



RESEARCH ARTICLE

Mediating Role of Cost Reduction on Agile, Lean, and Green Manufacturing to Performance of Pharmaceutical Industries in Thailand

Chayanan Kerdpitak^{1*}, Napassorn Kerdpitak², Teerapong Pongpeng³

¹Suan Sunandha Rajabhat University, Thailand

^{2,3}Mahidol University, Thailand

ARTICLE INFO

Received: Jul 29, 2024

Accepted: Sep 22, 2024

Keywords

Financial Performance

Lean

Green and Agile Drug Making

Cost Reduction

***Corresponding Author:**

chayanan.ke@ssru.ac.th

ABSTRACT

The financial performance of an organization is very crucial for that organization and it depends on various factors. The types of manufacturing i.e. lean manufacturing, agile manufacturing and green manufacturing are very important to be considered. This study was conducted was to study the impact of three types of manufacturing i.e. lean manufacturing, agile manufacturing and green manufacturing on financial performance of the firm in the presence of mediating role of cost reduction. The data for this particular study has been collected from 313 employees of pharmaceutical companies in Thailand. The collected data was subjected to SPSS and AMOS and the results obtained indicated that the impact of all the independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing on financial performance is found to be significant. On the other hand, the mediating impact of cost reduction has also been found as significant in all cases i.e. in the relationship between all independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing and dependent variable, financial performance. In other words, all the hypotheses generated by the reseracher in the current study have been accepted. Various implications, limitations and future research indications have also been discussed by the author in the study.

INTRODUCTION

Currently, in all areas of human life which include industry, health, services and educations show a rapid growth. This growth have direct linked with applications of lean. These application include the applications that contribute in improving the performance of the field in its services. In general, a number of studies have been conducted on assessment of lean manufacturing with its applications (Albzeirat et al., 2018). According to the Udokporo et al. (2020), the agility is explained as capability of organizations to ensure the lower cost of manufacturing, expanding the share in market, meeting the demands of customer, along with enable the industries to introduce speedy new products, eliminate the non-values activities and finally enhance the competitiveness of firms. Green practices used also in pharmaceutical industries. These industries face many challenges in all over the world, along with it have worth value around the world. With emerging challenges of the industries, various practices such as lean, agile and green manufacturing used for overcome these challenges. Following table 1.1 showed the challenges of pharmaceutical industries that it mostly face.

Table 1.1 Challenges faced by Pharmaceutical industries

Challenges faced by pharmaceutical	Percentage
Rising customer expectation	15
Poor scientific productivity	17
Cultural Scenario	13
Manufacturing costs	20
Generic firms	15
Entering new markets	10
Drug Licensing	10

Pharmaceutical industries of Thailand is emerging industry in all over the world. Due which it become a desire need to minimize the cost of production with using the techniques of agile, lean and green manufacturing industries. Following objectives used for carry out the study:

1. To analyze the impact of lean manufacturing on the Performance of pharmaceutical industries
2. To analyze the impact of agile manufacturing on the Performance of pharmaceutical industries
3. To analyze the impact of green manufacturing on the Performance of pharmaceutical industries
4. To analyze the impact of lean, agile and green manufacturing on the Performance of pharmaceutical industries with mediating role of cost reduction factor

Next section of the paper include literature review. After the second part, the third part of the study will be explained the methodology of the study. Section forth of this study will elaborated the results of hypothesis that either they accept or reject. Finally, in fifth part, the discussion and conclusion of the study will be explained.

LITERATURE REVIEW

Contingency Theory for Lean manufacturing

Lean manufacturing have an important place in the operational management of industries. This is beneficial for those sectors which have no theory for base. Contingency theory explained the structures of operational and context nature in which industries as well as firms synchronized and ultimately lead towards the better performance of organizations. According to this theory, lean, agile and green manufacturing consider a response variable which enhance the financial outcomes of organizations. Such variables use by industries in response of contextual factors. Furthermore, this theory also gave the concept of configurational aspect which explained the multi-dimensional installation of many characteristics of industries that at time work in various concepts. These response variable does not use din single production activity but also improve various outcomes of the organization such as performance of the industries (Pamornmast, Sriyakul, & Jermsittiparsert, 2019)

Lean Manufacturing and performance of industry

Lean manufacturing have close relation with the performance of the industries either it is operational or financial base. The most efficient advantages of lean manufacturing is improving the quality and productivity of labor and ultimately enhance the performance of the industries. It further reduce the time of production, costs for manufacturing and reduce the lead time (Abdelilah, El Korchi, & Balambo, 2018; Albashabsheh et al., 2019; Eze, Ifeagwazi, & Chukwuorji, 2019; Mikalef, Pateli, & van

de Wetering, 2016; Park, Bae, & Hong, 2019; Paul, Jena, & Sahoo, 2020; van Esch, Wei, & Chiang, 2018; Zhang, Wu, & Chen, 2018; Zhou, Mavondo, & Saunders, 2019). A number of tools for lean manufacturing have been developed to improve the financial performance of industries, according to contingency theory. Hence, lean manufacturing become a cause of improving the financial performance of the industries with cost effective performance (Mirdad, 2014). Following hypothesis is formulated:

H1: lean manufacturing enhance the performance of pharmaceutical industries

Agile Manufacturing and performance of industry

Thus, in 21 century, the enterprise of the agile is seen as the winning factor in market of competitive become strategy which help the industries to gain the highest performance (Albzeirat et al., 2018). Manufacturing by agile can be examined as the capability to prosper and survive continuously in the changing environment with unpredictable change, through effectively and quickly to market changing trend which further driven by designed services and products of customers (Pamornmast et al., 2019). According to contingency theory, agile manufacturing is response factors that enhance the operational or financial performance of the industries. Following hypothesis is formulated:

H2: Agile manufacturing enhance the performance of pharmaceutical industries

Green Manufacturing and performance of industry

In today research, practices of green manufacturing have direct relationship with financial performance of the organizations (Zhan et al., 2018). According to Huatuco et al. (2013), firms represent their efforts which reduce the irresponsible behavior of environment. Green manufacturing use environmental friendly practices which improve the performance of the organizations financially and also in practical manner (Hallam & Contreras, 2016). So, production of industries occur effectively by green manufacturing with using the less energy, less cost, as well as use raw material which ultimately enhance the financial performance of industries. Following hypothesis is formulated:

H3: Green manufacturing enhance the performance of pharmaceutical industries

Lean Manufacturing and performance of industry with mediating role of cost reduction

Reduce the cost in production become a powerful advantage for competitive and efforts are made to promote such steps (Debener et al., 2012). In this study, mediating role of cost reduction will be tested that in which manner it become efficient for enhancing the financial performance of industries. It is a significant factors that ultimately used by organizations to stay in competitive environment. Following hypothesis is formulated:

H4: with mediating role of cost reduction the lean manufacturing enhance the performance of pharmaceutical industries

Agile Manufacturing and performance of industry with mediating role of cost reduction

The cost factors of agile production in industries depend and associate with reduction of cost which occur as outcomes and actions like buying machines in flexible manner, efficient system of information and improve the capacity for tackling the sudden changes of demands. Similarly, through the manufacturing in agile manner the employees use information system for sharing the information and manage the production in high volume with less time of production and lower cost (Udokporo et al., 2020). Following hypothesis is formulated:

H5: with mediating role of cost reduction the agile manufacturing enhance the performance of pharmaceutical industries

Green Manufacturing and performance of industry with mediating role of cost reduction

Many organizations use and adopt the green practices in term of reducing the cost with the help of less energy ad utilization of materials and finally protection of reputation. Through manufacturing by green practices, production of industries achieved in efficient manner. Such practices used either lower usage of water and lower energy. Such manufacturing further reduced the costs of raw materials in which expenses also reduced with safety expenses that finally improve the financial performance of the business (Ghazilla et al., 2015) Following hypothesis is formulated:

H6: with mediating role of cost reduction the green manufacturing enhance the performance of pharmaceutical industries

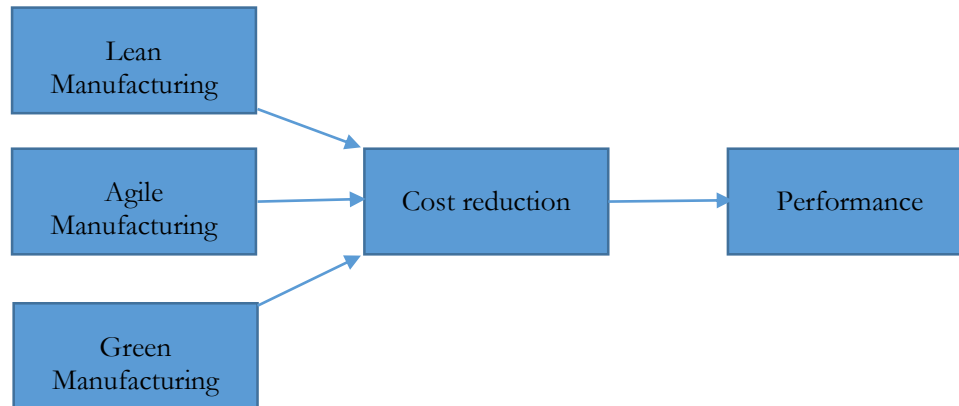


Fig 1: Conceptual Model

METHODOLOGY

Sample Description

The researcher has collected data through questionnaire self administration from various pharmaceutical companies of Thailand and this process included 323 managers of these firms in the form of respondents. These respondents have been selected by using purposive sampling technique as per the requirement of the study. The questionnaire that was administered by the researcher was made in a very careful and effective manner in such a way that the questionnaire included all types of questions in a particular sequence so that the interest of the respondents may be retained. The questionnaire was subject to the pre test in which different experts from the pharmaceutical companies were engaged but at the end of the pretest, no error was found out in the questionnaire. This pre test has been done so that the reliability and validity of the data collected through the questionnaires must be ensured. All the measurement items included in the questionnaire are relevant to the study topic and are taken from the past studies, so that the relevant and accurate responses may be obtained.

Measurement

All the variables and their constructs are measured by using their particularly related items. These items have been taken from the past studies by the researcher, so that the validity of the content may be enhanced. All these items have been measured on a five point Likert scale. The measurement items of different types of variables have been discussed in this section. The variables that are included in this study are Lean manufacturing, agile manufacturing, green manufacturing, cost reduction and financial performance. First of all, financial performance is the dependent variable and has been measured by 5 items that have been developed by the studies conducted in the past (Rivard, Raymond, & Verreault, 2006; Jumaa et al., 2024). In addition, lean manufacturing is an independent

variable and it has been measured by 3 measurement items that have been taken from the past study (Shah & Ward, 2003; Abdullah et al., 2024). In the similar way, agile manufacturing is another independent variable, measured by 3 measurement items taken from the past studies (Yusuf, Sarhadi, & Gunasekaran, 1999). Green manufacturing is the last independent variable of this study and measured by 7 items, developed by the past studies (Deif, 2011). In the last we have one mediating variable in the study too, names as cost reduction. This variable construct has been measured by 5 items, taken from the studies conducted in the past in the similar context (Spence, 1984). By using these items in the questionnaire designed by the researcher, valid responses will be collected from the respondents.

Statistical Analysis

The collected data has been effectively analyzed by the researcher by using the specialized software analyzes. Various kinds of information and specially the impact of various variables on each other may be found out. In this regard, demographic analysis, descriptive analysis and factor analysis have been obtained from software. On the other hand, confirmatory factor analysis and structure equation modeling have been obtained by using software.

DATA ANALYSIS

Demographics

Three types of demographics have been discussed by the researcher i.e. related to gender, age and experience in the organization. The number of respondents for the current study is 323; the demographic details have been given here. 169 males and 154 females are included in the total respondents. In context of age of the respondents, 96 respondents are having age less than 25 years, 130 are having age from 25 to 35 years, 72 people are having age from 35 to 45 years and in the last, just 12 respondents are having age more than 45 years. In context of experience, 46 respondents were having the experience of less than 2 years in the organization. Moreover, 138 respondents are having the experience of 2 to 5 years, 99 respondents are having the experience of 5 to 8 years while the remaining 30 employees have the working experience of more than 8 years.

Descriptive Statistics

The first and most important result obtained from the descriptive statistics is that no outlier has been observed in the collected data because the maximum and minimum values do not go out of the range of five point Likert scale. The second important result obtained is that the data is completely normal and ready to be used in the study because the skewness values of data are present in between the range of -1 and +1.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
LeanMan	313	1.00	5.00	3.3147	1.07769	-.282	.138
AgileMan	313	1.00	5.00	3.4003	1.07471	-.381	.138
GrenMan	313	1.00	5.00	3.5089	1.24032	-.502	.138
CostRed	313	1.00	5.28	3.4565	1.18336	-.503	.138
FinPerf	313	1.00	5.00	3.5761	1.19835	-.547	.138
Valid N (listwise)	313						

KMO and Bartlett's Test

In table 2, the values of KMO and Bartlett's test have been given and can be compared to the ideal conditions or ideal values of these tests. The ideal value of KMO test is very close to 1.00 while the

ideal value of Bartlett's test is less than 0.05. It is evident from the table that the values of both tests are close to the ideal situation and thus it can be stated that the factor analysis is useful for this study.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.949
Bartlett's Test of Sphericity	Approx. Chi-Square	11644.174
	Df	253
	Sig.	.000

Rotated Component Matrix

In order to make sure the validity and eligibility of the collected data, rotated component matrix can be used. If the factor loading values are more than 70% and if there is no cross loading issue, then the data is considered to be valid to be used in the study. Both the situations have been fulfilled according to table 3.

Table 3: Rotated Component Matrix^a

	Component				
	1	2	3	4	5
LM1				.794	
LM2				.888	
LM3				.828	
AM1					.826
AM2					.809
AM3					.813
GM1	.897				
GM2	.896				
GM3	.887				
GM4	.883				
GM5	.898				
GM6	.882				
GM7	.883				
CR1		.877			
CR2		.868			
CR3		.850			
CR4		.856			
CR5		.885			
FP1			.847		
FP2			.857		
FP3			.853		
FP4			.855		
FP5			.832		

Convergent and Discriminant Validity

In order to move the collected data forward in the research and apply different tests and techniques on it, it is necessary to validate the authenticity of the collected data. For this purpose, convergent and discriminant validity tests have been used, the results of which have been given in table 4. According to the table, all the conditions for data to be authentic and valid have been met both in case of convergent and discriminant validity.

Table 4: Convergent and Discriminant Validity

	CR	AVE	MSV	CR	LM	AM	GM	FP
CR	0.912	0.817	0.399	0.957				
LM	0.913	0.777	0.343	0.264	0.886			
AM	0.921	0.795	0.343	0.364	0.586	0.846		
GM	0.923	0.952	0.399	0.364	0.52	0.513	0.916	
FP	0.959	0.825	0.334	0.565	0.508	0.578	0.562	0.823

Confirmatory Factors Analysis

The results of confirmatory factor analysis can be observed in table 5, according to which, the values for all the indicators of CFA used in the study (Hassan, Hameed, Basheer, & Ali, 2020; Iqbal & Hameed, 2020), are within the appropriate range presented by the researcher. These results confirm that the hypothetical model is fit for use.

Table 5: Confirmatory Factors Analysis

Indicators	Threshold range	Current values
CMIN/DF	Less or equal 3	2.762
GFI	Equal or greater .80	.909
CFI	Equal or greater .90	.986
IFI	Equal or greater .90	.986
RMSEA	Less or equal .08	.049

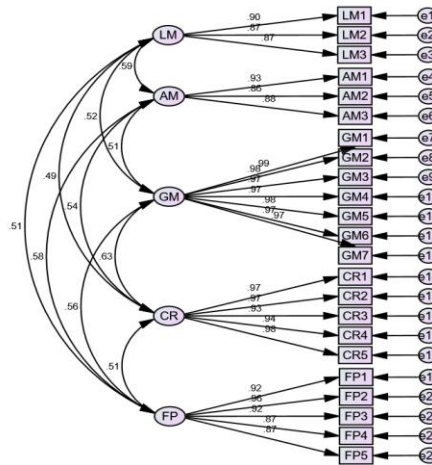


Figure 2: CFA

Structural Equation Modeling

The results of structural equation modeling have been given in table 6. In the table it can be seen that the impact of all the independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing on financial performance is found to be significant. On the other hand, the mediating impact of cost reduction has also been found as significant in all cases i.e. in the relationship between all independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing and dependent variable, financial performance.

Table 6: Structural Equation Modeling

Total Effect	GrenMan	AgileMan	LeanMan	CostRed
CostRed	.411***	.189**	.179**	.000
FinPerf	.283**	.307***	.160**	.203**
Direct Effect	GrenMan	AgileMan	LeanMan	CostRed
CostRed	.411***	.189**	.179**	.000
FinPerf	.199**	.268**	.124**	.203**
Indirect Effect	GrenMan	AgileMan	LeanMan	CostRed
CostRed	.000	.000	.000	.000
FinPerf	.083**	.038**	.036**	.000

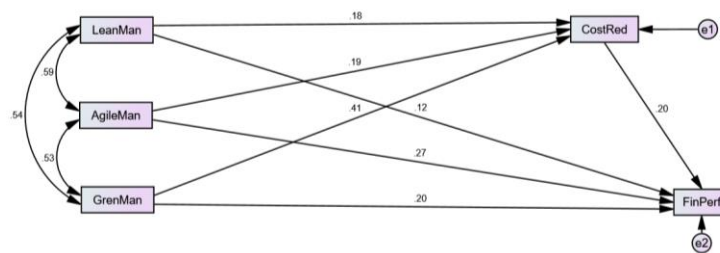


Figure 3: SEM

DISCUSSION AND CONCLUSION

Discussion

The main objective behind this study was to study the impact of three types of manufacturing i.e. lean manufacturing, agile manufacturing and green manufacturing on financial performance of the firm in the presence of mediating role of cost reduction. The first three hypothesis of the study involved that the impact of three independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing is significant for the financial performance. All these hypotheses have been accepted as per the results obtained in structure equation modeling. These results are consistent with the results of the studies that have been conducted in the past having same variables (Helleno, de Moraes, & Simon, 2017; Li, Zhang, Leung, & Yang, 2016; Qiu, Shaukat, & Tharyan, 2016). The next three hypotheses revolve around the mediating impact of cost reduction among the relationships between independent and dependent variables. These hypotheses have also been accepted as the mediating relationship has been found as significant in all the cases. These results are in line with the results presented by different researchers in the past (Gunasekaran et al., 2018; Marcelli et al., 2017; Wang & Sarkis, 2017; shannaq et al., 2024).

Conclusion

The financial performance of an organization depends on a number of factors and the types of manufacturing i.e. lean manufacturing, agile manufacturing and green manufacturing are having great importance in this regard. The main reason why this study was conducted was to study the impact of three types of manufacturing i.e. lean manufacturing, agile manufacturing and green manufacturing on financial performance of the firm in the presence of mediating role of cost reduction. The results of the study indicate that the impact of all the independent variables i.e. lean manufacturing, agile manufacturing and green manufacturing is significant for financial

performance. In the similar manner, the mediating role of cost reduction has also been found as significant in all the cases.

Implications

There are different theoretical, practical and policy making benefits of this study. Other researchers may find useful information about different aspects such as lean manufacturing, agile manufacturing and green manufacturing and their impact on financial performance. Different organizations may also use this study to improve their financial performance and reduce their costs by making favorable policies.

Limitations and Future Research Indications

First of all, the sample size of the study must be increased as compared to this study. Secondly, the countries other than Thailand should also be considered so that their perspective in regard to the current topic can be obtained. There are various tests and techniques that may be used to analyze data and have not been used in this study. These techniques may also be used for analysis purpose.

REFERENCES

- Abdelilah, B., El Korchi, A., & Balambo, M. A. (2018). Flexibility and agility: evolution and relationship. *Journal of Manufacturing Technology Management*.
- Albashesheh, A. A. N., Alhroob, M. N., Irbihat, B. E., & Javed, S. Impact of Accounting Information System In Reducing Costs In Jordanian Banks.
- Albzeirat, M. K., Hussain, M. I., Ahmad, R., Salahuddin, A., Al-Saraireh, F. M., & Bin-Abdun, N. (2018). Literature review: Lean manufacturing assessment during the time period (2008-2017). *International Journal of Engineering Management*, 2(2), 29.
- Amir, M., & Chaudhry, N. I. (2019). Linking Environmental Strategy to Firm Performance: A Sequential Mediation Model via Environmental Management Accounting and Top Management Commitment. *Pakistan Journal of Commerce and Social Sciences*, 13(4), 849-867.
- Debener, S., Minow, F., Emkes, R., Gandras, K., & De Vos, M. (2012). How about taking a low-cost, small, and wireless EEG for a walk? *Psychophysiology*, 49(11), 1617-1621.
- Deif, A. M. (2011). A system model for green manufacturing. *Journal of Cleaner Production*, 19(14), 1553-1559.
- Eze, J. E., Ifeagwazi, C. M., & Chukwuorji, J. C. (2019). Core beliefs challenge and posttraumatic growth: Mediating role of rumination among internally displaced survivors of terror attacks. *Journal of Happiness Studies*, 1-18.
- Ghazilla, R. A. R., Sakundarini, N., Abdul-Rashid, S. H., Ayub, N. S., Olugu, E. U., & Musa, S. N. (2015). Drivers and barriers analysis for green manufacturing practices in Malaysian SMEs: a preliminary findings. *Procedia Cirp*, 26(1), 658-663.
- Gunasekaran, A., Yusuf, Y. Y., Adeleye, E. O., & Papadopoulos, T. (2018). Agile manufacturing practices: the role of big data and business analytics with multiple case studies. *International Journal of Production Research*, 56(1-2), 385-397.
- Hallam, C., & Contreras, C. (2016). Integrating lean and green management. *Management Decision*.
- Hassan, S. G., Hameed, W. U., Basheer, M. F., & Ali, J. (2020). Zakat Compliance Intention Among Self-Employed People: Evidence From Punjab, Pakistan. *AL-ADWAH*, 34(2), 80-96.
- Helleno, A. L., de Moraes, A. J. I., & Simon, A. T. (2017). Integrating sustainability indicators and Lean Manufacturing to assess manufacturing processes: Application case studies in Brazilian industry. *Journal of Cleaner Production*, 153, 405-416.
- Huatuco, L. D. H., Montoya-Torres, J. R., Shaw, N., Calinescu, A., Wang, Z., & Sarkis, J. (2013). Investigating the relationship of sustainable supply chain management with corporate financial performance. *International Journal of Productivity and Performance Management*.
- Iqbal, J., & Hameed, W. U. (2020). Open Innovation Challenges and Coopetition-Based Open-Innovation Empirical Evidence From Malaysia *Innovative Management and Business Practices in Asia* (pp. 144-166): IGI Global.

- Li, K., Zhang, X., Leung, J. Y.-T., & Yang, S.-L. (2016). Parallel machine scheduling problems in green manufacturing industry. *Journal of Manufacturing Systems, 38*, 98-106.
- Marcelli, S., Gatti, C., Rocchi, R., Troiani, S., Di Tuccio, S., Giuli, C., . . . Santarelli, A. (2017). Chronic care model and cost reduction in initial health: a new approach for satisfaction and improvement of chronicity. *Geriatric Care, 3*(3).
- Mikalef, P., Pateli, A., & van de Wetering, R. (2016). IT flexibility and competitive performance: The mediating role of IT-enabled dynamic capabilities.
- Mirdad, W. K. (2014). A Conceptual and strategy map for lean process transformation.
- Pamornmast, C., Sriyakul, T., & Jermsittiparsert, K. (2019). Can Lean Manufacturing and 4.0 Industry Enhance the Financial Performance of Pharmaceutical Industries of Thailand? Mediating Role of Waste Reduction Behavior. *Systematic Reviews in Pharmacy, 10*(2), 318-327.
- Park, O., Bae, J., & Hong, W. (2019). High-commitment HRM system, HR capability, and ambidextrous technological innovation. *The International Journal of Human Resource Management, 30*(9), 1526-1548.
- Paul, M., Jena, L. K., & Sahoo, K. (2020). Workplace Spirituality and Workforce Agility: A Psychological Exploration Among Teaching Professionals. *Journal of religion and health, 59*(1), 135-153.
- Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review, 48*(1), 102-116.
- Rivard, S., Raymond, L., & Verreault, D. (2006). Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance. *The Journal of Strategic Information Systems, 15*(1), 29-50.
- Shah, R., & Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management, 21*(2), 129-149.
- Spence, M. (1984). Cost reduction, competition, and industry performance. *Econometrica: Journal of the Econometric Society, 101*-121.
- Udokporo, C. K., Anosike, A., Lim, M., Nadeem, S. P., Garza-Reyes, J. A., & Ogbuka, C. P. (2020). Impact of Lean, Agile and Green (LAG) on business competitiveness: An empirical study of fast moving consumer goods businesses. *Resources, Conservation and Recycling, 156*, 104714.
- van Esch, E., Wei, L. Q., & Chiang, F. F. (2018). High-performance human resource practices and firm performance: The mediating role of employees' competencies and the moderating role of climate for creativity. *The International Journal of Human Resource Management, 29*(10), 1683-1708.
- Wang, Z., & Sarkis, J. (2017). Corporate social responsibility governance, outcomes, and financial performance. *Journal of Cleaner Production, 162*, 1607-1616.
- Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing:: The drivers, concepts and attributes. *International Journal of Production Economics, 62*(1-2), 33-43.
- Zhan, Y., Tan, K. H., Ji, G., Chung, L., & Chiu, A. S. (2018). Green and lean sustainable development path in China: Guanxi, practices and performance. *Resources, Conservation and Recycling, 128*, 240-249.
- Zhang, J., Wu, W.-p., & Chen, R. (2018). Leveraging channel management capability for knowledge transfer in international joint ventures in an emerging market: A moderated mediation model. *Industrial Marketing Management, 75*, 173-183.
- Zhou, J., Mavondo, F. T., & Saunders, S. G. (2019). The relationship between marketing agility and financial performance under different levels of market turbulence. *Industrial Marketing Management, 83*, 31-41.
- Shannaq, R. M. A., Alsadi, M. M., Alkhuffash, S. R., Yousef, F., Daradkah, A. A. M., Jaradat, M. S., & Ajloun, J. (2024). Innovative Leadership among Public School Principals in Irbid Governorate: Teachers' Perspective. *Pakistan Journal of Life & Social Sciences*.
- Abdullah, A. A., & Hameed, T. S. (2024). Extension Tasks for Agricultural Employees in the Field of Combating Desertification in Nineveh Governorate. *Pakistan Journal of Life & Social Sciences*.
- Jumaa, I. Q., & Saad, K. S. (2024). Evaluation of the Suitability of the Soils of the Banks of the Tigris River in the Districts of Qal'at Saleh and Qurna for Wheat Production according to the (Sys) Standard. *Pakistan Journal of Life and Social Sciences*.