Identification of construction productivity components in Indonesia. Case study of construction projects at the ministry of public works and housing provision (PUPR)

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N M Anditiaman[1], R U Latief[1], I R Rahim[1], and R Arifuddin[1]

[1]Department of Civil Engineering, Faculty of Engineering, Universitas Hasanuddin, Makassar, Indonesia

E-mail: novisca_anditiaman@yahoo.com

Abstract. The problem faced by Indonesia at this time is the lack of information related to supply and demand related to the productivity component, so it needs a study to formulate an index of construction productivity in Indonesia. The analysis of the determination of the productivity component is carried out by the desk study approach with the standard of construction productivity calculation, the standard for construction work financing, and mapping analysis approach based on project technical document data from 3 Unor, namely Water Resources, Highways, and Cipta Karya. The mapping analysis results obtained that the Workforce Component consists of Experts, Skilled Workers, and Non-Skilled Workers, Work Equipment Components include heavy equipment and light equipment and Construction Material Components. Experts for Unor Water Resources consist of Water Resources Experts, Quality Management System, and K3 Construction, Unor Bina Marga, namely Road Engineering, Bridge Engineering, Quality Management System and OHS Construction. Unor Cipta Karya's experts consist of Environmental and Sanitation Engineering, Environmental Sanitation, Project Management, and Construction Management Experts. Skilled Workers from 3 Unor, namely Supervisors, Measurers, Land Mapping, Road Implementers/Irrigation, and K3 Officers. Non-skilled personnel consist of administrative and financial staff.

1. Introduction

The growth of the construction sector certainly requires the preparation of supporting resources which include the preparation of a conducive business environment, the preparation of a reliable Construction Services Business Entity (BUJK), the preparation of cheap and competitive construction work equipment, the preparation of construction materials as well as the preparation of reliable and highly competitive labor [1]. In the life cycle of a project that starts with the initiation process, the feasibility study, engineering design planning, procurement, and implementation will not be successful if the productivity factor of the resources used is not optimal properly. In the life cycle of a project, productivity performance is determined at the stage of its implementation (Construction). The thing that becomes a problem that generally arises in a construction implementation is the lack of productivity performance resulting from the resources used. Resources that are generally used in the construction process include funds (money), human resources, materials, equipment, work methods,

and information technology [2]. In addition to fulfilling the amount, labor also very related to the fulfillment of the quality aspects. The available construction workforce in adequate quantity and quality becomes a fundamental and strategic aspect in realizing a strong, reliable and competitive national construction capacity. As revealed by the Director-General of Construction of the Ministry of Public Works PUPR which shows the number of certified construction workers is still very poor or at 6.38% as outlined in figure 1.

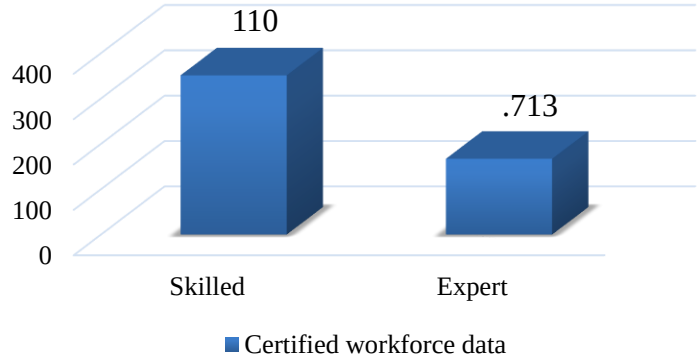

Figure 1. Certified workforce data

Looking at the data set out above, it can be concluded that the problem of Supply and Demand for construction workers is still a challenge that requires special attention and handling, industrial stakeholders [3]. Especially with the demand for certified experts and skilled workers, in an effort to increasingly support the performance of the construction sector that is sturdy, reliable and competitive at national and global levels. Because of course, without adequate construction workforce, competence, and superior qualifications, the market potential of the construction sector will be difficult to develop optimally. On the other hand, for the construction material component, the national cement production capacity (60.6 million tons) is still adequate, with an 80% utility rate. Problems related to cement such as allocations per province that do not match real demand, loading capacity at the destination port is inadequate to meet real demand (for example, in East Kalimantan), as well as limited land transportation facilities and infrastructure (for example in Papua) [4]. Meanwhile, for the standard steel production capacity (18.9 million tons) nationally with a utility level of 70%. The problem faced is that high-strength steel has not been produced domestically because of steel products that are not following the standards. As for asphalt, with a total supply of asphalt (930 thousand tons) nationally, it is inadequate to meet the needs with a 142% utility rate. Buton asphalt production capacity to replace oil asphalt (semi-extraction and full-extraction) still needs to be improved, and PT. Pertamina must meet the remaining asphalt supply-demand gap.

Regarding the needs of heavy equipment, the number of heavy equipment currently available nationally (150,000 units) is inadequate to meet the needs of heavy equipment with a 140% utility rate. Meanwhile, almost 50% (74,800 units) of existing heavy equipment is registered in DKI Jakarta Province, even though they are used in various other provinces [5]. The Directorate General of Construction Development (DJBK) of the Ministry of PUPR encourages local governments to increase the productivity of the supply chain of construction projects in the regions with the fulfillment of reliable, competitive labor, work equipment, and construction materials.

The problem currently faced is the absence of information related to supply and demand related to the productivity component of Indonesian construction. So it is necessary to prepare a study to formulate the construction productivity index in Indonesian construction projects. This research is one of the stages in a study to develop a construction productivity index in Indonesia with a case study of a construction project at the Ministry of Public Works and Housing Provision. This paper reports the

results of a preliminary study aimed at identifying the productivity component of a construction project, which is a stage in a study that aims to develop standards and productivity indexes to be a reference in planning construction projects in Indonesia.

2. Literature review

The development of standards and productivity indexes developed refers to the theories of productivity that have been developed. According to Pylcer (1992), productivity is the relationship between how much output is produced and how many inputs are needed to produce that output [7]. While productivity implies a comparison between the results achieved (output) with the overall resources used (input) [8]. The Productivity Measurement Approach consists of 2 approaches as contained in figure 2.

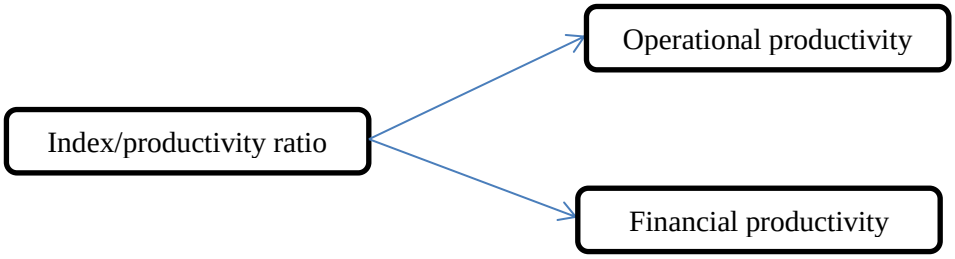

Figure 2. Productivity measurement method [8]

Productivity formula as follows:

$$\text{Index/productivity ratio} = \frac{Output}{Input} \quad \text{.....} \quad (1)$$

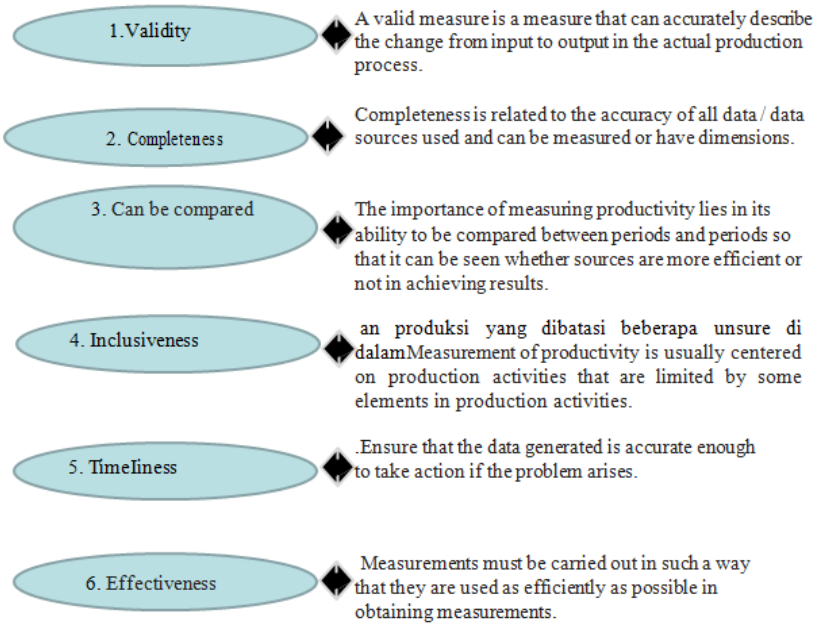

Figure 3. Productivity index criteria

Operational productivity is the ratio of the output unit to the input unit. Both the numerator and denominator are physical measurements (in units).

- Results of direct raw materials (output/unit of raw materials)
- Labour productivity, such as labour hourly output or output per worker.
- Process productivity (or activity), such as engine hourly output per kilowatt.

While financial products are also a ratio of output to input, the numerator or denominator is in units of currency (IDR). The Productivity Ratio/Index Criteria is outlined in figure 3.
The workforce coefficient number can also be different in each location, depending on local workforce performance. One of the resources that determine the success of a construction project is labour. Considering that in general, construction projects take place in different conditions, so in planning, the workforce should be equipped with productivity analysis and indicative influencing variables. This variable or factor, for example, is caused by geographical, climatic, skill, experience or regulations in force. The results of his research show the coefficient of labour productivity in the field is more effective than SNI and BOW analysis because the tools to work in the field are available well; workers also work as a team to maximize work in the field [9].

Two important aspects of productivity are work efficiency and effectiveness. Efficiency is a measure in comparing the planned use of input with actual input done. If the actual input is used, the greater the savings, the higher the level of efficiency. Effectiveness is a measure that gives an idea of how far the target can be achieved both in quality and quality. If the target percentage that can be achieved is getting bigger, then the level of effectiveness will be higher, and vice versa. Research on productivity has been carried out, including in Singapore, by Low in 1992. Low concludes that construction productivity is influenced by seven factors, namely build ability, the structure of industry, training, mechanization, and automation, foreign labour, standardization, building control. Paulus also said that planning was considered as one of the factors that were very influential in achieving increased productivity.

3. Research methodology

The operational research methodology was shown in figure 4 as stated that the output of the research is reforming the index of productivity and technical assessment. Data processed in the study refers to the Contract of Work Documents at the Ministry of Public Works and Housing which consists of (i) Price Recap; (ii) Cost Budget Plan; Job Unit Price Analysis; (iii) List of Labour Quantities; (iv) List of Material Quantities; (v) List of Equipment Quantities; (vi) Project Implementation Schedule. The types of construction projects are within the scope of the Directorate General of Water Resources (SDA), the Directorate General of Highways (BM), and the Directorate General of Cipta Karya (CK).

4. Results and discussion

From the results of data collection, analysis of data processing is then performed to obtain an initial overview of the data obtained. The analysis used to get an initial overview of the data is done with descriptive analysis to see the distribution of the number of project data in each Unor and also the distribution of the number of project data by type of work. Physical project data on the auction held obtained from the data project technical work contractual work documents: SDA, BM, CK which consists of 2 Fiscal Years:

- FY 2016 = 379 Projects
- TA 2017 = 437 Projects

Total Physical Projects are 816 Projects. Based on the analysis conducted, the Project Data distribution in each Unor is poured as shown in figure 5. Based on the results of data processing distribution of the amount of data based on Unor as outlined in figure 8, it can be concluded that the data from 3 Unor: Water Resources (SDA), Bina Marga (BM) and Cipta Karya (CK) are evenly distributed at +/- 30 %, except for data from Unor Housing Provision. From the data processing, it is obtained the distribution of project processed data by location/province, the above projects are spread throughout Indonesia with a profile of the distribution of data per Province FY 2016, and FY 2017 can be seen in figure 6.

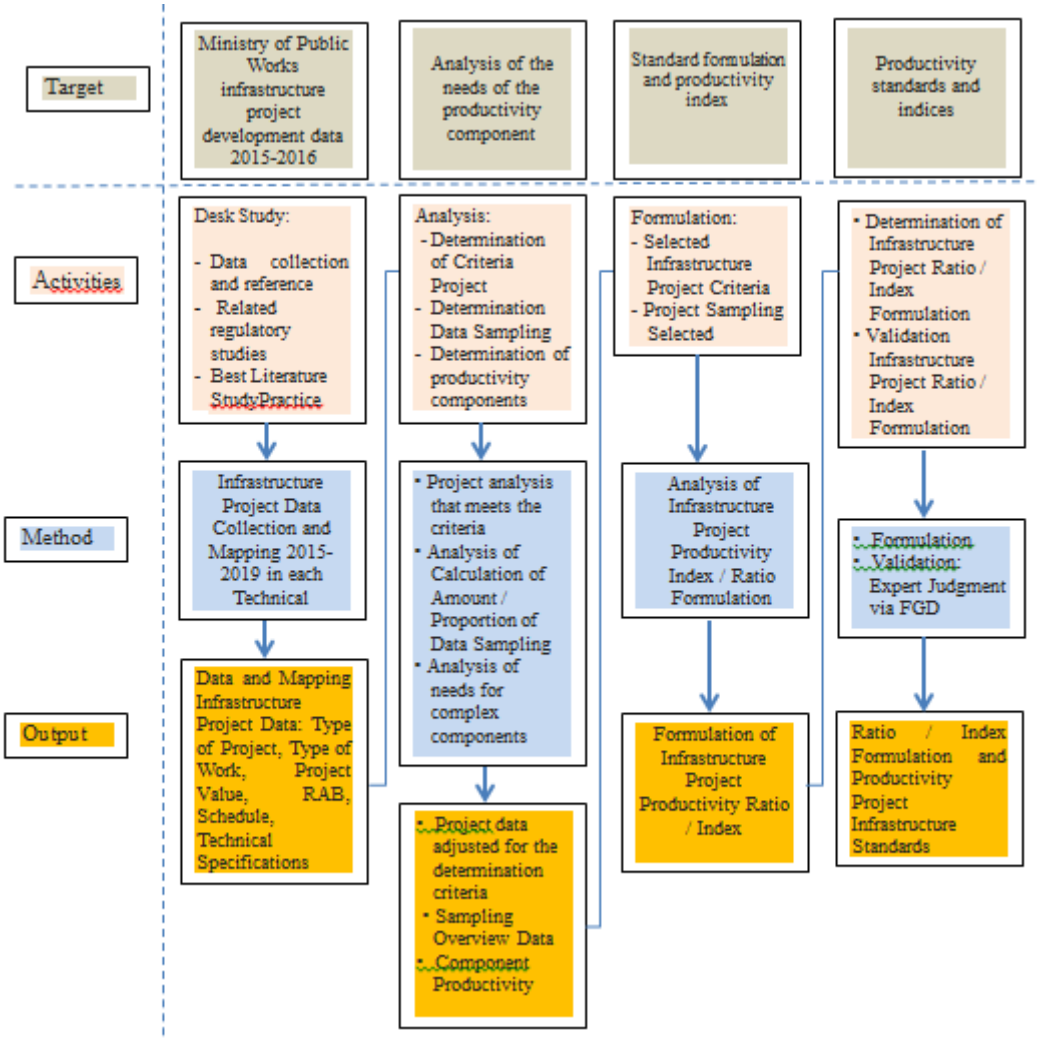

Figure 4. An operational framework for research activities

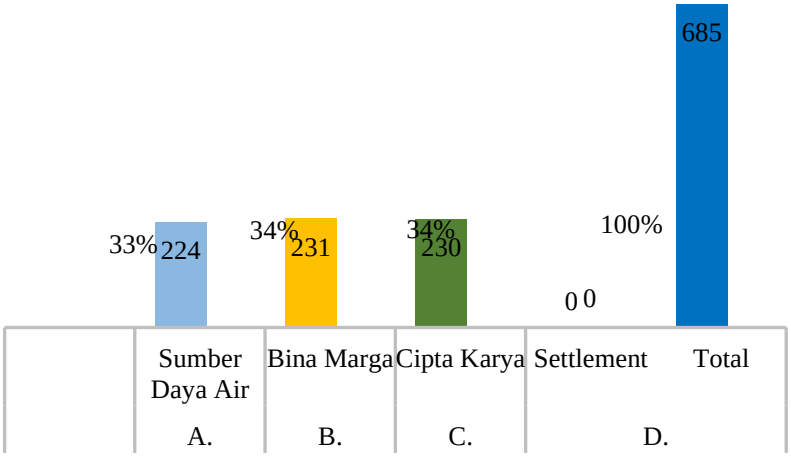

Figure 5. Project presentation based on the fiscal year

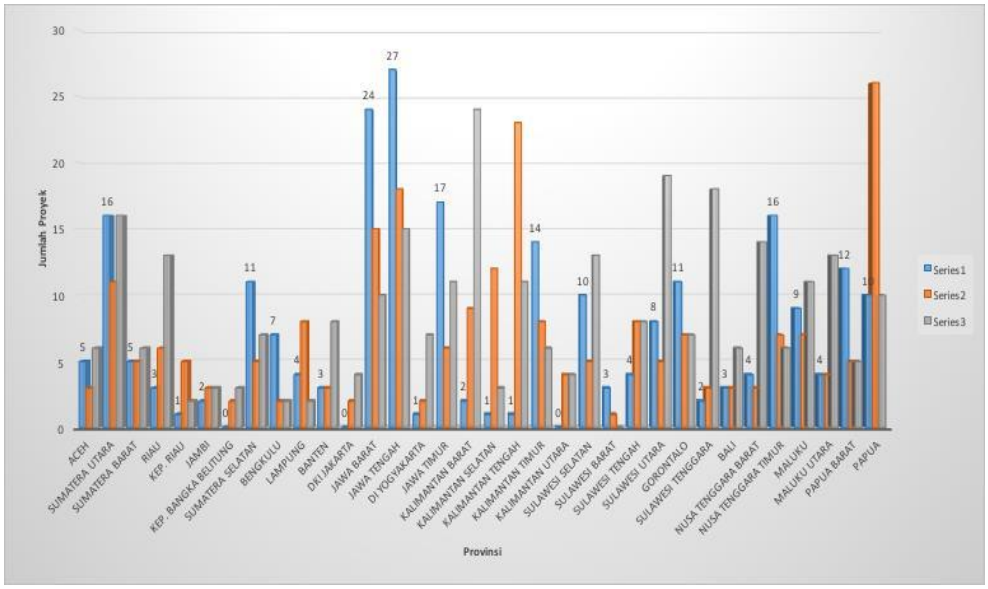

Figure 6. Distribution of construction projects by province

The results of processing data distribution of construction projects in all provinces show that the provinces of West Java, Central Java, and East Java still show the regions with the highest number of projects taking place in 2016 and 2017. Furthermore, based on project qualifications by referring to Ministerial Regulation Number 31/PRT/ M/2015, construction projects are divided into 3 parts, namely large projects with project costs> 50 billion, medium projects with vulnerable project costs of 2.5 billion-50 billion and small projects with project costs <2.5 billion. Data distribution according to the division is contained in figure 7.

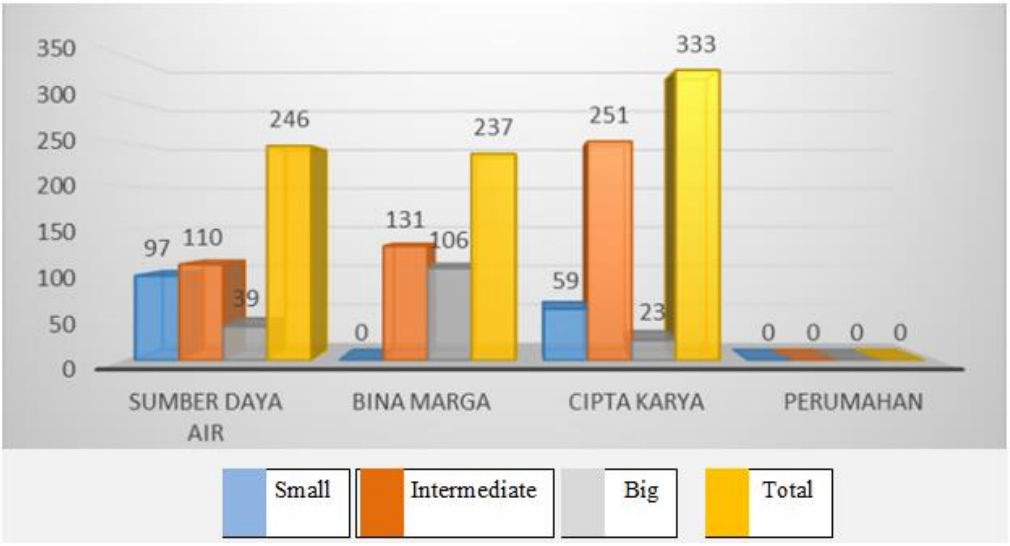

Figure 7. Recapitulation of project data distribution based on Unor and project value qualifications

The analysis of the determination of the productivity component is carried out with the desk study approach related to the calculation of construction productivity standards, regulations/standards for construction work financing and mapping analysis approach based on the project technical document data that has been obtained from the literature study and mapping analysis data obtained as follows:

Labour Components consisting of: (i) Experts, (ii) Skilled Workers and (iii) Non-Skilled Workers Work Equipment Components include (i) heavy equipment and (ii) light equipment. Construction material components mapping of the workforce is outlined in figure 8. While the results of the mapping analysis on the equipment are described as follows, the main construction work equipment includes bulldozer, excavator, concrete mixer/truck mixer, dump truck.

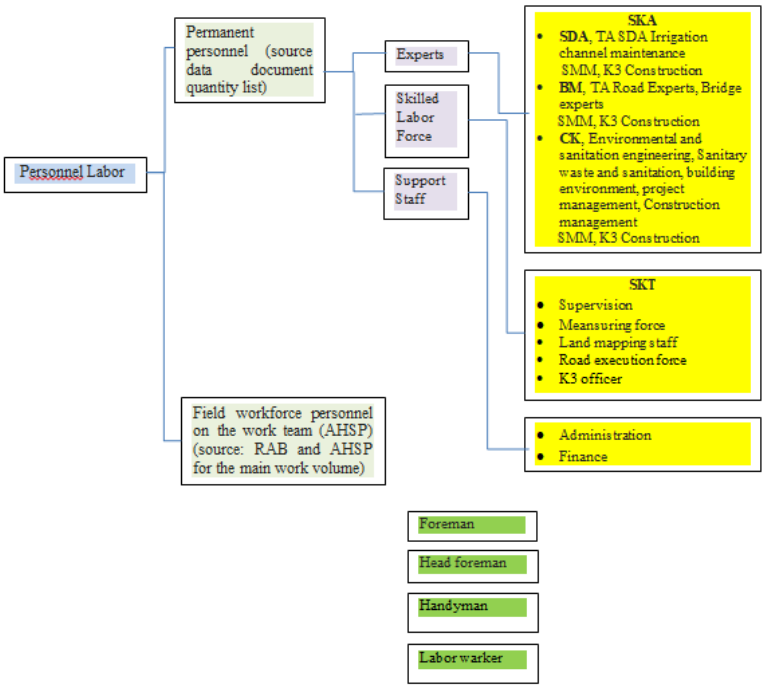

Figure 8. Mapping of construction workforce management

5. Conclusion

The result has shown a good trend of index productivity, therefore the summary of research conducted is workforce construction management is relatively good enough for implemented in the future. The determination of the productivity component is carried out with the desk study approach related to the calculation of construction productivity standards, regulations/standards for construction work financing and mapping analysis approach based on the project technical document data that has been obtained from the literature study and mapping analysis data obtained from construction material components.

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