

PERFORMANCE MEASUREMENT ANALYSIS OF CEMENT SACK WAREHOUSE USING BALANCED SCORECARD METHODS

(A CASE STUDY OF PT SINAR TAMBANG ARTHALESTARI)

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ABSTRACTS

Warehouse is recognized as an important facility for manufacturing companies. The purpose of warehouse may vary to each respective party that benefits from it. Because a huge amount of investment is poured over the existence of warehouse, these trigger the significance of performance measurement and assessment over the usage of warehouse. This paper deals with the application of Balanced Scorecard as a basis for creating indicators and metrics for warehouse performance's assessment, especially on the cements sacks warehouse in the respective company, PT Sinar Tambang Arthalestari. Experts' discussions presented that out of 4 perspectives of Balanced Scorecard, two are considered as the most important indicators to measure, which are costumer's perspective and internal business process' perspective. The customer's perspective indicator consists of quantity order fulfillment and quality order fulfillment, meanwhile the internal business process' is divided into space utility indicator and level stock control indicator. From the assessment's result, it showed that the warehouse is fairly-good operated. The details are, quantity order fulfillment for 40kgs is B-graded, 50kgs is C-graded; quality order fulfillment for 40kgs is A-graded and 50kgs is B-graded; space utility of warehouse is C-graded and level stock controls scored in D-graded. The result is further analyzed using 5WHY's analysis to find the basic cause of the performances. The analysis later explain that the poor performance of quantity order fulfillment indicators generated from the lack of schedule planning integration within the company, and the cause of performance on the space utility indicator is originated from the harbor authority. The poor performance of level stocks control issue is originally from the policy of company.

Keywords : *Balanced Scorecard, Warehouse Performance, Performance Measurement.*

I. INTRODUCTION

The heightened competition within manufacturing industries riled up companies involved to imply their best management strategies. The common methods concerned is to improve the functionality of their assest, including advancing their warehouse's system to ensure the safety of customers demands. Lambert [1] stated that warehouse is a fixed specific facility designed to satisfy the service's targets within the least amount of cost. Lambert considers warehouses as a part of logistic systems utilize to store items, such as raw materials, production components, work-in-processes, and finished products.

In the cement industries, the existences of warehouses is not a mere warehouses. The facts that warehouses cost heaps amount of care and considered as an immobile investment, the management could not break the importance of warehouses as the heart of cement industries in which depend on an actual demands of customers. The functionality of warehouses in cement industries is not limited to finished products' storage, but widened into a place to store machine components, spareparts, and cement sacks. These variety of warehouses usage are solid support system inside the unending mechanism of cement productions.

The summarized process of cement sack's warehouse is to be written below ; (a) The procurement planning of cement

sacks, (b) The contracts of cement sacks supplier, (c) The procurement of cement sacks, (d) The receiving stage of cement sack, (e) The storage of cement sack, and (f) The distribution of cement sacks to customers— production facilities, packaging division.

As stated above, the significance of warehouse had been proved by many companies especially in the cement industry. The cement sacks's storage is one of many important factors hold up into the cements' production processes. Thus, it's impartially needed to run on audits and performance measurement, both quantitatively and qualitatively. Through observations, the status quo mounted that the performance evaluations are articulated mere on the cement sacks' stocks and on-time delivery of cement sacks'. Those methods are seen as lacking to see the holistic and comprehensive view and scoring of warehouse management factors involved.

The previous studies within the topics of warehouse performance measurement are actually much lacking compared to another facility's performance assessment. Assessing the performance of warehouses has been largely ignored in research because of its complexity to determine the metrics of evaluation.

One of the sources the author used as a basis for warehouse performance measurement is done by Per Axelsson and Jonathan Frankel [2], using SCOR model as the method to evaluate the performance of warehouses. SCOR model emphasizes the warehouse as a part of supply-chain within the system, thus linking the warehouses as an integrated part of manufacturing systems. SCOR stressed the evaluation metrics on 4 aspects known as ground pillars which are performance, processes, practices, and people.

Bogale [3] created a modified conceptual framework to assess the performance of warehouse derived from another supply chain measurement model. Bogale divided the performance indicators into 4 major dimensions; quality, response time, cost and productivity to determine the level of warehouse' efficiency. Each dimension will have sub-dimensions to measure. This method is largely statistically-conducted following up the necessity of survey.

By any means, this research has purposes to deliver suggestion in the problems of warehouse performance assessment by using Balanced Scorecard method as the basis of creating indicators and metrics. The result of the performance's analysis would be examined through the root cause analysis methods, 5WHY's in order to evaluate the result of the measurement and find the reasons of shortage as resulted

Apple [4] considered warehouses as places to store items later used in production. The existency of warehouses are required within the coordination process of product's flow occurred as the result of imbalance between the supplies and demands. Those disparity push the needs of inventory to stock, creating a room for storage named warehouse. The objectives of warehouse usage may be varied according to the intentions of management to create warehouse. Generally the aim of creating inventory is to fully utilize the resources, while maintaining the maximum customer's service within the limited resources. As a foundation, the 4 goals of warehouse management are speed, efficiency, effectiveness and realibility.

The integrated part of warehouses as a supply chain support system developed the basic activities commonly done in which are (1) Receiving, (2) Put Away, (3) Storage, (4) Order Picking, (5) Checking and Packing, and lastly (6) Shipping.

Performance

The research focuses on performance assesment, thus assuming that performance is inseparable part to every actions accomplished in a facility within the management supervision. Stolovitch and Keeps [5] defined that performance is a collection of result achieved and referred to actions behind those achievement. Bernardin and Russel [6] also stated that performance is a documentation of results derived from the job's target and specification or certain activities in a certain period of time.

The term of performance measurement refer to a process to which the organizational level figure the result parameter to be achieved by programs and investment done systematically based on performance indicators divided by input, output, result and advantage. Atkinson established the systems of performance measurement as seen below.

1. Observing every organizational activities and emphasize on the customer's perspective.
2. Measuring each activity using measurement methods agreed.
3. Considering all part of activities performance in which comprehensively affecting customers,
4. Providing informations and feedbacks in order to help to identify problems and opportunity to improve.

Gordon [7] provides the explanation of performance assessment purposes, which are to improve and motivate employee's contribution to the company, provide a foundation to evaluate the performance's quality of each activity, to identify the necessity of training and development as in to establish the standard quality and to help decision making related to employee and process involved.

Balanced Scorecard

II. LITERATURE

Warehouse

Robert Kaplan and David Norton [8] stated that Balanced Scorecard is an assessment method involving 4 perspectives to evaluate the performance of organization. The four perspectives are; financial, customer, internal business process, learning and development. Commonly, Balanced Scorecard is widely used to evaluate the position of certain organization by seeing the holistic achievement built in the four perspectives of Balanced Scorecard. The basis of assessment is stretched into establishing Key Performance Indicators (KPI) to build a quantitative measurement from each perspective. KPI or Key Performance Indicators is a known method of quantitative measurement in a concept of performance evaluation. KPI's main purposes are to connect the visionary and missionary goals, organizational strategies and objectives of organizations in the means of achieving the right performances. KPI will help to measure the trend of organizational performances by providing signals of specific area needed to improve or fix. KPI accomodates comparison to other companies thus displaying the shortcomings and create a room of improvement.

III.METHODOLOGY

Early Stage of Research

The research started by conducting both literature study and field study to establish a solid ground of preliminary reviews. The literature study showed that warehouse performance assesment is not likely to be done, as much as lacking prior scientific studies. Thus, resulted a justification for the researcher to advance the idea of Warehouse Assessment by combining the KPIs with the concept of Balanced Scorecard. The complete process of research is explained in Fig. 1.

The objects of the research is a National Private Company specialized in cement-making industry, PT Sinar Tambang Arthalestari. The company started as early as 2013 and has been able to secure right proportion of cement-industry customers, mainly covering for domestic usage of cement. The company built three main warehouse utilized for different purposes, which are; sparepart warehouses, machine warehouses and cement-sacks warehouses. The company doesn't provide finished-goods warehouses since the newly-produced cements would be directly chaneled to distributors.

Data Collection

Data used in the research mainly originated internally. The data is obtained through the person in charge, the Deputy of Warehouse and The Head Department of Logistics. The researcher is able to collect data, classify as below :

- a. Balanced Scorecard.
- b. Monthly Report of Receiving and Delivery of Cement Sack.
- c. Key Performance Indicators.

Performance Measurement and Assesment

Firstly, the researcher established the basic evaluation for warehouse, derived from the Balanced Scorecard of the company in which had been discussed down to create a specific Balanced Scorecard exclusively used for Warehouse's assessment. The Key Performance Indicators served by digging down the needs of each aspects of Balance Scorecard within the warehouse, using observation and interactive discussion with the person in charge. Thus, generates a complete list of metrics to measure as shown in Fig 2. A thorough explanation and visualisation of Balanced Scorecard is showed in Fig 3. By the extensive discussions with the persons in charge, the researcher is able to further select the most significant indicators for each aspects of Balanced Scorecard preferred to warehouse' performances.

Through the monthly reports, the researcher is able to secure a thorough evaluations of warehouse by grading each indicators selected prior to further measurement, in a scoring mechanism; very bad, bad, enough, good, very good. Though, each indicators have each standard.

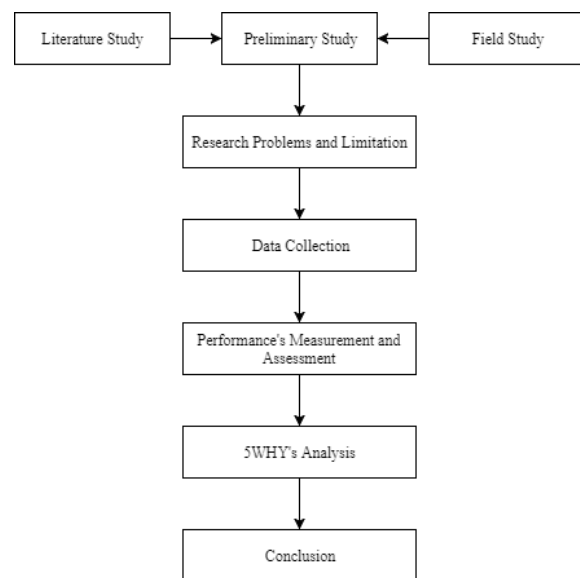


Fig. 1 Research Methodology

5WHY's Analysis

The result of assessment will be analysed using 5WHY's *Root Cause Analysis Tools* to resolve the causes of failures to adhere the performance's standard. The reason to perform the further deep root analysis of the result is objected to discover the instigators of the outcomes. The further analysis done, the better the analysis may be utilized as an outlook to improve the performances.

IV. RESULTS

Performance's Assessment Result

The performance assessment is conducted on two aspects of Balanced Scorecard, dealing with Customer Satisfaction aspects and Internal Business Process'. These aspects were emphasized by the persons in charge through in-depth discussion about effective warehouse management and its achievement.

Customer Satisfaction

Under the concern of Customer Satisfaction aspects, we graded the monthly report by using the indicators of order

completion by quantity and quality. The sole customer of cement sack warehouse is the Packaging Division under Production Department. The data in the research is compiled by two departments to keep in track of daily quantity delivered to packaging room. The other data provided the quality completion of cement sack's delivery. The data of cement sacks delivery is served by two types of packaging classified by the size of the sacks, 40 kgs and 50 kgs.

Aspects	Goals	KPI	Polarization	Formulation	Target
Financial					
F-1	Minimize Inventory Cost	Inventory Variation's Budget	MIN	Physical Stock Gap/Total of Stock	10%
Customer Satisfaction					
C-1	Perfectly Completed Delivery	% Order Quantity as Ordered	MAX	(Order Quantity Delivered / Order Quantity Req.) x 100%	100%
		% Order Reject	MIN	(Quantity of Reject / Order Quantity Req.) x 100%	0.40%
Internal Business Process					
IP-1	Improve the Receiving Process	Unloading Time	AVERAGE	Mean Time of Unloading per Rit	TBA
IP-2	Improve the Utility of Facility	% Space Utility	MAX	(Space Used / Space Reserved) x 100%	85%
IP-3	Improve Stock's Control	% LS Accomplished	MAX	(LS Quantity/12) x 100%	17 Days; 80%
IP-4	Improve Control's Quality	Qty and Quality Ordered	MIN	Guarantee Claims	10% per year
Learning & Growth					
LG-1	Improve Team's Knowledge	Staffs in Training per Month	MAX		Department Head, Superintendent = 4x per Year, Staff = 2x per Year
LG-2	SR Implementation	% SR Implemented	MAX		TBA
LG-3	Absence Rate	% Absence Days per Staff per Year	MIN	Total of Absence Days per Periods	4 Days per Staff per Month

SELECTED INDICATORS

Fig. 2 Balanced Scorecards Metrics

The measurement is stressed on the issue of both quantity fulfillment and quality fulfillment of delivery. Below are the result of delivery completion on quantity fulfillment for 40 kgs and 50 kgs packaging explained in Table 1 and Table 2.

The overall results showed that the quantity order fulfilment of 40kgs cement packaging is relatively good within 83.01% delivery rate. The opposing result of quantity fulfillment on 50kgs cement packagings measured on the scoring range of enough, within 78.72% rate of delivery.

Table 1.

Quantity Fulfilment Measurement of 40kgs Cement Packaging

Period	Delivery	Usage	Rate	Grade
January	721,200	799,280	90.23%	B Good
February	527,800	633,845	83.27%	B Good
March	479,600	558,018	85.95%	B Good
April	486,600	576,948	84.34%	B Good
May	553,800	634,871	87.23%	B Good
June	613,600	692,380	88.62%	B Good
July	441,000	553,604	79.66%	C Enough
August	831,800	1,042,007	79.83%	C Enough
September	822,400	1,003,932	81.92%	B Good
October	438,415	632,174	69.35%	D Bad
Total	5,916,215	7,127,059	83.01%	B Good

Table 2

Quantity Fulfilment Measurement of 50kgs Cement Packaging.

Period	Delivery	Usage	Rate	Grade
January	782.080	932.322	83.89%	B Good
February	424.480	587.903	72.20%	C Enough
March	388.960	478.158	81.35%	B Good
April	398.080	509.837	78.08%	C Enough
May	469.760	552.052	85.09%	B Good
June	591.520	681.707	86.77%	B Good
July	513.120	640.034	80.17%	B Good
August	771.040	1.028.729	74.95%	C Enough
September	766.080	1.014.133	75.54%	C Enough
October	616.081	842.754	73.10%	C Enough
Total	5.721.201	7.267.629	78.72%	C Enough

The measurement for quality metrics of delivery fulfillment necessarily performed based on the rejection data of cement sack delivered, following the packaging drop test before usage. The results of the measurement for 40kgs and 50kgs are as seen in the following Table 3 and Table 4.

Internal Business Processes

The subsequent aspects to measure from Internal Business Processes consisted of two selected indicators out of 4 served, in which are space utility of the warehouse and level stock's control. The space utility indicator is formulated by counting the average of cement's sack stored monthly in par of the capacity of the warehouse available. The data of space served

for cement sacks is comprised to 1.950.000 sheets of cement sacks. This amount is derived from the planned capacity of the warehouse. The tabulation result of space utility measurement is presented in Table 5.

At last, the second indicator to measure is level stock's control. By the procedures applied, certain standard of level stock is set to avoid miscalculation of cement sack's procurement. The number of cement sack stocks is maintained to ensure the stable process of packaging. The company set the level stock to minimumly last for 17 days. The better control of level stock is created by good management of physical checking of cement sacks stored in the warehouse. Thus, the level stock indicator is considered as one of the most impactful factors of warehouse performance. The result of the measurement listed in Table 6.

Table 3.

Quality Fulfilment Measurement of 40kgs Cement Packaging

Period	Delivery	Defect	Rate	Grade
January	721,200	1,577	0.22%	A Very Good
February	527,800	928	0.18%	A Very Good
March	479,600	719	0.15%	A Very Good
April	486,600	678	0.14%	A Very Good
May	553,800	701	0.13%	A Very Good
June	613,600	980	0.16%	A Very Good
July	441,000	933	0.21%	A Very Good
August	831,800	1,497	0.18%	A Very Good
September	822,400	1,461	0.18%	A Very Good
October	438,415	2,159	0.49%	D Bad
Total	5,916,215	11,633	0.20%	A Very Good

Table 4.

Quality Fulfilment Measurement of 50kgs Cement Packaging

Period	Delivery	Defect	Rate	Grade
January	782.080	1.896	0.24%	A Very Good
February	424.480	1.455	0.34%	B Good
March	388.960	737	0.19%	A Very Good
April	398.080	1.381	0.35%	B Good
May	469.760	1.617	0.34%	B Good
June	591.520	1.435	0.24%	A Very Good
July	513.120	2.114	0.41%	C Enough
August	771.040	2.540	0.33%	B Good
September	766.080	4.254	0.56%	C Enough
October	616.081	2.622	0.43%	C Enough
Total	5.721.201	20.051	0.35%	B Good

Table 5.

Space Utility of Warehouse

Period	Average OH	Capacity	Utility	Grade
January	1,023,162	1,950,000	52.47%	B Good
February	1,149,931	1,950,000	58.97%	B Good
March	1,264,548	1,950,000	64.85%	B Good
April	1,141,200	1,950,000	58.52%	B Good
May	931,355	1,950,000	47.76%	C Enough
June	652,700	1,950,000	33.47%	C Enough
July	473,710	1,950,000	24.29%	C Enough
August	277,064	1,950,000	14.21%	C Enough
September	358,200	1,950,000	18.37%	C Enough
October	126,194	1,950,000	6.47%	C Enough
Total	739,806	1,950,000	37.94%	C Enough

Overall Performance Measurement Result

Table 7 is served as the overall review of warehouse performance measurement result. The tabulation showed four selected indicators appraised based on the calculation of the data served to research.

As seen in Table 7, further analysis of the results will be concluded for each indicator scored below *B* or *Good*. Those are, quantity order fulfillment of 50kgs cement sacks under Customer Satisfaction aspect; space utility and level stock accomplishment under Internal Business Processes aspect.

5WHY's Analysis

The method is aimed to administer the basic cause of some results by repeatedly asking why five times following the statement posing as the problem occurred. The 5WHY's analysis conducted on performance indicators are showed in Table 8, Table 9 and Table 10 consecutively.

Table 6.

Level Stock Measurement

Period	Stock	Receiving	Usage	End Stocks	LS
January	675,629	796,000	932,322	539,307	18
February	539,307	882,000	587,903	833,404	41
March	833,404	336,000	478,158	691,246	45
April	691,246	378,000	460,905	608,341	40
May	559,409	378,000	552,052	385,357	22
June	385,357	672,000	681,707	375,650	17
July	375,650	414,000	640,034	149,616	7
August	149,616	924,000	1,028,729	44,887	1
September	44,887	1,170,000	1,014,133	237,000	7
October	237,000	1,106,000	1,108,851	293,353	8
Overall Percentage of Level Stock Control					60%

V. DISCUSSIONS

The result of the research generated from the performance assessment showed that Balanced Scorecard approach could be used as a basis to measure a facility performance, especially warehouse facilities in which involve many factors in its processes. By deriving the standard Key Performance Indicators from 4 perspectives on organizational Balanced Scorecard, the managerial level could establish a holistic point of view to assess its performance.

The main foundation of using Balanced Scorecard as a good performance measurement methods intended on the facts that Balanced Scorecard is a strategic control system which aligned departmental and personal goals to overall strategies. Enable the translation of organizational visions and strategies to objectives and measures in the financial, customer, internal business process and learning and growth point of view.

The measured indicators in this research had been included on Kolinski [9] who analyzed the general model of warehouse performances based on his own study compiled from Corbett [10], Sliwczynski [11], and Twarog [12] after suited to the purposes of the warehouse as the objects.

The absence of financial perspectives and learning and growth point of view from the assesment's indicators doesn't imply the unimportance of the two, but rather difficult to

develop and measured. The financial's point of view requires deeper understanding of investment's value and fiscal's status of the the facility, thus seemingly hard to obtain data necessary for the research, as it had been a company confidential. On the

other hand, the learning and growth perspective serves as the most wanted form of assessing the warehouse. Nevertheless, the indicators can turn inconsistent from the basic strategic aims and entrails to different threats.

Table 7.
Overall Result of Performance Measurement

Aspect	Goals	KPI	Measurement			
			Grade			
Customer Satisfaction			40 Kg	50 Kg	40 Kg	50 Kg
C-1	Order Fulfillment	% Order Quantity	B - 83,01%	C - 78.72%	Good	Bad
		% Order Reject	A - 0.20%	B - 0.35%	Very Good	Good
Internal Business Process			Grade			
IP-2	Facility Utility	% Space Utility	C - 37.94%		Enough	
IP-3	Stock's Kontrol	% Level Stock	D - 60%		Very Bad	

These indicators were also generated by asking the experts opinions who are in charge of managing and supervising the warehouse. The experts which consists of Head Department of Logistics and Deputy Manager of Warehouse emphasized the significance of customer's perspective on the assessment. Mainly considering the fulfillment of orders as the main factors to see warehouse's performances. Based on their preference of significant indicators indicating the facility performances, the result of the assessment presented a fairly functioning warehouse.

5WHY's analysis are done only on the poor performance's indicators. The analysis further explained the causes of poorly-functioning facilities. Out of the three indicators, two causes are generated from third's party policies which are company's headquarter management and PELINDO's. The quantity fulfillment analysis is outlining the lack of integration within the company resulting an imbalance schedule planning inter-divisionally.

VI. CONCLUSION

Due to the result of the study, ones conclude that warehouse is a partially important facility in the world of manufacturing. The benefits and losses of warehouse depends on the strategic, tactical and operational controls over it. Meanwhile, the warehouse performance assessment showed its complexity because of endless factors involving in warehouse processes and successes. The study explained the concept of warehouse assessment method by using the derivatives of organizational Balanced Scorecard to determine the warehouse's Key

Performance Indicators and chose the most significant indicators to measure. This concept of using Balanced Scorecard as basis is justified. From various sources, Balanced Scorecard is seen as a support to align the strategic goals to operational measurement. Thus, effectively help the managerial level to gain sufficient controls over the facility.

Based on the study, we conclude that:

1. Through the observations, and discussion with persons in charge, in a basis of Balanced Scorecard, the most significant indicators of warehouse's performances are chosen to be customer's perspective and internal business process's perspectives.
2. The result of warehouse performance assessment resumed to be fairly-good operated. In which the result of each respective's indicators are; Quantity Order Fulfillment for 40kgs is B-graded, 50kgs is C-graded; Quality Order Fulfillment for 40kgs is A-graded and 50kgs is B-graded; Space Utility of Warehouse is C-graded and Level Stock Controls scored in D-graded.
3. Root-Cause-Analysis is further done to find the basic cause of the poorly-performed indicators. By discussions and brainstorming with the experts, the poorly-performed indicators which are Quantity Order Fulfillment originated from the lack of schedule integration within the company, especially inter-divisional; Space Utility originated from the policy of harbor's authority; and Level Stock's Control caused by the internal policies of company.

Table 8.
5WHY's Analysis of Quantity Fulfillment Indicators

Problem	The delivery supply could not satisfy the packaging division demands.
1 st Why	Inter-divisions different schedule.
2 nd Why	Lack of coordination and inter-division team work.
3 rd Why	Lack of confirmation and information sharing between divisions.
4 th Why	SOP and work orders are instructed separately on the case, independently set their own instruction list.

5 th Why	The lack of awareness and understanding of co-sharing information between divisions internally. The lack of integration culture.
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Table 9.

5WHY's Analysis of Space Utility

Problem	The targeted space utility of the facility is not accomplished.
1 st Why	Great imbalance between the quantity of cement sack received to quantity of cement sacks delivered.
2 nd Why	The delay of suppliers.
3 rd Why	The unloading takes long time.
4 th Why	The harbor authority doesn't provide sufficient amount of unloading workers.
5 th Why	PELINDO's main policies and rules.

Table 10.

5WHY's Analysis of Level Stock Control

Problem	The fulfillment of Level Stock is below the target.
1 st Why	Billerud's tardiness on deliveries.
2 nd Why	The prolonged time for documents processing.
3 rd Why	Communications limited to management in headquarters.
4 th Why	The authority over suppliers rely upon HQ's management.
5 th Why	The company's policies and SOP

REFERENCES

- [1] Stock, J.R. dan Lambert, D.M. 2001. *Strategic Logistics Management*. 4th Ed. McGraw-Hill. New York.
- [2] Axelson, P., Frenkel. J. 2014. *Performance Measurement System for Warehouse Activities Based on the SCOR Model*. Thesis. Departement of Industrial Management and Logistic Faculty of Engineering Lund University. Sweden.
- [3] Bogale, T. 2016. *Assessment of Warehouse Peformance : A Case of Ethiopian Trading Enterprise*. Thesis. Department of Logistics and Supply Chain Management.
- [4] Apple, James M. 1990. *Tata Letak Pabrik dan Pemindahan Bahan*. ITB. Bandung.
- [5] Stolotvitch, Harold D., dan Keeps, Erica J. 1992. *Handbook of Human Performance Technology : A Comprehensive Guide for Analysis and Solving Performance Problem in Organizations*. Jersey-Bass Publisher. San Fransisco.
- [6] Bernardin, John H., dan Russel, Joyce E.A. 1993. *Human Resource Management : An Experimental Approach*. Prentice Hall. New Jersey.
- [7] Anderson, Gordon, C. 1993. *Managing Performance Appraisal System*. Blackwell Publishers. United Kingdom.
- [8] Kaplan, R.S dan Norton, David P. 1996. *Translating Strategy Into Action The Balanced Scorecard*. Harvard Business School Press. Boston.
- [9] Kolinski, A., Sliwczynski, B. 2015. *Evaluation Problem and Assessment Method of Warehouse Process Efficiency*. 15th International Scientific Conference Business Logistics in Modern Management.
- [10] Corbett, T. 1998. *Throughput Accounting*. North River Press. New York.
- [11] Sliwczynski, B. 2011. *Operational Controlling - A Tool of Translating Strategy Into Action*. Log Forum 7 (1), p. 45-59.
- [12] Twarog, J. 2005. *Measuring and Indicators of Logistics*. Publishing House of Institute of Logistics and Warehousing. Polish.