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Supply Chain Management Analysis on Plumbing Works

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ABSTRACT

One of the methods of applying lean construction in the construction sector that shifts from traditional to lean, eliminating all activities that do not generate added value, is supply chain management. This research compares the supply chain in two projects to decide on added value projects. This stems from the efficiency of establishing a simple organizational structure and encouraging contractors to focus more on the dominant material work. Supply Chain is a systems approach to delivering products to end consumers by using information technology and coordinating with suppliers and manufacturers/producers. The supply chain comparison for the second project is more inclined to the project apartment because it has four patterns and does not have much organizational coordination. In the apartment project pattern, the main contractor focuses on the project's core and provides activities to support subcontractors, such as elevator work. MEP work on buildings is complex, especially in coordinating the procurement of equipment, materials, and human resources because it involves many people and organizations both from outside and in the implementation process. Supply chain management in the construction sector is an effort to improve performance. To be more effective and efficient in providing high competitiveness for other contractor companies. Supply chain management in the construction sector is an effort to improve performance. To be more effective and efficient in delivering high competitiveness for other contractor companies. Supply chain management in the construction sector is an effort to improve performance.

Keywords: *Lean Construction; Supply Chain; MEP Work*

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ABSTRAK

Penerapan *lean construction* pada bidang konstruksi yang beralih dari tradisional menjadi ramping, diartikan pembuangan seluruh aktivitas yang tidak menghasilkan nilai tambah, salah satu metode adalah *supply chain managemen*, Penelitian bertujuan membandingkan dengan menggambarkan pola rantai pasok (supply chain) pada 2 proyek guna mengetahui jalur yang tidak menghasilkan nilai tambah. Hal bermula dari efisiensi membentuk struktur organisasi yang sederhana serta mendorong kontraktor lebih fokus pada pekerjaan material dominan. *Supply Chain* merupakan sistem pendekatan untuk mengantarkan produk pada konsumen akhir dengan menggunakan teknologi informasi, berkoordinasi dengan para pemasok, hingga manufaktur/produsen. Perbandingan *supply chain* untuk kedua proyek lebih condong pada proyek apartmen karena proyek apartmen mempunyai 4 pola dan tidak banyak memiliki koordinasi organisasi diatasnya. Pada pola proyek apartemen terdapat kontraktor utama yang berfokus pada inti proyek dan menyerahkan aktifitas pendukung kepada subkontraktor seperti pekerjaan lift. Pekerjaan MEP pada bangunan gedung memiliki tingkat kerumitan, terutama dalam hal koordinasi pengadaan peralatan, material, dan sumber daya manusia karena hal tersebut melibatkan banyak orang serta organisasi baik dari pihak luar maupun dalam pada proses pelaksanaan. Pengelolaan *supply chain* di bidang konstruksi merupakan usaha peningkatan kinerja. Untuk menjadi lebih efektif serta

efisien dalam memberikan daya saing yang tinggi bagi perusahaan kontraktor lainnya.

Kata kunci: *Lean Construction; Supply Chain;* Pekerjaan MEP

INTRODUCTION

The construction journey is limited by time, cost, quality, work safety [1] and involves five resources in its management, namely labour, costs, materials, tools, and methods [2] This results in uncertainty in the project and becomes more complex when viewed from one factor: the number and role of stakeholders involved. The supply chain includes all activities related to the flow and transformation of goods and services from the initial stages of processing raw materials to finished products enjoyed by consumers. Supply chain sustainability requires management that regulates, controls. It determines strategies so that the flow of information in the supply chain is close to conformity with consumer needs but can reduce production costs and be a means for companies to maintain quality and customer satisfaction [3]. The running of a construction project cannot be separated from the management from start to finish to get the product according to the criteria [4]. The supply chain method is related to producing goods in the correct quantity at the right time and place to achieve a minimum overall system cost and the desired service level. The concept of material procurement in construction supply chain management affects project success, a network of companies working together to create and deliver a product to users. The development of the supply chain determines the readiness of the contractor to carry out the work. Because competition is no longer at the company level but the supply chain level [5].

The mechanical, electrical and plumbing (MEP) systems include the installation of electricity, clean water, dirty water, ducting, plumbing, and ventilation in a building with a safety and comfort design for residents. Most construction projects have an implementation stage starting from the structure-MEP-architect because the implementation of the MEP is in the second order. It is necessary to make adjustments between the work before and after to minimize errors. So supply chain management at MEP contractors is an effective and efficient performance improvement effort that provides high competitiveness. Industry players realize that providing cheap, quality, and fast products and the need for collaboration, coordination, and synchronization of work in all parties involved in a building project is the primary key [6]

LITERATURE REVIEW

Supply Chain Concept

The supply chain is the approach to managing the flow of products, information, and finance by involving several parties from upstream to downstream, consisting of suppliers, factories, actors in distribution activities and logistics services. [7]. The supply chain logistics network is integrated with the relationships of several significant organizations (suppliers, manufacture, distribution, owners, customers). The supply chain component consists of the Upstream Supply Chain, which means that the upstream part includes all main activities (procurement). Starting from manufacturing companies with suppliers (in the form of manufacturers, assemblers, or both) and the connections between their suppliers (second-tier suppliers), Internal Supply Chain is an internal part of the supply chain covering the entire process of transforming inputs from suppliers into outputs. Organization to extend from the time of entry into the organization. The primary purpose of the internal supply chain is production management, manufacturing, and inventory control [8].

In 2014 research was conducted to identify supply chain patterns. There is a pattern of supply chain performance in housing projects that are said to be suitable for the concepts of conversion, flow, and value [9]. In 2015 supply chain analysis on structural work showed that the application of conversion in resource control and optimization and the application of the idea of partnering in resource procurement facilitates the flow of resources because it builds trust between contractors and suppliers. In 2017 there was research on building trust in the supply chain with seven determining factors with the scope of the relationship between the stakeholders involved (trust, company bona fides, cooperative relationships) [10]. This study compares the supply-chain

pattern of two private projects with the project ownership status of private companies and religious organizations from the management side.

METHOD

The research focus on plumbing work is in Project X and Project Z. Plumbing work is included in the MEP work with its implementation in the second stage and has complexity in terms of supplier selection because suppliers (in terms of quantity) offer relatively cheap prices as well as handling in terms of storage and the use of the material with the specifications determined by the building owner (Owner). Project X has a building function as offices, schools, studios, and places of worship with a total of 9 floors, while Project Z functions as a residence with a total of 50 floors. The method of carrying out the work is carried out simultaneously between structural works. Stages of research carried out in several stages, namely:

1. The first stage is a literature study related to the grid of questions that will be used for interviews with 7 resource persons consisting of Estimators, Site Managers, Project Managers, Operational and Logistics Managers. The selection of 7 resource persons using purposive sampling method with the criteria that the informants have approximately 3 years experience in similar projects and understand the supply chain.
2. The second stage, the preparation of a grid of questions to conduct interviews to find out new - detailed information related to problems in the supply chain carried out to the informants with a semi-structured method which has the understanding that there is a framework for a list of questions in advance but the questions can be developed / narrowed to saturation (data triangulation).).
3. The third stage is the completeness of the organizational structure data of the two projects, budget plans, material specifications, followed by observations to find out the pattern or line of orders and information from upstream to downstream.
4. The final stage, supply chain analysis is supported by documentation and interview results to get a pattern.

RESULTS AND DISCUSSION

Project X . Supply Chain Process

For project X, especially the plumbing work, the flow of goods and information is regulated directly through the Head Office of the MEP contractor. The supply chain pattern for project X is carried out based on several aspects of each relationship, namely:

- **Lower Level.**in terms of the direct contractor relationship with the owner such as the contract method to the owner. The plumbing work in project X is using the general contract method with a Lumpsum Fixed Price contract type.
- **Project Organization Level.**The project organization cooperates and provides information to each other related to the material needs used so that there is no miscommunication starting from the Project Manager to the workers.
- **Upstream Level.**Project X at the upstream level, especially in plumbing work, are suppliers or suppliers of materials that include incoming and outgoing goods, for coordination with suppliers in this project, they usually go directly to the procurement department, namely directly to the Head Office.

Project Z . Supply Chain Process

*Supply chain*in the Apartment Project Z, it is the same as in project X which starts from the Owner as an End User that requires a need or requires plumbing material that is requested from suppliers or material suppliers. In the Apartment Z project, there are also 4 patterns of supply chain relationships in it, including:

1) Pattern 1. The Z Apartment Project, all work is carried out by the main contractor, namely PT. Wika Building. In the coordination process for PT.Wika before going to the Owner, it must go through Construction Management (MK).

2) Pattern 2. The work subcontracted by the main contractor is AC work in the form of materials, tools and workers. Subcontractors have a pattern of coordination through the main contractor before going to the Constitutional Court because subcontractors are under the responsibility of the main contractor.
3) Pattern 3. The work that is subcontracted by the subcontractor is mechanical work (elevator) in the form of tools, workers and also materials, but there are some equipment and materials provided by the main contractor, therefore this is what distinguishes it from the second pattern.
4) Pattern 4. Work that is subcontracted by the main contractor to a specialist contractor, namely Cooling Tower work with work responsibilities covering materials, workers and tools.

***Supply Chain* Project X**

In project X, there are 5 patterns of supply chain relationships which result in the coordination of work and materials requiring no short time.

1) Pattern 1 in project X there are 2 organizations that are interconnected for implementation, namely PT. Tata Mulia Nusantara & material supply is carried out by suppliers, based on the results of interviews for the construction implementation of each division in accordance with the job desk accompanied by supporting documents between each section. Approval & selection of materials through the project manager while for approval of field material collection through the foreman, supervisor, logistics.
2) Pattern 2 is the Mechanical Elektical Plumbing (MEP) subcontractor there are 2 parties involved, the first is PT.Sinergi Makmur Sentosa with mechanical, electrical, plumbing work contracts in the form of materials, tools, supervision. The second party is a subcontractor which includes its employees. Each party has understood the job desk, including:
    1. Supplier selection & approval
    2. Material ordering & delivery
    3. As well as taking & stocking materials.
3) Pattern 3 supply chain project X with interview results, namely the STP (Sewage Treetment Plant) work given by the MEP contractor to the STP work specialist contractor which includes materials, workers and tools.
4) The pattern of 4 supply chain patterns in project X is AC work, the coordination with the AC contractor is the subcontractor of the MEP contractor in the form of materials, tools and workers, as well as specialist contractors, the coordination of the AC contractor must go through the MEP contractor first.
5) Pattern 5 on project X is architectural work, for architectural work for direct coordination through the Constitutional Court because for contracts from architect work directly through the owner.

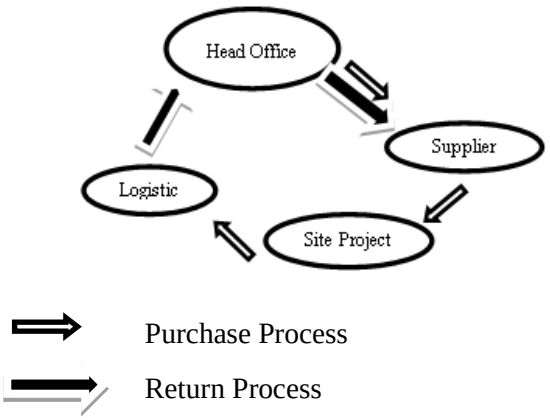


Figure 1. Project X. material flow chart

***Supply Chain* Project Z**

The Z apartment project has 4 supply chain relationship patterns, namely:

1) In pattern 1 for all work on project Z, especially plumbing work in the process, the purchase process until the installation of materials must go through the following procedures from the procurement – ordering – installation – evaluation process:
   1. Supplier Selection & Approval
   2. Material Ordering & Delivery
   3. Material pick-up & stock
2) In the second pattern, the supply chain of project Z is AC work which is subcontracted by the main contractor covering materials, tools and execution of work. For the coordination process in the supply chain pattern, it must go through the main contractor.
3) In the third pattern, the supply chain in project Z is mechanical work (elevator). In elevator work subcontracted by the main contractor in the form of materials, tools and work.
4) Finally, the fourth pattern in the supply chain in project Z is specialist contactors, namely the work of Colling Tower which includes materials, workers and tools which are procured by specialist contractors.

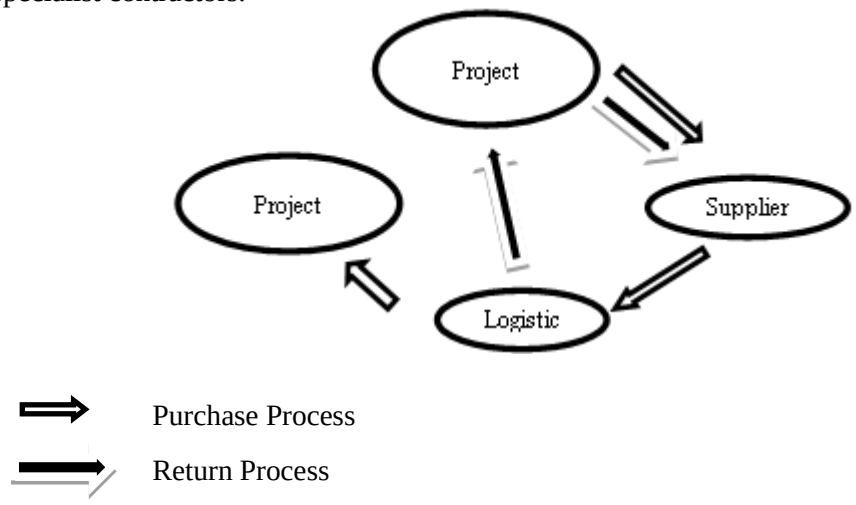


Figure 2. Material flow diagram for the Z apartment project

Comparison of Supply Chain Patterns between Project X and Z

Comparison of supply chain in both projects, project X is better because project Z has 4 supply chain patterns that are useful in reducing the coordination of the organization that houses it. The differences in supply chain for the two projects are:

1. In terms of material delivery in project X there is a 2 door method while for Apartment Z it is only through the 1 door method so that in project Z it is much shorter when sending materials to the project
2. In terms of purchasing materials on project X, it must go through the Head Office, while project Z purchases directly through the field procurement department.
3. In terms of supplier selection in project X, the right to choose is the purchasing and operational manager in HO, while in project Z, the right to choose suppliers is the procurement department and project manager in the project.

CONCLUSION

The type of contract used for both Project X and Apartment Project Z is a lump sum which means the volume and price have been determined and mutually agreed upon (the parties involved). For the supply chain pattern for project X, there are 4 patterns, meaning that it is more effective/efficient in terms of coordination compared to project Z. Finally, for project X, it is only through one door, so that if there is a material return, it can be processed immediately and facilitate

controlling. The different supply chain patterns of the two projects were caused by the inability and expertise of the contractors for several construction works which resulted in a cooperative relationship between suppliers- contractors- subcontractors.

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