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Enhancing Environmental Performance of Pharmaceutical Industry of Thailand: Role of Big Data, Green Innovation and Supply Chain Collaboration

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ABSTRACT
The study had the aim to find out the impacts of big data acceptance on environmental performance, impact of big data routinization on environmental performance and the impact of big data assimilation on environmental performance, the study took green innovation and green supply chain collaboration as mediators. The researcher critically analyzed the past researches and data and derived some hypothesis. There validation was done through conduction of survey and collection of data from Pharmaceutical Industry of Thailand where the researcher took a sample of 311 individuals. The researcher analyzed the data using SPSS and AMOS and got to know that the impacts of big data acceptance on environmental performance is insignificant, impact of big data routinization on environmental performance is significant and the impact of big data assimilation on environmental performance is significant as Well, the study took green innovation and green supply chain collaboration as mediators which were significantly mediating as well. The study is significant for practical, theoretical and policy making sector as well. However, the study lacks generalizability and also has a small sample size.
Keywords: Enhancing Environmental Performance, Pharmaceutical, Thailand, Big Data, Green Innovation, Supply Chain Collaboration
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INTRODUCTION

The main objectives of pharmaceutical industry is to develop a healthy system for human, with their service to provide medicine in every situation and time (Settanni, Harrington, & Srai, 2017). But unfortunately, globally the Pharmaceutical industries consider as key factor in degrading the environment which ultimately propose negative impacts on human health. Pharmaceuticals products in its all stages of life cycle such as production, use and finally dispose stage, can enter in environment in different forms. Residue of Pharmaceutical industries of Thailand have been find out in drinking, ground or surface water along with in sewage effluents, soil, manure and in various metrics of environment. This is scientifically prove that even small concentrations of residue of pharmaceuticals have dangerous effects in the environment (Garcia de Oliveira, Fang, & Lin, 2019). Critically, the pharmaceuticals residue discharge into the environment create antimicrobial resistance (AMR), which is consider by UN Environment as one of the serious health issue in the world that human face. Literature on pharmaceutical impacts have showed that Pharmaceuticals industries products have bad effects on population which occur mostly due to bacteria. Particularly such condition occur in Asia where most residue of Pharmaceuticals industries are Active Pharmaceutical Ingredients (APIs) (Garcia de Oliveira et al., 2019). Various widely known practices was Implemented for enhancing manufacturing standards for the management of environmental issues which resultantly reduce the bad environmental effects of their manufacturing activities. Thailand is consider as third most populous country of the south East Asia having 68 million of population. International monetary fund describe that Thailand have GDP of 1.1 trillion in 2016 which boost up almost 3.6 percent in 2108. Pharmaceutical industries of Thailand have very key position in international pharmaceutical market. Pharmaceutical industries of Thailand have value of 5 billion dollar in 2016 which double in 2020. It had a large share in economy of the Thailand. Along with economic and health benefits pharmaceutical industries of Thailand posing a threat on environment sustainability. Evaluation of the sustainable role of environment big data with its large and efficient velocity, diversity and quantity become helpful to analyze the issue (Song, Fisher, Wang, & Cui, 2018). Government, non-government sectors along with private organization use big data to enhance environmental protection. Increasing energy efficiency, climate change tracking, water quality monitoring and enhance the environment condition are the main aims of big data which further elaborated with the help of big data acceptance, routinization and assimilation. Similarly, green innovations consider as most key factor in pharmaceutical industries or other firms which highlight the development in sustainable manner with the help of continuous practice of modern innovations such as recycling of waste, energy saving and pollution preventive measures. That is why the productive and operative implementation of practices which are related to green innovations including green supply chain become an effective way (Moktadir et al., 2018) in enhancing the environmental role by pharmaceutical industries (Chithambaranathan, Subramanian, Gunasekaran, & Palaniappan, 2015). Further, products of pharmaceutical industry are first produced then transferred and finally consumed (S. K. Mangla, Kumar, & Barua, 2015). That is why it contain different supply chain than other manufacturing goods because of its importance and regulations (A. Narayana, A. Elias, & K. Pati, 2014). With innovation of green supply chain in pharmaceutical industries the revenue of the pharmaceutical industries enhance and it improve the environmental commitment of industries (S. K. Mangla et al., 2015). In pharmaceutical industries, green supply chain refer to reduce the products waste, enhance its output production and improving ecological sustainability (Dubey, Gunasekaran, & Papadopoulos, 2017). Following figure 1 indicate ding the trade market and forecasting of pharmaceutical industry;

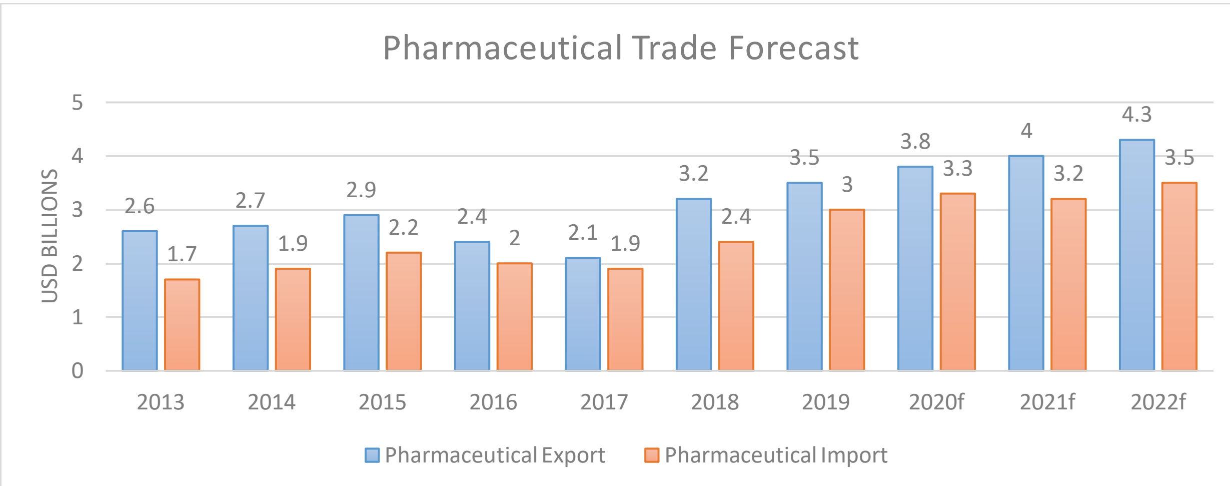


Figure 1: Pharmaceutical market forecasting

Pharmaceutical industries pose a serious environmental degradation effects. It is consider s key contribute in environmental pollution such effects has been seen in Asia including Europe. Pharmaceutical manufacturing reduce the efficiency of environment and due to bad Indian and Chinese legislation movements such condition is further exacerbated (Chen, 2019). In 2016 the pharmaceutical industries in Hyderabad, India contaminated the area the environment with its 95% pharmaceutical products which include high level bacteria (Bielen et al., 2017). Same case with Thailand, where industries pose a threat to environment. From past thirty years, pharmaceutical industries and organization are working to minimize their impact and to mediate the problem. But with the innovation of big data and green technologies it become accessible. It is become need of the present and future to use mediating role of big data, green innovation and green supply chain to reduce the environmental degradation by pharmaceutical products. The objectives of this study are following:

1. To analyze the impact of big data acceptance on environmental performance on pharmaceutical industry in Thailand.
2. To determine the impact of big data routinization on environment performance on pharmaceutical industry in Thailand.
3. To analyze the impact of big data assimilation on environment performance on pharmaceutical industry in Thailand.
4. To check the mediating role of green innovation in relationship between big data analytic dimension and environmental performance,
5. To check the mediating role of green supply chain collaboration between the big data analytic dimension and environmental performance.

Song et al. (2018) explain that the past studies show that various manufacturing sectors use big data analysis for ecological sciences and sustainability of the environment. Agriculture department of USA and Energy Protection Agency of USA use big data analysis to make a sustainable relation between protection of environment and development of agriculture. Further, many developing nations uses strategy of big data. Following this, many industries at sustainable manner have been emerged in the world which use big data to react in sustainable way for the production of goods (Dubey, Gunasekaran, Childe, Wamba, & Papadopoulos, 2016). Green innovations consider as important factor in environmental sustainability. But studies have lack of empirical and theoretical work on such methods which provide capable perspectives of these technologies such as big data, green innovation and green supply chain to enhancing the environmental role (Dangelico, Pujari, & Pontrandolfo, 2017). In short such techniques become available in health sciences which ultimately reduce the bad impacts of the industries. The structure of this paper include introduction including problem statement, objectives and significance of study in first part. Second portion highlight the literature review, third portion deal with methodology and next have result and discussion. While at the end conclusion of the study will be mention.

Literature Review and Dynamic Capabilities Theory

Productive transformational and reconfiguration competencies related to industries lead towards the awareness of organization and address the environmental challenges with continuous observation, choose of best practices and modern technologies (Wilden & Gudergan, 2015). At externally and internally level, reconfiguring and integrating the competencies address the changes issues with help of dynamic capabilities (DC) theory. But such dynamic capabilities development is limited due to choices of industrial managers and its characteristics. When company and its manager depend on past or existence knowledge, it face many challenges particularly in non-liner base market working. This thing urges industries or organizations to explore and build agenda to achieve goals with the help of information present in real-time, communication options and relationship of cross-functional. There is a difference between explicit and implicit knowledge, the dynamic capabilities are generated on the basis of declaration of direct knowledge and activities which perform by codification. In dynamic capabilities, attributes of organization's capabilities are expose in terms of developing combination of resources that link with same business mechanisms like development of products, allocation of resources and methods to generate knowledge. Furthermore, such a high dependency on dynamic capabilities assist the industries to attain their competitive objects and benefits by empowering thinking abilities, data combining and with expertise and modern techniques. In the term of enhancing environmental role of industries it is narrated that the dynamic capabilities gave the ways in which industries like pharmaceutical industries reconfiguring the technologies of big data, green supply chain and green innovation which based on green human resource management, such methods help the industries to achieve the environmental protection with sustainability (Ritter, Walter, Sienknecht, & Coviello, 2018). In addition, Dynamic capabilities also refer to industries the ways in which they use their big data, initiatives for big data by reconfiguring the resources within sustainable manner rather than single event (Braganza, Brooks, Nepelski, Ali, & Moro, 2017). Many studies have explain that analytics of big data show off dynamic capabilities applicability. While many researcher argue that technologies of big data are the methods which help the industries to work with changing environment and with changing conditions of market, due to its association feature with dynamic capabilities (Braganza et al., 2017; Wamba et al., 2017).

Big Data acceptance and Environmental Performance

Assunção, Calheiros, Bianchi, Netto, and Buyya (2015) defined big data in their study that the data which is large, quickly created and manage in such way that it become difficult to collect and process by using the traditional system of data management. Various agencies and industries of government and non-government level along with private sector use analytics and sets of big data to promote environmental role with sustainability. Take an example from 2012 when national; science foundation (NSF) of America gather important technologies which pushed big data science and projects. It invest a large amount of its income in analytics of big data especially in construction, mining, agricultural and manufacturing sectors (Song et al., 2018). Same case with China which also use big data in their sustainable practices. Big data deal with challenges and opportunities in sustainable operation of environment, Big data also has capability to transform the industries in such a manner that they meet and understand the emerging challenges of environment and along with it provide the supply chain to enhancing the role of sustainability(Papadopoulos et al., 2017). On the other way, traditional sources of big data are not available in accessing, acquiring and analyzing the big data (Seles et al., 2018). Analytics of Big data are getting more popularity in education along with in industries (Seles et al., 2018).

H1: Big data acceptance has significant impact on environmental performance.

Big Data routinization and Environmental Performance

The routinization of big data include industries governance mechanism in which technologies are integrate to achieve the desire goals. Industries use data to initiate the activities which ultimately reduce the harmful effects. A large quantity of data generate by industries which become a tricky work to manage, big data routinization gave the industries a way in which various opportunities are giving related to different fields which enhance and improve the productivity of the organization. Big data routinization include green supply chain and green innovation which reduce the bad impacts of pharmaceutical residue. According to dynamic capabilities, big data have capability to deal with emerging issue and minimize the negative impacts on environment by pharmaceutical industries. It is emerge with up to data decisions which help to produce and generate supply chain drivers. The pharmaceutical industries are under pressure to practice sustainable methods in their manufacturing for enhancing the role of environment (Raut et al., 2019). In big data routinization stage, the management sector of industries show their willingness towards new green technologies and appreciate such technologies and accept the data related to such innovations (Gunasekaran et al., 2017).

H2: Big data routinization has significant impact on environmental performance.

Big Data assimilation and Environmental Performance

Big data assimilation stage explain and include the ways in which new initiatives used and spread in the manufacturing of pharmaceutical products, which in result gave the benefits and enhance the environment in sustainable role.

Data assimilation of big data occur with the help of big data acceptance and big data routinization, it also enhance the industry performance with improving their capability and supply chain practices (Gunasekaran et al., 2017). In addition, big data assimilation explain changes with new technology and frame the capabilities of industry in such a manner that it aware about the environmental challenges and take steps to address these challenges. Due to natural resource depletion, pharmaceutical industries should manage and utilize the resources in sustainable manner through big data analytics. Such practices encourage the industries to participate in ecofriendly activities which also improve its social and economic consideration.

H3: Big data assimilation has significant impact on environmental performance

1.1 Mediating role of green innovation

Sustainability of environment become key issue in 21 century (Seles et al., 2018; Kasayanond, Umam, & Jermsittiparsert, 2019), which define as stability is the capability of a company or industry to behave and work not only for their current objective but also respond positively to future goals (Bansal & DesJardine, 2014). Green innovations consider as one of the less cost and efficient way to minimize the pressure on environment without reducing the competitiveness of economy (Costantini, Crespi, Marin, & Paglialunga, 2017). Green innovations ability to enhancing the performance of environment is not well performed without the green supply chain (Costantini et al., 2017). In accordance with capabilities dynamic, the industries such as pharmaceutical industries practice such green innovation technologies which gave awareness about environmental issues and capable them to find the ways which address these challenges. Green innovation along with adoption of products related to green innovation process reduce the level of energy consumption, emission of polluted materials, waste recycling, with green materials designs and utilization of sustainable resources (El-Kassar & Singh, 2019). Further, Dynamic capabilities theory develop capabilities of green innovation which lead towards better performance of industries (Dangelico et al., 2017). Due to growing depletion of natural resources, pharmaceutical industries are manage and utilize the resources in unsustainable manner by using green techniques (Wang & Song, 2014). While industries are bound to practice environment-friendly approaches and involve in ecofriendly activities which ultimately deliver sustainable environment (Carvalho, Govindan, Azevedo, & Cruz-Machado, 2017).

H4: Green innovation has a significant mediating role in the relationship between big data acceptance and environmental performance.

H5: Green innovation has a significant mediating role in the relationship between big data routinization and environmental performance.

H6: Green innovation has a significant mediating role in the relationship between big data assimilation and environmental performance.

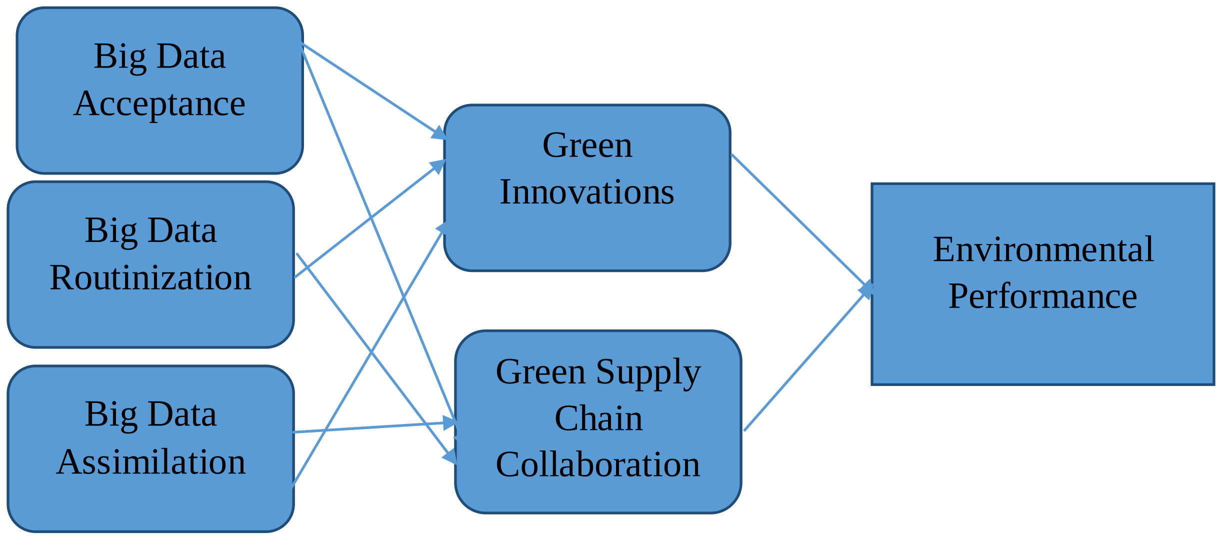
Mediating role of green supply chain collaboration

Green supply chain initiatives consider as initiation of green practices, distribution, manufacturing and reverse the logistics. Green supply chain help the green supply chain initiatives to improve the pharmaceutical industries output and gain economic and ecological benefits by disposing residue in ecofriendly manner, recycle the unused and unwanted medicine (Gunasekaran et al., 2017; Kumar, Holt, Ghobadian, & Garza-Reyes, 2015; S. Mangla, Madaan, & Chan, 2013). Green sourcing (de Sousa Jabbour, de Oliveira Frascareli, & Jabbour, 2015) is recognized as an important field in the pharmaceutical sector (de Sousa Jabbour et al., 2015), ensure the decline of negative impact on the environment and society (Faisal, 2016; Gunasekaran et al., 2017). Pharmaceutical industries in India use green supply chain initiatives to achieve the sustainability and enhancing the role of environment. Same methods should be used in Thailand to reducing the harmful impacts of pharmaceutics product (Baryannis, Validi, Dani, & Antoniou, 2019). Gunasekaran et al. (2017) explain in their study that the big data acceptance and its assimilation influence on supply chain which gave the performance of industries. Large data routinization in supply chain corporate with industries and enhance the many manufacturing performance. High research investment and development along with effective products are the aims of a pharmaceutical industries(Tseng & Chiu, 2013). High pressure from globally and domestically on sustainability of environment along with its consideration of economy of safety, it is recommended that to use and establish initiatives of green supply chain in manufacturing (Lintukangas, Kähkönen, & Ritala, 2016).

H7: Green supply chain collaboration has significant mediating role in the relationship between big data acceptance and environmental performance.

H8: Green supply chain collaboration has significant mediating role in the relationship between big data routinization and environmental performance.

H9: Green supply chain collaboration has significant mediating role in the relationship between big data assimilation and environmental performance



Research Model

RESEARCH METHODOLOGY

Population and Sampling

Research objective of this proposed research study is to examined the impact of big data acceptance, big data routinization on environmental performance, in mediating role of green innovation and green supply chain collaboration. In this proposed study, population of study is Pharmaceutical industry of Thailand because pharmacy sector is major contributor of Thailand economy, due to which Thailand has been earning high GDP and revenue but environmental performance of pharmaceutical companies is not up to mark as due to improper disposal of waste and chemicals cause serious health hazards. Due to these reasons, researcher accompany this research study in which he or she proposed few parameters such as big data capabilities, green innovation and supply chain collaboration which enhance environmental performance. Sampling frame constitute of MSD, Novartis, Roche and GSK pharmaceutical companies operating in Thailand, these companies have been incorporated practices of green production, supply chain collaboration and big data in their business operation that's why it is satisfactory to collect data from them. Managerial employees of these companies have been selected by following purposive sampling technique because data has to collected only from those who have know-how about concerned variables and they must have knowledge about environmental performance. For collecting responses, researcher distributes 360 questionnaires between selected respondents but he or she received only 345, out of which researcher considers only 311 valid as rest of them have been rejected on the bases of invalidity.

Data Collection Procedure

As researcher decided to follow survey strategy for data collection that's why researcher selects survey questionnaire as data collection procedure. Moreover, it also helps to collect primary, objective and numeric data, which can easily be analyzed through statistical analysis techniques. Researcher classifies questionnaire into two type of closed ended questions such as variable scale items and demographic questions, these questions originally written in English language. In the proposed study, for collecting responses from Thai people, researcher translates English language of questionnaire into native speaking language. Afterward, researcher uses back translation method for translating it back into English language because data analysis can easily be performed in English language. Further, researcher conducts pilot study, in which researcher collects feedback of 25 respondents about understandability of wording of items and structure of questionnaire. Moreover, researcher also collect feedback of industrial practitioners about content validity of measures and researcher rectifies mistakes and errors in questionnaire on the bases of collected responses. Coming towards administration techniques, researcher follows self-administering technique under which researcher personally visit respondents and resolve queries related to specific terms in questionnaire.

MEASURES

As many other authors have already been conducted different research study on concerned variables of proposed research study in previous literature and these authors have already been verified authenticity and validity of measurement items of questionnaire. Due to these reasons, researcher takes into account these specific research studies for adapting measurement items for this proposed research study. For measuring role of independent constructs, researcher adapts different no of items from different authors such as for big data acceptance measurement, 4 survey items have been adapted from research work of (Hazen, Overstreet, & Cegielski, 2012), for big data routinization measurement, researcher takes into account research work of (Hazen et al., 2012) and adapts 5 survey items and big data assimilation construct has been measured through 4 survey items taken from (Hazen et al., 2012). Further, researcher measured the mediating effect of green innovation through 9 measurement items, which have been adapted from (Chiou, Chan, Lettice, & Chung, 2011) and mediating role of green supply chain collaboration has been measured through 5 survey items adapted from (Chiou et al., 2011). 6 survey items have been adapted from (Lin, Tan, & Geng, 2013), for the measurement of environment performance construct. Responses of respondents regarding all these measurement items have been measured through 5-point Likert scale, which ranges from 1 (strongly disagree) to 5 (strongly agree).

Data Analysis Techniques

For analyzing authenticity, validity and reliability of collected data, researcher takes into consideration two main software such as AMOS and SPSS, by following which researcher performed various tests. AMOS has been accompanied for conducting two analysis such as confirmatory factor analysis (which helps to assessed discriminant validity, convergent validity and model fitness) and structure equation modeling (which assessed acceptance or rejection status of hypotheses). Further, SPSS has been taken into account for performing correlation test, regression test, descriptive statistics test and reliability test. For running the diagnosis of reliability test, two criteria have been examined such as Cronbach's alpha, it must have value greater than 0.70 cutoff value for ensuring items reliability and Composite reliability, its values have to exceed 0.70 threshold limit in order to ensuring internal consistency of data.

RESULTS AND ANALYSIS

Before switching towards formal estimation, the author performed post estimation analysis of data. The researcher estimated the frequency distribution of the respondents to check their relevant share according to gender, age and education. The primary data is comprises on 311 respondents of Thailand. In all the dataset, the proportion of male and female respondents are almost equally skewed. The proportion of female respondents is 47.3 percent, whereas the proportion of male respondent in total data set is 52.2 percent. The frequency distribution of data based on education indicates that the holders of master and post graduate degree constitute about 33.2 and 43.4 percent share, respectively. The learned individuals are good for eliciting response as they easily understand the nature and scope of questionnaire. Additionally, in order to check the proportion of respondents of various ages the author found the frequency distribution based on age group. The findings indicate that proportion of individuals more than 50 years constitute about 15.2 percent of whole dataset. The proportion of respondents under the range of 41-50 years is 31.2 percent. Thus, it can be presumed that most of the respondents belongs to middle age group.

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
BA	311	1.00	5.00	3.5091	1.16820	-.701	.138
BR	311	1.00	5.00	3.5743	1.09679	-.813	.138
BS	311	1.00	5.75	3.4252	1.06740	-.272	.138
GI	311	1.00	5.00	3.5457	1.09275	-.812	.138
GS	311	1.00	5.00	3.5107	1.06152	-.750	.138
EP	311	1.00	5.00	3.4487	1.09196	-.639	.138
Valid N (listwise)	311						

Table 1 stipulates the descriptive analysis of variables such as average, maximum, minimum, skewness, and standard deviation of variables' data. Minimum and Maximum values of all the variables is 1 and 5, respectively which denotes that variables' responses are noted on five point Likert scale. The average values of all the variables are moving around 3.5 to 3.6 that mean high percentage of respondents are slightly agree with the statement. For normal distribution, the threshold value of skewness should lie in the range of -1 and 1.The values of skewness test confirm the normal distribution in data.

Table 2: Factor Loading and Convergent validity

	GI	EP	BR	GS	BS	BA	CR	AVE
GI6	.834						0.964	0.747
GI4	.828							
GI7	.824							
GI9	.823							
GI5	.823							
GI8	.823							
GI3	.815							
GI2	.755							
GI1	.665							
EP6		.882					0.964	0.817
EP3		.878						
EP5		.870						
EP4		.854						
EP2		.832						
EP1		.772						
BR3			.866				0.945	0.774
BR2			.837					
BR1			.828					
BR4			.820					
BR5			.798					
GS4				.821			0.935	0.741
GS2				.811				
GS5				.805				
GS3				.804				
GS1				.787				
BS3					.807		0.904	0.702
BS2					.757			
BS4					.727			
BS1					.720			
BA2						.803	0.925	0.805
BA3						.794		
BA1						.778		

The findings of the component factor analysis (CFA) indicates the validity of measures (see table 2). The table also show the rotated component matrix of variables. The figures of CFA test also validates that all variables have valid construct as the load factors are higher than 0.7, which is threshold value for validity. Also, the issue of cross loading has also not found. In addition, the "convergent and discriminant" test also authorize the validity of measures.

Table 3: Discriminant Validity

	GS	BA	BR	BS	GI	EP
GS	**0.861**					
BA	0.586	**0.897**				
BR	0.490	0.595	**0.880**			
BS	0.469	0.351	0.419	**0.838**		
GI	0.573	0.578	0.521	0.568	**0.864**	
EP	0.449	0.348	0.427	0.693	0.492	**0.904**

Table 3 presents the findings of "convergent and discriminant" validity. The statistics of AVE and CR also confirm of convergent validity. The threshold values of AVE and CR for convergent validity are 0.75 and 0.7, respectively. The diagonal CR values also assure that variables are relatively more related with itself than other variables. The high value of diagonal digits than off diagonal digits in table endorse the discriminant validity of indicators

Table 4: Confirmatory Factors Analysis and KMO

CFA Indicators	CMIN/DF	GFI	IFI	CFI	RMSEA	KMO
Threshold Value	≤ 3	≥ 0.80	≥ 0.90	≥ 0.90	≤ 0.08	0.6 – 1.0
Observed Value	2.294	0.831	0.945	0.945	0.065	0.0945

Table 4 presents the findings of Kaiser-Meyer-Olkin (KMO) and Bartlett's Test. The KMO test indicates that how appropriate data is for Factor Analysis. The test evaluates sampling adequacy for each variable and for whole model. Moreover, the KMO statistic also denotes the proportion of variance among variables that may common variance. The results of KMO also confirms adequacy in sample data. The threshold range is lies between 0.6 - 1.0 for Confirmatory Factors Analysis. However, the observed values of KMO of all the variables are 0.90 which confirms adequacy in data.

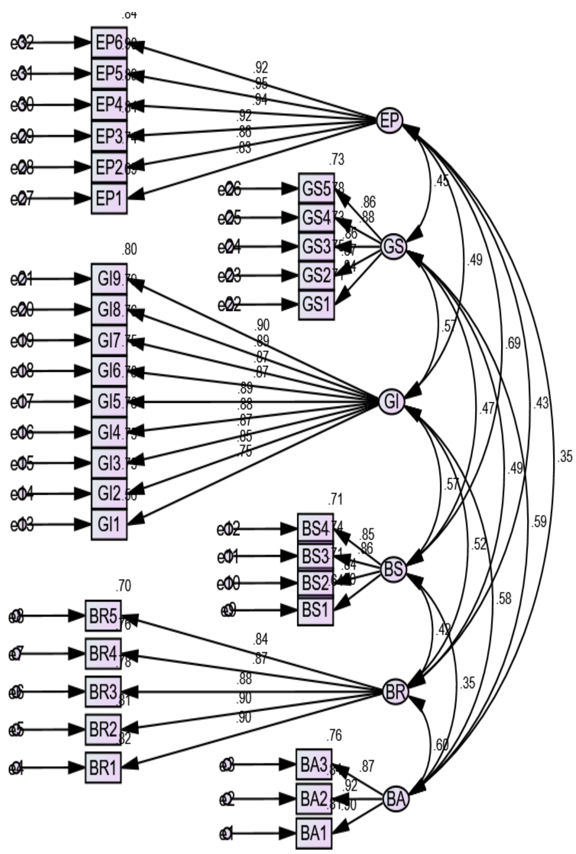


Figure 2: CFA

Table 5 presents the findings of SEM model which is estimated by employing AMOS. The model is employed to explore the significance of relationships between independent and dependent varibles. The results specify that the direct effect of all the variables except big data acceptance on competetive advantage is significant. The direct effect of big data routinization on enviromental performance of pharmaceuticals in Thailnad is significant as p-value is less that 0.05. The coeffcient indicates that 1 unit increase in big data routinization will enhace the enviromental performance of pharmaceuticals by 12.3 percent. Moreover, the coeffcient of big data assimiliation indicates that 1 unit increase in big data assimilaion will increase the enviromental performance of pharmaceuticals by 49.5 percent. Where as the indirect impact of all the variables through the chanel of green innovation and green supply chain collaboration are significant on enviromental performance of pharmaceutical in Thailand, as p-value is less than 0.05. The mediating coeffcients of green innnovation indicate that one unit increase green innovation will increase enviromental performace about 4.3 percent,1.9 percent, and 4.5 percent through big data acceptance, big data routinization, and big data capabilities, respectively. Besides, the indirect impact of all the variables through green supply chain capabilities are significant on environmental performance of pharmaceuticals, as p-value is less than 0.05. The mediating coeffcients of green supply chain capabilities indicate that one unit increase in green supply chain capabilities will increase enviromental performace about 7.4 percent, 2.4 percent, and 4.3 percent through big data acceptance, big data routinization, and big data capabilities, respectively. Therefore, it can be inferred that mediating impact of green innovation and GSC capabilities strengthens the relationships of big data acceptance, big data routinization, and big data capabilities with environmental performance of pharmaceutical in Thailand.

Table 5: Structural Equation Modeling

Hypothesis	B-Value	SE	P-Value	Decision
BAC→EP	-.068	.051	.214	Rejected
BRO→EP	.123	.051	.016	Accpted
BAS→EP	.495	.050	.000	Accpted
BAC→GI→EP	.043	.047	.000	Accpted
BRO→GI→EP	.019	.052	.002	Accpted
BAS→GI→EP	.045	.047	.000	Accpted
BAC→GS→EP	.074	.052	.000	Accpted
BRO→GS→EP	.024	.057	.033	Accpted
BAS→GS→EP	.043	.051	.000	Accpted

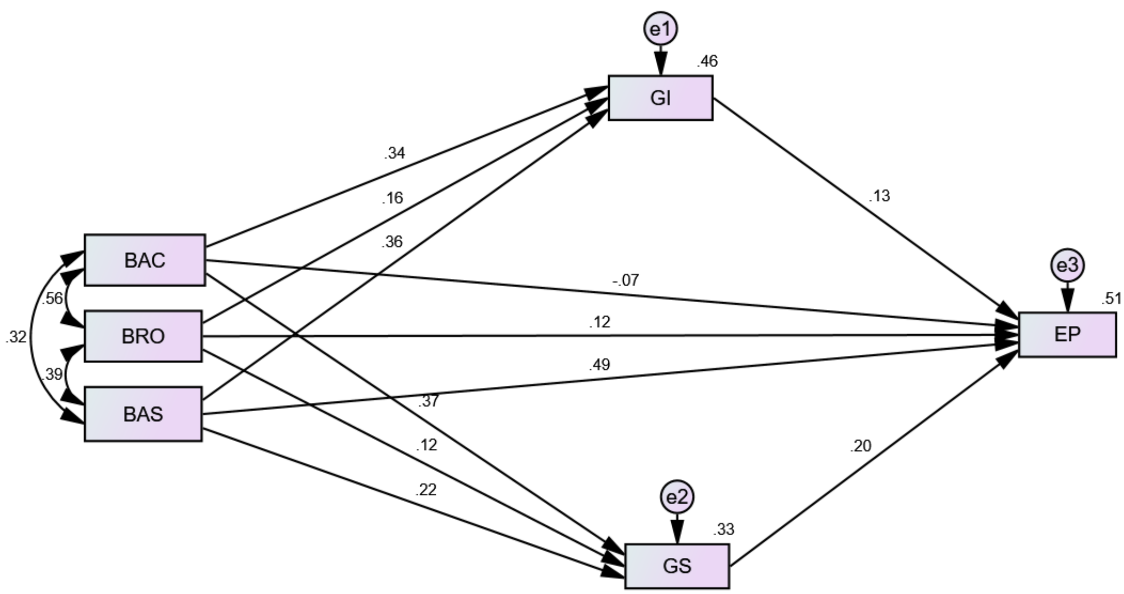


Figure 3: SEM

DISCUSSION AND CONCLUSIONS

DISCUSSION

This research focuses on investigation of the role of the properties of big data on the environmental performance of pharmaceuticals in Thailand by formulating various hypotheses. The first hypothesis stated that big data acceptance has a direct significant impact on environmental performance but it was rejected by the conducted tests. The second and third hypotheses show that the big data routinization and assimilation, respectively, have direct significant impact on the environmental performance of pharmaceutical companies in Thailand. Both of these were accepted with routinization having 12 percent and assimilation having 49 percent direct impact on environmental performance. The next three hypotheses were accepted and stated that the green innovation plays a mediation effect between big data properties and environmental performance. BAC has 34, BRO has 16 and BAS has 36 percent positive effect on green innovation which exerts a mediating collective effect of 13 percent on environmental performance. The last three hypotheses were also accepted and stated that the green supply chain collaboration plays a mediation effect between big data properties and environmental performance. BAC has 37, BRO has 12 and BAS has 22 percent positive effect on green supply chain collaboration which exerts a mediating collective effect of 20 percent on environmental performance. The results of this study can be confirmed in various studies (Albort-Morant, Leal-Rodríguez, & De Marchi, 2018; Gupta & Barua, 2017; Shafique et al., 2019; Sharma et al., 2018; Yildirim, Gottwald, Schüler, & Michel, 2016).

Conclusion

This study considers the properties of big, routinization, assimilation and acceptance, to study the mediating effects of green innovation and green supply chain collaboration on the environmental performance of pharmaceutical companies in Thailand. For this purpose, data was collected from Thailand's pharmaceutical companies and a sample of 311 respondents was extracted from the received responses. This data was tested through vigorous repeated analytical and statistical tests and procedures to show that big data properties have a significant impact on the environmental performance of Thailand's pharmaceutical companies through mediation roles of green innovation and green supply chain collaboration activities. The author has outlined implications of theoretical, practical and policy making contexts in the next section.

Implications

The current study aims to outline the effects that the properties of big data have on the environmental performance of pharmaceutical companies in Thailand and therefore this study has several implications in theoretical, practical and policy making contexts. The study outlines theoretical information about big data and green innovation that can help the researchers and peer academics to understand these concepts for future studies. In addition, this study can help the pharmaceutical companies to design and deploy practical plans for integrating green innovation and technologies of big data in their infrastructure. Moreover, the governmental bodies can use the information from this study to design policies that can help increase environmental performance and productivity in industrial sectors.

Limitations and Future Research Recommendations

No research is ever perfect and is always accompanied with certain limitations which can allow for finding future research directions and recommendations for improvements in literature and practice of research in the area under study. First limitation of this study is that it is a longitudinal research and better results may come forward from a horizontal study. In addition, the study has been conducted in context of Thailand only and only a limited number of tests have been applied on the data. There is a scope for future researchers to increase the sample and population sizes and use other tests and techniques to analyze the data. Moreover, the variables considered are also limited, which decreases the spectrum of research and therefore it is recommended by the author to use variables in different contexts and combinations so that effective results can be generated.

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