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Effect of green environment and technology on recycling waste management in the north of Thailand

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ABSTRACT

Waste management is most important in the current era of industrialization. Because with the increase in industry, the waste is also increasing day by day which has negative role on environment. In this way, the waste management is most important. Recycling is the major element which has positive role in waste management. Green environment and technology are mostly connected with the waste management through recycling. Therefore, objective of this study is to examine the role of green environment and technology on waste management recycling. For this purpose, a survey was carried out with the help of questionnaire. Population of the study is the waste management companies of Thailand. Respondents of the study are the employees of these companies. Results of the study shows that environmentally preferable building materials has positive effect on waste management. Waste reduction also has positive effect on waste management. Similarly, indoor air quality also has positive effect on waste management. Finally, technology has positive effect on waste management through recycling.

Keywords
Waste management, green environment, recycling waste, green environment, technology

Introduction

Waste management is the most important element of environment because it has major influence to maintain the quality of environment. In the current decade, the industrialization is increasing day by day which has major role in the environment. With the increase in factories, the waste is increasing in the environment and it also polluting the environment which has negative consequences on the human life. With the increase in factories, the smoke is also increasing in the environment and waste from different factories also polluting the environment. Therefore, the waste management is most important (Fei, Qu, Wen, Xue, & Zhang, 2016) to maintain the quality of life in a quality environment. That is the reason previous studies highlighted that waste management is most important (Malinauskaite et al., 2017; Sharma et al., 2020). Literature is emphasizing on the environmental quality and to reduce the pollution because it has several benefits. Polluted environment has major negative consequences on people which causes to spread various diseases. Therefore, this study is an attempt to highlight the importance of waste management through recycling and by examining the role of different factors which has influence on waste management recycling.

In all nations, environment is one of the most important concern of government as well as various waste management companies. In the same direction, Thailand is also one of the countries which has major focus to promote quality environment by reducing the waste in the environment. In Thailand, with the increase in the various industries, the waste is increasing in the environment which could be dangerous for the people living in various polluted areas. By observing this condition, the Thai government is also concerned to maintain the good quality environment. To address this condition, the current study focusing in recycling of waste. As given in the literature that recycling of waste is one of the most important part to handle waste and increase the quality (Gu, Zhang, Guo, & Hall, 2019; Meng et al., 2018). To provide the quality environment to the people is one of the prime responsibilities of government as well as various companies handling the waste. Number of companies are working in Thailand for waste management. Waste management categories are given in Figure 1. Along with the waste management companies, various companies also working to maintain the quality of environment. It is one of the priority areas for the companies to provide quality environment through recycling of waste. It is not only the responsibility of waste management companies; it is also the responsibility of general people to save the

environment by reducing the waste. It is one of the social responsibilities of business companies as well as individual people to maintain the quality of environment which has several benefits to all species.

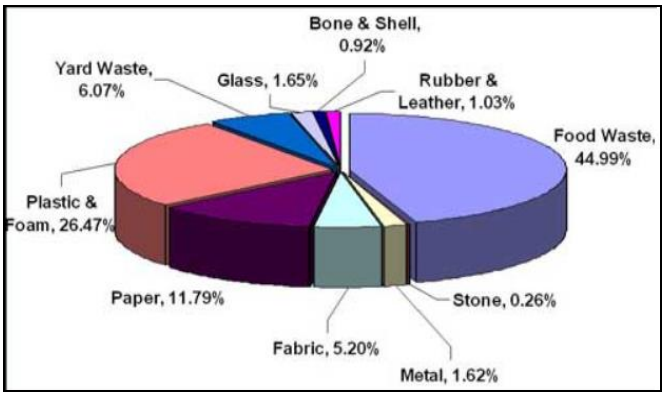

Figure 1. Waste Management in Thailand

There are several techniques applying by the companies to promote quality environment. Particularly, green environment is most important for the companies to enhance the reasonable quality of the environment by waste management through recycling. Actually, green environment representing the proper waste management through recycling. In this way, the building materials has vital role in environment. The construction companies use different building materials which has influence on the environment. The proper management of the building materials has the ability to promote green environment. Therefore, building material has major importance to enhance the quality of the environment. Number of previous studies also highlighted that building material has major role in environment (Ingrao et al., 2019; Oliver-Ortega et al., 2018). Furthermore, waste reduction is also an important element which has major role to promote waste management. Waste reduction is the important part of green environment. Therefore, to promote green environment, the role of waste reduction is most important. The waste from the industries must be reduced to promote waste reduction strategies and it led towards the waste management and green environment. Another important part of green environment is indoor air quality. Better quality of air has the possible effect on the green environment. Air quality has significant role in the health of people living in a specific area and showing the positive effect to support green environment. Hence, according to the current study, to promote green environment, three key areas must be promoted; environmentally preferable building materials, waste reduction and indoor air quality. Furthermore, technology also has major influence on waste management. Latest technology decreases the environmental pollution or increase the environmental quality. However, latest techniques in the of waste management has the ability to promote waste management. In this direction, it has possible effect to maintain the environmental quality.

Therefore, objective of this study is to examine the role of green environment and technology in waste management through recycling. Several studies are available in the literature showing the green environment and waste management (Havukainen et al., 2017; Nabavi-Pelesaraei, Bayat, Hosseinzadeh-Bandbafha, Afrasyabi, & Chau, 2017), however, the role of green environment is not examined on the waste management in relation to the recycling. Furthermore, the combination between green environment, technology and waste management is not examined in the literature. Hence, the current study has significant importance for the literature. This study also has major importance for the practitioners working in the various companies. Especially, this study is important for the management of waste management companies to promote waste management through recycling in relation to the green environment and technology.

Literature Review

Waste management has central importance to save the environment and to provide pollution free environment. There are several categories of waste management and all the categories are helpful to sustain the quality environment. Among all the categories of waste management, the current study selected waste recycling. Recycling is the procedure of changing waste materials into new materials as well as objects. Recycling can stop the waste of probably valuable materials as well as decrease the use of fresh raw materials, thereby dropping energy usage, air pollution (from incineration), as

well as water pollution (from landfilling). All categories of waste management are important for the environment and have the potential to promote quality environment for the people. However, it is not easy for the companies to promote better environment. The most important way to promote better environment is recycling. Recycling of material of wastage from various factories as well as houses may lead to the decrease in pollution in the environment. It is also shown by previous studies that recycling is most important (Chen, Zhang, Qi, Fourie, & Xiao, 2018; Malinauskaite et al., 2017; Yu et al., 2019).

According to the current study, green environment has important relationship with the waste management. Better level of green environment has the ability to promote waste management activities in Thailand. In this process, building material has important role to promote green environment. Environmentally preferable building materials has positive role to promote waste management and green environment. To promote the green environment, the role of waste reduction is also important. Additionally, indoor air quality also has positive effect on green management and has relationship with waste management through recycling. In addition, this, technology also has major importance for the waste management. As green environment has relationship with waste management, similarly, technology also has relationship with waste management. Therefore, green environment and technology has relationship with waste management and recycling (Krishna et al., 2020; Suhaimi, Rosli, Ariffin, Abd Wahab, & Idrus, 2020). The relationship between environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling is given in Figure 2. Environmentally superior building materials, waste reduction as well as indoor air quality represent the green environment.

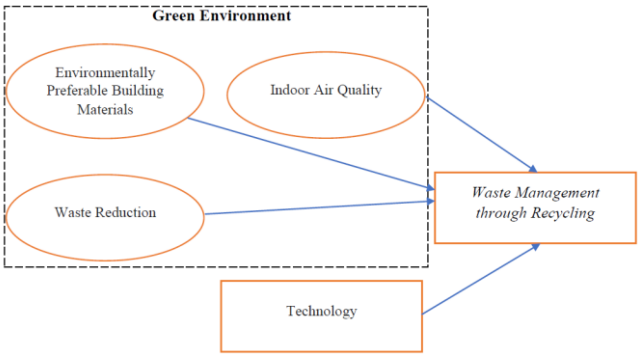

Figure 2. The relationship between environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling

Environmentally Preferable Building Materials and Waste Management through Recycling

Constructions industry is one of the famous industries worldwide which has significant importance. This industry always continues its operations to construct various buildings, roads, bridges etc. In this construction, there is ways the possibility of waste material in huge quantity. The construction material in huge quantity has the ability to decrease the performance of environment. As it can pollute the environment which may affect negatively on the lives of people living in a specific area. Therefore, to promote green environment, construction industry should prevent the environment from waste. Furthermore, green environment can also be promoted by using the environmental preferable material which has no harm to the environment. It is important because previous studies shows the construction material and green environment has major relationship (P. T. Lam, Chan, Chau, Poon, & Chun, 2011; Ritter, Skog, & Bergman, 2011). Environmentally preferable building materials has important role in waste management. Generally, to prevent the environment from construction material, the role of waste recycling is also most important. There is an important connection between green environment and waste management. Therefore, following hypothesis is proposed;

Hypothesis 1. There is a relationship between environmentally preferable building material and waste management through recycling.

Waste Reduction and Waste Management through Recycling

Waste reduction, also described as source reduction, is the exercise of using less material as well as energy to diminish waste generation and reservation of natural resources. Waste decrease is wider in scope than recycling as well as incorporates ways to avoid materials from ending up as waste before they reach the recycling stage. Waste reduction has major importance among the nations. Because increase in waste reduction increases the green environment and green environment has influence on waste management. Better the waste reduction better will be the waste management. As several previous studies shows that waste management is most important in case of environment (Ding, Zhu, Tam, Yi, & Tran, 2018; S. S. Lam et al., 2019). Hence, following hypothesis is proposed;

Hypothesis 2. There is a relationship between waste reduction and waste management through recycling.

Indoor Air Quality and Waste Management through Recycling

Air quality is also another important element of environment. Better air quality lead to the higher green environmental performance. Therefore, to promote green environment, the role of indoor air quality has central role. Indoor air quality denotes to the air quality within as well as around buildings and structures, particularly as it tells the health and ease of building occupants. Health effects from indoor air pollutants may be experienced soon after exposure or, possibly, years later. As several previous studies highlighted that indoor air quality has vital relationship with the environment (Kalimeri et al., 2016; Tähtinen et al., 2020). Therefore, increase in air quality increases the waste management which lead to the below hypothesis;

Hypothesis 3. There is a relationship between indoor air quality and waste management through recycling.

Technology and Waste Management through Recycling

In the current era of industry 4.0, the latest technology is increasing day by day and providing the ease to solve various problems including waste management. As waste management is a major challenge among the nations, however, it can be better handled with the help of new technology. The introduction of new technology can increase the management of waste. Technology in waste management has direct effect on the waste management through recycling. It has the ability to promote green environment. Because technology in recycling has major importance to promote waste management. There is important connection between waste management or recycling with technology (Bui, Tsai, Tseng, Wu, & Chiu, 2020; Hu, Wu, Cai, Lin, & Sun, 2020). Hence, it is hypothesized that;

Hypothesis 4. There is a relationship between technology and waste management through recycling

Research Method

This study used primary data to examine the relationship between environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling. Five variables, namely; environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling were measured in this study by using primary data. The primary data were collected with the help of questionnaire which is most suitable tool to collect the data from respondents. To measure the five given variables, this study used survey items from various previous studies in the filed of waste management. Therefore, by adopting several scale items, a questionnaire was designed for this study. In the survey questionnaire, two major sections were maintained. In the first section of the study, various questions related to the profile of respondents were asked and second section of the questionnaire was designed to ask various questions related to the key variables; environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling. Finally, waste management companies' employees were selected as the respondents of this study. 600 questionnaires were distributed among these waste management companies, and 600 valid questionnaires were returned which were used for data analysis. Waste management companies of Thailand were selected in this study for data collection. Data were collected by using the simple random sampling and cluster sampling (Kaur, Patil, Shirk, & Taillie, 1996; Ul-Hameed, Mohammad, & Shahar, 2018).

Findings

After data collection, data were entered in the excel sheet for analysis. However, errors in the data must be removed to promote the accuracy in results. In this direction, the current study carried out initial data screening to examine the errors to fix the errors before data analysis through Partial Least Square (PLS). After the data screening PLS was applied which is most suitable for data analysis (F. Hair Jr, Sarstedt, Hopkins, & G. Kuppelwieser, 2014; Fattah & Setyadi, 2019; J. F. Hair, Sarstedt, Pieper, & Ringle, 2012). Table 1 shows the missing value along with the outlier (Yang et al., 2020). It is found that the current study data has no missing value as well as outlier which is in line to get original results. Table 1 shows the minimum and maximum value which is showing the outlier in the data. It is found that none of the value is above 5 and none of the value is below 1 which shows that data has no outlier. PLS first part is given in Figure 3 which shows the factor loadings. Figure 3 shows that all the variables have factor loadings above 0.4. Environmentally preferable building materials (EPBM) is measured by using six scale items, waste reduction is measured by using five scale items, indoor air quality is measured by using the six scale items, technology is also measured by using six scale items and waste management through recycling is measured by using seven scale items. Hence, all the scale items for environmentally preferable building materials, waste reduction, indoor air quality, technology and waste management through recycling is above 0.4 which is acceptable in the current study.

Table 1. Data Statistics

	No.	Missing	Mean	Median	Min	Max	SD	Kurtosis	Skewness
EPBM1	1	0	2.948	4	1	5	0.99	-1.855	-1.538
EPBM2	2	0	3.486	4	1	5	1.321	-0.956	-0.497
EPBM3	3	0	3.645	4	1	5	1.417	-1.881	-1.735
EPBM4	4	0	2.603	4	1	5	0.958	-1.004	-0.697
EPBM5	5	0	3.466	4	1	5	1.186	-1.679	-1.466
EPBM6	6	0	3.431	4	1	5	0.939	-0.923	-0.35
IAQ1	7	0	2.814	4	2	5	0.843	-0.508	-0.296
IAQ2	8	0	3.666	4	2	5	0.802	-0.481	-0.087
IAQ3	9	0	3.634	4	2	5	0.816	-0.464	-0.152
IAQ4	10	0	3.693	4	2	5	0.8	-0.505	-0.079
IAQ5	11	0	3.645	4	2	5	0.815	-0.464	-0.147
IAQ6	12	0	3.669	4	2	5	0.993	-1.117	-0.04
WR1	13	0	3.738	4	2	5	1.172	-1.376	-0.344
WR2	14	0	3.686	4	2	5	1.051	-1.262	-0.079
WR3	15	0	3.769	4	2	5	1.18	-1.315	-0.443
WR4	16	0	3.586	4	2	5	1.175	-1.46	-0.176
WR5	17	0	3.669	4	2	5	1.151	-1.418	-0.186
TECH1	18	0	3.593	4	2	5	1.163	-1.436	-0.168
TECH2	19	0	3.741	4	2	5	1.153	-1.308	-0.377
TECH3	20	0	3.631	4	2	5	1.159	-1.402	-0.234
TECH4	21	0	3.641	4	2	5	1.14	-1.36	-0.233
TECH5	22	0	3.703	4	2	5	0.994	-1.095	-0.118
TECH6	23	0	3.741	4	1	5	1.144	-1.221	-0.397
WMR1	24	0	3.686	4	1	5	1.038	-1.096	-0.161
WMR2	25	0	3.793	4	2	5	1.171	-1.259	-0.485
WMR3	26	0	3.624	4	1	5	1.183	-1.349	-0.28
WMR4	27	0	3.683	4	1	5	1.137	-1.294	-0.26
WMR5	28	0	3.603	4	1	5	1.141	-1.32	-0.215
WMR6	29	0	3.738	4	1	5	1.133	-1.176	-0.416
WMR7	30	0	3.631	4	2	5	1.147	-1.368	-0.248

Note: EPBM = Environmentally Preferable Building Materials, WR = Waste Reduction, IAQ = Indoor Air Quality, TECH = Technology, WMR = Waste Management Through Recycling

Table 2. Cross-Loadings

	Environmentally Preferable Building Materials	Indoor Air Quality	Technology	Waste Management through Recycling	Waste Reduction
EPBM1	0.546	0.113	0.174	0.181	0.167
EPBM2	0.456	0.059	0.116	0.131	0.117
EPBM3	0.827	0.358	0.421	0.386	0.369
EPBM4	0.839	0.347	0.418	0.402	0.401
EPBM5	0.585	-0.04	0.169	0.178	0.189
EPBM6	0.632	-0.017	0.158	0.181	0.188
IAQ1	0.13	0.438	0.141	0.114	0.106
IAQ2	0.079	0.474	0.102	0.077	0.052
IAQ3	0.063	0.397	0.056	0.055	0.048
IAQ4	0.032	0.387	0.065	0.031	0.006
IAQ5	0.047	0.389	0.069	0.08	0.064
IAQ6	0.287	0.903	0.559	0.498	0.515
TECH1	0.34	0.313	0.881	0.843	0.764
TECH2	0.291	0.354	0.833	0.824	0.745
TECH3	0.355	0.358	0.82	0.746	0.669
TECH4	0.396	0.32	0.771	0.682	0.667
TECH5	0.275	0.843	0.883	0.461	0.475
TECH6	0.322	0.442	0.824	0.75	0.819
WMR1	0.282	0.364	0.537	0.688	0.665
WMR2	0.345	0.497	0.706	0.868	0.812
WMR3	0.305	0.288	0.73	0.836	0.787
WMR4	0.323	0.332	0.715	0.81	0.789
WMR5	0.361	0.344	0.809	0.848	0.75
WMR6	0.28	0.362	0.82	0.827	0.736
WMR7	0.354	0.344	0.806	0.853	0.658
WR1	0.328	0.447	0.835	0.769	0.855
WR2	0.283	0.364	0.564	0.619	0.707
WR3	0.382	0.497	0.738	0.78	0.848
WR4	0.315	0.282	0.756	0.841	0.888
WR5	0.319	0.309	0.72	0.807	0.809

Note: EPBM = Environmentally Preferable Building Materials, WR = Waste Reduction, IAQ = Indoor Air Quality, TECH = Technology, WMR = Waste Management Through Recycling

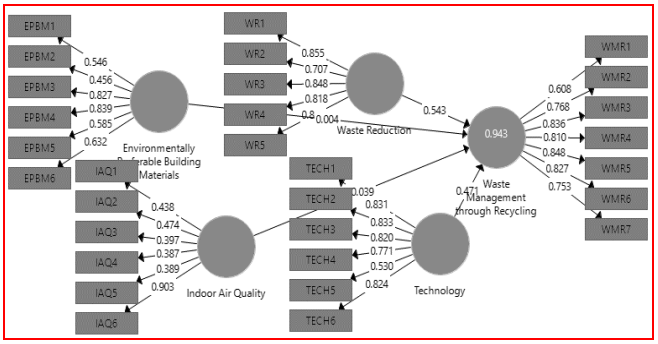

Figure 3. Measurement Model

Cronbach Alpha is also examined in this study to check the reliability. Furthermore, to check the reliability, composite reliability (CR) was also examined in this study. It is found that environmentally preferable building materials has CR 0.818, waste reduction has CR 0.904, indoor air quality has CR 0.875, technology has CR 0.899 and finally, waste management through recycling has CR 0.916. Hence, all the variables have CR above 0.7 which is recommended by J. Hair, Hollingsworth, Randolph, and Chong (2017). In addition to this, this study also examined the average variance extracted and it is found that all the variables; EPBM, waste reduction, indoor air quality, technology and waste management through recycling has average variance extracted above 0.5 which confirmed the convergent validity. Furthermore, this study also examined the discriminant validity (Henseler, Ringle, & Sarstedt, 2015) which is above the minimum acceptable level and examined by using cross-loadings. CR and average variance extracted is given in Table 2. The discriminant validity is given in Table 3.

Table 3. Reliability and Convergent Validity

	Alpha	rho_A	CR	(AVE)
Environmentally Preferable Building Materials	0.766	0.844	0.818	0.439
Indoor Air Quality	0.728	1.18	0.875	0.282
Technology	0.863	0.883	0.899	0.602
Waste Management through Recycling	0.892	0.897	0.916	0.612
Waste Reduction	0.867	0.874	0.904	0.654

Note: EPBM = Environmentally Preferable Building Materials, WR = Waste Reduction, IAQ = Indoor Air Quality, TECH = Technology, WMR = Waste Management through Recycling

Structural equation modeling (SEM) is most important approach to examine the data to test hypotheses (J. Hair et al., 2017; J. F. Hair, 2010; J. F. Hair, Ringle, & Sarstedt, 2013; J. F. Hair et al., 2012; Henseler & Chin, 2010; Iqbal & Kousar, 2018). Therefore, SEM was used to test the relationship between EPBM, waste reduction, indoor air quality, technology and waste management through recycling. The direct effect of environmentally preferable building materials was examined on waste management through recycling. The direct effect of waste reduction was examined on waste management through recycling. Furthermore, the direct effect of indoor air quality was examined on waste management through recycling. In addition to this, the direct effect of technology was examined on waste management through recycling. These results are given in Table 4 and SEM process is given in Figure 4.

The direct effect of environmentally preferable building materials on waste management through recycling is significant as the t-value is 2.279. The direct effect of waste reduction on waste management through recycling is also significant with t-value is 17.113. Additionally, the direct effect of indoor air quality on waste management through recycling is also significant with t-value 2.068. In addition to this, the direct effect of technology was examined on waste management through recycling which shows significant and positive relationship as the t-value is 13.489. Therefore, results of the study show that EPBM, waste reduction, indoor air quality and technology has positive effect on waste management through recycling. R-square value is 0.943 which is showing that; EPBM, waste reduction, indoor air quality and technology are expected to bring 94.3% change in waste management through recycling.

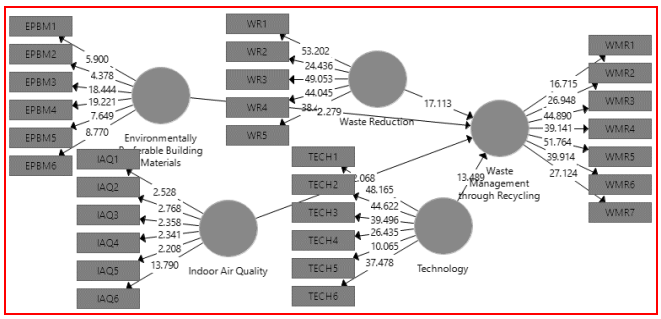

Figure 4. Structural Model

Table 6. Results

	(O)	(M)	SD	T Statistics	P Values
Environmentally Preferable Building Materials -> Waste Management through Recycling	0.004	0.004	0.018	2.279	0.031
Indoor Air Quality -> Waste Management through Recycling	0.039	0.037	0.019	2.068	0.039
Technology -> Waste Management through Recycling	0.471	0.467	0.035	13.489	0
Waste Reduction -> Waste Management through Recycling	0.543	0.546	0.032	17.113	0

Note: EPBM = Environmentally Preferable Building Materials, WR = Waste Reduction, IAQ = Indoor Air Quality, TECH = Technology, WMR = Waste Management Through Recycling

Conclusion

Results of the current study has significant importance for the green environment and waste management. As this study examined the relationship between EPBM, waste reduction, indoor air quality, technology and waste management through recycling. Objective of this study is to examine the role of green environment and technology on waste management recycling. To access the impact of green environment of waste management through recycling, the major parts of green environment was considered which include; EPBM, waste reduction and indoor air quality. The effect of technology was also examined on waste management through recycling. For this purpose, data were collected from the waste management companies of Thailand with the help of questionnaire and analyzed by using the statistical software. Finally, results of the study highlighted the valuable insights for the literature. According to the results of this study, green environment has major importance for waste management. To promote waste management, green environment practices has major importance and has the ability to effect positively on waste management through recycling. Results of the study shows that environmentally preferable building materials has positive effect on waste management. Increase in environmentally preferable building materials increases the waste management. Furthermore, waste reduction also has positive effect on waste management. It shows that increase in waste reduction increase the waste management. Similarly, indoor air quality also has positive effect on waste management. More the air quality, more will be the waste management through recycling. In addition to this, this study also examined the effect of technology on waste management. This study found that introduction of latest technology by the waste management companies has important role to promote waste management. Finally, technology has positive effect on waste management through recycling. Therefore, green environment and technology has the potential to influence waste management through recycling in Thailand.

Implications

Several studies are carried out to the environmental performance and green environment. Along with this, several studies are carried out on waste management. Studies are also available on recycling waste. However, the relationship between green environment, waste management and recycling were not examined in the previous studies in a signal study to examine the influence on each other. Therefore, the relationship between EPBM, waste reduction, indoor air quality, technology and waste management through recycling has unique contribution to the literature. The integration between green environment and technology has vital role to influence waste management. Especially, this relationship is first time carried out among the waste management companies of Thailand. Practically, this study also has major importance for the waste management companies of Thailand. This study recommended that EPBM, waste reduction and air quality have positive role to promote green environment. Waste management companies should promote EPBM, waste reduction and air quality to increase the quality of environment. Waste management companies should also introduce latest technology to enhance the recycling which has positive role in waste management.

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