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Construction Material and Equipment Demand Estimation in Indonesia

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- Founded in 1999 to answer deficit of certified construction experts in Indonesia and equity with foreign construction experts
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- Student Body: 5,000 students in 10 study program including in Civil Engineering, Industrial Engineering, and Agricultural Engineering Programs
- Arround 10,000 Engineering Graduates since 1990

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- Background
- Literature Review
- Methodology
- Discussion and Policy Implication
- Conclusion

BACKGROUND

- The Government of Indonesia has established strategic infrastructure development targets whose numbers are increasing very sharply.

- The activity of infrastructure construction will experience a considerable increase, massive, and evenly distributed in almost all parts of Indonesia.

- Increased national infrastructure investment will also have an impact on the need for reliable construction resource availability support.

- Ministry of Public Work (MPW) concerns the absence of accurate information of the demand for material resources and construction equipment that will improve the effectiveness and efficiency of construction work

OBJECTIVES

- → to formulate the need of CME through analysis of the Bill of Quantity (BOQ) document of projects from Indonesia MPW in year 2016.

CONSTRUCTION MATERIAL AND EQUIPMENT (CME) DEMAND ESTIMATION FROM BOQ

- Demand per work unit (e.g. per square meter area) for each material are analyzed with reference to the Unit Price Analyses (UPAs) from the BOQ of each project

- CME demand in the project can be estimated by dividing the total price for the CME divided by the unit price

- Once the CME demand estimation for each project is derived from above steps from the BOQ data, then the demand estimation for each categories of project may be formulated (everage of all projects analyzed)

CONSTRUCTION MATERIAL AND EQUIPMENT (CME) DEMAND ESTIMATION FROM BOQ

- For **material Portland Cement (PC)** material there is a percentage of 12% (average of all projects analyzed), or in the form of equation is:
  - **PC (KG) = (0.12 x PV) / UP**
    - Where:
      - PV = Project Value (Rupiah)
      - UP = Unit price of material

- For example for the upcoming 2019:
  - the estimated value of the project to be done is 50 trillion rupiah
  - the unit price of PC is 3000, - rupiah per kg.

- Then the demand estimate for cement is:
  - PC demand = (0.12x 50 Trillion) 3000 = 2,000,000,000 kg

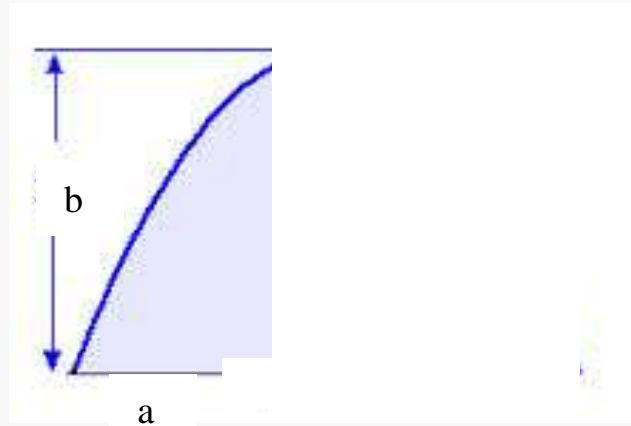# CONSTRUCTION MATERIAL AND EQUIPMENT (CME) DEMAND ESTIMATION FROM BOQ

- For **Equipment Dump Truck** of 3.5 ton capacity if the percentage is 7% (average of all projects analyzed), or in the form of equation is:
  - Dump Truck (hour) = (0.07 x PV)/UP = X
    - Where:
      - PV = Project Value (Rupiah)
      - UP = Equipment unit per hour
- If the dump truck hour demand estimation is X, then the demand estimation of dump truck unit can be calculated as:
  - Dump truck (unit) = (X / Y) / Z
    - Where:
      - Y = Average duration of the project
      - Z = Average hours worked per unit per unit of project duration
    - The average project duration (Y) data is obtained from BOQ data of each projects averaged
    - The average working hours per unit per unit of project duration is assumed to be 8 hours per day

- The need for equipment in the project generally is to experience an increase over the duration of the project that can be approached with a half-parabolic model as shown below:

- The area of the half of the parabola A is equal to

$$2/3 \text{ x a x b}$$

CONSTRUCTION MATERIAL AND EQUIPMENT (CME) DEMAND ESTIMATION FROM BOQ

- For example for the upcoming 2019:
  - Estimated project value to be done is 50 Trillion rupiah
  - Dump truck unit price is 200 000, - rupiah per hour
  - The need for 3.5 ton dump truck size is:
  - Dump truck hour demand = (0.07x 50 trillion x 200,000 = 17,500,000 hours

- It is assumed that the average project duration of 4 months (120 working days) and dump trucks work 8 hours per day per unit
  - The total number of units required during the year 2019 are:
    - (17,500,000/120)/8 = 18,229.17
    - or rounded 18,230 units of dump truck.

METHODOLOGY

- **Data Collection**
- Focused on CME in Indonesia MPW projects in year 2016
- The total number of BOQ project data is 5500 data contract holders in 2016.
- Samples with the principle of random sampling of 160 data (each 40 data for each 4 DGs of Indonesia MPW).
- **Data Analysis**
- The data then is analyzed by using principles and procedures as described before
  - .

RESEARCH FINDINGS

RESEARCH FINDINGS

Tabel 4. Summary of Formula Demand of Construction Material

No	Material	Formula	Average Unit Price (Rupiah)	Unit
1	Fine Aggregate	(0,0591 x PV)/UP	271,494.23	M3
2	Stone	(0,0116 x PV)/UP	263,454.15	M3
3	Coarse Aggregate	(0,1662 x PV)/UP	232,125.71	M3
4	Asphalt	(0,0361 x PV)/UP	12,063.89	KG
5	Portland Cement	(0,0494 x PV)/UP	1,706.93	KG
6	Steel Pipe	(0,0033 x PV)/UP	103,341.89	M'
7	PVC Pipe	(0,0085 x PV)/UP	182,951.82	M'
8	Reinforcement Steel	(0,0727 x PV)/UP	12,311.96	KG
9	Profile Steel	(0,0043 x PV)/UP	15,617.71	KG
10	Steel Prestress Strand	(0,0092 x PV)/UP	1,710,642.71	KG
11	Ready mix Concrete	(0,0128 x PV)/UP	1,342,693.62	M3
12	Precast Concrete	(0,0316 x PV)/UP	2,104,654.87	M3

RESEARCH FINDINGS

Tabel 5. Summary of Formula Demand of Construction Equipment

No	Equipment	Formula	Average Unit Price (Rupiah)	Unit
1	Asphalt Mixing Plant	(0,0066 x PV)/UP	7,159,295.13	Hour
2	Asphalt Finisher	(0,0002 x PV)/UP	382,521.67	Hour
3	Asphalt Sprayer	(0,0000 x PV)/UP	116,580.49	Hour
4	Bulldozer/Motor Grader	(0,0127 x PV)/UP	707,049.67	Hour
5	Compressor	(0,0003 x PV)/UP	204,949.03	Hour
6	Concrete Mixer	(0,0081 x PV)/UP	82,842.15	Hour
7	Crane	(0,0104 x PV)/UP	406,966.17	Hour
8	Dump Truck/Flat Bad Truck	(0,1123 x PV)/UP	373,851.57	Hour
9	Excavator	(0,2907 x PV)/UP	691,123.51	Hour
10	Wheel Loader	(0,0015 x PV)/UP	520,133.68	Hour
11	Roller(Vibra,Tandem,Pneumatik)	(0,0188 x PV)/UP	694,513.11	Hour
12	Concrete Vibrator	(0,0062 x PV)/UP	74,596.91	Hour
13	Water Tanker	(0,0023 x PV)/UP	272,160.98	Hour
14	Jack Hammer	(0,0028 x PV)/UP	534,564.65	Hour
15	Concrete Finisher	(0,0017 x PV)/UP	361,236.32	Hour
16	Truck Mixer/ Agitator	(0,0032 x PV)/UP	508,497.21	Hour
17	Batching Plant	(0,0074 x PV)/UP	609,468.08	Hour

RESEARCH FINDINGS

- For example for material of Portland Cement (PC)
  - Estimated project value to be done is 50 Trillion rupiah
  - Portland Cement (PC) unit price is 1,706.93 rupiah per kg
  - The formula for PC is: (0.0494 x PV) / UP

    = 0.0494 X 50,000,000,000,000) / 1.706.93 =

    1,447,042,350.89 kg

RESEARCH FINDINGS

- For example for the Concrete Mixer equipment:
  - Estimated project value to be done is 50 Trillion rupiah
  - Concrete Mixer unit price is 82,842.15 rupiah per hour
  - The formula is: (0.0081 x PV) / UP
    - = 0.0081 X 50,000,000,000,000) / 82,842.15
    - = 4,888,815.66 hours
- It is assumed that the average project duration of 4 months (120 working days) and concrete mixers work 8 hours per day per unit
  - The total number of units required during the year 2019 are:
    - (4,888,815.66/120)/8 = 5,092.51 or rounded to 5,093 units of Concrete Mixer.

RESEARCH FINDINGS

- For example for the Concrete Mixer equipment:
  - Finally, the demand peak number of Concrete Mixer equipment unit for the in 2019 Indonesia MPW projects may be estimated equal to:
  - 3/2 x 5,093 / 120 or equal to 63.66 units
  - or rounded up to 64 units per day.

Findings and Discussion

- By estimating the demand of CME well at the beginning of the fiscal year using the formula:

- it will be easy to predict the availability of existing resources within the country to meet the needs of all activities.

- the demand estimation data can be used as an initial guide for CME manufacturers, distributors and contractors to undertake planning related to its procurement in Indonesia MPW construction projects.

- This can be one of supporting the achievement of contruction activity implementation target in the field according to planned construction schedule.

Findings and Discussion

- The formulated CME demand estimation will improve the effectiveness and efficiency of construction work
  - The availability of demand data which includes:
    - the main material types
    - construction equipment
    - the volume of needs and
    - its distribution demands

  to be immediately prepared and coordinated among related parties in a country as a framework of orderly administration, management and control, and the continuity of the efforts of providing sufficient CME.

CONCLUSION

CONCLUSION

- The BOQ analysis to calculate the demand estimation of CME may be conducted to build the formulation of CME demand in a certain period of time.

- By using the formulations the CME demand estimation may be estimated with data of project value, unit price, average use per day of the CME, and the average project duration.

- The demand estimation of CME is important and strategic in the development of planning so that there is no shortage of CME resources in the implementation of the construction projects, and thus the planned schedule and progress in construction may be better achieved.

THANK YOU
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