeting, in accordance with construction progress and on-site materials, the actual situation, in turn presented the material for the follow-up. If necessary, take corrective measures.

Daily consumes the material payment plan is to the demand plan supplement. Refers to one day of time payment, only pays the material which the second day of institute needs. Consumes in the material payment plan introduces "the combination cell" the concept in the date. A combination cell is package of materials, refers to is constructing scene some position, to some kind of work in a factory, a work needs the material the set. Therefore, Japan consumes the material payment plan to divide into many units. Some combination cell plan unites efforts the formulation by the material supplier and the material coordinator. The contractor should explain in detail each combination cell quantity, the material type, the supplier, the receive contractor, as well as the plan stipulation's payment time, the means of transportation, the distributing point need the equipment and the packing detail. As a result of including the unit description and the plan payment date and so on all details, the contractor may in the early time to the seller under the order form.

#### C. Site layout and storage

Usually, the scene material has not registered in any inventory control system. In some situations, the scene stock monitors by the computer electronic forms. But keeps in stock the record, because the manual handling process and

the material migration information registration often has the flaw not identically. Therefore, needs a more effective method to determine the scene stock and the work level material.

Site layout planning by the owner, contractor and designer to develop joint consultation, including: determining the location of individual contractors working area and scope of the work area is fixed or a temporary; determine site Transportation: warehouse material field as close as possible location and use of mechanical lifting construction of vertical transportation position, in order to avoid secondary transportation, but can not choose the location of the impact of construction and should be yellow as much as possible in the transportation, loading and unloading convenient place<sup>[14]</sup>.

The construction realistic situation indicated that the material and construction machinery's arrangement, the working procedure order successively and so on has the close relation, has the mistake slightly, extremely easy to cause sabotages work, doing over, the delay time and so on bad event to occur. Therefore, the scene arrangement not only limits to the recognition essential space and the formulation general arrangement, but must explain in detail the construction order and the conflict, the job practice and need the time, when the necessity must make the revision.

D.Owner, design business and contractor's triple role.

The logistics serves for the engineering construction project's construction, began in the design, and finally works on-site installation. Engineering logistics processes at the beginning of the logistics of certainty factors, construction project management through logistics management, but also target the logistics process. Therefore, in the logistics process design, contractors and owners have an important role. To ensure the project completed on schedule, the need for coordination of resources and the progress of the relationship between analysis and design, contractors and owners in all aspects of the logistics information, a reasonable allocation of resources to develop and adjust plans and construction schedule, and timely feedback to enable logistics process and reasonable and open.

In the production process, neither side played three different roles: suppliers, manufacturers and customers. The whole process from the construction, this kind of triple roles are everywhere. Business owner clients is to design for designers with the necessary information and requirements. Through designers for his services, the owners audit program design and material requirements for contractors to provide material specifications and other information. In this process, the contractor for design business customers, by designing business plans and requirements for construction, the building owners to provide satisfactory facilities.

In design business's design process, contractor's construction process and in owner's review process, the design business, the contractor and the owners acts as the manufacturer the role. This had demonstrated the process viewpoint, different from the traditional view the role of this tripartite view.

E. Specialized logistics management team

Construction projects of the complexity of the logistics must designate a dedicated logistics management team operating the logistics of the operation, construction and management as a part of the scene. To ensure the effective operation of the logistics, the logistics management team dedicated to all involved in construction projects by the corporate senior management representatives, or as the Committee. Committee of the whole management process, to resolve the inevitable conflicts. Daily operation of the scheme established by the Committee to provide the necessary materials, coordinate the work of individual contractors, tracking and wholesalers cooperation. Its main responsibilities are as follows:

- Prepare the site plan and instruct the point of delivery;
- Organize the planning materials delivered for the weekly meetings;
- Participate and help define the "combined unit" to determine demand;
- Examine the materials delivered to the site;
- Meet material suppliers every day and monitor the delivery of the material.;
- Coordinate the use of the clmmom materials handing facilities;
- Evaluate the change of the supply plan.If we really need to change the supply of the material.we should take cprresponding measure;
- Organize the collection and the return of the material for the second use;
- Deal with the waste;
- Make sure the relevant parties use the concepts of the logistics.

#### **THE KEY RESPONSIBILITY IDENTIFICATION OF ALL PARTIES IN PHYSICAL DISTRIBUTION MANAGEMENT**

For a construction project, it is a process for proprietors, contractors, providers, and designers to share information, make plans and interaction. Therefore, improving the physical distribution management requires the efforts of all

parties. However, one of obstacles of the application of engineering construction projects in physical distribution management is that the beneficiaries are hard to identify. Thus, in order to identify the contribution of each party to the improvement of physical distribution management and ensure the responsibilities of each party, it should be illustrated the key responsibilities<sup>[15]</sup>.

#### A. Proprietors

Proprietors expect that builders that the handover can be made efficiently and cost friendly. Thus, in order to provide assistant for the further unfolding of the project, proprietors should prepare the plan of the early-stage of the project in advance by appointing some certain parties. Additionally, they should ensure all key participants sign the plan to explicit the duties.

Thus, key points for the proprietors:

- Proprietors should explicit the plan of the project in early stage.
- Proprietors should prepare the guide, which will assist participants to understand the duty of the physical distribution providers.

#### B. Designers:

Designers play a crucial role in the achievement of an efficient physical distribution. It would be supportive if designers draft the flow sheet in the early stage of the project. Additionally, they should prepare bill of materials (BOM), which is a part of the physical distribution project. This requires the participation of the technicians who have the statistic and cost accounting background. Designers need to highlight the importance of physical distribution to all members and explicate by training.

Therefore, the duties of designers:

- Prepare the flow sheet, which is the part of the whole designing scheme.
- Prepare the BOM for professional persons.
- The professional designing institution should involve the physical distribution techniques which related to their profession in the early education and training of designers

#### C. major contractors and professional contractors

Construction managers are always regarded as crucial crew in the coordination of physical distribution projects. However, some research indicates that the functions that construction managers make in the coordination of physical distribution do not reach the expectation. Nevertheless, major contractors still take responsibilities of projects. They are very important in the negotiation and drafting physical distribution plan with other parties at the early stage. MOB is a crucial data in the plan. And every contractor should make plans which are related to their major, which include how to optimal the skilled workers.

Therefore, the key responsibility of the main contractor and professional contractors are:

- The main contractors have to prepare the logistics plan with other participants in the project in the initial stages of the project.
- The main contractors and professional contractors summarize the way to develop new technology of logistics.
- Working with IT staffs should maximize use the technology of information which available or after improvements can be used.
- The main contractor has to summarize the experience of projects and promote it, then to provide the recommendations that to improve the logistics of the construction project based on practical experience.

#### D. Manufacturers, suppliers and sales

The key part for the logistic of construction is to ensure that the products can arrive at the site within the required time and quantity. It is not only relying on the efficiency of the supply network, but also the advance planning about the required materials and products in construction site. In addition, this logistic also rely on the project's planners and the unit who provide the material and products, that is the communication between the suppliers.

The full partnership between manufacturers and suppliers can have a significant effect on the improvement of the project logistics. If they are involved in the project earlier,, especially if they can provide information for the list of materials of the design stage and input infor,ation for the logistics plan ultimately,they will make a significant contribution to the efficiency of the project logistics.

Therefore, the key responsibility of the manufacturers, suppliers and sales are:

- The bill of materials comes from the main manufacturers, suppliers and sales that as part of project logistics plan.
- Try to use the third-party logistics and the available technology means that from other manufacturing industry.

- Manufactures, suppliers and sales determine their allocation of cost through their pricing strategies.
- Manufacturers, suppliers and vendors and contractors should be the experience of the project to popularize.

### CONCLUSION

In view of the engineering construction project physical distribution's characteristic, has analyzed the engineering construction project scene physical distribution management major effect factor. The scene physical distribution's key question is the information flow optimizes, the plan to formulate and to control, the scene arrangement, the owner, the design business and contractor's tertiary role, has carried on the preliminary discussion to it. And proposed that the establishment special physical distribution management group management engineering items of basic construction physical distribution, guarantees the physical distribution effective operation. Finally, it distinguishse the key responsibility of logistics management owners, designers, main contractors and specialist contractors and manufacturers, suppliers and vendors.

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