

Bidding Models Analysis on Ship Repair Projects (Friedman and Ackoff & Sasieni Models)

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Abstract

The existence of a ship project carried out with a tender system by the LPSE allows all shipyard industries to bid on the project, this causes the chances of winning to become smaller, the determination of the tender price greatly determines the size of the profit that can be obtained and the percentage of the possibility of winning the project in a shipping industry. Therefore, the strategy of determining the bid price is very important. The statistical method used is multi discrete distribution, and multi normal distribution, while the bidding model uses Friedman (1956) and Ackoff & Sasieni (1968) models.

The results obtained the best bid price strategy to win an auction or tender is the model that produces the lowest optimum mark-up, namely the Friedman model with multi normal distribution, while for Ackoff & Sasieni it produces a higher bid than the Friedman model except in certain company conditions.

Keywords: tender, bidding strategy, probability of winning, expected profit, mark up

I. INTRODUCTION

Currently, the number of shipyards in Indonesia has reached 250 companies, of which five are government-owned enterprises. Shipyards in Indonesia are currently capable of building various types and sizes of ships up to 50,000 DWT and repairing ships with a capacity of 150,000 DWT. However, out of 250 national shipyards, only 10 companies have a production capacity of more than 10,000 DWT with the largest graving dock facility of 300,000 DWT located in Batam and Banten (Ministry of Industry, 2015).

Indonesian Association of Shipbuilding and Offshore Facilities (Iperindo)'s data shows that since 2018 the condition of the

shipbuilding industry is considered unfavorable because there is almost no procurement of government shipbuilding. The purchasing power of new ships from the private sector is also still weak. The shipyard utility rate throughout the year is only about 30% of the installed capacity of 1.2 million GT. (Bisnis.com, 2019).

The development of the shipping industry in Indonesia has led to increasingly fierce business competition. In an effort to get a job (project) in the construction and ship repair service sector which is the main job in the shipping industry, almost always go through a process called an auction (tender). This process is very important for the shipping industry, because the continuity of its business depends on the success or failure of this process.

The determination of the auction price (tender) is determined by various considerations and sometimes only based on business sense. The determination of the tender price greatly determines the size of the profit (profit) that can be obtained and the percentage of the probability of winning a project in a shipping industry. Therefore, the strategy of determining the bid price becomes very important and strategic. (Ali, 2020)

Since 2008 the procurement of goods/services has started using the Electronic Procurement Service (LPSE) system. In this system, each contractor can participate in a tender after the package and tender specifications are announced by the relevant agency as the project owner. Thus the process of determining the winner of the tender becomes open and free from fraud. The more participants who take part in the tender, the smaller the chance to win the tender. If you don't use the right bidding strategy, it will be very difficult to win the tender.

The estimated mark-up value implemented in the project bid can be used as

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a reference in submitting the bid price, where the mark-up value obtained is the mark-up value calculated through previous bidding data in an area with a certain time span. The mark-up calculation approach model is a tool for the shipping industry in formulating its strategy in dealing with competitive bidding system tenders, so as to find out the best opportunity to participate in tenders or get the optimum opportunity to win projects and obtain optimum profits. (Ali, 2020)

In this study, two approaches to statistical methods were used, namely multi discrete distribution, and multi normal distribution. While the bidding model uses the Friedman (1956) and Ackoff & Sasieni (1968) models.

II. METHODOLOGY

The research methodology shown at Figure 1.

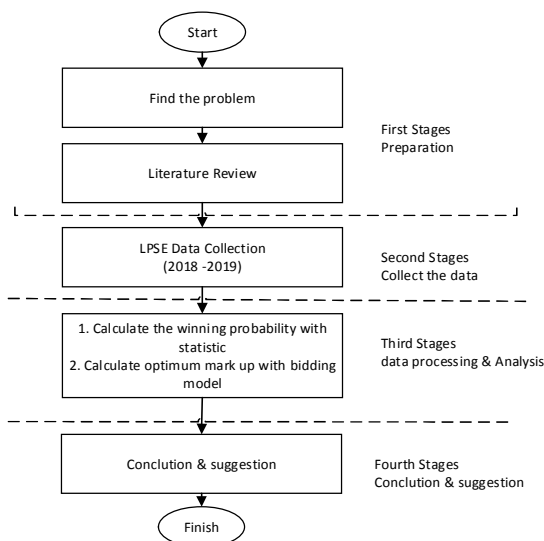


Figure 1. Research Methodology

The following are the stages of the methodology in this research.

Stage 1: Preparation

a. Problem Formulation

Every company can join the tender that held by LSPE so the winning probability became smaller to win the tender, so the companie need to make the strategy how to mark up the bid document.

b. Literature review

This stage is carried out by collecting literature review in order to obtain references that support the research process. The literature used in research is

based on journals, books related to risk management and books related to loading and unloading.

Stage 2: Data Collection

The data required is secondary data obtained from the Ministry of Transportation's Electronic Procurement Service (LPSE), which can be accessed online via <http://lpse.dephub.go.id/>.

Stage 3: Data processing and analysis

- Data processing with a statistical approach is to determine the method used, Multi Discrete Distribution and Multi Normal Distribution Methode.
- Calculate the maximum expected profit and determine the optimum mark-up using twobidding models, y the Friedman model, and the Ackoff & Sasieni model.

Stage 4: Conclusions and Suggestions

At this stage a conclusion is drawn according to the problem. While advice is given with the aim to provide recommendations for further research.

III. RESULT AND DISCUSSION

A. Companies bidding Data

Based on LPSE's data from 2018 to 2019 that meet the requirements of this research, there are 31 ship repair auctions with 42 contractor companies which are the result of selection based on problem constraints. The terms of the project taken are ship repair work projects with a minimum of 2 (two) competitors contractors and with a minimum project price of Rp. 1.000.000.000,00 (one billion rupiah). Companies selected to participate in tenders at least 2 (two) times in ship repair tenders during 2018-2019. obtained. The number of companies makes the data conditions not ideal to be tested so that data selection is carried out which will only be used for further research.

B. Model Friedman

1. Multi Discrete Distribution

The results of the calculation of the probability of winning and the expected profit with a multi discrete distribution for the Friedman model can be seen in Table 1.

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Table 1. Probability of Win and Expected profit with Multi Discrete Distribution for Friedman Model Model.

Mark-up (%)	R	P. Win	Expected Profit
25,00	1,25	0,64130	16,03256
24,00	1,24	0,62603	15,02481
23,00	1,23	0,61101	14,05322
22,00	1,22	0,59623	13,11701
21,00	1,21	0,58169	12,21541
20,00	1,20	0,56738	11,34767
19,00	1,19	0,55332	10,51301
18,00	1,18	0,53948	9,71072
17,00	1,17	0,52588	8,94004
16,00	1,16	0,51252	8,20024
15,00	1,15	0,49937	7,49062
14,00	1,14	0,48646	6,81044
13,00	1,13	0,47377	6,15902
12,00	1,12	0,46130	5,53564
11,00	1,11	0,44906	4,93963
10,00	1,10	0,43703	4,37030
9,00	1,09	0,42522	3,82697
8,00	1,08	0,41362	3,30898
7,00	1,07	0,40224	2,81567
6,00	1,06	0,39107	2,34640
5,00	1,05	0,38010	1,90051
4,00	1,04	0,36935	1,47738
3,00	1,03	0,35879	1,07638
2,00	1,02	0,34844	0,69689
1,00	1,01	0,33830	0,33830
0,00	1,00	0,32835	0,00000
-1,00	0,99	0,31859	-0,31859
-2,00	0,98	0,30904	-0,61807
-3,00	0,97	0,29967	-0,89902
-4,00	0,96	0,29050	-1,16200
-5,00	0,95	0,28152	-1,40758
-6,00	0,94	0,27272	-1,63632
-7,00	0,93	0,26411	-1,84876

Source: Data processed, 2020

From Table 1, the optimum mark-up value is 25% with the expected profit obtained is 16.03256%. The correlation between expected profit and mark up in the multi discrete distribution for the Friedman model shows that the expected profit increases along

with the increase in the mark up value applied, which can be seen in Figure 2.

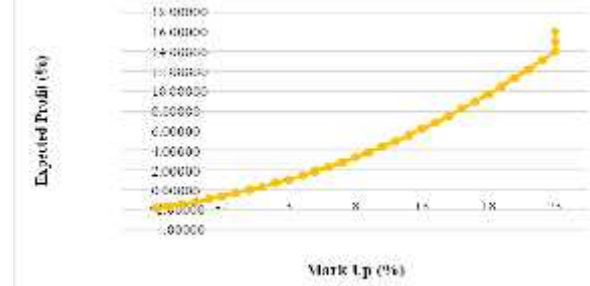


Figure 2. The correlation between Expected Profit and Mark Up Using Multi Discrete Distribution for Friedman Model

2. Multi Normal Distribution

The results of calculating the probability of winning and expected profit with multi normal distribution for Friedman's model for Company A can be seen in Table 2.

Table 2 Probability of Win and expected profit with Multi Normal Distribution for Friedman Model

Mark-up (%)	R	P. Win	Expexted Profit
25,00	1,25	0,00000	0,00003
24,00	1,24	0,00000	0,00006
23,00	1,23	0,00001	0,00012
22,00	1,22	0,00001	0,00023
21,00	1,21	0,00002	0,00044
20,00	1,20	0,00004	0,00081
19,00	1,19	0,00008	0,00146
18,00	1,18	0,00014	0,00255
17,00	1,17	0,00025	0,00432
16,00	1,16	0,00045	0,00712
15,00	1,15	0,00076	0,01140
14,00	1,14	0,00126	0,01771
13,00	1,13	0,00205	0,02670
12,00	1,12	0,00326	0,03906
11,00	1,11	0,00504	0,05541
10,00	1,10	0,00761	0,07613
9,00	1,09	0,01125	0,10122
8,00	1,08	0,01625	0,12997
7,00	1,07	0,02296	0,16072
6,00	1,06	0,03177	0,19062
5,00	1,05	0,04306	0,21530
4,00	1,04	0,05721	0,22885
3,00	1,03	0,07456	0,22369
2,00	1,02	0,09539	0,19078

1,00	1,01	0,11988	0,11988
0,00	1,00	0,14810	0,00000
-1,00	0,99	0,18001	-0,18001
-2,00	0,98	0,21542	-0,43083
-3,00	0,97	0,25401	-0,76204
-4,00	0,96	0,29538	-1,18151
-5,00	0,95	0,33898	-1,69491
-6,00	0,94	0,38424	-2,30544
-7,00	0,93	0,43051	-3,01358

Source: Data processed, 2020

From Table 2, the optimum mark-up value is 4% with an expected profit of 0.22885%. The correlation between expected profit and mark up on the multi normal distribution for the Friedman model can be seen in Figure 3.

Based on Figure 3, it is not recommended if Company A applies a mark up below 0% because it will cause losses to the company. And it is also not recommended if you apply a mark up above 15% because the expected profit generated is very small, even close to 0%.

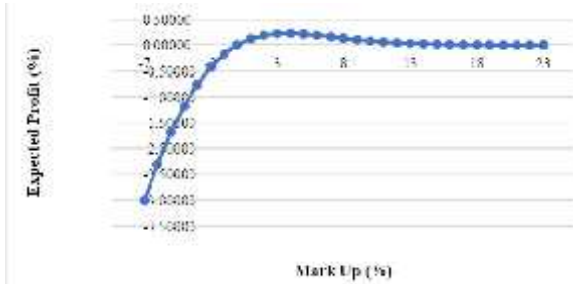


Figure 3. The correlation Between Expected Profit and Mark Up Using Multi Normal Distribution for Friedman Model

C. Model Ackoff dan Sasieni

The Ackoff & Sasieni method only takes one data which is the company with the lowest bid during the auction range.

1. Multi Discrete Distribution

Bidding analysis is performed on company A. The results of the probability of winning and Expected profit are shown in Table 3.

Table 3 Probability of Winning with Multi Discrete Distribution for Ackoff and Sasieni Models

Mark-up (%)	R	P. Win	Expected Profit
25,00	1,25	0,83200	20,80009
24,00	1,24	0,82535	19,80834

23,00	1,23	0,81869	18,82990
22,00	1,22	0,81204	17,86478
21,00	1,21	0,80538	16,91297
20,00	1,20	0,79872	15,97447
19,00	1,19	0,79207	15,04928
18,00	1,18	0,78541	14,13740
17,00	1,17	0,77876	13,23884
16,00	1,16	0,77210	12,35359
15,00	1,15	0,76544	11,48165
14,00	1,14	0,75879	10,62302
13,00	1,13	0,75213	9,77771
12,00	1,12	0,74548	8,94570
11,00	1,11	0,73882	8,12701
10,00	1,10	0,73216	7,32163
9,00	1,09	0,72551	6,52956
8,00	1,08	0,71885	5,75081
7,00	1,07	0,71219	4,98536
6,00	1,06	0,70554	4,23323
5,00	1,05	0,69888	3,49441
4,00	1,04	0,69223	2,76891
3,00	1,03	0,68557	2,05671
2,00	1,02	0,67891	1,35783
1,00	1,01	0,67226	0,67226
0,00	1,00	0,66560	0,00000
-1,00	0,99	0,65895	-0,65895
-2,00	0,98	0,65229	-1,30458
-3,00	0,97	0,64563	-1,93690
-4,00	0,96	0,63898	-2,55591
-5,00	0,95	0,63232	-3,16161
-6,00	0,94	0,62567	-3,75400
-7,00	0,93	0,61901	-4,33307

Source: Data processed, 2020

From Table 3 it can be seen that the optimum mark up obtained is 25% with an expected profit of 20.80009% which is further illustrated in Figure 4.

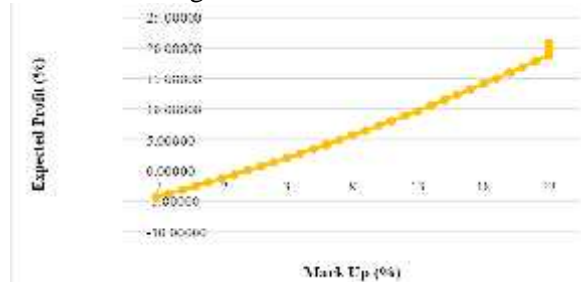


Figure 4. The correlationbetween Expected Profit and Mark Up Using Multi Discrete Distribution for Ackoff and Sasieni Models

It can be seen in Figure 4, the correlation between expected profit and mark up in the multi discrete distribution for the Ackoff and Sasieni model shows that the expected profit increases along with the increase in the value of the applied mark up. It is not recommended if Company A applies a mark up below 0% because it will cause losses to the company.

2. Multi Normal Distribution

In the multi normal distribution, one company is also taken which is the company with the lowest bid. The results of the calculation of the probability of winning and the expected value will be shown in Table 4.

From the calculation results in Table 4, it can be seen that the optimum mark-up value is 9% with an expected profit of 2.59603% at an R value of 1.09. The graph of the correlation between expected profit and mark up for multi normal distribution using the Ackoff & Sasieni model is shown in Figure 5.

Table 4. Probability of Winning and Expected Value with Multi Normal Distribution for Ackoff and Sasieni Models

Mark-up (%)	R	P. Win	Expected Profit
25,00	1,25	0,013970	0,349248632
24,00	1,24	0,018052	0,433246536
23,00	1,23	0,023118	0,531712614
22,00	1,22	0,029331	0,645291527
21,00	1,21	0,036873	0,774327184
20,00	1,20	0,045930	0,918598757
19,00	1,19	0,056694	1,077189166
18,00	1,18	0,069353	1,248362765
17,00	1,17	0,084086	1,429462143
16,00	1,16	0,101052	1,616834346
15,00	1,15	0,120386	1,805796491
14,00	1,14	0,142189	1,990649425
13,00	1,13	0,166519	2,164745803
12,00	1,12	0,193385	2,320615856
11,00	1,11	0,222741	2,450150236
10,00	1,10	0,254484	2,54483511
9,00	1,09	0,288448	2,596030339
8,00	1,08	0,324410	2,595277604
7,00	1,07	0,362089	2,534622137
6,00	1,06	0,401155	2,406929601
5,00	1,05	0,441236	2,206178945

4,00	1,04	0,481928	1,927712873
3,00	1,03	0,522810	1,568429905
2,00	1,02	0,563453	1,126905714
1,00	1,01	0,603436	0,60343618
0,00	1,00	0,642360	0
-1,00	0,99	0,679856	-0,6798557
-2,00	0,98	0,715599	-1,43119852
-3,00	0,97	0,749316	-2,24794867
-4,00	0,96	0,780789	-3,1231571
-5,00	0,95	0,809861	-4,04930426
-6,00	0,94	0,836434	-5,01860196
-7,00	0,93	0,860469	-6,0232812

Source: Data processed, 2020

Figure 5 shows the correlation between expected profit and mark up on the multi normal distribution for the Ackoff and Sasieni model in Company A. It is not recommended if Company A applies mark up below 0% because it will cause losses to the company. And it is also not recommended if you apply a mark up that is too high because it will form a gentle valley on the normal distribution graph or show a very small expected profit, even close to 0%.

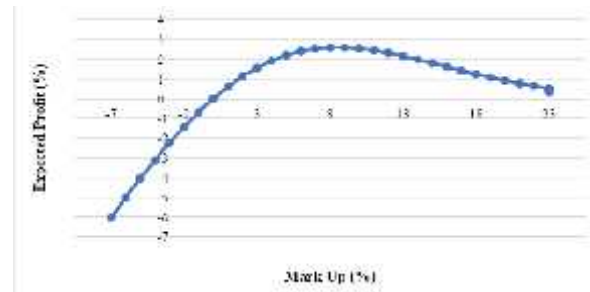


Figure 5. The Relationship Between Expected Profit and Mark Up Using Multi Normal Distribution for Ackoff and Sasieni Models.

D. Analisis Expected Profit

From the analysis of the overall bidding model that has been carried out, it can be concluded that the optimum mark-up value with maximum expected profit at Company A is shown in Table 5.

Table 5. Optimum Mark Up Results and Maximum Expected Profit

Type of Distribution	MODEL	MARK-UP OPTIMUM (%)	EXPECTED PROFIT
Multi Discrete Distribution	Friedman	25	16,03256
	Ackoff dan Sasieni	25	20,80009

Multi Normal Distribution	Friedman	4	0,22885
	Ackoff dan Sasieni	9	2,59603

IV. CONCLUSION

From this research, the following conclusions can be drawn:

- The best bid price strategy to win an auction or tender is the model that produces the lowest optimum mark up, namely the Friedman model with multi normal distribution, while Ackoff & Sasieni produces a higher bid than the Friedman model except in certain company conditions.
- In developing a bid strategy to win the tender, the Friedman model can be used as an illustration in determining the bid price by analyzing past data, while the Ackoff & Sasieni model only analyzes data from the lowest company so that it cannot provide an overview in determining the bid price.

Suggestions from this research

Further research on bid strategy models, bid pricing and cost estimation using other models or using different case studies to compare contractor behavior is needed.

References

- Ali, Subagyo,(2020). Analisis Strategi Harga Penawaran Pada Proyek Reparasi Kapal (Studi Kasus : Layanan Pengadaan Secara Elektronik (Lpse) Kementerian Perhubungan). Tugas Akhir PPNS Surabaya
- American Association of Cost Engineering (AACE). (1992). Skill and Knowledge of Cost Engineering. 3 ed. West Virginia.
- Bisnis.com. (2019). *Ekonomi & Bisnis : Manufaktur (Orderan Sepi, Industri Galangan Kapal Fokus Bisnis Perbaikan)*. [Online] URL : <https://ekonomi.bisnis.com/read/20190320/257/902255/orderan-sepi-industri-galangan-kapal-fokus-bisnis-perbaikan> [Accessed 15 Januari 2020].
- Edquist, Charles. et.al. (2000). Public Technology Procurement and Innovation. Kluwer Academic Publishers, Boston.
- Dimiyati, H.A Hamdan dan Kadar Nurjaman. (2016). Manajemen Proyek. 2 ed. CV.Pustaka Setia, Bandung (Jawa Barat).
- Kementerian Perhubungan. (2006-2019). *Layanan Pengadaan Secara Elektronik (LPSE) Kementerian Perhubungan*. [Online] URL : <http://lpse.dephub.go.id/> [Accessed 10 November 2019].
- Kementerian Perindustrian. (2015). *Siaran Pers : Industri Perkapalan Nasional Tumbuh Signifikan*. [Online] URL : <https://kemenperin.go.id/artikel/12704/Menperin:-Industri-Perkapalan-Nasional-Tumbuh-Signifikan> [Accessed 7 November 2019].
- Lind, Douglas A., William G. Marchal dan Samuel A. Wathen. (2013). Teknik-Teknik Statistik dalam Bisnis dan Ekonomi. 15 ed. Salemba Empat, Jakarta.
- Oktaviani, Cut Zukhrina, Cut Mutiawati dan Nadya Maulisa. (2018). *Penentuan Nilai Mark-up Penawaran Kontraktor Dengan Model Friedman*. Jurnal Teknik Sipil, X(02), pp. 7-11.
- Patmadjaja, Harry. (1999). Model Strategi Penawaran untuk Proyek Konstruksi di Indonesia. Riset Jurusan Teknik Sipil, Fakultas Teknik Sipil dan Perencanaan, <http://puslit.petra.ac.id/journals/civil/>. Universitas Kristen Petra, Surabaya.
- Prabhamandala, Nadendra Rangga, Yusuf Latief dan Jade Sjafrica Petroceany. (2014). *Permodelan Mark Up Harga Penawaran Kontraktor Pada Proses Pelelangan*. pp. 1-18.
- Peraturan Lembaga LKPP Nomor 14 Tahun 2018 tentang Layanan Pengadaan Secara Elektronik (LPSE).
- Peraturan Lembaga LKPP Nomor 9 Tahun 2018 tentang Tata Cara E-Tendering.
- Peraturan Presiden RI Nomor 16 tahun 2018 tentang Pengadaan Barang/Jasa Pemerintah.
- Peraturan Presiden RI Nomor 54 Tahun 2010 tentang Pengadaan Barang/Jasa Pemerintah.