APPLICATION OF SIMULATION AND MCDEA IN SME FOOD PROCESSING COMPANY: A CASE STUDY AT A COFFEE PROCESSING FACTORY
(Penggunaan Simulasi dan MCDEA di Syarikat Pemprosesan Makanan PKS: Suatu Kajian Kes di Kilang Pemprosesan Kopi)

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ABSTRACT

Food production in the manufacturing sector contributes significantly to the development of the Malaysian economy. Therefore, the improvement of food manufacturing should be emphasised so that it is possible to ensure its sustained growth. This study focuses on applying a simulation model and Multi-Criteria Data Envelopment Analysis (MCDEA) in the food manufacturing system. A case study on an SME food processing company was modelled and analysed to improve the system's overall performance. In this study, simulation experiments and MCDEA were used to improve the processing system, and several improvement models were suggested. The simulation model of each improvement was used to generate inputs and outputs, while MCDEA was used to determine the most efficient improvement model to minimise waiting time. The result demonstrates that IM7 is the most efficient model as compared to other improvement models. This model suggests adding a worker into the packaging process and reducing processing time at grinding and packaging processes. The methods and the results obtained can assist the management of a factory in making better decisions and can offer insights to other SME companies to help improve the performance of their food processing system.

Keywords: improvement model; MCDEA; simulation; food processing

ABSTRAK

Pengeluaran makanan di sektor perkilangan memberikan sumbangan yang besar kepada perkembangan ekonomi Malaysia. Oleh itu, peningkatan pembuatan makanan harus dititikberatkan agar dapat memastikan perkembangan yang berterusan. Kajian ini memfokuskan pada penggunaan model simulasi dan Analisis Penyampulan Data Pelbagai Kriterium (APDPK) dalam sistem pembuatan makanan. Kajian kes di sebuah syarikat pemprosesan makanan PKS dimodelkan dan dianalisis untuk meningkatkan prestasi keseluruhan sistem. Dalam kajian ini, eksperimen simulasi dan APDPK digunakan untuk menambah baik sistem pemprosesan, dan beberapa model penambahbaikan dicadangkan. Model simulasi bagi setiap penambahbaikan digunakan untuk menghasilkan input dan output, sementara APDPK digunakan untuk menentukan model penambahbaikan yang paling cekap bagi mengurangkan masa menunggu. Hasilnya menunjukkan bahawa IM7 adalah model yang paling cekap berbanding dengan model penambahbaikan yang lain. Cadangan untuk model ini adalah dengan menambah bilangan pekerja di proses pembungkusan dan mengurangkan masa pemprosesan pada proses pengisaran dan pembungkusan. Kaedah dan hasil yang diperoleh dapat membantu pengurusan kilang membuat keputusan yang lebih baik, dan dapat memberikan pandangan kepada syarikat PKS yang lain untuk membantu meningkatkan prestasi sistem pemprosesan makanan mereka.

Kata kunci: model penambahbaikan; MCDEA; simulasi; pemprosesan makanan

References

Altiok T. & Melamed B. 2007. *Simulation Modeling and Analysis with Arena*. United States: Academic Press.

Banker R.D., Charnes A. & Cooper W.W. 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science* **30**(9)**:** 1078-1092.

Banks J., Carson J.S., Nelson B.L. & Nicol D.M. 2010. *Discrete-Event System Simulation*. 5th Ed. Upper Sadle River, NJ: Pearson Education.

Charnes A., Cooper W.W. & Rhodes E. 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research* **2**: 429-444.

DOSM. 2016. Department of Statistics Malaysia, Report on Economic Census 2016. https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=RDRSYVRzK1JFcmh0dm5mV1I4NkFJQT09 (18 Jan 2021).

Farah H. & Liong C.-Y. 2014. Penggunaan simulasi Arena untuk meningkatkan prestasi perkhidmatan dobi. *Journal of Quality Measurement and Analysis* **10**(2): 65-75.

Li X.B. & Reeves G.R. 1999. A multiple criteria approach to data envelopment analysis. *European Journal of Operational Reseach* **115**(3): 507-517.

Low S.K. & Liong C.-Y. 2015. Simulation modeling for evaluating performance of commuter system with Arena. *Journal of Quality Measurement and Analysis* **11**(2): 47-60.

Mat Desa W.L.H., Kamaruddin S., Nawawi M.K.M. & Zulkepli J. 2015. Evaluation on absenteeism effect in production line at aircraft composite manufacturer. *Jurnal Teknologi* **77**(5): 63-67.

Nazhatul Sahima M.Y., Liong C.-Y., Abu Yazid M.N. & Wan Rosmanira I. 2018. Discrete event simulation and data envelopment analysis models for selecting the best resource allocation alternative at an emergency department's green zone. *Sains Malaysiana* **47**(11): 2917-2925.

Norazura A., Razamin R., Jafri Z.H., Teo A. H., Noraida A.G. & Waleed K.A. 2017. A generic simulation optimization model of emergency department resource capacity. *Journal of Engineering and Applied Sciences* **12**(6): 1558-1565.

Razman M.T. 2006. *A Practical Approach to Computer Simulation Modelling*. Serdang: Universiti Putra Malaysia Press.

Sargent R.G. 2013. Verification and validation of simulation models. *Journal of Simulation* **7**(1): 12-24.

Siti Nur Shahirah M.S. & Ruzanita M. R. 2020. Modeling the Food Manufacturing System by using Simulation: A case study at XYZ factory. AIP Conference Proceedings 2266, 070002-1 -070002-8.

SME. 2018. SME Corporation Malaysia. SME Annual Report 2017/18. https://www.smecorp.gov.my/index.php/en/laporan-tahunan/3342-laporan-tahunan-pks-2017-18 (20 Jan 2021).

Wan Malissa W.M.A, Wan Rosmanira I. & Husyairi H. 2016. Estimating emergency department maximum capacity using simulation and data envelopment analysis. *Indian Journal of Science and Technology* **9**(28): 1-10.

Zahraee S.M., Golroudbary S.R., Hashemi A., Afshar J. & Haghighi M. 2014. Simulation of manufacturing production line based on Arena. *Advanced Materials Research* **933**: 744-748.

Zerafat A.M., Emrouznejad A., Mustafa A. & Rashidi Komijan A. 2009. Selecting the most preferable alternatives in a group decision making problem using DEA. *Expert System with Applications* **36**: 9599–9602.

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