Manufacturing Capability, Sustainability Strategy and Manufacturing Performance of Indonesia Automotive Manufacturer

Edwin Aditya Herbanu
Department of Industrial Engineering
Universitas Indonesia
Salemba, Jakarta, Indonesia
edwin.aditya61@ui.ac.id

Rahmat Nurcahyo
Department of Industrial Engineering
Universitas Indonesia
Kampus Baru UI Depok, Depok 16424, Indonesia
rahmat@eng.ui.ac.id

Abstract

The implementation of sustainability strategy in corporate has continued to grow steadily in recent years. This is particularly true for automotive manufacturer. This research discusses the relationship between influential variables with performance in Indonesia automotive manufacturer by manufacturing capability and sustainability strategy. Data are collected from automotive manufacturers around Jakarta, Bekasi & Karawang area. Data is processed using Structural Equation Modeling (SEM). The analysis of this paper in the selected companies is provided with the purpose to help understand how automotive manufacturers know the effect of sustainability strategy in manufacturing performance based on their manufacturing capability.

Keywords
Manufacturing Capability, Sustainability Strategy, Manufacturing Performance, Automotive Manufacturer

1. Introduction

The acceptance of sustainability strategy in corporate has continued to grow steadily in recent years (Sukitch et al., 2015). Manufacturing is regarded as a key sector in sustainability due to its high volume of resource consumption, increasing annual introduction of new products that require a relatively high amount and generation of materials, energy and wastes, an increasing volume of emissions throughout the product life cycle and the collective impact of manufactured products and manufacturing processes on the immediate community (Joung, et all., 2013). Manufacturing companies are not only aiming to improve operations in terms of flexibility, delivery, quality, and cost, but also attempting to be competitive in terms of environmental and social issues (Caniels et al., 2013; Vachon and Klassen, 2008).
Failing to manage these sustainability issues can substantially damage the image of the company and thus affect its performance (Chen L., 2008). This research discusses the relationship between influential variables with performance, especially for environment in Indonesia automotive manufacturer namely manufacturing capability and sustainability strategy.

2. Literature Review

The company must be able to measure the resulting capacity and capabilities within the workforce at all levels and map this against future products and services the company aims to break into. Once the company is convinced that they have covered the core stage and ensured that each element within that stage is developed fully, the team then moves on to the operational systems stage (Pham Duc T., Thomas Andrew J., 2012).
Due to the relative newness of environmental sustainability in the manufacturing sector (often called green manufacturing) as a discipline, the industry needs to acquire new capabilities (knowledge, skills, and values) in order to convert environmentally-sustainable manufacturing aspirations into practice (Zhu et al., 2008).
In order to obtain a more in-depth understanding, a survey should be carried out on manufacturers based on the type of industry in future work such as automotive, power generation, electrical and electronics, as well as food industries. In addition, it would be interesting to examine the moderating role of different types of sustainable manufacturing practices such as company ownership, type of industry and technological advancement in future work (Rashid et al.,2015)
Future research can examine the interrelationship between sustainability strategy and operations strategy. Such an inquiry is necessary for investigating whether sustainability factors can be integrated into a company's overall operations strategy (Chen L., 2015). Future studies may attempt to collect data from several layers of managers (e.g. top, middle, and lower levels) to minimise the potential for common method bias (Wijethilake C., 2016).
So, this research focus in automotive industry and to help understand how automotive manufacturers know the effect of sustainability strategy in manufacturing performance based on their manufacturing capability.

3. Theoritical Background

Sustainability is usually considered to be development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Bruntland Report for the World Commission on Environment and Development, 1992). Developing and integrating a detailed sustainability vision into your long-term strategic plan in a way that creates lasting value whilst also building public trust is a common challenge for all types of organisations. Strategy in the age of sustainability will perhaps challenge the way to understand the role of the corporation in society, and may help reinforce or even accelerate the current social and environmental trends and expectations, as a society, place on organisations. Yet, to the extent that such pressures are effective in further pushing the same or other organisations towards fundamentally rethinking what their strategy is all about, and in doing so, addressing the world's biggest social and environmental issues, then in the longer term challenging the current mindsets will almost certainly be beneficial.
A capability is the ability to perform or achieve certain actions or outcomes. Manufacturing capabilities are characterized by the set of practices in use. The capabilities are formed by the objectives for the manufacturing system paired with the history of decisions in manufacturing related issues (Größler and Grübner, 2006). Also, dependent on the set of capabilities inherent in the system at hand different performance levels can be achieved, i.e. capabilities are the basis for operational performance
Performance is the accomplishment of a given task measured against present known standards of accuracy, completeness, cost, and speed. An attempt to isolate the performance of the operations function is to utilise measures where the management of operations plays an integral part, i.e. operational performance measures (Flynn and Flynn, 2004). Dimensions used conveniently coincide with the common set of competitive priorities, i.e. quality, delivery, flexibility and cost performance.

4. Research Methodology

To test and get data, we asked automotive manufacturer in Indonesia especially in A Group around Jakarta area to participate in our survey. Through our personal network, we had been introduced to several layers of managers at various automotive company. We contacted these managers directly to participate in our survey. The number of samples is 100. This number is considered appropriate particularly in terms of overall suitability measure with chi-square probabilistic ratio for data processing with Structure Equation Model (SEM)
The data from respondents were processed using ANOVA testing and by Structural Equation Modeling (SEM). The number of samples is 100 companies. This number is considered appropriate particularly in terms of sample size recommendations ranging from 40 to 240, respectively (Wolf Erika J. et all., 2013). The questionaire as research instruments was also developed based on the research model. The questionaire related to manufacturing capabilities

and sustainability strategy consist of 4 main variables namely quality, cost, delivery and environment, while manufacturing performance questionaire is consist of two main variables namely manufacturing performances and environment performance.
Main data processing consists of analysis of measurement model, simplification of latent variable by calculating Latent Variable Score (LVS), experiment result of Confirmatory Factor Analysis (CFA) and stuctural model testing. Latent variables are implied by the covariance among two or more measured variables. In this research, the variables are Manufacturing Capability (Man Cpb), Sustainability Strategy (Sus Strat), and Manufacturing Performance (Man Prf).

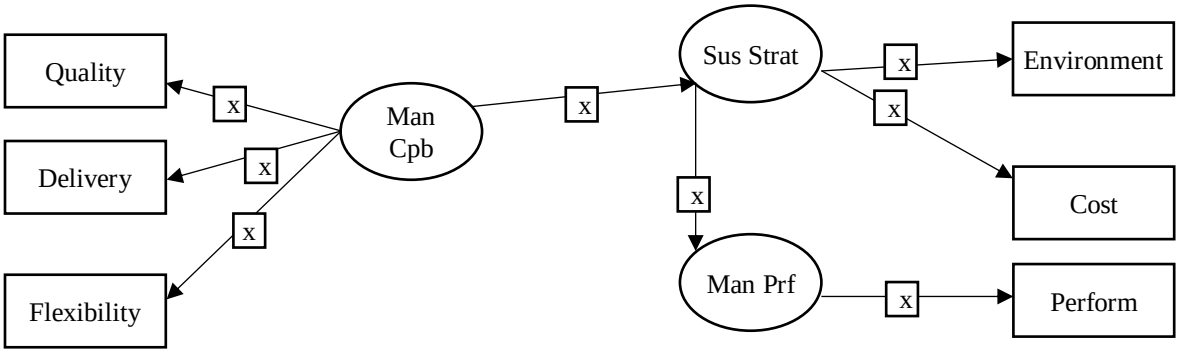

Figure 1. Path diagram of structural model research.

Our processing consist of :

- Chi Square. The purpose of this analysis is to develop and test a model that fits the data. The value of the Probability Chi-squares > 0.05 marks identical with the theory of empirical data/model.
- Goodness Of Fit index (GFI) is to describe Index level of suitability of the model as a whole are calculated from the quadratic residual of the model predicted compared to the actual data. The value of GFI > 0.90 hinted the model tested had good compliance.
- The root Mean Square Error of Approximation (RMSEA). RMSEA is a measure that tries to correct the tendency of statistic chi-square reject models with a large number of samples. RMSEA values between 0.05 and 0.08 indicates a good index to receive the suitability of a model.
- Normed Fit Index (NFI). This index is also a size comparison between the proposed model and a null model. The recommended value is the NFI > 0.90.
- Comparative Fit Index (CFI). The CFI is also an incremental compliance index. Magnitude of this index is in the range of 0 to 1 and the value of that approach 1 indicates conformance level model has a good one. The value of the recommended acceptance is CFI > 0.90.
- Adjusted Goodness Of Fit Index (AGFI). The recommended value is AFGI > 0.90, the greater the value the better the alignment then AFGI owned models.

Viewing of Goodness of Fit Index (GOFI) from output Lisrel also can reflect whether the existing data, to support the research model that has been previously set or not.

5. Result and Discussion

We can see whether there are differences among the three latent variables (Man Cpb, Sus Strat, and Man Prf) by the ANOVA testing. The test is evaluated from the three profiles of respondents, based on division, job position and responsibilities of respondents.
After get the data, next step is validity and reliability. Testing of data that is visible from the value of the Standardized Loading Factor (SLF) reflects whether the observed variables have been measured Latent Variable research and reliable or not. In the form of grains of the questionnaire contained questions/answers that are available with the ordinal scale (Likert scale) using five level scale of alternative answers. Likert scales are called ordinal because the statement strongly agree having higher levels against agreed and agree higher against doubt/neutral, and so on. Based on the test results, obtained findings are worthy of use in research data retrieval, which is proved from the overall coefficient of p-value < 0.05.

Confirmatory Factor Analysis (CFA) test model study was conducted to determine the Latent Variable anywhere that is valid and can be further processed to test the structural model.
To see whether the research hypothesis acceptable or not, we use model structural. This is done by analyzing theprocessing of the T-value (t value) to test hypotheses of significance to the research model. T-Value is the measure of the statistical significance of an independent variable b in explaining the dependent variable y.
The function of SEM is to tests hypotheses about relationships between variables. Hypothesis accepted if the absolute number of t> 1.96 (for 2-tailed) which is equivalent to $p < 0.05$, then accept alternative hypothesis with a coefficient in accordance with the proposed research hypotheses (positive or negative) where previously measured first value Standardized Factor Loading research model. To see how far the data support the model, then used the indicator value by GOFI for all latent variables structural model. The calculation results are listed in Table 1 as follows.

Table 1. Goodness Of Fit Index (GOFI) Structural Model Research

Interaction Latent Variable	Conclusion
(H1) Man Cpb → Sus Strat	Manufacturing Capability influence Sustainability Strategy significantly, H1 accepted
(H2) Sus Strat → Man Prf	Sustainability Strategy influence Manufacturing Performance significantly, H2 accepted

6. Conclusion and Future Research

As conclusion, all hypotheses can be accepted by the path : Manufacturing Capability (Man Cpb), Sustainability Strategy (Sus Strat), and Manufacturing Performance (Man Prf). This path is shown to prove the truth of the hypothesis that manufacturing capabilities will affect the sustainability strategy which applied in the automotive company, and will also affect the performance of the company.
Based on ANOVA testing, we can conclude that for latent variable in Manufacturing Capability (Man Cpb), Sustainability Strategy (Sus Strat), and Manufacturing Performance (Man Prf) in almost all groups of respondents profile shows the results of 'no difference'.
In order to obtain a better and more comprehensive understanding of sustainability, it is suggested for future research to increase the number of participating firms and compare also with different industry or countries. It is also worthwhile to explore the differences of the capability and strategy approaches for sustainability between the big firm's and small/medium firm's.

References

Bhupendra, K. V., & Sangle, S. What drives successful implementation of pollution prevention and cleaner technology strategy? The role of innovative capability. *Journal of Environmental Management*, 155, 184–192, 2015.
Caniels, M.C.J., Gehrsitz, M.H. & Semeijn, J., Participation of suppliers in greening supply chains: An empirical analysis of German automotive suppliers, *Journal of Purchasing and Supply Management*, vol. 19, no. 3, pp. 134-143, 2013.
Chen L., Sustainability and company performance: Evidence from the manufacturing industry., Sweden, 2013.
Chen L., Sustainability and company performance: Evidence from the manufacturing industry, 2015.
Drake DF, Spinler S., Sustainable Operations Management: An enduring stream or passing fancy?, *Manufacturing & Service Operations Management*. 15:4-p.689-700, 2013.
El Mola, K.G. and Parsaei, H., Dimensions and measures of manufacturing performance measurement, *Proceedings of the 40th International Conference on Computers and Industrial Engineering (CIE)*, Awaji, pp. 1-6, 2010.
Epstein, M.J., Roy, M.-J., Sustainability in Action: Identifying and measuring the key performance drivers. Long Range Plan. 34, 585e604, 2001.
Found, P., Beale, J., Hines, P., Naim, M., Rich, N., Sarmiento, R. and Thomas, A., A theoretical framework for economic sustainability of manufacturing industry, *European Opearations Management Association (EUROMA) Conference*, University of Strathclyde, Glasgow, 2006.

Hair Jr, Joseph F., et al. Multivariate Data Analysis. 7th ed. Prentice Hall; 2009.
Hon, K.K.B., Performance and evaluation of manufacturing systems, CIRP Annals – Manufacturing Technology, Vol. 54 No. 2, pp. 139-154, 2005.
Joung, C. B., Carrell, J., Sarkar, P., & Feng, S. C. Categorization of indicators for sustainable manufacturing. Ecological Indicators, 24, 148–157, 2013.
Kleindorfer PR, Singhal K, Van Wassenhove LN., Sustainable Operations Management. Production and Operations Management, 14:4-p.482- 492, 2005.
López, M.V., Garcia, A. & Rodriguez, L., Sustainable development and corporate performance: A study based on the Dow Jones sustainability index, *Journal of Business Ethics*, vol. 75, no. 3, pp. 285-300, 2007.
Nurcahyo R., and Wibowo A.D., Manufacturing Capability, Manufacturing Strategy and Performance Of Indonesia Automotive Component Manufacturer, 2015.
Pham D.T., and Thomas A.J., Fit manufacturing: a framework for sustainability, 2012.
Rashid S.H.A., Sakundarini N., Ghazilla R.A.R., Thurasamy R., The impact of sustainable manufacturing practices on sustainability performance Empirical evidence from Malaysia, 2015.
Safizadeh, M.H., Ritzman, L.P. and Mallick, D., Revisiting alternative theoretical paradigms in manufacturing strategy, Production and Operations Management, Vol. 9 No. 2, pp. 111-27, 2000.
Salzmann, O., Ionescu-Somers, A., Steger, U., The business case for corporate sustainability: literature review and research options. Eur. Manag. J. 23 (1), 27e36, 2005.
Schroeder, R.G., Flynn, E.J., Flynn, B.B. and Hollingworth, D., Manufacturing performance trade-offs: an empirical investigation, paper presented at 3rd International Conference of the European Operations Management Association, London, 1996.
Sukitsch, M., Engert S., and Baumgartner R. J., The Implementation of Corporate Sustainability in the European Automotive Industry: An Analysis of Sustainability Reports, Innovation and Sustainability Research, University of Graz, Austria, 2015.
Vachon, S. & Klassen, R.D.,Environmental management and manufacturing performance: The role of collaboration in the supply chain, *International Journal of Production Economics*, vol. 111, no. 2, pp. 299-315, 2008.\
Wijethilake C., Proactive Strategic Responses to Sustainability Determinants : The Use of Management Control Systems, 2016.
Zhu, Q.H.; Sarkis, J.; Lai, K.-H., Confirmation of a measurement model for green supply chain management practices implementation. *Int. J. Prod. Econ*, 111, 261–273, 2008.

Biographies

Edwin A. Herbanu is currently student Master Degree in Industrial Engineering Department, Faculty of Engineering Universitas Indonesia. He holds a Bachelor of Engineering degree in Mechatronics Engineering from Institute Technology Sepuluh Nopember. Now he works in Denso Indonesia as production and engineering section. His research and job area are production system, production performance, lean manufacturing and TQM.

Rahmat Nurcahyo is an senior lecturer in Industrial Engineering Department, Faculty of Engineering Universitas Indonesia. He holds a Bachelor of Engineering degree in Mechanical Engineering from Universitas Indonesia, a Master of Engineering Science degree in Industrial Management from University of New South Wales Australia and Doctoral degree in Strategic Management from Universitas Indonesia. His research interest in total quality management, production system, lean system and maintenane management. He served as faculty advisor of IEOM student chapter Universitas Indonesia.