Productivity Analysis and Efficiency of Transportation Clay Raw Materials in Small Brick Industries using Grandong Based on Appropriate Technology

Sunaryo[1], Andi Bahrun[2], Magribi[3], Endro Sukotjo[4]

ABSTRACT- The main objective of this research is to analyze productivity and efficiency, in transporting clay raw materials, in small brick industries, using Grandong a conveyance made by researchers and the community, based on Appropriate Technology in the Onembute Village of Konawe Regency. The method of research is done by measuring the performance of the tool directly, then analyzing productivity and efficiency, thus it will be known how much the value of efficiency, from the use of Guandong, compared to using a Dump Truck. Based on the results of the study, for the transportation of clay raw materials, in small brick industries using Grandong, in rural or inland areas, it is strongly recommended, especially equipment based on Appropriate Technology and local assemblies, this is due to spare parts, waste of scrap metal is sufficient a lot and human resources for operators and technicians are quite available and able to handle it, this type of equipment is still very much needed for small industry activists in rural areas.

Keywords: Transportation**,** Grandong, Productivity, Efficiency**,** Appropriate Technology.

1 INTRODUCTION

Bricks with a mixture of clay and (Rice-Husk-Ash) RHS have long been developed, and the results are very good and can reduce the use of clay and reduce agricultural waste [1]. Increasing the quality of bricks is getting more attention from business people and researchers, the use of RHS in addition to increasing the quality of strength, also reducing the weight so that it does not burden construction which can result in construction failure due to dead loads. Thus, whatever the way people do will be an effort to make a profit.

Factors influencing costs in a small industry are factors in transportation costs, the use of certain trucks can increase the utilization of trucks so that transportation costs can be reduced [2], including the use of traditional transportation equipment that is locally based on appropriate technology is needed in an area small industry.

Cost control in a project needs to be controlled so that financial inequality does not occur [3], ways and ways to overcome it, by carrying out the functions of management properly and correctly, one of which is a scarcity of material supply. And bricks are also a material that is very necessary for the purposes of building construction projects, without any bricks, the completion of the project work will not be achieved.

In modern times there are many buildings using wall panels and the like [4], but even so the use of bricks since ancient Roman times, to this day is of course still used in addition to the use of wall panels and so on. This indicates that brick products are viewed as having many shortcomings but are still produced by small industries, and the users or buyers are still bricks as the material of choice. Likewise with the development of plastic waste mixture bricks [5], just look at clay version bricks that go through the burning process occupying the top market, especially in developing countries.

The production of clay bricks through the combustion process, in the walls of the house, is an insulation that has thermal conductivity [6]. This is because clay bricks cannot deliver heat and can also not deliver cold, such things are very much needed in human life, thus building construction materials that are very suitable. And the installation of good bricks is very much determined by other components such as concrete and reinforcement which will assemble into a building [7]. Where the role of concrete construction and columns is needed in the installation of bricks. Including that the strength of the concrete and its reinforcement greatly affect the strength structure of the brick roof [8], because the brick wall will not be able to stand alone. The portal in a building is also very functional to protect the brick wall [9] so as not to experience cracks and even collapse due to a good portal.

Plastering work on brick walls will be cheaper if, the bricks installed are from the manufacture of good and quality bricks [10]. Thus the selection of bricks must have criteria of good quality, the texture can glue with more stucco and soil to influence the weather.

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Since the days of ancient human civilization, clay brick from the combustion process, to this day is still an infrastructure building material that dominates the market [11]. To produce good and quality bricks, a mixture of various types of clay must come from other regions, thus a cheap and simple transportation tool and based on Appropriate Technology is needed. The use of Dump Trucks is very inefficient which results in losses and greatly affects the sustainability of small brick industry businesses, besides that it can influence expensive selling prices and affect market share and public purchasing power. Furthermore, it will affect the growth of development in a region or region within a country.

It is very clear that the use of bricks and ancient brick crafts has been around for thousands of years. The oldest shaped mud brick, found near Damascus in Syria, is estimated to have existed since 7500 BC. Not only that, mud bricks are widely used by Ancient Egyptian civilization and even the first dry clay bricks estimated in 4000 BC, were found in Mesopotamia (now Iraq) [12]. Not only that the Chinese nation is very clever in the field of brick and not only bricks but also includes ceramics or vessels made of clay and the result is very monumental in the form of the Great Wall of China, this is evident that since the 5th century BC and it claims to be the only man-made object visible from space. For a long time, the Romans have used bricks for a long time and became the main ingredient in building their kingdom's infrastructure, even reaching Europe some 2000 years ago. Scientists in Rome developed the manufacture of bricks as a craft, including the use of mortars that function as adhesives during installation or spacing, this was evidenced by the influence of orders from the kingdom, due to the decline of the Roman Empire which finally occurred, the expertise in the field of brick also declined. In the second half of the seventeenth century, after the Great Fire of London in 1666, in fact, there began modern civilization where the British developed innovations using bricks in building and it took nearly 200 years to study them, and in the nineteenth century, the beginning of manufacturing bricks are produced mechanically using modern machines at that time and leave the old method or manual manufacturing method. However, the emergence of mechanical production bricks, growth in the brick industry is relatively slow because clay bricks that have been printed still use very old models of stoves that are very inefficient. And since 1930 the introduction of Hoffmann's stoves in the brick industry has made great progress, at that time brick production in the UK doubled to the start of the Second World War.

Rice-Husk-Ash (RHA) is also an agricultural waste that is not left behind used as a mixture of bricks adding RHA which is useful for reducing the weight of bricks and adding strength [13], all of which are supported by Appropriate Technology that is very helpful in the process of making bricks starting from local transporters, stirrers that can mix until homogeneous and do not miss the gauges of various characteristics of the modified red stone.

In the current era Appropriate Technology seems to have died and abandoned people and turned to modern technology [14], but in fact Appropriate Technology will also grow and develop with the times, only Appropriate Technology is not produced in bulk at the factory and only produced independently or individually in a village, for that economic activist and small industries in rural areas will still look for opportunities to create needs to support their businesses. Thus business people and scientists will work together to create innovations based on Appropriate Technology, the reason being that Appropriate Technology can use old iron waste materials and is based on simple technology using spare parts not owned by them (usually using car and motorcycle parts) and not using imported spare parts.

In addition to clay bricks, there are also many alternative bricks made from cement and are equipped with lime grooves as interlocking [15], are becoming more competitors and becoming a choice for consumers of the choices that will be used between bricks clay or alternative bricks made of cement, whatever production is produced will still run out and even experience shortages so that a project often experiences delays.

It turns out that the application of Appropriate Technology will provide the best results for small industries, therefore the involvement of scientists and practitioners of technology is not only talking about theory but more important is how the application of applications at the field level even to remote areas [11]. Thus it is not mistaken from a Onembute District in Konawe Regency, in the process of transporting clay material rows the main material for making red stones must be taken from the mountain and transported to Bangsal using researchers' assemblies with the name Grandong (local name), a four-wheeled haul carrier with a 22 HP diesel engine made from diesel fuel. Axles, transmission, and steering are made from scrap metal. The legality of the driver does not require a license, because the conveyance is only through a village road, and the road is made by the local community. Of course, the use of this transportation equipment is very profitable compared to using a Dump Truck and other modern carriers.

Human Factors and Ergonomics Society became a new name after Europe gradually experienced traditional binding to the basic sciences or application fields that put forward human factors and ergonomics that work must be made according to the size of the human body [16]. It is highly prioritized for scientists and activists, tool designers who can help human tasks according to the size requirements of the human body so that they always return to humans as subjects.

2 LITERATURE REVIEW

Appropriate Technology rarely explains it, the word is not purely from the technology itself, it is true that Appropriate Technology means that the technology used is very simple, but the word comes from economics that has nothing to do with technology, the word came from an economist from Germany named EF Schumacher. This German writer has written the book "Small is Beautiful", believes that "small businesses will increasingly contribute strongly in the future for the prosperity of a nation" [17]. That Appropriate Technology starts from the small can be useful and contribute in the future to the prosperity of a nation. On the other hand, Appropriate Technology is also growing rapidly in addition to the use of high technology. Appropriate Technology by [18] in his book entitled "Appropriate Technology for Sustainable Living" says what is Appropriate Technology but still Schumacher's book is used to explain and summarize the philosophy of Appropriate Technology in his book, Small Is

Beautiful (1978) where he describes the central doctrine of Appropriate Technology as (a) simple, (b) small scale, (c) low cost, and (d) without violence. The US Office of Technology Assessment has perfected these principles by describing Appropriate Technology as (a) small scale, (b) saving energy, (c) environmentally friendly, (d) labor intensive, (e) controlled by the local community, and (f) sustainable at the local level. [18] also says about the definition of Appropriate Technology that can be defined as "intentional formation of matter, energy, and processes to meet needs". Technology and design processes are closely interrelated, for the creation of all artifacts, environments, and man-made systems is the result of deliberate activity by the designer, whether he is an architect, a farmer, a housewife, or a child. The design, whether we choose to call it or not, is around us. Actually what is the purpose of Appropriate Technology, still in his book [18] says that "Designers work in a variety of obstacles, and trade-offs are always involved. First, there are broad goals determined by society or by business plans: increased productivity; greater market share; higher level of employment; more interesting community; etc". And the next goal is to be more clear and detailed then; "In its most basic sense, the right technological goals represent the basic human and social values that we hope for everyone."

The clay brick industry works and methods from time to time have been very different, for now, it has been very advanced but it is still dominated by Appropriate Technology, but even so what is important is the factor of worker safety and ergonomic equipment which are the main requirements must be fulfilled [19]. For the role of scientists and technicians, it is very important to provide innovation and understanding so that in a process work can be done easily. Fast and correct.

In project activities, construction equipment is the main factor that is of particular concern in budgeting, every detail must be measured in designing a budget, whether it is rented or bought, if it is rented, the user will be adjusted to the needs and if purchased, the project does not buy at full price except in multi-year project [20].

But the machine productivity model can be solved using mathematical equations, but it must be seen the characteristics and uses, of course, all will be controlled by humans or operators, so that sometimes the productivity can be in accordance with the speed and skills of the users. operator, but in this mathematical equation has been calculated, including natural factors, material factors and conditions of equipment that will work or work [21].

In a project activity, construction equipment is a major factor that is of particular concern in budgeting, any detail must be measured in designing the budget, whether it is rented or purchased, if rented, the use will be adjusted to the needs and if purchased, the project does not buy at full price except in a multi-year project [21].

However the model of heavy equipment productivity can be solved using mathematical equations, but it must be seen its characteristics and usefulness, surely all will be controlled by humans or operators, so that sometimes its productivity can be in accordance with the speed and skill of the operator, but in this mathematical equation has been calculated, including natural factors, material factors and the condition of the equipment that is going to work or are working [21].

However the model of heavy equipment productivity can be solved using mathematical equations, but it must be seen its characteristics and usefulness, surely all will be controlled by humans or operators, so that sometimes its productivity can be in accordance with the speed and skill of the operator, but in this mathematical equation has been calculated, including natural factors, material factors and the condition of the equipment that is going to work or are working [21]. Thus, in general, you can use the following equation:

$$Q = \frac{v \times tf \times 60}{1000 \times ct} \quad \text{..... (1)}$$

Where:

Q = hourly tool production (m^3/hours)
v = capacity per cycle m^3
tf = tool efficiency factor
ct = cycle time (minutes)

$$D = \frac{i(1+i)^n}{(1+i)^n-1} \quad \text{..... (2)}$$

Where :

D = Depreciation
t = Total production per year
P = Annual cash outflows (IDR)
S = Resale value (IDR)
n = Total number of periods
i = Discount Rate (%)

$$R = \frac{(L-R)D}{O} \quad \text{..... (3)}$$

$$I = \frac{2\% R}{O} \quad \text{..... (4)}$$

$$F = (0.125\text{-}0.175)\text{Ltr/HP/Hours} \times P \times Fp \quad \text{..... (5)}$$

$$Luc = (0.10\text{-}0.20)\text{Ltr/HP/ Hours} \times P \times Lp \quad \text{..... (6)}$$

$$Ws = \frac{(6.25\text{-}8{,}75)L}{O} \quad \text{..... (7)}$$

$$Sp = \frac{(12.5\text{-}17{,}5)L}{O} \quad \text{..... (8)}$$

Where :

I = Insurance and Others
R = Return on capital
O = Operating Hours/year
D = Depreciation (Capital factor)
F = Fuel
Luc = Lubricant
Ws = Workshop
Sp = Sparepart
L = Local value
P = Annual cost (IDR)

Appropriate Technology in modern times as it is today, is still very much needed for the construction of infrastructure that is useful for human life, especially in small towns, rural areas. And the most important is the coastal areas and small islands [22].

3 RESEARCH METHODS

The research method is done by measuring the performance of the tool directly, then analyzing productivity and efficiency, so it will be known how much the value of efficiency, from the use of Guandong, compared to using a Dump Truck. The research map can be seen in Fig. 1 and 2.

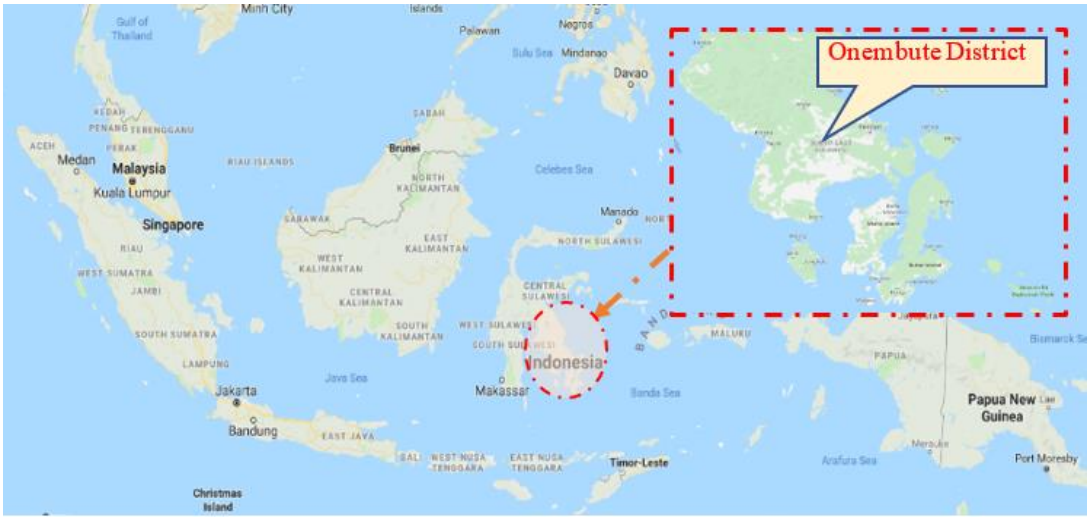

Fig.1. The Research Map

Fig.2. The Map Details of the small brick industrial area of Onembute District

a. Damp Truck b. Grandong

Fig.3. . a. Dump Trucks is factory made and b. Grandong is made by researchers and society

4 RESULTS

The most important step in this analysis is the list of basic unit prices, without this list taken directly from workers or operators in the field, so that the base unit price is also called the first variable in this study, the other steps cannot be worked out if this step has not clear. Wage prices are taken in the field if not paid in hours, so we can simply take whatever method is used in the field for basic payments, generally using a payroll basis based on daily wages. Based on the daily wage, we convert it into wages in working hours. There is also a list of unit prices issued by the local government, but we still use the base unit price, which is taken directly in the field, so there is no deviation.

So what happens for fuel oil, researchers use non-subsidized prices, even though small industries actually may use subsidized fuel oil. Complete basic unit prices can be seen in Table 1, as follows:

TABLE 1
Basic Price

No.	Discription	Unit	Basic Price (IDR) Day	Hours	Information
1	Operator	Hours	200,000.00	28,571.43	
2	Gasoline	Liters	10,000.00		
3	Diesel	Liters	10,000.00		
4	Lubricant	Liters	50,000.00		

4.1. Analysis of equipment rental value

The equipment that will be analyzed in this study is Grandong (local name) a raw material transportation equipment in brick making, in small industries in Onembute District, Konawe Regency. This tool is designed and assembled by researchers and the public, using scrap metal waste and using existing spare parts on the market, such as car and motorcycle parts.

Damp Truck was used in the analysis as a comparison and previously the community used the Dump Truck and had switched to using Grandong. The use of Dump Trucks by the community is only for the transportation of bricks to the city in Fig.2b, where bricks will be delivered by the buyer. More analysis of equipment rental will be shown in Table 2, as follows:

TABLE 2
Analysis of equipment rental value

No.	Discription	Code	Analysis of rental value Grandong	Dump Truck	Unit	Information
A.	General					
1	Power	Pw	40	100	HP	
2	Capasity	C	3	8	ton	
3	Economics period	n	5	5	year	$D=\frac{i(1+i)^n}{(1+i)^n-1}$
4	Operating Hours/year	O	2,000	2,000	hours	$R=\frac{(L-R)D}{O}$
5	Local value	L	40,000,000	435,000,000	IDR	
6	Discount rate	i	10	10	%/year	
7	Tax	T	10	10	%	$I=\frac{2\%R}{O}$
8	Fuel prices	Fp	10,000.00	10,000	IDR	
9	Lubricant prices	Lp	50,000.00	50,000	IDR	
10	Operator		28,571.43	28,571.43	IDR./hr	
11	Helper		0		IDR./hr	F = (0.125-0.175)Ltr/HP/ Hoursx P x Fp
B.	Direct Cost					
1	Residual value 10%.Lp	R	4,000,000	43,500,000	IDR	
2	Depreciation (Capital factor)	D	0.26380	0.26380	-	Luc=(0.10-0.20)Ltr/HP/ Hours x P x Lp
3	Direct cost:					
a	Return on capital	R	4,748.35	51,638.36	IDR	
b	Insurance and Others	I	40.00	435.00	IDR	
	Subtotal (B)	G	4,788.35	52,073.36	IDR	
C.	Indirect Cost					
1	Fuel	F	60,000.00	150,000.00	IDR	
2	Lubricant	Luc	30,000.00	75,000.00	IDR	
3	Workshop	Ws	1,500.00	16,312.50	IDR	
4	Sparepart	Sp	3,000.00	32,625.00	IDR	$Ws=\frac{(6.25-8.75)}{O}$
5	Operator		28,571.43	28,571.43	IDR	
6	Helper		0.00	0.00	IDR	$Sp=\frac{(12.5-17.5)}{O}$
	Subtotal (C)		123,071.43	302,508.93	IDR	
D.	TOTAL	To	127,859.78	354,582.29	IDR	
		Tx	12,785.98	35,458.23	IDR	Tx = T/100 X To
		Total	140,645.76	390,040.51	IDR	

Based on the analysis of table 2, the Grandong rental value of IDR140,645.76 is obtained, the value of the Dump Truck rental is IDR390,040.51. These three values are the second variable of this study and the first variable in table 1 is about the basic price.

4.2. Productivity analysis and coefficient Grandong

The productivity analysis and coefficient Grandong are to calculate productivity as the third variable and the coefficient as the fourth variable, will be explained as in table 3 below:

TABLE 3
Productivity and coefficient Grandong

No.	Discription	Code	Productivity and coefficient (Distance, km)					Unit	Information
			1 km	2 km	3 km	4 km	5 km		
	Grandong								
1	Hauling distance	L	1.0	2.0	3.0	4.0	5.0	km	
2	Transport capacity	V	2.6	2.6	2.6	2.6	2.6	-	
4	Efficiency Factor	Ef	0.80	0.80	0.80	0.80	0.80	-	
5	Soil density	D	1.30	1.30	1.30	1.30	1.30	-	CT = Ct1+Ct2……Ctn
6	Loaded average speed	v1	20.00	20.00	20.00	20.00	20.00	minute	
7	Average speed is empty	v2	30.00	30.00	30.00	30.00	30.00	minute	
8	Cycle time								
	- Time to fill up	Ct1	60.00	60.00	60.00	60.00	60.00	minute	
	- When transporting	Ct2	3.00	6.00	9.00	12.00	15.00	minute	$Q=\frac{V \times EfxH \times 60}{CTx1000}$
	- Unloading Time	Ct3	60.00	60.00	60.00	60.00	60.00	minute	
	- Time back	Ct4	2.00	4.00	6.00	8.00	10.00	minute	
		CT	125.00	130.00	135.00	140.00	145.00	minute	$Co=\frac{1}{Q}$
9	Production Capacity	Q	0.77	0.74	0.71	0.69	0.66	m^3/hours	
10	Coefficient	Co	1.3021	1.3542	1.4063	1.4583	1.5104	hours	

Based on table 3, the Grandong coefficient values obtained are as follows: or the 1 km is 1.3021, for the 2 km is 1.3542, for the 3 km is 1.4063, for the is 4 km 1.4583 and for the 5 km is 1.5104.

4.3. Productivity analysis and coefficient Dump Truck

The productivity analysis and coefficient Dump Truck are to calculate productivity as the third variable and the coefficient as the fourth variable, will be explained as in table 4 below:

TABLE 4
Productivity and coefficient Dump Truck

No.	Discription	Code	Productivity and coefficient (Distance, km)					Unit	Information
			1 km	2 km	3 km	4 km	5 km		
	Dump Truck								
1	Hauling distance	L	1.0	2.0	3.0	4.0	5.0	km	
2	Transport capacity	V	5.2	5.2	5.2	5.2	5.2	-	
4	Efficiency Factor	Ef	0.80	0.80	0.80	0.80	0.80	-	
5	Soil density	D	1.30	1.30	1.30	1.30	1.30	-	CT = Ct1+Ct2……Ctn
6	Loaded average speed	v1	30.00	30.00	30.00	30.00	30.00	minute	
7	Average speed is empty	v2	50.00	50.00	50.00	50.00	50.00	minute	
8	Cycle time								
	- Time to fill up	Ct1	60.00	60.00	60.00	60.00	60.00	minute	$Q=\frac{V \times EfxH \times 60}{CTx1000}$
	- When transporting	Ct2	2.00	4.00	6.00	8.00	10.00	minute	
	- Unloading Time	Ct3	5.00	5.00	5.00	5.00	5.00	minute	$Co=\frac{1}{Q}$
	- Time back	Ct4	1.20	2.40	3.60	4.80	6.00	minute	
		CT	68.20	71.40	74.60	77.80	81.00	minute	
9	Production Capacity	Q	2.82	2.69	2.57	2.47	2.37	m^3/hours	
10	Coefficient	Co	0.3552	0.3719	0.3885	0.4052	0.4219	hours	

Based on table 3, the Dump Truck coefficient values obtained are as follows: or the 1 km is 0.3552, for the 2 km is 0.3719, for the 3 km is 0.3885, for the is 4 km 0.4052 and for the 5 km is 0.4219.

4.4. Bill of quantity analysis

Analysis of bill of quantity is the final result based on the four variables above, will be explained as in table 5 below:

TABLE 5
Bill of quantity

No.	Discription	Unit	Unit Price (IDR)	Bill of Quantity (per m^3)									
				1 km		2 km		3 km		4 km		5 km	
				coef.	Total (IDR)	coef.	Total (IDR)	coef.	Total (IDR)	coef.	Total (IDR)	coef.	Total (IDR)
1	Drandong	Hours	140,645.76	1.30	183,132.50	1.35	190,457.80	1.41	197,783.10	1.46	205,108.40	1.51	212,433.70
2	Dump Truck	Hours	390,040.51	0.36	138,545.64	0.37	145,046.32	0.39	151,546.99	0.41	158,047.67	0.42	164,548.34


a. Traditional brick stove


b. Brick sales to the city

Fig.4. . a. The process of burning bricks and b. Brick sales by suppliers to the city


a. Scrap metal waste (Truck)


b. Scrap metal waste (pick up)

Fig.5. . Scrap metal waste

Based on table 5, the final result of the Granding: the 1 km is IDR183.132,50, for the 2 km is IDR190.457,90, for the 3 km is IDR197.783,10, for the is 4 km IDR205.108,40 and for the 5 km is IDR212.344,70. And the final result of the Dump Truck: the 1 km is IDR138.545,64, for the 2 km is IDR145.046,32, for the 3 km is IDR151.546,99, for the is 4 km IDR138.047,67 and for the 5 km is IDR164.548,34.

5 DISCUSSION

Bill of quantities analysis; Based on the results of observations and data processing, Obtained the value of transporting clay brick making material, the value is measured based on distances ranging from 1 km to 5 km, using Grandong and Dump Truck, so the difference is the price of clay wage units per cubic meter.

Discussions from the results of this study are as follows:

5.1 Types and Specifications of Grandong

Grandong is a carrier of clay raw materials for small brick industries as in figure 5, made by researchers and the community, all materials use Scrap metal waste as in figure 5a. 5b. with the principle of using Appropriate Technology. This carrier is very suitable for use in rural and inland areas either in groups or individually, which will be useful to help humans and participate in infrastructure development in a region. The principle of appropriate technology in modern times like today is still very relevant and very desirable because it is simpler and cheaper and does not require high technology and spare parts do not depend on imported products. Grandong specifications as follows: a) Frames and chassis are made from waste car trucks or other types of Pick Up cars; b) Tubs made of wood; c) The main driving machine uses a 22 HP Diesel engine; d) Diesel fuel. Besides being

able to lift clay raw materials, it can also use other materials such as wood and other needs in brick production.

5.2 Summary of Values

Based on the results of the Productivity analysis and efficiency of transportation clay raw materials in small brick industries using Grandong based on Appropriate Technology, concluded as the final result in table 7 below:

TABLE 6
Summary of Value

No.	Distance	Unit Price (IDR)		Prosentase (%)		Information
		Drandong	Dump Truck	Drandong	Dump Truck	
1	1 km	183,132.50	138,545.64	18.52	18.28	
2	2 km	190,457.80	145,046.32	19.26	19.14	
3	3 km	197,783.10	151,546.99	20.00	20.00	
4	4 km	205,108.40	158,047.67	20.74	20.86	
5	5 km	212,433.70	164,548.34	21.48	21.72	
		988,915.51	757,734.96			

Based on Table 6, then the increased value for each distance per km is obtained, for the lowest Grandong the increase is 18.52% and the highest increase is 21.48%. While for the Dump Truck the lowest increase value is 18.28% and the highest increase value is 21.72%.

Based on Table 6 and Figure 2, the farthest distance is estimated to be up to 5 km, while the reality in the distance field from the source of clay is only 3 km, and there is also a distance of 500 m, so the center point is taken as an estimate.

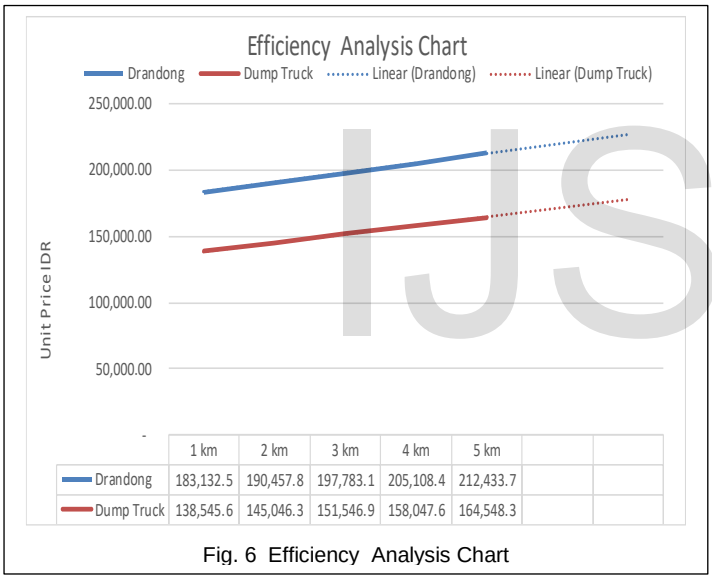

Fig. 6 Efficiency Analysis Chart

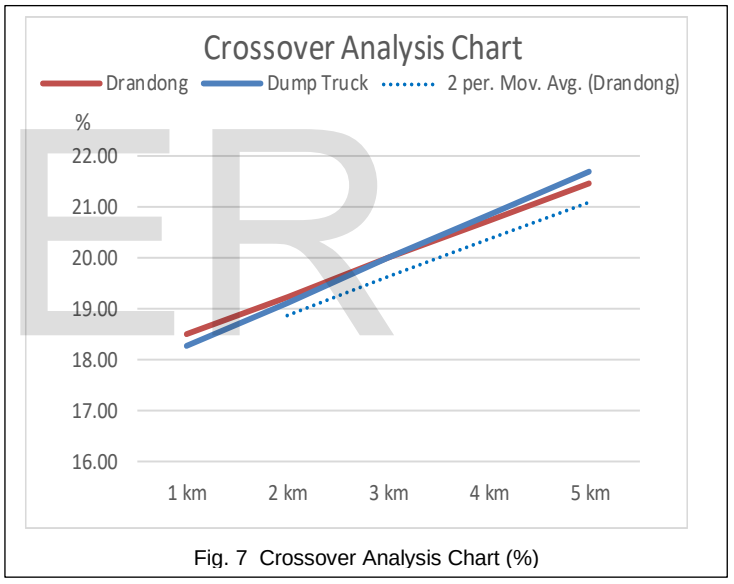

Fig. 7 Crossover Analysis Chart (%)

Based on Figure 6, the position of the value of transporting clay using Grandong is more expensive, while the value of Dump Truck is cheaper, but in reality the community prefers to use Grandong, this is because the cost of ownership is cheaper and the cost of spare parts is lower, rental costs like Table 2 also cheaper. It's just that the load capacity is only 2 m^3/trip.

TABLE 7
Number of trips per day

No.	Discription	Code	Values	Unit	Information
1	Number of Ward	a	255	unit	
2	Number of Grandong	b	15	unit	
3	Clay raw material/ward/month	c	10	m^3	
4	Amount of trip/day/unit	d	5.67	trip	$d = \frac{(a+c)}{b} / 30$
	Rounding		6.00	trip	

In figure 7 there is a crossover at a value of 20.00% with a distance of 3 km, this means that the ideal distance is only 3 km, even though the use of Grandong is more expensive, over a distance of 3 km, then in the red line graph Grandong intersects and moves at the bottom position. This means that after the red line moves in the lower position, it implies that the use of Grandong is more profitable than the use of Dump Trucks.

In a day, it can be seen in Table 7. Grandong can carry only 6 trips of clay, while the ability is 8 trips/day, thereis still 2 trips/day, it is used to transport of firewood logs 2trips/day, used for the furnace in figure 2.a.

5.3 Research limitations and suggestions for further researc

Further research suggestions and creative ideas:

a). Design and analysis of material transport of rows using cable-way in mountainous areas.

b). Design and analysis of transportation of construction materials using cable-way in weir and dam projects.
c). Design and analysis of transportation of construction materials using an offshore cable-way building project.
d). Design and analysis of transportation of agricultural products using rural cable-way and plantations.
e). Design and analysis of row transport of small industrial material using rail-way.

The last series to advance our Indonesian nation as a young generation must be innovative and creative, not consumptive.

6 CONCLUSIONS

The conclusion that based on the results obtained is as follows:

Transportation of clay brick raw materials, in small industries, the use of Grandong is more expensive than the use of Dump Trucks. But in fact, the use of Grandong is more interested in the community, this is due to lower ownership costs, besides maintenance costs and spare parts for using Grandong are cheaper.

The use of transport equipment in this study and any tools that are used for the benefit of a small and simple scale, using self-assembled equipment and based on Appropriate Technology are still very relevant and profitable, even though now is modern times. The reason is that the use of modern and large equipment is very irregular for small and simple scale jobs.

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