# SUSTAINABILITY STRATAGY FOR ALTERNATIVE FUEL IN CEMENT KILN

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# กลยุทธ์สร้างความยั่งยืนการให้บริการกำจัดกากอุตสาหกรรมในเตาปูนซิเมนต์

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรดุษฎีบัณฑิต

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SUSTAINABILITY STRATAGY FOR ALTERNATIVE FUEL IN CEMENT KILN

Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for a Doctor's Degree.

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คำสำคัญ: ความเต็มใจที่จะจ่าย/ความเต็มใจที่จะยอมรับ/เตาปูนซิเมนต์/วิธีการสมมุติเหตุการณ์ให้ประมาณค่า/วิธีการทดลองทางเลือก/สมการโครงสร้าง/เผาร่วมในเตาปูนซิเมนต์

บริษัทผู้ผลิตปูนซิเมนต์มีศักยภาพที่สามารถให้บริการกำจัดขยะและกากอุตสาหกรรมในชื่อการเผาร่วมในเตาปูนซิเมนต์(Co-Processing) การดำเนินดังกล่าวเป็นการนำกากอุตสาหกรรมมาเป็นเชื้อเพลิงทดแทน ทำให้สามารถลดการใช้เชื้อเพลิงหลักซึ่งจะเป็นการอนุรักษ์ทรัพยากรและเป็นการกำจัดกากอุตสาหกรรมในเวลาเดียวกัน ทำให้ได้ประโยชน์ทางบวกด้านสิ่งแวดล้อมในเวลาเดียวกัน เป็นทางเลือกที่ดีสำหรับการกำจัดกากอุตสาหกรรม เป็นมิตรต่อสิ่งแวดล้อม ลดการฝังกลบ เป็นพลังงานทางเลือกของอุตสาหกรรมปูนซีเมนต์ในหลายประเทศในขณะเดียวกัน ในปัจจุบันประเทศไทยมีแผนยุทธศาสตร์หลักด้านพลังงานของกระทรวงพลังงานที่ได้จัดทำแผนแม่บทพลังงาน 5 แผนในช่วงระหว่างปี 2561-2580 มีการส่งเสริมการใช้พลังงานทดแทนในการผลิตกระแสไฟฟ้า ทำเกิดโรงไฟฟ้าพลังงานขยะมากขึ้นและมีโรงไฟฟ้าพลังงานขยะที่มีศักยภาพที่จะสามารถรับกำจัดกากอุตสาหกรรมได้โดยมีข้อได้เปรียบในเรื่องระยะทางการขนส่ง เนื่องจากอยู่ใกล้กับแหล่งอุตสาหกรรมเหตุผลนี้จึงทำให้เกิดโรงไฟฟ้าพลังงานขยะเกิดขึ้นจำนวนมากและกระจายตัวอยู่ทั่วประเทศ ทำให้เกิดการแข่งขันการให้บริการกำจัดกากอุตสาหกรรมในตลาด Waste to Energy อย่างมากในปัจจุบัน ดังนั้น เพื่อให้เกิดการพัฒนาอย่างยั่งยืนในการให้บริการ ผู้วิจัยจึงศึกษามิติที่เกี่ยวข้องกับผู้ให้บริการแบบเผาร่วมในเตาปูนซิเมนต์โดยผลการศึกษานี้ ผู้ให้บริการ Co-Processing Service สามารถนำไปวางแผนเชิงนโยบาย การให้บริการอย่างยั่งยืนต่อไปในอนาคต จากการทบทวนวรรณกรรมพบ 4 มิติที่สำคัญ ในการศึกษาดังต่อไปนี้

การศึกษาที่ 1 : เพื่อพัฒนาแบบจำลองสมการโครงสร้างของปัจจัยที่มีอิทธิพลในการเลือกใช้บริการ กำจัดกากอุตสาหกรรม ซึ่งถูกชี้วัดด้วยปัจจัยที่ที่พัฒนาขึ้นจากกการทบทวนวรรณกรรม ซึ่งปัจจัยดังกล่าวเป็นจุดเด่นของการให้บริการ Co-Processing ในรูปแบบตัวแปรแฝงและใช้แบบจำลองสมการโครงสร้างวิเคราะห์ความสัมพันธ์ดังกล่าว

การศึกษาที่ 2 : เพื่อพัฒนาแบบจำลองสมการโครงสร้างของปัจจัยที่มีอิทธิพลต่อการยอมรับเทคโนโลยีกำจัดกากอุตสาหกรรมในเตาปูนซิเมนต์เป็นแบบจำลองที่พัฒนาขึ้นจากโมเดลการยอมรับเทคโนโลยี (Technology Acceptance Framework) นำมาประยุกต์เพื่ออธิบายความสัมพันธ์ในบริบทของการยอมรับเทคโนโลยีกำจัดกากอุตสาหกรรมในเตาปูนซิเมนต์ ในรูปแบบตัวแปรแฝงและใช้แบบจำลองสมการโครงสร้างวิเคราะห์ความสัมพันธ์

การศึกษาที่ 3 : เพื่อประเมินมูลค่าความเต็มใจที่จะจ่ายค่าบริการกำจัดกากอุตสาหกรรมและประเมินมูลค่าความเต็มใจที่จะยอมรับค่าบริการกำจัดกากอุตสาหกรรม โดยศึกษาความเต็มใจที่จะจ่ายของลูกค้าด้วย Double Bounded Close-Ended และ Contingent Valuation Method สำหรับความเต็มใจที่จะยอมรับคำนวณจากอัตราส่วนเพิ่มในการทดแทน Marginal Rate of Substitution ของค่าสัมประสิทธิ์จากคุณลักษณะที่ชดเชยกับราคาค่ากำจัดเทียบกับราคาค่ากำจัด

การศึกษาที่ 4 : เพื่อพัฒนาแบบจำลองในการพยากรณ์การเลือกใช้บริการกำจัดกากอุตสาหกรรมในเตาปูนซิเมนต์ โดยพัฒนาแบบจำลองจากโอกาสของ Unobserved Heterogeneity และวิเคราะห์โดยใช้ Random Parameters With Heterogeneity In Means And Variances เพื่ออธิบายความสัมพันธ์เชิง Individual เพื่อลดอคติและการอนุมานที่ผิดพลาดให้น้อยที่สุด เพื่อพยากรณ์การเลือกใช้บริการกำจัดกากอุตสาหกรรมในเตาปูนซิเมนต์



สาขาวิชา วิศวกรรมการจัดการพลังงานและโลจิสติกส์ ลายมือชื่อนักศึกษา ศุภฤกษ์ สุมรงาม
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Keyword: Willingness to Pay (WTP)/Willingness to Accept (WTA)/Cement Kiln/ Contingent Valuation Method (CVM)/Choice Experiment (CE)/Structure Equation Model (SEM)/Co-Processing

Recently, sustainable industrial waste disposal tends to be managed through a circular economy with value-adding by turning waste into energy while Waste to Energy refers to the use of waste heat as a renewable and primary fuel for power plants. Cement manufacturing companies can provide industrial waste disposal services in the form of Co-Processing in cement kilns. This operation is to take industrial waste into renewable fuel, which can reduce main fuel (coal) usage, conserve the resource, and dispose of industrial waste, to positively benefit the environment in the meantime. This is a good alternative for industrial waste disposal that is environmentally friendly, reduces landfills, and can be used to generate renewable energy for the cement industry in many countries. In Thailand, under strategic energy planning, the Ministry of Energy has prepared five energy master plans during 2015–2036. According to the declared plan, a promotion of using renewable energy in generating electricity results in more Waste to Energy power plants which potentially manage industrial waste disposal, they have an advantage in transportation distances due to their proximity to industrial sites. Thus, the waste-to-energy power plants are abundantly built and they subsequently scatter throughout the country. According to the study result, Co-Processing Service providers can use it to make policy planning for sustainable service provision in future. Refer to literature review, it found that there are 4 main dimensions of the study as follow.

Case Study no. 1: To develop a Structural Equation Model of factors affecting to selection of industrial waste disposal service which is indicated by factors developed from the literature review. Such factors are main points of the Co-Processing service, in a form of latent variable, and it uses Structural Equation Model to analyze the mentioned relation.

Case Study no. 2: To develop a Structural Equation Model of factors affecting to Technology Acceptance of industrial waste disposal in cement kiln which is developed from Technology Acceptance Framework by applying to explain a relation in the context of Technology Acceptance of industrial waste disposal in cement kiln, in form a of latent variable, and it uses Structural Equation Model to analyze the relation.

Case Study no. 3: To evaluate value of the Willingness to Pay for industrial waste disposal fee, and evaluate the Willingness to Accept industrial waste disposal fee by studying the Willingness to Pay of customers with Double Bounded Close-Ended, and Contingent Valuation Methods. For the Willingness to Accept, it is calculated by Marginal Rate of Substitution ratio of coefficient from a characteristic which is substituted by disposal fee, in comparison to disposal fee.

Case Study no. 4: To develop a Structural Equation Model to forecast the selection of industrial waste disposal service by developing the model of Unobserved Heterogeneity, and analyzing by using Random Parameters with Heterogeneity in Means and Variances to explain Individual Relation, to reduce bias and the least mistake of inference, in order to forecast the selection of industrial waste disposal service in cement kiln.



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Academic Year 2021 Advisor's Signature ________

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# SYMBOLS AND ABBREVIATIONS

| | | |
|---|---|---|
| $\alpha$ | = | Statistically significant level |
| df | = | Degree of freedom |
| $\chi^2$ | = | Chi-square |
| RMSEA | = | Root Mean Square of Approximation |
| SRMR | = | Standardized Root Mean Residual |
| CFI | = | Comparative Fit Index |
| TLI | = | Tuker Lewis Index |
| SEM | = | Structural Equation Modeling |
| CFA | = | Confirmatory Factor Analysis |
| EFA | = | Exploratory Factor Analysis |
| CR | = | Composite Reliability |
| AVE | = | Average Variance Extracted |
| FEM | = | Fixed Parameter Estimation model |
| REM | = | Random Effect Model |
| RPM | = | Random Parameter Model |
| RPHM | = | Random Parameter Heterogeneity in the Means |
| RPHMV | = | Random Parameter Heterogeneity in Mean and Variances |
| WDCK | = | Waste Disposal in Cement Kilns |
| WDCP | = | Waste Disposal by Co-Processing in Cement Kilns |
| WDSCK | = | Waste Disposal Service in Cement Kilns |

## SYMBOLS AND ABBREVIATIONS (Continued)

| | | |
|---|---|---|
| MRS | = | Marginal Rate of Substitution |
| MM | = | Marketing Mix |
| TPB | = | Theory of Planned Behavior |
| TAM | = | Technology Acceptance Model |
| MLE | = | Maximum Likelihood Estimate |
| M | = | Mean |
| SD | = | Standard Deviation |
| SK | = | Skewness |
| Ku | = | Kurtosis |
| DCE | = | Discrete Choice Experiments |
| WTP | = | Willingness to Pay |
| WTA | = | Willingness to Accept |
| CVM | = | Contingent Valuation Method |
| W2E | = | Waste to Energy |
| WTE | = | Waste to Energy |
| WtE | = | Waste to Energy |
| WTE - Power Plant | = | Power plant use waste for renewable energy to generate electricity |
| Auto E-license | = | Electronic system for automatically send waste or unused materials out of the factory via an electronic system |
| Co-Processing | = | Cement manufacturing companies potentially provide waste disposal services in Cement Kiln and Waste which has a quality of renewable fuel in Cement Kiln |

# CHAPTER I
# INTRODUCTION

## 1.1 Rationale of the research

According to industrial waste disposal in Thailand, in regard to service providers who can take the industrial waste into energy, there are two major groups of players who have ability to dispose the industrial waste in large amount. First group is Waste to Energy power plant who demands the industrial waste for power planting fuel (Energy Regulatory Commission, 2020) while (Energy Regulatory Commission, 2020) defined that Waste to Energy Power Plant can use the industrial waste as a main Waste to Energy (WtE). It is a method of waste management, and it is a benefit to power planting (Khan & Kabir, 2020) which people are widely interest in this kind of technology worldwide (Istrate, et al. 2020) Also in Thailand, there is the existing distribution of WtE nationwide. Refer to data of (Energy Regulatory Commission, 2020) in the operational plan of energy supervision phase 4 (2020–2022), it found that there is promotion of electricity production by industrial Waste to Energy Power Plants. It is in accordance with the growth on demand of electricity use in Thailand where there is an encouragement of government policy to promote electricity production by renewable energy from the producers which will be purchased by government sector (Energy Regulatory Commission, 2022) So the income will be generated from industrial waste disposal fee of customers from electricity sale (Tan et al. 2015) Moreover, considering by group of main service providers, second group who takes industrial waste into a renewable energy by Co-Processing in Cement Kiln, whereas such disposal is to take waste or industrial waste into the process of renewable fuel to reduce use of main fuel (coal) which is the benefit from waste or industrial waste disposal, as well as to help reducing environmental pollution at the same time (Baidya, et al. 2016; Kaddatz, et al. 2013; Nagle, et al. 2020) Nowadays, service providers have to employ experienced persons, use technology and invest in high value. Most of providers are cement manufacturers who mainly locate in central Thailand. (Kaddatz et al. 2013) had mentioned that the income will be generated by industrial waste disposal fee from customers. Also, to use industrial waste as a substituted fuel reduce cost and decrease pollution of coal usage. So, it that the WTE it could be said that industrial waste disposal service providing business in Thailand is highly competitive. Also, there are many service providers in comparison to the rising industrial waste. From what mentioned above, we could consider each dimension of the study as follow.

Factors affecting to service selection according to research of (Emmerich et al. 2020) who mentioned that factors affecting to Technology Acceptance of renewable energy (Bio Fuel, Station battery, Hydrogen Fuel) are Trust in that technology, and Trust in persons who take such technology into operation while it has to be technology which has positive impact to environment. It is conformed to research of (Park & Ohm, 2014) who has studied factors affecting to selection on various kinds of renewable energy technology, including the electricity produced by waste. It was mentioned that factors affecting to the selections are Trust, Perceived Benefit, Perceived Risk, and Perceived cost, Refer to study result of factors affecting to service selection, (Huh et al. 2015) also said that it can be taken into marketing strategy operation to match customer's demand, in order to improve customer satisfaction as well as determine long term plan for the renewable energy service. According to relevant research review, it can be summarized that factors affecting to selection of service can be taken into method of service improvement and development of industrial waste disposal by WtE and Co-Processing groups. Refer to the mentioned reasons, they are taken into research objectives in order to develop a Structural Equation Model of factors affecting to selection of industrial waste disposal service.

Willingness to Pay (WTP): In reference to research of (Ndebele, 2020) it said that to use Green Electricity, customers do not get support on any compensation by government but it is customer's WTP. The research result let us know that customers have Willingness to Pay due to they are aware of positive impact to the environment. It is confirmed to the research of (Guo et al. 2014) who mentioned that assessment on Willingness to Pay is a popular concept in the study of renewable energy since it is to evaluate that how much the customer's is Willing to Pay, in order to have positive impact to the environment. It can be concluded that Willingness to Pay is the value of industrial waste disposal fee in customer's point of view who are Willing to Pay to industrial waste disposal by WtE and Co-Processing service providers. For how much the value of disposal fee will be on customer's Willingness to Pay, by this cause, it can be taken into a research objective to evaluate value of customer's Willingness to Pay for the industrial waste disposal fee, in customer's point of view toward industrial waste disposal service providers.

Willingness to Accept (WTA): According to research of (Ghalehkhondabi et al.2020) who mentioned that hazardous industrial waste disposal has to be managed by disposal system which is properly designed to reduce environmental impact. Meanwhile, the industrial waste disposal fee in return has to be high as well. Also (Kaddatz et al. 2013) had suggested in the research that the cement production will create air pollution from coal usage. However, if we can increase use of renewable energy, it will help to reduce the release of air pollution. Nevertheless, disposal fee has to be substituted for impact of the process. This is also conformed to research of who said that Willingness to Accept is to evaluate economic value, in order to substitute the environmental aspect. Refer to the relevant research review, it can be summarized that Willingness to Accept is the value of industrial waste disposal fee by WtE and Co-Processing service providers which had evaluated for customer's acceptance by calculating the impact of process, and environmental substitution. Since it is the disposal which requires high value of technology and administration cost, the disposal fee will also be high, while the disposal fee offered by service providers which customer will accept, and customers are Willing to Accept on what factors of substitution on disposal fee. From the mentioned cause, it is taken into the research objective, in order to evaluate the Willingness to Accept value of industrial waste disposal by customers

Developing model to forecast the service selection of industrial waste disposal by Co-Processing: If we consider from customers who want to utilize industrial waste while disposing by using it as raw material of power planting, by this method, it will help to dispose the rising industrial waste, and produce electricity from the renewable energy or Green Electricity (Ndebele, 2020) Also, (Shrimali, 2020) said that the electricity power generated by coal is not a clean energy and its price is fluctuated. So, there is a suggestion on alternative power planting from renewable energy. This is conformed to research of (Yang et al. 2016) who mentioned that electricity generated from renewable energy let customers have significant choice. Therefore, we can summarize that Customer's choice in selection of industrial waste disposal service can be chosen from both WtE and Co-Processing since these two groups are the big providers, and there is also a technology which helps with industrial waste disposal by reducing the main energy. Also, it is a direction of Circular Economy which demands to decrease industrial waste to landfill by utilizing doctrine of Waste Hierarchy (Malinauskaite & Jouhara, 2019) From this reason, it can be taken into the research to develop forecasting model on selection of industrial waste disposal service by Co-Processing since they are the existing service providers who have waste energy power plant as the new competitor. Refer to study result, it will let us know which factors are able to forecast the selection of industrial waste disposal service by Co-Processing.

## 1.2 Purpose of the research

1.2.1 To develop a Structural Equation Model of factors affecting to Selection of industrial waste disposal service by Co-Processing.

1.2.2 To evaluate value of the Willingness to Pay for industrial waste disposal service by Co-Processing and WTE-Power Plant.

1.2.3 To evaluate value of the Willingness to Accept industrial waste disposal service by Co-Processing and WTE-Power Plant.

1.2.4 To develop a Forecasting model on selection of industrial waste disposal service by Co-Processing.

## 1.3 Scope of the research

1.3.1 Samples are chosen by group of staff from companies, government sectors, educational institutions, and cargos who used to have industrial waste disposal service.

1.3.2 Study area covers 5 regions of Thailand, including Central, Eastern, Northern, Southern, and Northeastern regions.

1.3.3 Make Compensative studies based on industrial waste disposal service providers which can be taken into main energy for power planting, and waste disposal service providers which can be taken into substituted fuel by Co-processing in Cement Kiln.

## 1.4 Contribution of the research

1.4.1 To rectify construct indicators of a Structural Equation Model from factors affecting to service selection as a method to develop and improve the industrial waste disposal service by Co-Processing approach.

1.4.2 Able to take value of the Willingness to Pay for industrial waste disposal service into a method to determine service fee for customers of industrial waste disposal service by Co-Processing and WTE-Power Plant.

1.4.3 Able to take value of the Willingness to Accept industrial waste disposal service by Co-Processing and WTE-Power Planting into a method to determine a service policy to attract customers from a factor of customer's significant decision to accept substituted characteristic of service fee.

1.4.5 Construct forecast a selection of industrial waste disposal service by Co-Processing

1.4.6 Able to take the study result to utilize with for the overseas cement companies who provide Co-Processing service, as well as use this study as a base for further study in future.



## 1.5 Organization of the research

Chapter I: Mentioned about background of the study, research objectives, research boundary, and the expected benefits.

Chapter II: Study factors affecting to the selection of industrial waste disposal service in Cement Kiln.

Chapter III: Study factors affecting to the Technology acceptance on industrial waste disposal in Cement Kiln.

Chapter IV: Study value of the Willingness to Pay for service fee and the Willingness to Accept

Chapter V: Study the forecast on selection of industrial waste disposal service in Cement Kiln.

Chapter VI: Summarize the study result from 4 studies (Chapter II-IV).

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# CHAPTER II

# STRUCTURAL EQUATION MODEL OF FACTORS INFLUENCING THE SELECTION OF INDUSTRIAL WASTE DISPOSAL SERVICE IN CEMENT KILNS

## 2.1 Abstract

Industrial waste disposal in a Cement Kiln is an operation that includes waste disposal as well as the conversion of waste into renewable energy, which is a cement industry in many countries. This research studied business factors related to the intention to use Co-Processing industrial waste disposal service in Cement Kilns by surveying the data with questionnaires from 1,251 customers nationwide. The objectives of this research were to study the relationship of business factors by using Structural Equation Modeling to analyze factors influencing the selection of industrial waste disposal service in Cement Kilns. The study results found that customer attitude towards the following factors, including service providers, perceived ease of use, perceived usefulness, disposal price, service provider location, promotion, people, and a service provider's infrastructure, influenced intention to use the service. The variables that customers gave importance to were the industrial waste disposal with Zero wastes to Landfill and the use of industrial waste relevant to the circular economy by using the industrial waste, which has a quality of renewable fuel in Cement Kiln as the renewable fuel of the cement furnace. According to the re-search results, service providers in Cement Kilns can potentially plan service strategies to achieve sustainability for further business operations in a highly competitive market.

## 2.2 Rationale of the research

There have been various methods of industrial waste disposal, such as industrial wastes (Bogush et al. 2020; Viczek, et al. 2020), sewage sludge (Da et al. 2021; Lv et al.

2016; Z. Yang et al. 2019), and hazardous waste (Guimarães et al. 2018; Yang et al. 2014). Concurrently, there are studies on reducing industrial waste generation with the principle of waste management hierarchy (Cole et al.2019; Nelles et al.2016; Skaggs, et al.2018; Van et al.2016). Incidentally, reducing industrial waste is ineffective; however, industrial waste requires disposal. Nowadays, using sanitary landfills (Nik et al.2021) and incineration (Pek & Jamal, 2011) are disposal methods: however, they do not get benefits from industrial wastes (Malinauskaite et al. 2017). At present, contrary to the old concept of merely eliminating the wastes, in addition to using waste more than conventional incinerator waste (Siddiqi et al. 2020), the concept of sustainable waste management with a circular economy is the management of wastes from production and consumption by bringing produced and consumed raw materials into a new production process. With a circular economy waste management approach, this process creates value by turning from industrial wastes to converting Waste to Energy (Malinauskaite et al. 2017). Its technology covers the utilization of heat from waste incineration and that of converting waste into renewable fuels in cement kilns, or the main fuels for electricity generation of waste-to-energy power plants.

Cement manufacturing companies potentially provide waste and industrial waste disposal services called "Co-Processing in a Cement Kiln". The industrial waste which has a quality of renewable fuel in Cement Kiln is used as the renewable fuel of the cement furnace. It consequently reduces the use of coal, conserves resources, and simultaneously disposes of industrial wastes (Malinauskaite & Jouhara, 2019). Moreover, the disposal does not have an impact on the environment (Bogush et al. 2020). It is a good choice for industrial waste disposal, environmental friendliness, and landfill reduction (Viczek et al. 2020), being the renewable energy of the cement industry in many countries (Kosajan et al. 2020).

In Thailand, under strategic energy planning, the Ministry of Energy has prepared five energy master plans during 2015–2036. According to the declared plan, a promotion of using renewable energy in generating electricity results in more waste-to-energy power plants (Commission, 2019) which potentially manage industrial waste disposal. According to Commission (2019), they have an advantage in transportation distances due to their proximity to industrial sites. Thus, the waste to energy power plants are abundantly built and they subsequently scatter throughout the country.

Industrial waste is sewage or unused materials produced by industrial plants. It requires disposal technology methods with specially designed management systems. Therefore, the hiring cost of industrial waste disposal is higher than that of ordinary waste. Such high management prices consequently cause the highly competitive industrial waste disposal business in Thailand (Department of industrial works, 2020b). The Cement Kilns Co-Processing industrial waste disposal service providers are the early groups in the industrial waste disposal business. In addition, they are service providers potentially handling the tasks in large quantities with an international standardized management system (Baidya et al.2016). However, due to more competitors increasingly entering the market, the former customers have switched to use the new competitors' service.

From the previous studies, there have been studies on the feasibility of using different types of Co-Processing industrial waste disposal in Cement Kilns (Samolada & Zabaniotou, 2014; Yang et al. 2019). In reference to the literature review, the research studied the probability of using waste as a renewable fuel in Cement Kiln. Referring to literature review, it was found that there is experimental research where the waste has a calorific value equivalent to coal and is brought to replace the coal trial in Cement Kiln. In parallel, there have been studies on the impacts of industrial waste disposal on cement quality (Ping et al. 2020), and on the environment in industrial waste disposal management as well (Guimarães et al. 2018; Lv et al. 2016). While Emmerich et al. (2020); Ndebele (2020) conducted a study on the acceptance of renewable energy technologies without mentioning Co-Processing technology in Cement Kilns, there were some studies on waste disposal in terms of business, such as municipal solid waste in landfill (Di Foggia & Beccarello, 2021). However, these did not mention the Co-Processing of industrial waste disposal in the Cement Kiln business. As mentioned above, there have never been studies on factors influencing the selection of the Co-Processing industrial waste disposal in Cement Kilns services. The industrial waste disposal of cement companies uses industrial waste as a renewable fuel to reduce coal consumption due to the coal shortage probability in the future (Ping et al.

2020). In addition, waste disposal potentially yields a return on disposal costs (Baidya et al. 2016). Owing to the mentioned benefits, more competitors have been progressively emerging (Department of industrial works, 2020b). Thus, from the research gap, this research will supportively fulfill the related factors in terms of business by studying the relationship between the factors and the intention to use Co-Processing industrial waste disposal in Cement Kiln service using Structural Equation Modeling. The research results potentially acknowledge the causal relationship of factors influencing service selection. With customers' empirical data compared to the established model, the service providers can subsequently take these results to plan the business strategies for their business sustainability in the future.

## 2.3 Literature review

### 2.3.1 Theoretical framework

Due to the limited research on the causal factors related to the intention to use the service of Co-Processing industrial waste disposal in Cement Kilns, to find the solution, this research has studied a literature review and built a research framework starting from the large to the small one to find the factors. Beginning at the literature review, we divided its results into three main conceptual framework groups. The first group studied renewable technology acceptance, such as Bronfman (2012); Ndebele (2020); Park and Ohm (2014),studied using factors including intention to use renewable technology, renewable technology acceptance, perceived risk acceptance, perceived reward, and trust. The second group studied waste management, such as (Cole et al. 2019; Ghalehkhondabi et al. 2020; Vassanadumrongdee and Kittipongvises 2018), using factors including waste disposal service providers, trust, perceived benefit of service usage, and waste disposal knowledge. The third group studied the waste-to-energy, such as Jaworski and Kajda-SzczeŚniak (2020); Vassanadumrongdee and Kittipongvises (2018); Vrabie (2021), using factors including acceptance and benefit of usage. These conceptual framework groups are summarized and widely studied using theoretical frameworks including marketing mix, Theory of Planned Behavior, and the Technology Acceptance Model.

### 2.3.2 Marketing Mix

The main goals of this research are to study, discuss, and explain the casual business factors influencing the intention to use Cement Kilns Co-Processing industrial waste disposal service. The service providers can use the research results to plan the strategic business. Similar to the research of Xu et al. (2019), it stated the Cement Kiln Co-Processing of industrial waste disposal should be concurrently considered a potential business in addition to the balance of the various types of industrial waste disposal. Many researchers have studied business factors: for example, Wonglakorn et al.(2021) studied customer loyalty in logistics services (Wonglakorn et al. 2021) and Kwok et al. (2020) argued that business operation must start from positioning the business in the market to differentiate through the use of marketing mix theory in management. This is similar to the study of Salman, Tawfik et al.(2017), which additionally explained that applying the marketing mix theory into management would increase the business competitiveness. In the meantime, Othman et al. (2021); Pomering and Johnson (2018) added that the marketing mix theory, consisting of factors including product, price, place, promotion, people, physical, process, corresponded to (Mesak, Bari, & Ellis, 2020). Moreover, there are several examples of researchers such as Wongleedee (2015) who studied the marketing mix theory of selling products, while Bukova et al. (2017) applied the marketing mix into service jobs by taking the mentioned theory to establish hypothesis and test with Structural Equation Modeling (SEM). The research results found that the marketing mix theory resulted in the business operation success. Nowadays, the researchers increasingly use the marketing mix theory along with a Structural Equation Modeling. For example, Bukhari et al. (2020); Lee and Jin (2019); Sheau et al. (2013) used the marketing mix theory together with the Structural Equation Modeling in merchandising and discovered that the customer purchase intention depends on the product. Menegaki (2012) studied the renewable energy business and found that the customer intention to use service depends on the product, service, and price. Similar to Oflac, et al. (2015), they discovered that the customer's intention to use service depends on service, price, place, promotion, physical, people, and process. Corresponding to Blut et al.(2018); Bukova et al. (2017), they stated that the marketing mix is a fundamental tool for controlling the success in business operations. Therefore, it can be concluded that from the marketing mix theory, the frequently used factors comprising price, place, promotion, people, and physical are normally studied with Structural Equation Modeling (SEM).

### 2.3.3 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) is the application of the limitation of The Theory of Reasoned Action (TRA) Alam et al. (2021) proposed by Ajzen (1985). He defined that the planned behavior resulted from the intention comprising three influencing factors, including attitudes towards behaviors (Tu & Yang, 2019), subject norm, and perceived behavioral control. Attitude towards behavior is an assessment of an individual's overall behavior and its consequences. Weber et al, (2020) added that the behavioral expression included both positive and negative aspects. In addition, Cheunkamon et al. (2020) added that an individual's positive behavior will lead to their positive attitudes towards behaviors. On the other hand, their negative behavior will result in their bad attitudes towards behaviors. Subject norm is an individual perception of a need or social expectations which put an impact on an individual. It can be a group of close people or an influencing group which has an impact on that person. Corresponding to (Amato et al.2021) and Ali et al. (2021), they described that the tendency of behavioral expression increases when an individual assesses that the influencing group requires it. Based on this concept, Lou et al.(2020); Nduneseokwu et al. (2017) used the Theory of Planned Behavior (TPB) to study waste management. Ali et al. (Ali et al. 2021), Apipuchayakul & Vassanadumrongdee, (2020) studied this theory with the intention to buy energy-saving equipment. In addition, Cheunkamon et al. (2020) applied the Theory of Planned Behavior (TPB) to the Structural Equation Modeling (SEM) to consider personal factors affecting the intention to use technology social media. In conclusion, with the Theory of Planned Behavior, the researchers collaboratively studied the factors, including attitudes toward behaviors, subject norm, and intention with Structural Equation Modeling (SEM).

### 2.3.4 Technology Acceptance Mode (TAM)

Davis (Davis, 1989) developed the Technology Acceptance Model (TAM) from Ajzen's TRA theory Ajzen (1985), of which the introduction and development began in 1975. Later in 1985, the additional factors of belief and perceived behavioral control in decision-making were announced and consecutively developed to be the Theory of Planned Behavior (TPB) in 1989. The subsequent improvement grew into the theory of information technology acceptance and became the Technology Acceptance Model (TAM) (Wang et al.2019). This theory addresses the factors affecting the acceptance or use of technology. It consists of perceived ease of use, perceived usefulness, and attitude. Weber et al. (2020) further explained that it is an expression of acceptance for forecasting personal attitudes among various current technologies corresponding to (Chin & Lin, 2016; Tsaur & Lin, 2018). Cheunkamon et al. (2020) clarified that it is a widely accepted and prevalent theory for researchers to explore the intention to use technology. In terms of application, there is a variety of studies using it. For example, Alam et al. (2021) used this model to study households' intention to use solar power, while Zhang et al. (2020) and Chin and Lin (2016) studied this theory in the field of energy business. In terms of the factors that the researchers used to study in Technology Acceptance Model (TAM) (2021); Cheunkamon et al. (2020); Chin and Lin (2016) used attitude, subject norm, perceived ease of use, and perceived usefulness. From the Technology Acceptance Model, it can be concluded that the factors the researchers generally used to study in the research with Structural Equation Modeling (SEM) consisted of attitude, perceived ease of use, and perceived usefulness.

### 2.3.5 Structural Equation Modeling (SEM)

Hair (2006); Kline (2005) defined Structural Equation Modeling (SEM) as the causal and correlation analysis with multivariate analysis that combines variable correlation techniques, variance, and correlation coefficient. The variables in Structural Equation Modeling can be both independent and dependent variables. They can also examine the established model compared with the actual data. In this study, the business factors emerged from the reviewed literature were taken to formulate the hypotheses and subsequently tested by using a Structural Equation Modeling entitled "Structural Equation Model of factors influencing the selection of industrial waste disposal service in Cement Kilns". It consists of a measurement model, which describes the linear relationship of factors and exogenous variables, while using structural equation to confirm the structural correlation, which is established from the literature review compared to the empirical data to investigate whether they were consistent or not. The results will be further discussed.

**2.3.6 Integration of theories (Marketing Mix, TPB, TAM)**

The relationship between TPB and TAM theories has been accepted and widely applied with their similarities. Regarding attitude, which provided both positive and negative results, the TAM theory also complements the TPB theory on perceived ease of use that affected satisfaction and intention (Cheunkamon et al. 2020). Consistent with Alam et al. (2021), they stated that the use of TAM impossibly reflects the total environment to be studied. Along with perceived ease of use and perceived usefulness factors to forecast attitude, it should simultaneously use the TPB theory with attitude and social norm to predict intention. The study is also consistent with Ali et al. (2021), who believed that predicting intention must be used together with attitude and social norm. In addition, Mustafa, Ahmad, Shaari, and Jannat (2021) had the same agreeable direction. Bukhari et al. (2020) added that forecasting customer intention required to supportively study with attitude, social norm, price, and people. Furthermore, in terms of business, the researchers must study together with the marketing mix theory, which consists of the factors of price, place, promotion, people, and physical (Menegaki, 2012; Oflac et al. 2015; Sheau-Ting et al. 2013).

Therefore, this study concluded that the researchers have taken the literature review results to study the factors of price, place, promotion, people, and physical (the marketing mix theory) for explaining the causal relationship with the intention to choose the service. The factors of intention to choose this service has been collaboratively studied with social norm and attitude (Theory of Planned Behavior). In addition, with the Structural Equation Modeling (SEM), the researchers studied the factors of perceived ease of use and perceived usefulness (Technology Acceptance Model) to describe a causal relationship with attitude Structural Equation Modeling (SEM) to determine the causal and path relationship.

**2.3.7 The service providers of Co-Processing in Cement Kilns in Thailand**

Waste disposal is a challenging issue due to the increasing amount of waste generated by the population and daily activities (Kumar & Agrawal, 2020), specifically, industrial waste produced by sewage or unused industrial products. Waste disposal requires specially assembled machinery and technology, with high investment costs as well as standardized management (Xu et al. 2019), leading to higher outsourcing costs than normal waste. Industrial waste disposal businesses in Thailand are highly competitive due to such high bills. According to the data from the Department of industrial works (2020b) and (Commission, 2019), the existing nine service providers of Co-Processing waste disposal in cement are cement factories, with the majority of them located in Central Thailand. Currently, there are 137 service providers across the country's Department of industrial works (2020a), including central waste treatment plants, covering central waste incineration plants (Incineration/Co-incineration). Therefore, the goal of this research is to design services according to customer needs to achieve sustainability in Co-Processing industrial waste disposal services under intense competition.

**2.3.8 Hypothesis development**

Perceived ease of use is the simplicity of sending industrial waste disposal in the Cement Kilns because the group of service providers for Co-Processing industrial waste disposal service in Cement Kilns has a continually standard developed management system. The Department of industrial works has given service providers access to the Auto E-License system. Customers can use such a system to automatically send waste or unused materials out of the factory via an electronic system (Auto E-License). Through this way, customers can remove industrial waste disposal from the factory by reducing the waiting time for approval from the Department of Factory from 30 days in the case of ordinary permission to only two working days due to the standard waste disposal service specified by the Department of Factory, with a reference to the list of service providers. The list of service providers can refer to the Department of industrial works (2020a).

Perceived usefulness: the strength of Co-Processing industrial waste disposal in Cement Kilns is its perceived usefulness. According to Viczek et al. (2020), industrial waste disposal in the Cement Kilns would be the raw materials for production, leaving no residues (Zero wastes to landfills). Stafford et al. (2015) demonstrated that the management of Co-Processing industrial waste disposal is standard. Furthermore, it is a disposal method of Zero waste to landfills. Thus, it can simultaneously recycle industrial waste into renewable energy and industrial waste disposal as the delivery of waste disposal by the Auto E-License system interacts positively with perceived usefulness.

Subjective norm: According to Bukhari et al. (2020), this is a personal decision based on other related parties, like a group of people or close friends, whereas Wan et al. (2017) demonstrated that social norms and attitudes influence intention. Weber et al. (2020) added that a social norm is a social drive to make something conformable or unacceptable.

Attitudes toward service use: Tu and Yang (2019) stated that purchase intention is an opportunity caused by personal factors linked with attitudes and social norms. Ali et al. (2021) emphasized that attitudes are feelings depending on individual factors or circumstances.

Price: According to Kwok et al. (2020), one of the marketing mixes is the price factor. It accomplishes this by setting prices that cover the business's cost and added profits. For the highest profitability achievement, the set price should allow for customer acceptance. When a customer recognizes the value of the goods or services they receive, they feel that the price is worthwhile. However, the disposal cost must be profitable for the disposal service providers and affordable for the service users.

Place: The industrial waste disposal service organizations are the Cement Kiln companies, where most in Thailand have factories located in the central region, not near the industrial sites of the customers' companies that produce the waste and scatters in all regions of the country. On the contrary, considering the positive aspects of the location, the service providers have factories located in the country's central region with convenient transportation routes. In addition, many customer factories still use the service to transport industrial waste from distant locations.

Promotion: The promotion factor needs to be simultaneously combined with the price and place of service providers to attract service users through a communication channel to induce customers to utilize the service (Choi & Jin, 2015; Oflac et al. 2015; Sheau-Ting et al. 2013), stating that building a business image, not having an impact on the environment, potentially increases the customers' confidence and their intention to use the service.

People of Service providers: Oflac et al. (2015) stated that the personnel of service providers are an indispensable part of any organization that requires development. Daily servicing and continuous learning by those specialized people potentially build credibility for customers and distinctiveness for business. Koľveková et al. (2019) illustrated that customers considered the selection of a service based on the provider's personnel. Hence, service providers should focus on service quality strategies.

Physical: physical factors, such as products or the service provider's infrastructure systems, are tangible for customers. They potentially demonstrate the service quality and reflect the service provider image Kwok et al. (2020). Considering the Co-Processing industrial waste disposal service in Cement Kilns, it is a technology widely accepted and employed across the globe.

Based on the literature review in Table 1, price, place of service provider, promotion, people, physical, attitude, subject norm, perceived ease of use, and perceived usefulness are factors to be evaluated in this research. At this point, the connection between each factor was analyzed and hypotheses were formulated based on the research objectives for factors impacting the selection of industrial waste disposal service in Cement Kilns. The following are the results and details of the hypothesis.

Hypothesis 1 (H1). Perceived ease of use influences perceived usefulness positively.

Hypothesis 2 (H2). Perceived usefulness has a positive impact on attitudes toward the service.

Hypothesis 3 (H3). Perceived ease of use influences attitudes toward service utilization positively.

Hypothesis 4 (H4). Subjective norm has a positive effect on attitudes toward service use.

Hypothesis 5 (H5). Subjective norm has a favorable impact on the service use intention.

Hypothesis 6 (H6). An attitude toward service utilization has a positive influence on the intention to use service.

Hypothesis 7 (H7). Price has a positive influence on the intention to use the service.

Hypothesis 8 (H8). Place influences the intention to use service positively.

Hypothesis 9 (H9). Promotion has a positive impact on the intention to use the service.

Hypothesis 10 (H10). People have a positive influence on the intention to use the service.

Hypothesis 11 (H11). Physical influences the intention to use service positively.

**Table 2.1** Research hypotheses.

| Hypothesis/Relationship | | Previous Studies |
|---|---|---|
| H1 | : Perceived ease of use -> Perceived Usefulness | Cheunkamon, Jomnonkwao, and Ratanavaraha (2020), Tian et al. (2016), Alam, Ahmad, Othman, Shaari, and Masukujjaman (2021), Al-Rahmi, Alzahrani, Yahaya, Alalwan, and Kamin (2020) |
| H2 | : Perceived Usefulness -> Attitude | Cheunkamon et al. (2020), Alam et al. (2021), Tu and Yang (2019), Chin and Lin (2016), Al-Rahmi et al. (2020), Mustafa, Ahmad, Shaari, and Jannat (2021) |
| H3 | : Perceived ease of use -> Attitude | Alam et al. (2021), Chin and Lin (2016), Tu and Yang (2019), Mustafa et al. (2021), Müller (2019) |
| H4 | : Subjective norm -> Attitude | Bukhari et al. (2020), Wan, Shen, and Choi (2017), Weber, Büssing, Jarzyna, and Fiebelkorn (2020) |
| H5 | : Subjective norm -> Intention to use | Tu and Yang (2019), Alam et al. (2021) |
| H6 | : Attitude -> Intention to use | Cheunkamon et al. (2020), Tu and Yang (2019), Ali, Shafiq, and Andejany (2021) |
| H7 | : Price -> Intention to use | Bukhari et al. (2020), Sheau-Ting, Mohammed, and Weng-Wai (2013), Menegaki (2012), Oflac, Dobrucalı, Yavas, and Escobar (2015), Kwok, Tang, and Yu (2020), Ghalehkhondabi et al. (2020) |
| H8 | : Place -> Intention to use | Sheau-Ting et al. (2013), Menegaki (2012) |
| H9 | : Promotion -> Intention to use | Sheau-Ting et al. (2013), Oflac et al. (2015), Choi and Jin (2015) |
| H10 | : People -> Intention to use | Oflac et al. (2015), Koľveková et al. (2019), D. Chonsalasin, S. Jomnonkwao, and V. Ratanavaraha (2020) |
| H11 | : Physical -> Intention to use | Kwok et al. (2020), Salman, Tawfik, Samy, and Artal-Tur (2017) |

## 2.4 Materials and methods

### 2.4.1 Data collection

An online questionnaire in the Google form was used in this survey. The Customer Service Department and sales representative's questionnaires (Table A1) via email and application lines to customers were acquired from the customer list of an industrial waste disposal service provider, who is the leader in Co-Processing waste management in Cement Kilns. The target groups are current customers and those who employ the service, including industrial plants, warehouses, companies, government agencies, and educational institutions covering all regions of Thailand. The surveyed data collection was between April 2021 and July 2021.

### 2.4.2 Data analysis

First, the literature reviews yielded a model specification (T. et al. 2019) which included the following factors: price, place, promotion, people and physical, attitude, subject norm, perceived ease of use, and perceived usefulness in-service use.

Second, take the factors to create a path diagram showing the correlation between the variables relevant to the research hypotheses to test the causal relationship (Wonglakorn et al. 2021), as depicted in Figure 2.1

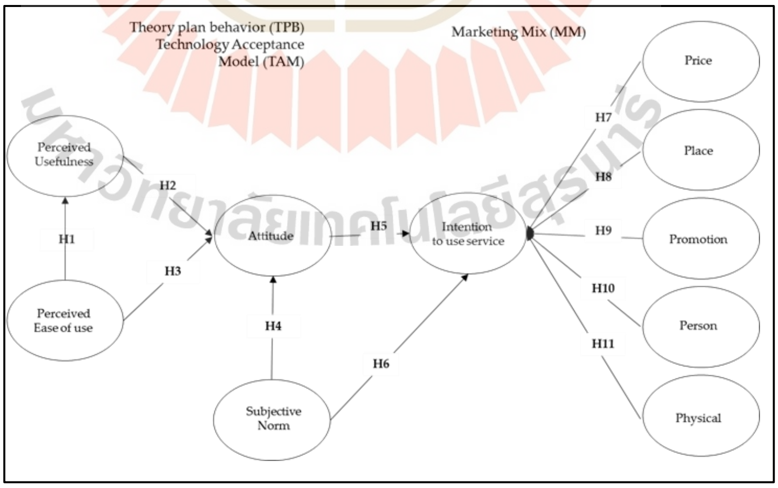


**Figure 2.1** A research hypothesis model.

Third, checking the data distribution from the questionnaire according to R. B. Kline (2010), the skewness should be less than three, and the kurtosis must be less than ten. The maximum likelihood estimate can estimate the model parameters in the case of the normally distributed data.

Fourth, model estimation (Cheunkamon et al. 2020). In this research, the regression coefficient estimation, factor loadings, variance, and covariance were analyzed by statistical program called Mplus seven, maximum likelihood estimation were applied (Champahom et al. 2020; Chanpariyavatevong et al. 2021; Cheunkamon et al. 2020; Chonsalasin et al.2020; T. et al. 2019).

Fifth, check the goodness-of-fit model, as detailed in Table 2, to explain how well the hypothesis model is consistent with the empirical data by examining the following values, including (1) the ratio between ($\chi^2$/df) should not exceed 3, (2) the Root Mean Square Error of Approximation (RMSEA) should be less than 0.05, (3) Standardized Root Mean Square Residual (SRMR) should not exceed 0.05, (4) Comparative Fit Index (CFI) should be greater than 0.95, and (5) the test results of goodness-of-fit model with Tucker–Lewis Fit Index (TLI) must be greater than 0.95. If the results of the goodness-of-fit model can pass all requirements, it can confirm consistency between the model and the empirical data.

**Table 2.2** Model fit indicated.

| Model Fit Indicated | Target |
|---|---|
| $\chi^2$/df | <3 |
| SRMR | 0.05 |
| RMSEA | 0.05 |
| CFI | >0.95 |
| TLI | >0.95 |

Note: Reference; (Champahom et al. 2020; Chanpariyavatevong et al. 2021; Hooper, 2008; Hu, 1999; P. B. Kline, 2005; Steiger, 2007; T. et al. 2019; Wu, 2009).

The data from the questionnaire requires reliability and validity test before analyzing with the Structural Equation Modeling. The reliability test employed

Cronbach's alpha, as shown in Equation (1) (Wood, 2011), assessed the internal consistency. In other words, it checke whether the respondents consistently answer the same subjects or not. The responses are consistent if the reliability test result is more than 0.7 (Fornell, 1981). The formula is as follows.

$$\alpha = \frac{K}{K-1}\left(1-\frac{\sum_{i=1}^{k}\sigma_{yi}^{2}}{\sigma_{x}^{2}}\right) \tag{2.1}$$

Where K denotes the number, $\sigma_x^2$ represents the mean of the variance of the questions, and $\sigma_{yi}^2$, shows the mean of the covariance of the questions.

The next process is to examine the Average Variance Extraction (AVE) and Constructed Reliability (CR) (Gefen, 2005), which are the index values for the same factor's capacity. When checking the threshold, the CR value should be higher than 0.7 and the AVE value should be greater than 0.5 (Construction and Building MaterialsFornell & Larcker, 1981; Davis, 1989b). The formulas are as follows:

$$AVE = \frac{\left(\sum_{i=1}^{n}\lambda_i\right)}{n} \tag{2.2}$$

$$CR = \frac{\left(\sum_{i=1}^{p}\lambda_i\right)^2}{\left(\sum_{i=1}^{p}\lambda_i\right)^2 + \sum_{i=1}^{p}V(\delta)} \tag{2.3}$$

where $\lambda_i$ is completely standardized loading for the i^th indicator, $V(\delta_i)$ is variance of the error term for the i^th indicator, p = number of indicators.

## 2.5 Results

### 2.5.1 Descriptive statistics

According to the data from Tables 3 and 4, the skewness value should be less than three and the kurtosis must be less than 10 when testing the data distribution. The skew-ness for all observed values ranged from −0.796 to 1.565, and the kurtosis values ranged from 0.411 to 0.896. Due to the acceptable range, it confirms the normal distribution data and potentially performs parameter estimation in the subsequent model based on these values. The data from the questionnaire, the complete questionnaires obtained from 1,251 samples were divided by their characteristics into 687 (55%) males and 564 (45%) females. For respondents' age, there are 293 (23%) The first most respondents group are 20 and 30, 489 (39%) were between the ages of 31, and 40, 369 (29%) were between the ages of 41–50, 98 (7.8%) were between the ages of 51–60, and 2 (0.2%) were over 61. For the education level of the respondents, 4 respondents (0.3%) graduated from high school/vocational certificate, 91 samples (7%), 362 samples (29%) had vocational diploma/technical certificate/diploma, 791 samples (63%) had a bachelor's degree, 362 samples (29%) had a Master's degree, and 2 samples (0.2%) had a Doctoral degree.

**Table 2.3** Sample characteristics.

| Characteristics | Category | Frequency |
|---|---|---|
| Gender | Male | 687 |
| | Female | 564 |
| Age | 20–30 | 293 |
| | 31–40 | 489 |
| | 41–50 | 369 |
| | 51–60 | 98 |
| | > 61 | 2 |
| Education | High school/vocational | 4 |
| | Diploma | 91 |
| | Bachelor's degree | 791 |
| | Master's degree | 362 |
| | Doctoral degree | 2 |

Table 2.4 Variables and Indicators

| Variables | Indicators |
|---|---|
| PRI1 | The cost of transportation is reasonable for the transportation distance. |
| PRI2 | The price of industrial waste disposal is appropriate when compared to quality and service. |
| PR13 | Price is the first consideration in selecting an industrial waste disposal service carrier. |
| PRI4 | Price is the first consideration in selecting the industrial waste disposal service provider. |
| PLA1 | Transportation distance is one of the factors you consider selecting the service use. |
| PLA2 | Consider selecting the service, you consider selecting the waste disposal nearby your entrepreneurs. |
| PLA3 | The place of Co-Processing waste disposal in Cement Kilns of service providers is appropriate. |
| PROM1 | Communicate the industrial waste disposal types which can be disposed of in the Co-Processing in Cement Kilns. |
| PROM2 | Helpful advice on the Co-Processing industrial waste disposal in Cement Kilns. |
| PROM3 | Auto E-License system can reduce the time for requesting the permission of taking industrial waste disposal out of the factory. |
| PEO1 | Sales representatives have knowledge and expertise in industrial waste management. |
| PEO2 | Carriers are skillful and professional. |
| PEO3 | Employees of the disposal plant are skillful and professional. |
| PHY1 | The waste disposal service providers can help and advice on industrial waste disposal. |
| PHY2 | The disposal plants have physical characteristics ready to dispose of industrial waste. |
| PHY3 | The industrial waste transportation system is ready, and the monitoring system of vehicle conditions is available. |

**Table 2.4** Variables and Indicators (Continued)

| Variables | Indicators |
|---|---|
| ITU1 | Have the intention to continue using the Co-Processing industrial waste disposal service in Cement Kilns. |
| ITU2 | Have the intention to use the Co-Processing industrial waste disposal service in Cement Kilns in the future. |
| ITU3 | Will return to use the Co-Processing industrial waste disposal service in Cement Kilns. |
| ATT1 | The service providers of Co-Processing in Cement Kilns can remove industrial waste effectively. |
| ATT2 | The use of Co-Processing industrial waste disposal in Cement Kilns is more cost-effective than other industrial waste disposal methods. |
| ATT3 | Your company will have a better image of waste disposal if you use Co-Processing industrial waste disposal in Cement Kilns. |
| SJN1 | Choose the Co-Processing if the business groups similar to yours chose it. |
| SJN2 | Choose the Co-Processing if the entrepreneurs nearby yours chose it. |
| SJN3 | Choose Co-Processing if its technology is in a trend of a large number of users. |
| PU1 | Can take the industrial waste out of the factory with the Auto E-License system. |
| PU2 | Can reuse the industrial waste as renewable energy. |
| PU3 | Can manage Zero wastes to landfill. |
| PEOU1 | Have a clear standard for industrial waste disposal. |
| PEOU2 | Reduce the time for requesting permission to take the industrial waste with Auto E-License system. |
| PEOU3 | Ease of coordination and asking for industrial waste disposal information. |

Table 2.5 Descriptive statistics.

| Item | Adapted from | Variables | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Price | (Salman et al. 2017) | PRI1 | 4.02 | 0.023 | −0.583 | 0.111 |
| | (Wongleedee, 2015) | PRI2 | 4.11 | 0.026 | −0.654 | 0.286 |
| | (Oflac et al. 2015) | PR13 | 3.95 | 0.027 | −0.826 | 0.416 |
| | (Azzadina, Huda, & Sianipar, 2012) | PR14 | 3.98 | 0.024 | −0.829 | 0.375 |
| Place | (Ravangard, Khodadad, & Bastani, 2020) | PLA1 | 3.94 | 0.024 | −0.609 | 0.102 |
| | (Simanjuntak, Sumarwan, & Situmorang, 2020) | PLA2 | 3.92 | 0.029 | −0.397 | −0.696 |
| | (Kwok et al. 2020) | PLA3 | 3.73 | 0.026 | −0.710 | 0.688 |
| Promotion | (Chockalingam & Isreal, 2016) | PROM1 | 3.99 | 0.023 | −0.660 | 0.654 |
| | (Menegaki, 2012) | PROM2 | 3.98 | 0.031 | −0.869 | 1.565 |
| | (Sheau-Ting et al. 2013) | PROM3 | 4.25 | 0.025 | −0.906 | 0.638 |
| | (Ravangard et al. 2020) | PEO1 | 4.20 | 0.020 | −0.481 | −0.407 |
| People | (Ravangard et al. 2020) | PEO2 | 4.18 | 0.028 | −0.492 | −0.534 |
| | (Ravangard et al. 2020) | PEO3 | 4.20 | 0.020 | −0.447 | −0.494 |
| Physical | (Sheau-Ting et al. 2013) | PHY1 | 4.28 | 0.020 | −0.614 | −0.102 |
| | (Ijadi Maghsoodi, Saghaei, & Hafezalkotob, 2019) | PHY2 | 4.29 | 0.021 | −0.771 | 0.217 |
| | (Roslan, Wahab, & Abdullah, 2015) | PHY3 | 4.25 | 0.023 | −0.713 | 0.087 |

**Table 2.5** Descriptive statistics. (Continued)

| Item | Adapted from | Variables | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Intention to use co-processing | (Nduneseokwu, Qu, & Appolloni, 2017) | ITU1 | 4.22 | 0.030 | −0.495 | −0.536 |
| | (Alam et al. 2021) | ITU2 | 4.30 | 0.027 | −0.658 | −0.465 |
| | (Ali et al. 2021) | ITU3 | 4.23 | 0.024 | −0.557 | −0.399 |
| Attitude | (Yufei Yang, Xue, & Huang, 2014) | ATT1 | 4.27 | 0.020 | −0.52 | −0.475 |
| | (Xu et al. 2019) | ATT2 | 4.21 | 0.021 | −0.564 | −0.308 |
| | (D. Chonsalasin et al. 2020) | ATT3 | 4.23 | 0.020 | −0.47 | −0.51 |
| Subjective Norm | (Wan et al. 2017) | SJN1 | 4.12 | 0.022 | −0.695 | 0.508 |
| | (Wan et al. 2017) | SJN2 | 4.02 | 0.025 | −0.847 | 0.685 |
| | (Wan et al. 2017) | SJN3 | 4.07 | 0.024 | −0.650 | 0.076 |
| Perceived usefulness | (Tsaur & Lin, 2018) | PU1 | 4.20 | 0.023 | −0.898 | 0.747 |
| | (Baidya et al. 2016) | PU2 | 4.33 | 0.022 | −0.993 | 0.805 |
| | (Bogush et al. 2020) | PU3 | 4.39 | 0.020 | −0.968 | 0.483 |
| Perceived Ease of use | (Stafford, Viquez, Labrincha, & Hotza, 2015) | PEOU1 | 4.28 | 0.020 | −0.646 | −0.123 |
| | (Cheunkamon et al. 2020) | PEOU2 | 4.22 | 0.023 | −1.017 | 1.451 |
| | (D. Chonsalasin et al. 2020) | PEOU3 | 4.21 | 0.021 | −0.420 | −0.796 |

### 2.5.2 Reliability and validity

The test findings for each factor found the Cronbach's alpha values between 0.739 and 0.931, confirming the data consistency. The test results of each factor showed the CR value ranging from 0.969 to 0.995, and the AVE value was between 0.912 and 0.985. Thus, the statistical results confirmed that the data passed the criteria.

### 2.5.3 Measurement model

Table 2.5 depicts the results of the data measurement model from the questionnaires comprising 10 factors and 31 observed variables. The obtained findings confirmed the goodness-of-fit of the Structural Equation Model of factors, influencing the intention to use Co-Processing industrial waste disposal service in Cement Kilns.

The measurement model results can show that the model is consistent with the empirical data and confirms that the exogenous variables from the questionnaire can indicate the independent variables obtained from the literature review. All the observed variables are statistically significant ($p < 0.001$). The first three highest factor loadings and the least factor loadings are as follows:

1. The factors of intention to use industrial waste disposal service in Cement Kilns measured from three observed variables (ITU1, ITU2, ITU3) found that the variable ITU1, "Have the intention to continue using Co-Processing industrial waste disposal in Cement Kilns", had the highest factor loading value (Factor loading = 0.896).

2. The physical factor of the industrial waste disposal service provider measured by three observed variables (PHY1, PHY2, PHY3) found that the variable PHY1 "The waste disposal service providers can help and give advice in industrial waste dis-posal", had the second factor loading value (Factor loading = 0.851).

3. The physical factor of the industrial waste disposal service provider, measured by three observed variables (PHY1, PHY2, PHY3) found that the variable PHY 3 "The industrial waste transportation system is ready and the monitoring system of vehicle condition is available" had the third factor loading (Factor loading = 0.833).

4. The factor with the least factor loadings is the price factor of the industrial waste dis-postal cost, measured by four observable variables (PRI1, PRI2, PRI3, PRI4), which found that the variable PRI4 "Price is the first consideration in selecting the industrial waste disposal service provider" had the lowest factor loading (Factor loading = 0.610).

**Table 2.6** Measurement model results.

| Item | Variables | Loading | *t*-Value | Error-Variance | Cronbach's Alpha | CR | AVE |
|---|---|---|---|---|---|---|---|
| Price | PRI1 | 0.757 | 45.267 | 0.017 | 0.820 | 0.992 | 0.971 |
| | PRI2 | 0.819 | 60.779 | 0.013 | | | |
| | PR13 | 0.772 | 49.749 | 0.016 | | | |
| | PR14 | 0.610 | 29.523 | 0.021 | | | |
| Place | PLA1 | 0.721 | 25.548 | 0.027 | 0.705 | 0.989 | 0.969 |
| | PLA2 | 0.742 | 22.395 | 0.031 | | | |
| | PLA3 | 0.712 | 22.647 | 0.027 | | | |
| Promotion | PROM1 | 0.627 | 16.316 | 0.032 | 0.751 | 0.969 | 0.912 |
| | PROM2 | 0.511 | 11.899 | 0.035 | | | |
| | PROM3 | 0.621 | 18.563 | 0.033 | | | |
| People | PEO1 | 0.722 | 24.585 | 0.026 | 0.864 | 0.984 | 0.952 |
| | PEO2 | 0.718 | 23.932 | 0.025 | | | |
| | PEO3 | 0.709 | 21.782 | 0.026 | | | |
| Physical | PHY1 | 0.851 | 86.939 | 0.010 | 0.859 | 0.995 | 0.984 |
| | PHY2 | 0.790 | 64.474 | 0.012 | | | |
| | PHY3 | 0.833 | 78.808 | 0.011 | | | |
| Intention to use co-processing | ITU1 | 0.896 | 96.808 | 0.009 | 0.931 | 0.994 | 0.985 |
| | ITU2 | 0.825 | 72.014 | 0.011 | | | |
| | ITU3 | 0.789 | 61.027 | 0.013 | | | |
| Attitude | ATT1 | 0.781 | 40.295 | 0.019 | 0.874 | 0.988 | 0.966 |
| | ATT2 | 0.779 | 46.644 | 0.017 | | | |
| | ATT3 | 0.695 | 22.541 | 0.024 | | | |
| Subjective Norm | SJN1 | 0.832 | 74.880 | 0.011 | 0.883 | 0.994 | 0.981 |
| | SJN2 | 0.760 | 52.996 | 0.014 | | | |
| | SJN3 | 0.814 | 67.667 | 0.012 | | | |
| Perceived usefulness | PU1 | PU1 | 0.697 | 33.056 | 0.831 | 0.988 | 0.966 |
| | PU2 | PU2 | 0.679 | 38.047 | | | |
| | PU3 | PU3 | 0.812 | 45.475 | | | |
| Perceived Ease of use | PEOU1 | PEOU1 | 0.808 | 41.809 | 0.851 | 0.986 | 0.961 |
| | PEOU2 | PEOU2 | 0.706 | 31.899 | | | |
| | PEOU3 | PEOU3 | 0.617 | 29.306 | | | |

### 2.5.4 Structural model

The results are shown in Figure 2 and Table 6. The values of the model fit are as follows: = 745.239, df = 287, $p < 0.01$, $\chi^2$/df = 2.595, RMSEA = 0.036, CFI = 0.980, TLI = 0.968, and SRMR = 0.031 at the statistical significance level (** p = 0.001, * p = 0.05). Therefore, this can confirm that the empirical data matches the hypothetical model. Based on the results of eleven research hypotheses, the hypothesis testing results found that the perceived ease of use has a positive influence on the perceived usefulness (Factor loading = 0.814, $p < 0.001$), supporting the hypothesis H1. Instantaneously, the perceived usefulness of service use had a positive influence on the attitude towards service use (Factor loading = 0.693, $p < 0.001$). The obtained result supported the hypothesis H2. This is in line with the attitude towards service use, which was positively influenced by the perceived ease of use (Factor loading = 0.388, $p < 0.001$), supporting the hypothesis H3. Regarding the social norm hypothesis and attitude towards the intention to use service, the social norm factor had a positive influence on the customer attitude towards the service providers (Factor loading = 0.162, $p < 0.001$), supporting the H4 hypothesis, but it was not consistent with the intention to use factor that was also positively influenced by the social norm factor (Factor loading = 0.054, $p > 0.05$), but not statistically significant, thus rejecting the hypothesis H5. From the hypothesis on attitude to intention to use service, it was found that it was positively influenced by the attitude towards service use (Factor loading = 0.532, $p < 0.001$), thus supporting the hypothesis H6. The price factor had a positive influence on the intention to use the service (Factor loading = 0.136, $p < 0.001$), thus supporting the hypothesis H7. This was consistent with the factor of service provider's place, which had a positive influence on intention to use service (Factor loading = 0.018, $p < 0.05$), thus supporting the hypothesis H8. This was in line with the factor of service providers' promotion which had a positive influence on intention to use service (Factor loading = 0.326, $p < 0.001$), thus supporting the hypothesis H9. In addition, the intention to use factor was positively influenced by the factor of people of the Co-Processing service providers in Cement Kilns (Factor loading = 0.748, $p < 0.001$), thus supporting the hypothesis H10. In addition, the service provider's physical factor had a positive influence on the intention to use service (Factor loading = 0.386, p < 0.001), thus supporting the hypothesis.

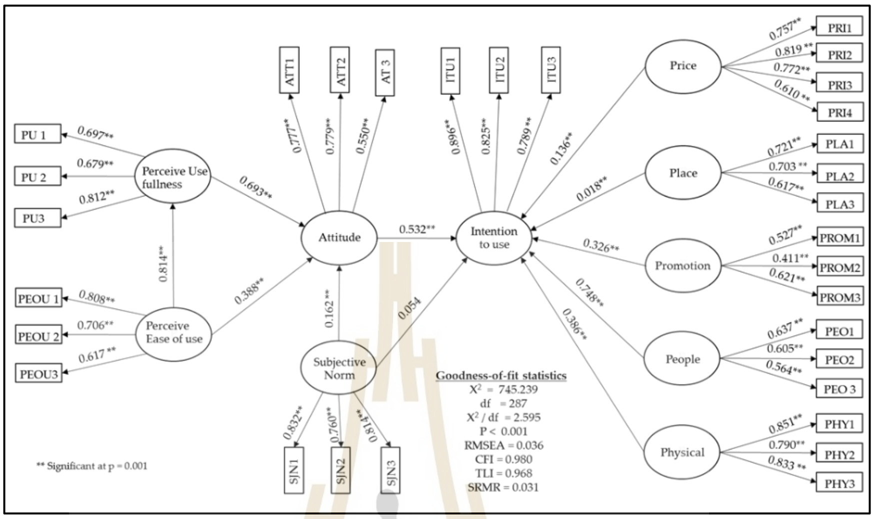

Figure 2.2 Result from structure equation model.

Table 2.7 Testing hypotheses results with Structural Equation Modeling.

| Hypothesis | Relationship | Loading | Standard Error | *t*-Value | Result |
|---|---|---|---|---|---|
| H1 | Perceived ease of use -> Perceived Usefulness | 0.814 ** | 0.023 | 35.205 | Supported |
| H2 | Perceived Usefulness -> Attitude | 0.693 ** | 0.096 | 7.239 | Supported |
| H3 | Perceived ease of use -> Attitude | 0.388 ** | 0.082 | 4.753 | Supported |
| H4 | Subjective norm -> Attitude | 0.162 ** | 0.042 | 3.864 | Supported |
| H5 | Subjective norm -> Intention to use | 0.054 | 1.302 | 0.118 | Not Supported |
| H6 | Attitude -> Intention to use | 0.532 ** | 0.271 | 4.997 | Supported |
| H7 | Price -> Intention to use | 0.136 ** | 1.306 | 1.635 | Supported |
| H8 | Place -> Intention to use | 0.018 ** | 2.166 | 1.855 | Supported |
| H9 | Promotion -> Intention to use | 0.326 ** | 1.874 | 1.775 | Supported |
| H10 | People -> Intention to use | 0.748 ** | 1.801 | 2.081 | Supported |
| H11 | Physical -> Intention to use | 0.386 *** | 1.223 | 0.316 | Supported |

## 2.6 Discussion

Hypothesis H1, perceived ease of use of the service had a positive influence on the perceived usefulness with a factor loading = 0.814. Therefore, the findings of this research confirm the results in line with (Alam et al. 2021; Cheunkamon et al. 2020; Tian et al. 2016), which revealed that the perceived ease of use factor has a positive impact on the perceived usefulness factor.

Hypothesis H2, perceived usefulness has a beneficial influence on attitudes toward service providers with factor loading = 0.693. The research results are the same as the customers' recommendations from the questionnaire providing that "Co-Processing industrial waste disposal can assist reduce the usual fuel consumption of Cement Kilns". In the terms of perceived usefulness and attitude, the association between perceived usefulness and attitude was also consistent with the work of (Müller, 2019; Mustafa et al. 2021; Tu & Yang, 2019). Hence, it can be concluded that this study results potentially confirmed the findings were consistent with (Al-Rahmi et al. 2020; Alam et al. 2021; Cheunkamon et al. 2020; Chin & Lin, 2016; Mustafa et al. 2021; Tu & Yang, 2019), discovering that the perceived usefulness influences attitude factor positively.

Hypothesis H3, perceived ease of use has a positive influence on attitudes toward service use with a factor loading of 0.388. From the questionnaires, the customers commented that "the first choice for selection of the Co-Processing waste disposal in Cement Kilns is good servicing with full-service management". As a result, the study verified the findings consistent with (Alam et al. 2021; Chin & Lin, 2016; Müller, 2019; Mustafa et al. 2021; Tu & Yang, 2019), which revealed that the perceived ease of use factor has a positive influence on the attitude factor.

Hypothesis H4, this hypothesis aimed to determine whether a social norm has a positive influence on attitudes toward service providers. With factor loading = 0.16., the customers' opinions from questionnaires stated that "this waste disposal method can compete with others." Therefore, the result of this study confirmed the findings of (Bukhari et al. 2020; Wan et al. 2017; Weber et al. 2020), which discovered that a social norm has a positive impact on attitude.

Hypothesis H5, Subjective norm influences the intention to use service positively with a factor loading of 0.054. The results revealed that it positively influenced the intention to use the service, but it was not statistically significant customers want to hire a disposal contractor who can accept all sorts of customers' waste since the waste disposal or unused industrial waste contain various types including office waste, canteen waste, and waste. In other words, the decision to utilize the service depends on each company, not the subjective norms mentioned above. When considering the group of waste disposal service providers in the country, there are many groups like landfills, kilns, and waste power plants. Some brokers accept all forms of waste, sort it, and find a legal disposal contractor, which unable industrial waste disposal in Cement Kilns. Thus, the study results contradict (Alam et al. 2021; Tu & Yang, 2019), which discovered that the social norm is statistically significant and influences the intention to use.

Hypothesis H6: attitude toward service application has a positive influence on the intention to use service. According to the study results, the relationship between these two factors had a factor loading = 0.532, relevant to the customer feedback from the questionnaire stating that "this approach is reliable, and take waste to beneficially utilize in Cement Kilns." Therefore, it can conclude that the results of this study confirmed the findings of (Ali et al. 2021; Cheunkamon et al. 2020; Tu & Yang, 2019), discovering that the intention to use had a causal connection with the attitude factor.

Hypothesis H7, with factor loading = 0.136, the price factor was statistically significant on the intention to use the service. Consistent with the customer's proposal and suggestion from the questionnaire, it stated that "In the case of covering the customer's waste, the high price is acceptable." Studies have shown that price was statistically important with in-service decision-making. Relevant to (Blut et al. 2018; Che et al.2021), this research finding confirmed the results consistent with (Bukhari et al. 2020; Ghalehkhondabi et al. 2020; Kwok et al. 2020) discovering that the price factor influences the intention to use.

Hypothesis H8, the place factor has a positive effect on the intention to use the service. With factor loading = 0.018. Similar to customers' recommendations from the questionnaire, they denoted to “set up an intermediary, organize marketing promotion to reduce transportation distances, and leverage every cement plant in Thailand to benefit every kiln, every trademark.” As a result, it concluded that the study result confirmed the findings compatible with (Blut et al. 2018; Menegaki, 2012; Sheau-Ting et al. 2013) discovering that the place of the service providers influences the intention to utilize service.

Hypothesis H9, Promotion has a positive influence on the intention to use service, with factor loading = 0.326. Similar to the recommendations from the customer in the questionnaire “the service providers should promote the Co-Processing waste disposal via online to increase the customer perceptions and understandings.” Therefore, it can be concluded that the finding of this research confirmed the results consistent with (Choi & Jin, 2015; Menegaki, 2012; Oflac et al. 2015; Sheau-Ting et al. 2013) discovering that promotion has a positive impact on the intention to use factor.

Hypothesis H10, the study result indicated that people have a positive influence on the intention to use service with factor loading = 0.748. Comparable with the customers’ recommendation from questionnaires, they illustrated that “there are various waste types. In terms of the quality of the sludge itself, industrial waste disposal in a Cement Kiln is limited. Hence, the sales representatives have to closely collaborate with the factories to dispose of industrial waste without any obstacles.” The mentioned reasons confirmed that the intention to use is positively influenced by the service providers’ people. As a result, it can be concluded that this research finding confirmed similar results with (Koľveková et al. 2019; Oflac et al. 2015; Tanveer et al.2021), discovering that people influenced the intention to use.

Hypothesis H11, Physical has a positive impact on the intention to utilize service, with factor loading = 0.386. This fact is also related to customer recommendations from a questionnaire stating that "call for the service provider to receive a variety of waste and a higher daily amount." Therefore, it can be concluded that the research result confirmed the consistent findings with (Kwok et al. 2020; Salman et al. 2017; Tanveer et al. 2021) which found an effect between physical factors and the intention to use.

## 2.7 Conclusion

The study found that customers' intention to utilize the service from factor customers gave importance to being waste disposal with Zero waste to landfill in Cement Kiln, and use service because of its relevance to the Circular Economy by using wastes as renewable fuels in Cement Kilns. The procedures for building a strategic plan to employ Cement Kilns industrial waste disposal services are as follows;

First, the research results revealed that customer's perceived ease of use of service offered by the service providers starting from the clear standard for considering industrial waste, allowing customers to know the waste types that can or cannot be disposed of in the Cement Kilns. The communication channels and their coordination are convenient with the service providers' standardized management for reducing the request time for permission to remove the customers' industrial waste from the factory with the Auto E-License system. Only a few service providers of Co-Processing industrial waste disposal service in Cement Kilns receive this privilege. The system allows customers to reduce the time it takes to remove waste out of the factory from one month to less than two business days. The study results confirmed that the mentioned reasons have a positive influence on the perceived usefulness of service use. Consequently, service providers must focus on the business strategy, quick response, and continually improve developmental support and customer assistance. When customers perceive ease of use, they will get perceived usefulness from applying the service to maintain existing customers and acquire new customers.

Second, customers perceived the usefulness of industrial waste disposal services in Cement Kilns because the industrial waste disposal can be renewable fuel and will not cause waste to be disposed of (Zero waste to landfill) according to the research findings. Customers' attitudes toward using the service. When more waste is disposed of in the Cement Kilns, it helps to highly reduce the waste from landfills and the environmental impact, as waste disposal in Cement Kilns is environ-mentally friendly disposal. Based on research findings, service providers have to use a strategy building that emphasizes distinctiveness by focusing on niche markets preferring to dispose of waste in a Zero waste to landfill method. Waste disposal in Cement Kilns can be called a win-win solution since the customers can get rid of waste without harming the environment, and service provider's benefit from industrial waste as renewable fuels. Moreover, the research results also indicate that those profits must be promoted to acknowledge customers' strong points which are considered the selling point of this disposal method to expand the increasing number of customers.

Third, the perceived ease of use of the service and the perceived usefulness from utilizing the service as mentioned above had a beneficial influence on positive attitudes toward using the service. Customers' attitude toward the effective method of Co-Processing industrial waste disposal in Cement Kilns and the service provider's image in terms of waste management, was confirmed by the experiment results. As a result, to enhance their business growth, service providers have to use a proactive Growth Business strategy to develop services and communicate strengths to customers to gain their confidence and expand the number of customers and build further business growth.

Fourth, attitude is the most influential factor positively influencing intention to use service according to the research results. From the various strategies mentioned to increase the customers, what service providers must keep in mind and pay attention to maintaining the loyalty of old customers. It is based on actual service satisfaction when compared to the service expectations as well as the service values. Due to the current economic recession, service providers must use stability business strategy. Thus, it is essential to maintain the existing customer base by improving the efficiency of service providers' internal processes.

This research is not with limitations. Although considerable factors were uncovered in term of their influence on the selection of industrial waste disposal service in Cement Kilns in Thailand, other differently relevant factor such as technology acceptances of industrial waste disposal service, transport distances, trust in technology, and customer's trust in industrial waste disposal service providers, should be considered for further re-search in other regions of service providers from different countries. Therefore, future research may use the current study as a basis for improving the investigation of factors influencing the selection of industrial waste disposal service in Cement Kilns by additionally considering the above-mentioned factors.

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# CHAPTER III

# FACTORS AFFECTING TO ACCEPTANCE OF INDUSTRIAL WASTE DIPOSAL SERVICE IN CEMENT KILN

## 3.1 Abstract

Industrial waste disposal in Cement Kiln (Co-Processing in Cement Kiln) is the operation along with waste disposal, and taking waste into renewable energy which is an alternative of cement industry in several countries. Due to the high business competition among service providers of industrial waste disposal in Thailand, customer acceptance toward service provision of industrial waste disposal by Co-Processing in Cement Kiln is among business competitors of industrial waste disposal with multi-technology. This study aims to seek for factors in relevant to customer acceptance toward industrial waste disposal by Co-Processing in Cement Kiln, in order to explain causal acceptance of customer. Data survey was operated by 1,251 samples of customer questionnaire nationwide. Confirmatory Factor Analysis(CFA) and study result confirmation were operated by Structural Equation Model. Analysis result found that observed variables and factors of this study could strongly describe customer acceptance factor toward service providers of industrial waste disposal in Cement Kiln. By this study result, service providers can take it into business strategic planning to create sustainability in business operation for service providers of industrial waste disposal by Co-Processing in Cement Kiln in future. Also, this study can be the base for business study of industrial waste disposal business by Co-Processing in Cement Kiln in future.

## 3.2 Rationale of the research

Nowadays, industrial waste disposal management problem is one of the greatest challenges, especially in developing countries, (Emmerich et al. 2020; Rabbani et al.2020) mentioned that industrial waste is the waste created by industrial activities which is not beneficial duringproduction process. Industrial waste is considered as environmental problem at global level, and it has to be seriously solved while encountering such problem, as well as to reduce burden and environmental impact. While (Zhang et al.2018) had a contrast opinion that some industrial wastes could be transformed into accessible resource or mineral, and it was worth to reuse and recycle. Industrial waste created by one company might be useful as input material, or it might be accepted by another company. Recently trendy and popular technology is Waste to Energy (WtE) (Mani, 2020). (Malinauskaite et al. 2017) also mentioned that industrial waste management in group of WtE which has capacity to dispose industrial waste in large amount, and it is an acceptable technology in top rank of industrial waste disposal. Such technology is waste disposal by Co-Processing in Cement Kiln which is conformed to (Baidya et al. 2016) who mentioned that the disposed industrial waste could be passed through waste transforming process to reuse as energy and substituted material in Cement Kiln which is an effective waste disposal method.

According to the mentioned reasons regarding business competition of the industrial waste disposal service providers, we could say that service providers of industrial waste disposal in Cement Kiln are also able to turn industrial waste into renewable energy. So, this research aims to study Factors Affecting to Acceptance of Industrial Waste Disposal Service in Cement Kiln.

Refer to the above aim, researcher had searched for research data from ScienceDirect and Scopus database by using logic of AND, OR, waste disposal, waste management, Industrial waste, waste service, Waste to Energy, WTE, W2E, Technology Acceptance, Acceptance, SEM, EFA, CFA, Co-Processing, and Acceptance. Such logic is to search for research methods, and the search results found that there are not many studies on business factors of disposal service in Cement Kiln which focus on marketing sector. From the research exaples of (Baidya et al. 2016; Choy et al. 2004; Elfaham & Eldemerdash, 2019; Kaddatz et al. 2013; Kosajan et al. 2021; Stafford et al. 2015; Viczek et al.2020; Xu et al. 2019) they were to study possibility of waste disposal in Cement Kiln. there was only (Xu et al. 2019) who mentioned that beside studying probability of the industrial waste disposal in Cement Kiln which we should consider along with the business terms in order to create balance of industrial waste. Also, the search results found that model of Technology Acceptance Frame Work (TAF) is conformed to a research method which mentioned about factor of renewable technology acceptance. The study draft consisted of no. 2 Literature Review which used key concept of the Technology Acceptance Framework (TAF) with additional application from relevant literature reviews to obtain factors being used in this research in order to study about industrial waste disposal service provider contexts, as well as to make the research hypotheses. Refer to no. 3. Material and Methods are to explain methods of questionnaire survey, data collection, and to mention about examination of data consistency. These are to analyze the modeling and Structural Equation Model, including descriptive explanation of the statistic. For no. 4. Result, we mentioned about data results of modeling and Structural Equation Model to causally explain factors affecting to customer acceptance toward industrial waste disposal service in Cement Kiln, as well as to mention about examination of data consistency between model, and empirical data. According to no. 5. Discussion, it is to mention about the research result, in reference to research hypotheses, including an additional explanation of relevant research. Also, for no. 6. Conclusion and Strategic Planning, we talked about the overall study statistic, and mentioned about strategic planning of service providers which should focus on service planning by using this study as a reference. Reference to Figure 1.

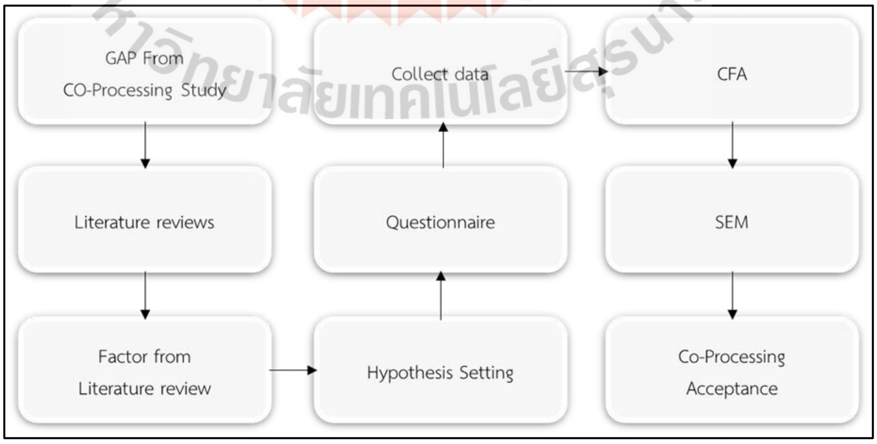


**Figure 3.1** Study framework.

### 3.3 Literature review

Table 1 summarizes the previous studies on waste disposal by Co-Processing in Cement Kilns. Refs. (Baidya et al. 2016; Elfaham & Eldemerdash, 2019; Kaddatz et al. 2013; Kosajan et al. 2021; Samolada & Zabaniotou, 2014; Stafford et al. 2015; Viczek et al. 2020; Xu et al. 2019) they were to study possibility of waste disposal in Cement Kiln. However, there is no research mentioning the factors related to customer acceptance toward technology of waste disposal by Co-Processing in Cement Kiln. Based on previous studies regarding Co-Processing in Cement Kiln, we began by considering work of (Xu et al. 2019) who mentioned that industrial waste disposal by Co-Processing in Cement Kiln. Besides studying possibility of waste disposal, we should consider along with business aspect to make balance of industrial waste. While (Kosajan et al. 2021) said that waste disposal in Cement Kiln has a strength regarding environmental friendliness while disposing, and it is able to dispose large amount of waste. So we have to promote this strength in the competition to build good attitude toward disposal. This study also added factors of Trust (Basfirinci & Mitra, 2015; Emmerich et al. 2020), and Acceptance (Baidya et al. 2016; Emmerich et al. 2020), Waste Disposal Knowledge, and Risk Perception (Park & Ohm, 2014; Qi, Qi, & Ji, 2020). According to study of (Stafford et al. 2015; Viczek et al. 2020), it also said that promotion on Intention of waste disposal in Cement Kiln should start from Waste Disposal Policy by promoting image of waste disposal which can reduce environmental impact, and it has no impact to waste disposal operators. Also, we should promote Intention on Benefits which customers can dispose the waste along with Benefit of transforming waste into renewable energy. So, this study has added the study on factors of Policy (Emmerich et al. 2020; Ndebele, 2020; Oliver et al.2011), and Benefit Perception (Bogush et al. 2020; Stafford et al. 2015). So, The Contribution of this study, to study and seek for factors in relevant to acceptance on industrial waste disposal technology by Co-Processing in Cement Kiln, in order to causal explain with empirical data from customers by comparing with the created model. Then service providers can use this research result to plan for business strategy, in order to create sustainability of business operation in future.

As per the factors considered, three key concepts were applied. First, TAF (Huijts et al.2014) which discusses technology acceptance, is applied extensively. Second, the study on technology acceptance (Qi et al. 2020) by applying factors of Trust, Technological Knowledge, Value Perception, and Risk Perception, in order to causally explain Technology Acceptance Finally, the concept in (Park & Ohm, 2014) which considers the cost factor, was applied. However, it excluded the acceptance factor. Also, ref (Emmerich et al. 2020) had added on taking Technology factor into practice because Technology usage needs a person to take it into service provision then we have to study by adding service provider factor. Nevertheless, the mentioned research is still lack of Acceptance factor in term of business. This research will fulfill TAF idea regarding Technology Acceptance of renewable energy by studying Technology capable for waste disposal, however, a lack of acceptance factor remains a concern in terms of business. This study fulfills the TAF concept, which considers the technology acceptance of renewable energy by studying factors that enable waste disposal and convert waste into renewable energy simultaneously by Co-Processing in Cement Kilns. Trust which covers technological trust and service provision, will be discussed, along with a study on technological knowledge, perceived value, and perceived risk factors. Also, according to various technologies in the competition of waste disposal in Thailand, customers accept the technology of industrial waste disposal by Co-Processing in Cement Kilns due to the zero waste to landfills policy. Therefore, this covers and fulfills the technology acceptance based on TAF to simply explain technology acceptance of industrial waste disposal by Co-Processing in Cement Kiln. The factors of this study are summarized as follows: Industrial waste disposal policy of customer, customer's trust in waste disposal technology by Co-Processing in Cement Kilns, customer trust in a group of industrial waste disposal service providers by Co-Processing in Cement Kiln, perceived benefits of service usage, perceived risk of waste disposal by Co-Processing in Cement Kilns, knowledge of disposal technology, and customer acceptance toward a group of disposal service providers by Co-Processing in Cement Kilns. The details of each factor are explained below:

**Table 3.1** Summary of previous studies regarding Waste Disposal by Co-Processing in Cement Kiln.

| Author(s)/Year | Study | Country | Study possibility | Industrial Waste Disposal from Business Aspect | Key Finding |
|---|---|---|---|---|---|
| (Kaddatz et al. 2013) | Co-Processing | Australia | ✓ | - | Use of Industrial lubricant can reduce main energy like coal while the disposal does not affect to environment. It is an option for industrial waste disposal and it can be the renewable energy for Cement Kiln. |
| (Stafford et al. 2015) | Co-Processing | Latin-America | ✓ | - | Industrial waste disposal is an option in accordance with law, and reduces environmental impact which is accepted internationally. For example, in Netherlands, it can be renewable energy to substitute main energy in Cement Kiln for up to 80%, and in Germany, Austria, as well as Norway, it can be used for more than 60%. |

Table 3.1 Summary of previous studies regarding Waste Disposal by Co-Processing in Cement Kiln. (Continued)

| Author(s)/Year | Study | Country | Study possibility | Industrial Waste Disposal from Business Aspect | Key Finding |
|---|---|---|---|---|---|
| (Xu et al. 2019) | Co-Processing | China | ✓ | - | MSS Waste Disposal Problem needs to be considered due to there is increasing number of wastes yearly, and Facility used in waste disposal is not enough. So, this kind of waste disposal in Cement Kiln is an option since there are 36 cement manufactures nationwide. Disposal in Cement Kiln is an acceptable method, and it can reduce impact while disposing. |
| (Elfaham & Eldemerdash, 2019) | Co-Processing | Egypt | ✓ | - | Study result found that it can dispose Solid wastes in Cement Kiln. Data obtained from the study is within acceptable criteria. It is also acceptable regarding environmental impact reduction, and it becomes the trend of waste disposal recently. |

**Table 3.1** Summary of previous studies regarding Waste Disposal by Co-Processing in Cement Kiln. (Continued)

| Author(s)/Year | Study | Country | Study possibility | Industrial Waste Disposal from Business Aspect | Key Finding |
|---|---|---|---|---|---|
| (Kosajan, Wen, Fei, et al. 2021) | Co-Processing | China | ✓ | - | Waste Disposal in Cement Kiln is a result of disposal affecting to environment less than general kilns and landfill. However, operation cost is higher than recent disposal cost so there is suggestion that there should be the substitution form relevant organizations, along with waste sorting from origin, and Economic evaluation of the project. |
| (Kosajan, Wen, Zheng, et al. 2021) | Co-Processing | China | ✓ | | According to continuously increasing waste initiating ratio (MSW), as well as growth ratio of competitors' kiln, study result found that waste disposal in Cement Kiln has a strength of environmental friendliness, and it can dispose large amount of waste. So we have to promote this toward the competition. Study on factors in relevant to Intention to use service from Cement Kiln in business aspect. |

Factor of Customer’s Acceptance In reference to the relevant literature review, we can divide research which mentioned about acceptance into 3 characteristics, including 1) Acceptance of WtE Technology, 2) Acceptance of Renewable Energy Technology, and 3) Waste Management. While these research (Cui et al 2020., Ham & Lee, 2017; Menikpura et al. 2016) mentioned about Acceptance of WtE Technology, and other research (Bronfman et al. 2012; Dugstad, et al.2020; Huijts et al. 2014; Ndebele, 2020) mentioned about Acceptance of Renewable Energy Technology. While (Malinauskaite et al. 2017) said that it is the acceptable technology toward waste disposal which can reduce environmental impact, this research result can be extended for further study on factors of Acceptance and Waste disposal in Cement Kiln. Seeking for factors in related to Customer’s Acceptance on use of industrial waste disposal service is main issue of this study, in order to understand causal factors regarding Customer’s Acceptance in consideration of service selection among several service providers of industrial waste disposal. Therefore, when we are able to understand motivation and factors affecting to Customer’s motivation, service providers can take it into strategic management planning in accordance with customer’s demand (empirical data of this study) to create continuous business operation, as well as to generate attraction on new customers toward service usage Trust in Technology (Chonsalasin et al. 2020) mentioned that Customer’s Trust in service provider is what must be certainly found. Customer’s Trust in service provider will be more or less, depending on service quality obtained by customer. While (Emmerich et al. 2020) had described that there are two characteristics of Trust, including overall image of Trust in technology, and Trust toward service provider who has operated such technology. Also, Customer’s Trust will be increased when service provider expresses that the business has operated with no environmental impact. While considering industrial waste disposal by Co-Processing in Cement Kiln, it is reliable for standard disposal, and Trust in no environmental impact (Kaddatz et al. 2013), able to dispose various types of waste, as well as able to dispose large amount of waste by no need to build a kiln but it is able to use the recently available Cement Kiln (Kosajan et al. 2021).

Trust in service provider group of industrial waste disposal by Co-Processing in Cement Kiln Factor of service provider is used to consider along with factors of Benefit Perception, and Technology Acceptance (Huijts et al. 2014). Also, considering service provider group of industrial waste disposal by Co-Processing in Cement Kiln, it found that Cement Kilns are spread worldwide (Baidya et al. 2016). While 9 service providers of industrial waste disposal by Co-Processing in Cement Kiln in Thailand are mostly located in central region (Department of industrial works, 2020a; Energy Regulatory Commission, 2563), and due to service provider group of industrial waste disposal has standard management system with its continuous development (Department of industrial works, 2020a), this study would like to prove that customers have Intention to use service by considering service provider group of industrial waste disposal by Co-Processing in Cement Kiln. According to this study survey, it will study overall image on service provider group of industrial waste disposal, by no means of separating survey on each service provider's company. We have made research hypotheses as below.

- Hypothesis 1: Trust in Technology had positively influences to Value Perception of Service Usage.
- Hypothesis 2: Trust in Technology had positively influences to Risk Perception of Service Usage.
- Hypothesis 3: Trust in Service Providers had positively influences to Value Perception of Service Usage.
- Hypothesis 4: Trust in Service Providers had positively influences to Risk Perception of Service Usage.

Customer's Knowledge of Industrial waste disposal knowledge of industrial waste disposal can be considered by previous research e.g. (Han et al. 2019) found that people are willing to pay for waste management service fee which is influenced by environmental awareness. (Ferreira & Marques, 2015) also discovered that teenagers have less environmental awareness than adults. While (Ndebele, 2020) mentioned that environmental impact awareness is still a factor people place importance on willingness and encouragement of renewable energy. Nowadays, sustainable waste management tends to be managed by Circular Economy which is a waste management from production and consumption by taking materials which are passed through production and consumption then entered to Re-material process or is reused. For example, there is the policy of EU countries to reuse waste by using Waste to Energy technology which is the "Think outside the Box" waste disposal method, beside traditional waste disposal one (Malinauskaite et al. 2017). It is in accordance with Circular economy method which is able to take waste into renewable energy. We have made research hypotheses as below

- Hypothesis 5: Knowledge of Industrial Waste Disposal had positively influences to Value Perception of Service Usage.
- Hypothesis 6: Knowledge of Industrial Waste Disposal had positively influences to Risk Perception of Service Usage.

Value Perception of Service Usage Factor influencing to consideration is Benefit of renewable energy usage, (Park & Ohm, 2014) conforming to (Bronfman et al. 2012) who mentioned that Benefit Perception has the highest influence to acceptance of power plant source. This finding is also in accordance with (Wang, Wang, Lin, & Li, 2019) who affirmed that Benefit Perception has significance toward decision making. Also, if we consider benefit of using industrial waste disposal service by Co-Processing in Cement Kiln which can help to reduce environmental impact, and (Elfaham & Eldemerdash, 2019; Stafford et al. 2015; Viczek et al. 2020) had said that it can dispose industrial waste, including dangerous and non-dangerous wastes, taking into renewable energy and substituted material by operating along with resource conservation and reduction of $CO_2$ releasing.

- Hypothesis 7: Value Perception of Service Usage positively influences to Acceptance Co-Processing Technology.

Risk Perception of Service Usage Risk from service usage is a perception which customers consider when they found that there is more risk than benefit of service usage which might not get the attention of usage (Qi et al. 2020), conforming to (Wang et al. 2019) who mentioned that Risk perception versus perception along with Knowledge of renewable energy technology is that, if there is perception or Knowledge that renewable energy can reduce environmental impact. Also, it causes low level of Knowledge about Risk Perception on use of renewable energy Technology, while (Zhang, & Sun, 2013) who studied about Risk of waste to energy power plant, had described that there are various characteristics of Risk e.g. Technical Risk, Environment, and Municipal Solid Waste (MSW) Supply Risk. So it should be evaluated for the project's success.

- Hypothesis 8: Risk Perception of Service Usage positively influences to Acceptance Co-Processing Technology.

Customer's Policy on Industrial Waste Disposal Refs. (Stafford et al. 2015; Viczek et al. 2020) reported that the promotion of waste disposal in Cement Kilns should begin from the development and implementation of waste disposal policies to promote its concept, reducing environmental impact. Moreover, it has no impact on waste disposal operators. The benefits transforming waste into renewable energy should also be promoted. Therefore, this study includes factors relating to Zero-Waste to landfill policy (Emmerich et al. 2020; Ndebele, 2020; Oliver et al. 2011), which conforms to the report of ref. (Emmerich et al. 2020) that policy is a motivation that creates development. Ref. (Ndebele, 2020) reported that policy is also a considerate factor (Cole et al.2019; Nelles et al.2016; Skaggs et al.2018; Tan et al. 2015; Van et al.2016). Nowadays, waste disposal management includes an idea of maximum utilization before disposal by the waste management hierarchy doctrine, which is well-known waste disposal strategy, beginning with waste reduction or avoidance, then reuse, recycle or compost, energy recovery, and waste disposal without utilization, e.g., disposal or release. Among these various disposals, industrial waste disposal in Cement Kilns stands out for the disposal without grounds that require further disposal. In contrast, the disposal of industrial waste becomes raw material for cement production. Thus, it is industrial waste disposal in the form of Zero-Waste to landfill (Baidya et al. 2016). This approach is employed to understand whether customers who intend to use industrial waste disposal service by Co-Processing in Cement Kiln are willing to get service because they have a waste disposal policy on zero waste to landfill as motivation.

- Hypothesis 9: Customer's Industrial Waste Disposal Policy positively influences to Acceptance Co-Processing Technology.

The Contribution of this study, to study and seek for factors in relevant to acceptance on industrial waste disposal technology by Co-Processing in Cement Kiln, in order to causal explain with empirical data from customers by comparing with the created model. Then service providers can use this research result to plan for business strategy, in order to create sustainability of business operation in future. Reference to Figure 1. So, the cause of this research is that how service providers of industrial waste disposal by Co-Processing in Cement Kiln in Thailand will be able to maintain recent customer's base and to increase number of customers among the recent highly competitive situation of service providers of industrial waste disposal in Thailand. We have made research hypotheses in reference to Table 2 and Figure 2 as below.

**Table 3.2** Research Hypotheses are as follow.

| | Hypotheses | Adapted From |
|---|---|---|
| H1: | Trust in Technology (+) ⟶ Perceive Benefit | (Emmerich et al. 2020; Park & Ohm, 2014; Wang et al. 2019) |
| H2: | Trust in Technology (+) ⟶ Perceive Risk | (Emmerich et al. 2020; Park & Ohm, 2014; Wang et al. 2019) |
| H3: | Trust in Waste Processor (+) ⟶ Perceive Benefit | (Emmerich et al. 2020) |
| H4: | Trust in Waste Processor (+) ⟶ Perceive Risk | (Emmerich et al. 2020) |
| H5: | Waste Disposal Knowledge (+) ⟶ Perceive Benefit | (Park & Ohm, 2014) |
| H6: | Waste Disposal Knowledge (+) ⟶ Perceive Risk | (Park & Ohm, 2014) |
| H7: | Perceive Benefit (+) ⟶ Acceptance | (Qi et al. 2020) |
| H8: | Disposal Policy (+) ⟶ Acceptance | (Emmerich et al. 2020; Ndebele, 2020) |
| H9: | Perceive Risk (+) ⟶ Acceptance | (Qi et al. 2020) |

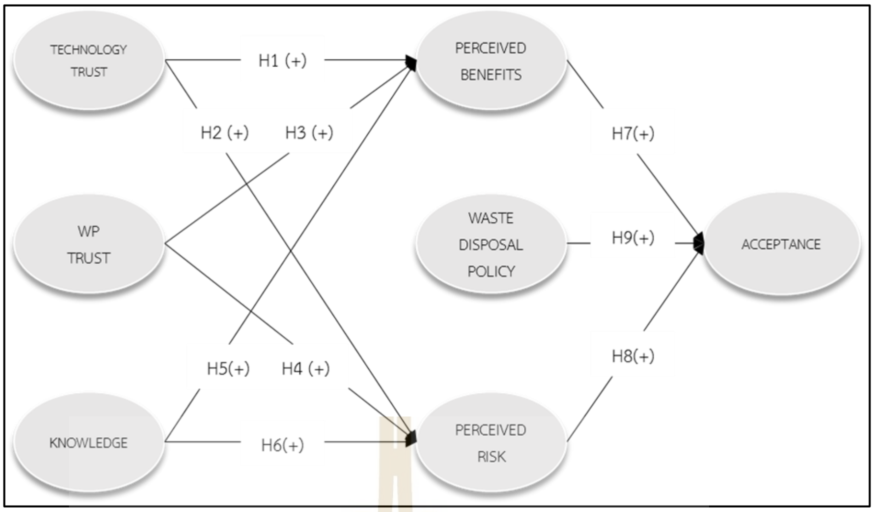


**Figure 3.2** Hypotheses.

## 3.4 Material and methods

### 3.4.1 Survey design

Questionnaire design: Taking factors in relevant to intention to use service of industrial waste disposal in Cement Kiln resulted by results of literature review, study by customer's questionnaire survey, and list of questions will be asked about overall image on service providers of industrial waste disposal by Co-Processing in Cement Kiln which is not a specific survey of each service provider. Questionnaire is divided into 2 parts, first part is general information of participants, second part includes factors affecting to Acceptance service, details as presented in Table 3. this research has used Structural Equation Model and Parameter Estimation by using Maximum likelihood. Data collection; we used online questionnaire through Google form. There were 2,000 questionnaires being sent through email, and Line Application to customer service sections and sales representatives to survey on customers of waste industrial disposal service by Co-Processing in Cement Kiln, in reference to customer's list of a leading service provider of waste industrial disposal service by Co-Processing in Cement Kiln. Target groups are current customers and repeated customers, including manufactures, warehouses, companies, government sectors, and educational institutes, covering all regions of Thailand. Questionnaire proportion is divided by number of customer listings in each region of Thailand,

### 3.4.2 Data analysis

First process: Analyze by descriptive statistic (Prosperi et al. 2019) to describe respondents' general information,

Second process: Test the Reliability by using Cronbach 'Alpha. (Wood, 2011) mentioned that this process test is to examine if respondents intend to answer the questionnaire. When they answer the same questions, it should be consistent. If it found inconsistency in this process, we cannot analyze such factors. (Fornell, 1981) said that Cronbach 'alpha value can be calculated by Equation 1, and it has to be over 0.7. While (Gliem J.A., 2003) also described that $\alpha \geq 0.9$: is considered as great, $0.7 \leq \alpha < 0.9$: considered as good; $0.6 \leq \alpha < 0.7$: considered as acceptable; $0.5 \leq \alpha < 0.6$: considered as poor, and $\alpha < 0.5$: considered as unacceptable.

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_{yi}^{2}}{\sigma_{x}^{2}}\right) \qquad (3.1)$$

Where K denotes the number, $\sigma_x^2$ represents the mean of the variance of the questions, and $\sigma_{yi}^2$, shows the mean of the covariance of the questions.

This process needs to be examined data harmony by examining Constructed Reliability (CR) and Average Variance Extraction (AVE) which present ability of similar factor loading, (Hair, 2006) and it is able to calculate CR, as well as AVE from Equation 2 and 3.

$$CR = \frac{\left(\sum_{i=1}^{n} L_i\right)^2}{\left(\sum_{i=1}^{n} L_i\right)^2 + \sum_{i=1}^{n} e_i} \qquad (3.2)$$

$$AVE = \frac{\left(\sum_{i=1}^{n} L_i\right)}{n} \qquad (3.3)$$

Third process: For CFA process, it is to measure relation of observed variables, (L.K. Muthen, 2010). While CFA is used to confirm relation between groups of observed variable and latent variable. Also, (Byrne, 2012) described that CFA is used in case researcher has knowledge about previous study on empirical study of latent variables, or researcher has support theories (Thompson, 2004), and can examine harmony of information by reference and suggestions as follow. Ratio between ($\chi^2$/df) should note be over 3 (P. B. Kline, 2005), (CFI) should be over 0.95, (Hu, 1999), (TLI) should be over 0.95, (Hooper, 2008), (RMSEA) Index is less than 0.05, (J.H. Steiger, 2007), and (SRMR) should not be over 0.05 (Wu, 2009).

Fourth process: This process will create SEM from result of literature review on factors related to the study, consisting of (1) Ratio of ($\chi^2$/df), due to this study consists of samples = 1,251. When we consider only $\chi^2$value, it will affect to hypotheses rejection when number of samples (n >200), (R. B. Kline, 2010) so it is recommended that we should use ratio between chi-square per number of degrees of freedom for examination, (2) RMSEA index, (3) SRMR, (4) CFI, and (5) TLI. (James H Steiger, 1990).

## 3.5 Result

### 3.5.1 Descriptive statistics

Data obtained from questionnaire: There is completed response from 1,251 samples, details as showed in Table 3. While result in Table 4 found that all observed variables' Skewness values are between -1.811 and -0.420, and Kurtosis values are between -0.706 and 3.234 Therefor the data distribution could be considerable as normal and also shown basic statistic of observed variables is obtained from 21 questions of questionnaire. According to Figure 3, expressing Mean and SD. It found that the maximum mean of variable is Value Perception of Service Usage (Mean = 4.60), then Trust in Industrial Waste Disposal Technology by Co-Processing in Cement Kiln, Service Acceptance, Customer's Trust in Service Providers, and Knowledge of Industrial Waste Disposal. Also, it found that customers have the lowest Risk Perception from Service Usage. For examination of data distribution, Skewness should be less than 3, and Kurtosis must be less than 10 in reference to (R. B. Kline, 2010).

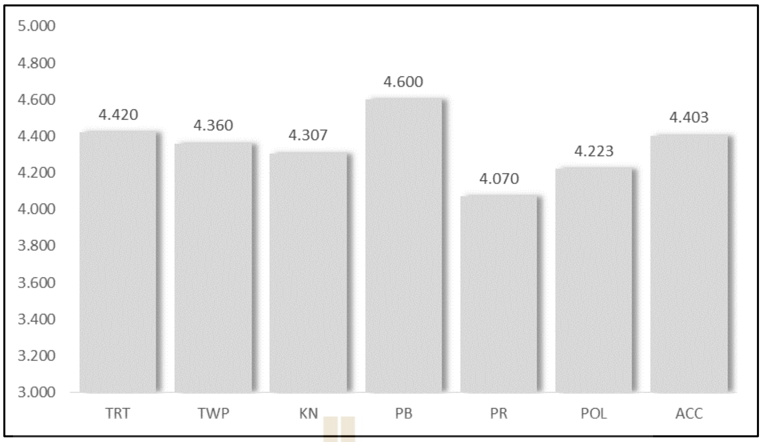


**Figure 3.3** Variable's means from Questionnaire.

**Table 3.3** Respondents' information.

| Characteristics | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 687 | 55 |
| | Female | 564 | 45 |
| Age | 20–30 | 293 | 23 |
| | 31–40 | 489 | 39 |
| | 41–50 | 369 | 29 |
| | 51–60 | 98 | 7.8 |
| | >61 | 2 | 0.2 |
| Education | High School / Vocational | 4 | 0.3 |
| | High vocational / Technical / Diploma | 91 | 7 |
| | Bachelor Degree | 791 | 63 |
| | Master Degree | 362 | 29 |
| | Doctor's Degree | 2 | 0.2 |
| Position | Safety Officer | 230 | 18 |
| | Environmental Officer | 321 | 26 |
| | Production | 204 | 16 |
| | Engineering | 85 | 7 |
| | Logistics | 83 | 7 |
| | Purchasing | 62 | 5 |
| | Administration | 69 | 6 |
| | Others | 197 | 16 |

### 3.5.2 Measurement model

The examination found that measurement model is in accordance with data, considering by result of second-order CFA of the measurement model. To examine analysis result on confirmatory factors of EFA, when we compare criteria consisting of ratio between $\chi^2$/df, it should be less than 3, (P. B. Kline, 2005), CFI should be over 0.95, (Hu, 1999), TLI index should be over 0.95, (Hooper, 2008), RMSEA index should be less than 0.05, (J.H. Steiger, 2007), and SRMR should not be over 0.05, (Wu, 2009). Also, study result has presented values as follow; ratio of chi-square per number of degree of freedom: = 1,050.982, df = 423, $p < 0.001$, $\chi^2$/df = 2.484, (RMSEA) = 0.034. (CFI) = 0.977, (TLI) = 0.966, and (SRMR) = 0.045. Refer to study result, comparing with the criteria, it can confirm that measurement model is in accordance with the data. According to Table 4,

**Table 3.4** Observed variables used for the Questionnaire.

| Code | Indicator | Adapted from | M | SD | Sk | Ku |
|---|---|---|---|---|---|---|
| | Trust In Technology | | | | | |
| V1 | Trust in Industrial Waste Disposal Technology which reduces environmental impact. | (Emmerich et al. 2020) | 4.50 | 0.60 | -0.854 | 0.077 |
| V2 | Trust in Industrial Waste Disposal Technology which utilizes industrial waste as energy. | (Emmerich et al. 2020) | 4.35 | 0.735 | -0.908 | 0.244 |
| V3 | Trust in Industrial Waste Disposal Technology “Co-Processing in Cement Kiln” | (Basfirinci & Mitra, 2015; Emmerich et al. 2020) | 4.41 | 0.683 | -0.977 | 0.680 |
| | Trust In Waste Processor | | | | | |
| V4 | Trust in Reliability of Service Providers. | (Basfirinci & Mitra, 2015) | 4.39 | 0.682 | -0.862 | 0.35 |
| V5 | Trust in Management Standard of Service Providers. | (Emmerich et al. 2020) | 4.40 | 0.715 | -0.96 | 0.298 |
| V6 | Trust in Reputation of Service Providers. | (Basfirinci & Mitra, 2015; Emmerich et al. 2020) | 4.29 | 0.758 | -0.81 | 0.101 |
| | Disposal Knowledge | | | | | |
| V7 | Want to dispose industrial waste by turning it into energy. | (Park & Ohm, 2014) | 4.02 | 0.817 | -0.583 | 0.111 |
| V8 | Co-Processing in Cement Kiln causes no ash since it will turn to be raw material of cement production. | (Baidya et al. 2016) | 4.11 | 0.797 | -0.654 | 0.286 |
| V9 | Waste disposal in regular kiln causes ash which need to be further disposed. | (Baidya et al. 2016) | 4.54 | 0.717 | -1.615 | 2.654 |
| | Perceived Benefits | | | | | |
| V10 | Waste disposal by Co-Processing in Cement Kiln will cause no ash from disposal. | (Viczek et al. 2020) | 4.44 | 0.800 | -1.661 | 3.234 |
| V11 | Industrial Waste Disposal along with turning it into renewable energy at the same time. | (Tsaur & Lin, 2018) | 4.69 | 0.574 | -1.811 | 2.838 |
| V12 | Waste disposal by Co-Processing in Cement Kiln is the Zero waste to landfill. | (Bogush et al. 2020) | 4.67 | 0.592 | -1.541 | 2.889 |

Notes: M = Mean (Mean), SD = Standard Deviation = Skewness, Ku = Kurtosis,

Table 3.4 Observed Variables used for the Questionnaire. (Continued)

| Code | Indicator | Adapted from | M | SD | Sk | Ku |
|---|---|---|---|---|---|---|
| | **Perceived Risk** | | | | | |
| V13 | No worry if waste is disposed by Industrial Waste Disposal Technology by Co-Processing in Cement Kiln. | (Park & Ohm, 2014) | 4.12 | 0.776 | -0.695 | 0.508 |
| V14 | No worry about Service Providers of Industrial Waste Disposal by Co-Processing in Cement Kiln. | (Park & Ohm, 2014) | 4.02 | 0.881 | -0.847 | 0.685 |
| V15 | No worry about limitation on types of industrial waste for disposal. | (Park & Ohm, 2014) | 4.07 | 0.831 | -0.65 | 0.076 |
| | **Policy** | | | | | |
| V16 | Entrepreneur's Environmental Policy determines selection of Industrial Waste Disposal Method. | (Baidya et al. 2016; Ndebele, 2020) | 4.20 | 0.82 | -0.898 | 0.747 |
| V17 | There is Industrial Waste Disposal Policy by Zero Wastes to landfill. | (Stafford et al. 2015) | 4.33 | 0.76 | -0.993 | 0.805 |
| V18 | Considering to select Industrial Waste Disposal which can reduce environmental impact while disposing. | (Kosajan, Wen, Zheng, et al. 2021) | 4.39 | 0.72 | -0.968 | 0.483 |
| | **Accept** | | | | | |
| V19 | Waste Disposal by Co-Processing in Cement Kiln" will be one of your options. | (Baidya et al. 2016; Dissakoon Chonsalasin et al. 2020) | 4.44 | 0.678 | -0.902 | 0.006 |
| V20 | Zero waste to landfill, "Waste Disposal by Co-Processing in Cement Kiln" will be one of your options. | (Baidya et al. 2016; Dissakoon Chonsalasin et al. 2020) | 4.42 | 0.666 | -0.802 | 0.025 |
| V21 | Turn waste into energy, "Waste Disposal by Co-Processing in Cement Kiln" will be one of your options. | (Baidya et al. 2016; Emmerich et al. 2020) | 4.35 | 0.707 | -0.025 | 0.050 |

Notes: M = Mean (Mean), SD = Standard Deviation = Skewness, Ku = Kurtosis,

**Table 3.5** CFA Result.

| Indicator | Code | $\alpha$ | CFA (Loading are significant at $\alpha$ = 0.01) | | | |
|---|---|---|---|---|---|---|
| | | | Loading | Error-variances | CR | AVE |
| Trust in Technology | | 0.883 | | | 0.985 | 0.790 |
| | V1 | | 0.845 | 0.033 | | |
| | V2 | | 0.789 | 0.028 | | |
| | V3 | | 0.737 | 0.027 | | |
| Trust in Wastes processor | | 0.846 | | | 0.981 | 0.751 |
| | V4 | | 0.785 | 0.022 | | |
| | V5 | | 0.713 | 0.034 | | |
| | V6 | | 0.755 | 0.029 | | |
| Disposal Knowledge | | 0.881 | | | 0.988 | 0.756 |
| | V7 | | 0.795 | 0.014 | | |
| | V8 | | 0.728 | 0.023 | | |
| | V9 | | 0.745 | 0.013 | | |
| Disposal Policy | | 0.881 | | | 0.991 | 0.795 |
| | V10 | | 0.856 | 0.017 | | |
| | V11 | | 0.735 | 0.015 | | |
| | V12 | | 0.794 | 0.022 | | |
| Perceived Benefit | | 0.883 | | | 0.992 | 0.799 |
| | V13 | | 0.786 | 0.014 | | |
| | V14 | | 0.858 | 0.018 | | |
| | V15 | | 0.752 | 0.013 | | |
| Perceived Risk | | 0.846 | | | 0.982 | 0.722 |
| | V16 | | 0.735 | 0.022 | | |
| | V17 | | 0.723 | 0.023 | | |
| | V18 | | 0.708 | 0.028 | | |
| Acceptance Co-Processing | | 0.881 | | | 0.994 | 0.797 |
| | V19 | | 0.836 | 0.034 | | |
| | V20 | | 0.788 | 0.030 | | |
| | V21 | | 0.766 | 0.027 | | |

## 3.6 Structural equation

The study results which found that $\chi^2$= 297.512, df = 122, p < 0.001, while $\chi^2$ /df = 2.43, which (P. B. Kline, 2005) suggested that ratio between $\chi^2$/df, or it should not be over 3, then we considered RMSEA = 0.034, which (J.H. Steiger, 2007) suggested that (RMSEA) should be less than 0.05, while SRMR = 0.027, also (Wu, 2009) suggested that (SRMR) should not be over 0.05. Then we considered CFI = 0.988, which (Hu, 1999) recommended that (CFI) should be over 0.95, and considered TLI = 0.979, which (Hooper, 2008) suggested that (TLI) should be over 0.95. Examination results could strongly confirm that the created model by literature reviewing is in accordance with empirical data as presented in Figure 4 and details as showed in Table 6.

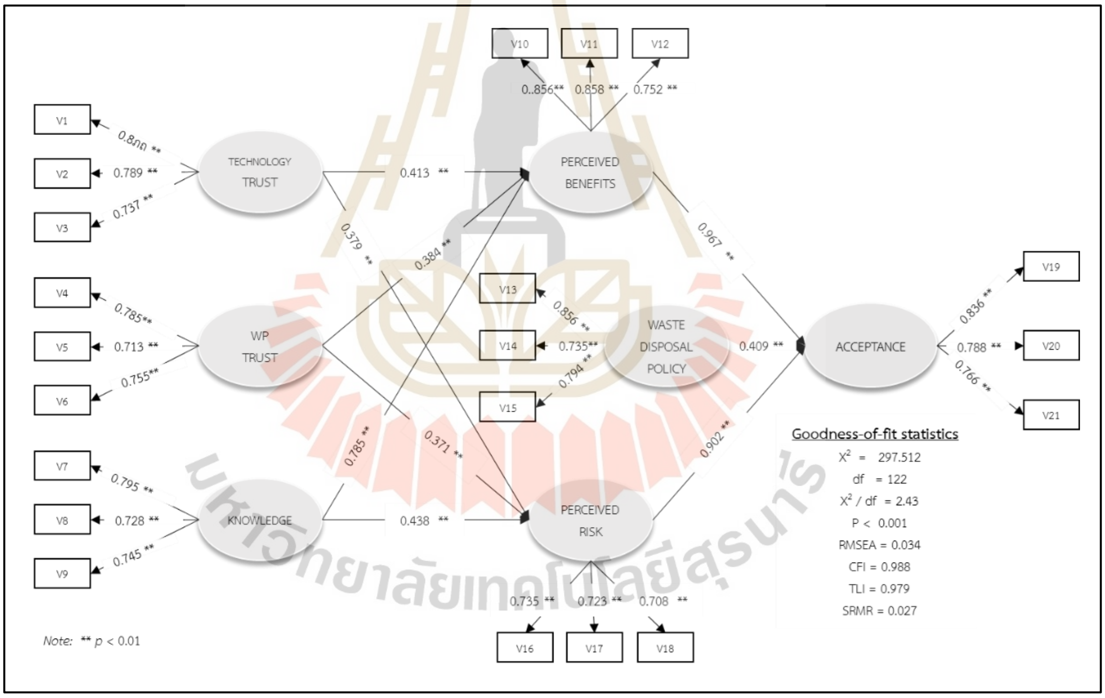


**Figure 3.4** Results of Structural Equation Model.

**Table 3.6** Direct and indirect influences from Structural Equation Model.

| Hypotheses | Effect Path | Direct-Effect Value | Result |
|---|---|---|---|
| H1 | TRT ⟶ PB | 0.413** | Support |
| H2 | TRT ⟶ PR | 0.379** | Support |
| H3 | TRWP ⟶ PB | 0.184** | Support |
| H4 | TRWP ⟶ PR | 0.371** | Support |
| H5 | KN ⟶ PR | 0.785** | Support |
| H6 | KN ⟶ PB | 0.438** | Support |
| H7 | PB ⟶ ACC | 0.967** | Support |
| H8 | POL ⟶ ACC | 0.409** | Support |
| H9 | PR ⟶ ACC | 0.092** | Support |

Note: ** $p < 0.01$

## 3.7 Discussion

From the results, considering the research hypotheses, we can summarize the factors affecting the acceptance of industrial waste disposal services by Co-Processing in Cement Kilns. The customer trust factor toward the technology of industrial waste disposal service by Co-Processing in Cement Kilns positively influences the perceived benefits from service usage with factor loading = 0.413 and $p < 0.001$; so, it supports hypothesis H1. This result correlate with. (Baidya et al. 2016), which reported the trust in technology of waste disposal by Co-Processing in Cement Kilns and the perceived benefits from service usage by explaining that waste can be used as renewable energy to substitute the main fuel of Cement Kiln by determining TSR%. The industrial waste is converted into renewable energy of Cement Kilns to reduce the main energy usage of Cement Kiln, which conserves resources and disposes of industrial waste with no waste left for further disposal; the disposed waste will be combined as production material (Elfaham & Eldemerdash, 2019; Malinauskaite & Jouhara, 2019; Stafford et al. 2015). The disposal does not affect the environment. Ref. (Bogush et al. 2020) described that it is a good option to transform industrial waste disposal into renewable energy for the cement industry (Güereca et al.2015; Kosajan et al. 2020; Samolada & Zabaniotou, 2014; Viczek et al. 2020; Yan et al. 2018).Meanwhile, the customer trust factor in the technology of waste disposal by Co-Processing in Cement Kilns positively influences the factor of perceived risk from service usage with factor loading = 0.379 and $p < 0.001$; thus, it supports hypothesis H2, which confirms that when customers trust in technology and group of service providers, they will have a correct understanding about the occurred risks, and trust in a decreasing concern about service usage (Qi et al. 2020). Also, this result concures with that in ref. (Park & Ohm, 2014), where the customer trust factor positively influences the factor of perceived risk from service usage. When customers have trust, the perceived risk decreases and the perceive benefits increases from service usage, which must be essentially considered for customers to develop trust. Such trust will be created when there is clarity of non-environmental impact, reasonable service fee, knowledge of technology, and the support policy on service usage.

The factor of customer's trust in a group of industrial waste disposal service providers by Co-Processing in Cement Kilns positively influences the factor of perceived benefits from the service usage with factor loading = 0.384 and $p < 0.001$; so, it supports hypothesis H3. This study confirms that customers perceived benefit from disposal by Co-Processing in Cement Kiln, and ref. (Kosajan et al. 2021) had described that industrial waste disposal by Co-Processing in Cement Kiln should be promoted by advocating its merits. This result confirmed the study by Emmerich et al. (2020), who reported that trust comprises technological and service providers' trust. Further, this result confirms the study performed by Samolada and Zabaniotou (2014), who reported that, industrial waste disposal by Co-Processing in Cement Kilns, are more acceptable than building an incinerator, since they can trust in the technology and its standard.

The customer trust factor in a group of industrial waste disposal service providers by Co-Processing in Cement Kilns positively influences the perceived risk factor from service usage with factor loading = 0.371 and $p < 0.001$; hence it supports hypothesis H4. If customers understand the strength of using Co-Processing service in Cement Kilns, it will decrease risk concerns. This result conforms to ref. (Viczek et al. 2020), which reported that a group of service providers worldwide who could use trust and chance to persuade customers to promote waste disposal. It is in accordance with Prosperi et al. (2019), who mentioned that the service provider's technology and management system should be developed to enable industrial waste disposal to meet customer's needs and earn the customer's trust. This result confirms that customer trust in a group of service providers positively influences the factor of perceived risk from service usage with statistical significance.

Knowledge of industrial waste disposal technology positively influences the factor of perceived benefits from service usage with factor loading = 0.785 and $p < 0.001$; so, it supports hypothesis H5. This result shows that the customer's knowledge of industrial waste disposal positively influences the perceived value of industrial waste disposal by Co-Processing in Cement Kilns. This influence exceeds toward the factor of perceived risk. On the contrary, the factor of knowledge of industrial waste disposal is statistically significance in both ways; it positively influences both the perceived benefits from service users and the perceived risk factors. This result conforms to the study Wang et al. (2019), who discovered that educating people about nuclear energy will have a positive effect and on people's acceptance.

Knowledge of industrial waste disposal technology positively influences the factor of perceived risk from service usage with factor loading = 0.483 and $p < 0.001$; so, it supports hypothesis H6. While (Park & Ohm, 2014) reported that knowledge is a key factor to be considered, the risk factor should also be considered. This result conforms to the study by Wang et al. (2019), who found that educating people about energy technology is to have positive relation and significance to people's acceptance. Additionally, ref (Qi et al. 2020) mentioned that customers would understand the occurred risk correctly; their trust will decrease concerning service selection.

The factor of perceived benefits from service usage positively influences the acceptance factor with factor loading = 0.967 and $p < 0.001$; hence it supports hypothesis H7. Variable of the factor of perceived benefits from industrial waste disposal by Co-Processing in Cement Kiln has the highest factor loading, and it positively influences the acceptance factor while this latent variable is measured by three observed variables. the factor loadings can be sorted out as follow; Disposal by Co-Processing in Cement Kiln is a Waste Disposal coming along with renewable energy utilization (Samolada & Zabaniotou, 2014), Waste Disposal by Co-Processing in Cement Kiln is Zero wastes to landfill (Baidya et al. 2016), and Waste Disposal by Co-Processing in Cement Kiln is a completed disposal with no ash left. This finding is to confirm that customers accept Industrial Waste Disposal Service by Co-Processing in Cement Kiln from factor of Value Perception of Industrial Waste Disposal by Co-Processing in Cement Kiln which is in accordance with (Malinauskaite et al. 2017) who mentioned that Waste Disposal Service by Co-Processing in Cement Kiln is a method which gets intention, and it is in the WtE group in order to reduce environmental impact regarding disposal, affirmed by (Stafford et al. 2015) who said that Industrial Waste Disposal Service by Co-Processing in Cement Kiln is a disposal according to law, has no environmental impact, and it is accepted worldwide.

The factor of customer's industrial waste disposal policy positively influences the acceptance factor with factor loading = 0.402 and $p < 0.001$; so, it supports hypothesis H8. The latent variable with the least factor loading, which influences the acceptance factor, but still places importance on the customer's decision, is the factor of the customer's industrial waste disposal policy, which can be measured by three observed variables, sorted out by factor loading in order as follows: Environmental Policy of your enterprise is a method to determine way of Industrial Waste Disposal, Selecting a method to dispose Industrial Waste which can reduce environmental impact while disposing, and Industrial Waste Disposal Policy by Zero Waste to landfill. Refer to the research result, it is to confirm that Customer's Waste Disposal Policy is in relevant to factor of Intention to use service. (Baidya et al. 2016) had given meaning of this issue that Disposal by Co-Processing in Cement Kiln is a modern technology, it can reduce environmental impact from Industrial Waste Disposal, and it does not generate waste from processing waste in Cement Kiln e.g., Bottom and fly ashes. So, it is called, "Co-Processing in Cement Kiln". It is conformed to (Stafford et al. 2015; Viczek et al. 2020) who described that promotion on intention to dispose industrial waste by Co-Processing in Cement Kiln should begin with Waste Disposal Policy by promoting waste disposal image which can reduce environmental impact, and it does not affect to operators while disposing. Moreover, we should promote intention of benefit which customers will received while disposing by turning the waste into renewable energy.

Further, the perceived risk factor from service usage positively influences the acceptance factor with factor loading = 0.902 and $p < 0.001$; thus, supporting hypothesis H9. While considering the factor loading of the latent variable at the second level after the perceived benefits' factor from service usage, which is the factor of risk perception when customers perceive that there is a lesser risk in service usage, it influences the acceptance factor (Park & Ohm, 2014; Qi et al. 2020). If we rank the latent variables in the modeling by the factor loading from perceived risk factor from the service usage, the variables can be ranked in descending order of factor loading as follows: 1) variable of “there is no concern if the waste is disposed of by technology of industrial waste disposal by Co-Processing in Cement Kilns;” 2) variable of “there is no concern about the group of industrial waste disposal service providers by Co-Processing in Cement Kilns;” and 3) variable of “there is no concern about limitation of industrial waste types for disposal service.” Thus, evidently, trust in disposal technology, trust in the group of service providers, and knowledge of technology positively influence the perceived risk factor from service usage.

### 3.8 Conclusion and strategic planning

Overall statistical result: According to literature review, all observed variables can explain overall factors in this study. Refer to analysis on factors in relevant to Acceptance on Industrial Waste Disposal Service by Co-Processing in Cement Kiln, if we consider Structural Equation Model obtained by CFA, this study results still let us know that factors can describe relation of Intention to get service with 0.001 statistical significance. Similarly, from study result, there is stability of variables which can explain causal relation of Acceptance factor on Industrial Waste Disposal Service by Co-Processing in Cement Kiln, conforming to Model created along with empirical data.

While considering analysis result of measurement model, it found that factor with the highest factor loading is Value Perception of Service Usage, then factor of Customer’s Industrial Waste Disposal Policy and factor of Trust in Industrial Waste Disposal Technology by Co-Processing in Cement Kiln. Such finding is also conformed to analysis result of Structural Equation Model which found that factors of Trust in Industrial Waste Disposal Technology by Co-Processing in Cement Kiln, Value Perception of Waste Disposal by Co-Processing in Cement Kiln, and Customer’s Waste Disposal Policy which does not want the Industrial Waste Disposal to affect to environment with statistical significance.

This study investigates and confirms the relationship between the customer acceptances of using industrial waste disposal services by Co-Processing in Cement

Kilns. It also explores relevant factors obtained from literature review and compares them to the empirical data. The statistical significance of the variables used herein is 0.001, which confirms that the observed variables of this study can strongly and easily explain the factors affecting customer acceptance of industrial waste disposal service by Co-Processing in Cement Kilns. Thus, based on the research hypotheses, it can be summarized that if the direct influence of factors on the acceptance factor is considered, the latent variable of the factor of perceived value on industrial waste disposal service that positively influences the acceptance factor in using industrial waste disposal service by Co-Processing in Cement Kilns is the highest. Also, the factor of perceived risk from service usage is the second. Followed by the factor of zero waste to landfill policy, that positively influences the factor of acceptance of service usage. Also, all factors are statistically significant.

Service providers' strategic planning should focus on Niche Market which has policy on Zero waste to landfill. In reference to empirical data of this study, it found that factor of Customer's Intention to use service, considering by factor loading of Structural Equation Model (SEM). If we sort out factors by the highest factor loading, we found that factors of Customer Trust in Industrial Waste Disposal Technology by Co-Processing in Cement Kiln, and Service Provider Group have the highest factor loading. It is to confirm that customers trust in Service Provider Group so they should particularly place importance on this factor to build Customer's Trust. Next, factor with high factor loading is Value Perception of Service Usage of Industrial Waste Disposal Technology by Co-Processing in Cement Kiln which can also confirm that customer place importance on this factor as priority.

This study is limited in the sense that although considerable factors were uncovered in terms of their influence on selecting industrial waste disposal services in Cement Kilns by developing a TAF model that considers Technology Acceptance, other factors related to service provision, such as the intention to the use of industrial waste disposal service, price (disposal fee), distances between waste processors and generators, and service quality are not used herein.

Further studies on industrial waste disposal by Co-Processing in Cement Kilns are required in many regions worldwide. This study is a referral model of a study in Thailand. Therefore, researchers from other regions can further extend this research in other relevant dimensions and factors in terms of business to match service provision with customer's needs, such as intention to the use of industrial waste disposal service, price (disposal fee), distances between waste processors and generators should be considered for further research in other regions of service providers from different countries. Therefore, by using this study result on business factors, and factors related to acceptance to use industrial waste disposal service by Co-Processing in Cement Kiln as a role model in their further study.

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# CHAPTER IV

# WTP AND WTA FOR ALTERNATIVE FUEL IN WASTE TO ENERGY SECTOR COMPARISON BETWEEN CO-PROCESSING AND WTE-POWER PLANT

## 4.1 Abstract

Waste to Energy technology is a technology that can dispose of industrial waste along with its use as a fuel for waste power plants and as a renewable fuel in cement kilns. At present, there is high competition between Co-Processing and WTE-Power Plant service provider groups. Industrial waste can be used as fuel and also get disposal costs from customers. Therefore, with disposal technology, disposal costs are high, but how much customers are Willingness to Pay for disposal, and which factors are significant to the Willingness to Accept to compensate for the disposal cost are questionable. To compare WTA values between Co-Processing and WTE-Power Plant, this study used the Bidding Price Choice Experiment (CE) questionnaire to assess WTP and MRS by surveying customers across Thailand. From the study results, the value of WTP is 1,161 baht per ton, and customers are Willingness to Accept the factor of no-environmental impact on industrial waste disposal. To compensate for the disposal cost, the value of WTA is 1,397 baht per ton. They are Willingness to Accept the factor of transportation cost for waste disposal over long distances to compensate for the disposal cost, the value of WTA equaled 1,440 baht per ton with statistical significance. For service providers, the results from this study can be used as guidelines to revise industrial waste disposal prices and plan strategies based on the factors significantly contributing to the customer's decision.

## 4.2 Rationale of the research

Currently, the trend of the circular economy to maximize the waste benefits is a popular movement (Malinauskaite & Jouhara, 2019) If considering waste from industries, also known as industrial waste, it is waste left over from industrial processes and it cannot be used for any other benefits, resulting in the requirement for waste disposal (Department of industrial works, 2020) To conform with the circular economy guidelines for industrial waste disposal with optimal benefits during the disposal time, the customers should consider using waste or industrial waste disposal services from Waste to Energy (WTE) service providers who can dispose of waste or industrial waste and simultaneously exploit industrial waste such as municipal solid waste (Kosajan et al. 2020) , and industrial waste (Bogush et al. 2020) as energy. These wastes have heat value that can be used as coal. The major service providers in Thailand are Co-Processing and the WTE-Power Plant service providers.

A WTE-Power Plant service provider group in Thailand has the main strategic energy plan of the Ministry of Energy. During the years 2015–2016, it has created 5 energy master plans, promoting renewable energy in the production of electricity, constructing more waste power plants (energy, 2015), and building potential waste power plants that potentially serve industrial waste disposal. Due to the advantages in transportation distances, according to the data from the Energy Regulatory Commission (2020) there are a lot of waste-to-power plants spread throughout the country as their locations are close to industrial sources. Considering the potential of cement manufacturers to provide the services of waste and industrial waste in their cement kilns, or Co-Possessing service provider group. It is the introduction of industrial waste to be converted to an alternative fuel to reduce the main fuel (coal) consumption, which, at the same time, will both conserve resources and eliminate industrial waste (Elfaham & Eldemerdash, 2019; Malinauskaite & Jouhara, 2019; Stafford et al.2015) The positive benefit to the environment or the environmentally friendly process, which reduces landfills (Viczek et al.2020) is not only an alternative for industrial waste but also energy for the cement industry in many countries (Bogush et al. 2020; Kosajan et al. 2020; Viczek et al. 2020).

For industrial waste that has been eliminated with the WTE service provider, customers who use the service must pay for disposal service. The disposal fees attract competition between Co-Possessing and the WTE-Power Plant service providers. In addition, the increasing number of service providers in the future tends to cause price competition as the disposal technology comes along with the high disposal price

(Ghalehkhondabi et al.2020) On the other hand, there are many types of industrial waste disposal services in Thailand, so customers can choose from a variety of services. The price that customers are Willingness to Pay and which outstanding attributes of the WTE service providers significantly affect their decision-making. For the reasons mentioned above, the purposes of this study are to examine the customers' Willingness to Pay for industrial waste disposal and investigate the significant attributes that potentially compensate for the disposal or the WTP for industrial waste disposal fees for the WTE service providers to revise the service rate and recognize the characteristics that cause customers to make decisions in consideration with strategic planning in the future. According to recent research in Table 4.1, there are a few studies that mention WTP and WTA, comparing Co-Processing and WTE-Power Plant. For example, C.-K. Pek and O. Jamal (2011) used the CE to compare the sanitary landfills and kilns, Plum, Olschewski et al. (2019) compared the studies between electrical energy and electricity production from solar studies using CE, Chen (2019) studied the use of CE to manage the 3 scenarios of community waste disposal. Thus, from the previous studies, it can be concluded that there are 3 research gaps, (1) there has been no comparison between Co-Processing and WTE-Power Plants using the analysis with WTP for predicting the service selection regarding price; (2) there has not yet been a study of factors significantly affecting Willingness to Accept the price to compensate for the disposal costs; and (3) there has not yet been a study of the significant factors influencing Willingness to Accept for the compensation for WTA disposal in terms of monetary value.

**Table 4.1** Previous studies on renewable energy and waste management.

| Authors | Country | Unit of analysis | Control tipping | Sanitary landfill | Incineration | Green residents | conventional residents | Hydro-power | Coal-power | Renewable Electricity | New electricity company | New non-electricity | Well-known non-electricity | Co-Processing | WTE- Power Plant | Service of waste collect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| This Study | Thailad | Industrial Wastes disposal | | | | | | | | | | | | ✓ | ✓ | |
| (C. K. Pek & O. Jamal, 2011) | Malaysia | Solid waste disposal | ✓ | ✓ | ✓ | | | | | | | | | | | |
| (Chau, Tse, & Chung, 2010) | Hong Kong | Residents | | | | ✓ | ✓ | | | | | | | | | |
| (Siyaranamual, Amalia, Yusuf, & Alisjahbana, 2020) | Indonesia | Electricity service | | | | | | ✓ | ✓ | | | | | | | |
| (Ndebele 2020) | New Zealand | Electricity service | | | | | | | | | ✓ | ✓ | ✓ | | | |
| (Rai, Bhattarai, & Neupane, 2019) | Nepal | Solid wastes | | | | | | | | | | | | | | ✓ |
| (Chen, 2019) | Taiwan | Municipal solid waste | | | | | | | | | | | | | | ✓ |
| (Plum et al. 2019) | Switzerland | Electricity service | | | | | | | | ✓ | | | | | | |

### 4.2.1 WTP for Co-Processing and WTE-power plant

This article studied customers' Willingness to Pay for industrial waste disposal and the attributes that can compensate for the disposal with the WTE service providers, comprising Co-Processing and the WTE-Power Plant. Therefore, the research on waste management and research related to renewable energy in WTP and WTA have been studied. In this regard, Wu et al.(2020) stated that the Willingness to Pay(WTP) is the intention to improve the product or service qualities. On the other hand, the Willingness to Accept is the Willingness to Accept the inferior quality or service. If considering WTP, many researchers have conducted studies to evaluate the WTP in many ways, such as Vassanadumrongdee et al.(2018) which applied the concept of the Theory of Planned Behavior to study the factors influencing the WTP to improve the waste separation in Bangkok. The results realized that the inconvenience of separating community waste is a problem and an obstacle to sorting it. In addition, personal norms and the perception of the problem of community waste have a positive influence on Willingness to pay. Han et al. (2019) have studied the Willingness of the people who would pay for the rural waste management service in China. As sustainable rural development requires a comprehensive waste management strategy, it consists of all steps from waste collection and transportation to treatment and waste disposal. The analysis methods included logistic regressions, Microsoft Excel, and SPSS. The results showed that the factor of money paid based on the delivery distance significantly affected the Willingness to Pay. To analyze the willingness to pay, the research of Kayamo (2022) was conducted by using a questionnaire consisting of questions inquiring about the Willingness to Pay to improve the environment through eco-friendly waste disposal methods. The first question begins with the starting price of the initial bid (BI). If the respondents answered yes, it means that they are Willingness to Pay a starting price. The next question will propose a higher price, called the "Higher Bid" (BH). In the event that the respondents answer no, it means that they are not Willingness to Pay the starting price. The next question will propose a lower price, called the Lower Bid (BL). The above questions can be written as an equation as follows:

$$Y = 0, \text{ if } WTP < Bl, (No - No) \tag{4.1}$$

$Y = 1$, if $Bl < WTP < Bi$, (No – Yes)

$Y = 2$, if $Bl < WTP < Bh$, (Yes – No)

$Y = 3$, if $Bh < WTP < B+$ (Yes – Yes)

The mean WTP evaluation can be calculated from the WTP results from the Double Bounded Close-Ended WTP questionnaire: No-No, No-Yes, Yes-No, and Yes-Yes. The results were then multiplied by the percentage for each price that respondents answered, and the multiplier results of each value were added together to form a mean WTP.

**4.2.2 WTA for Co-Processing and WTE-power plant**

Many researchers have studied the attributes that potentially compensate and evaluate a Willingness to Accept, such as Yacob, Kabir, and Radam (2015) who studied the Willingness to Accept the disposal cost of left-over cooking oil for biodiesel using the bidding price method due to its inappropriate disposal in the past. The analysis of this study uses the contingent evaluation method (CVM) to assess the Willingness to accept (WTA) of the household in the same direction as Triguero et al.(2016) which was studied in Europe. As the researchers aimed to study the waste management strategy with the cooperation of both the government and the private sector, they conducted a study in 28 European countries about personal influence in disposing of waste, recycling, and evaluating various alternatives for waste management. The research results showed that the influential factors are environmental awareness, gender, and education level. In addition, they found that higher environmental awareness led to more Willingness to Accept. When considering the methods used to evaluate the Willingness to Pay, many researchers, such as Dugstad et al. (2020); (García et al. 2016; Kim et al.2020; Seroa et al. 2018; Yacob et al. 2015; Zhou et al. 2018) stated in the same way that the prevalent method is stated preference (SP), which can be divided into two categories: the contingent valuation method (CVM) and the choice experiment (CE). The first method is to assess the value by supposing the incident. CVM is a survey method using questions to demonstrate individual satisfaction. In other words, it is a method of valuation with the consumer's evaluation by direct inquiries. The stated preference was developed to assess the monetary value of the product without market prices under the assumed situation. It is the most popular way to evaluate the value of products without market prices and is additionally applied to marketing products when their quality changes. The second method is the choice experiment (CE), which is used to study satisfaction by directly inquiring interviewees in the created situations. It is based on the consumer theory that the decision to consume products results from the usefulness of the decision by using the Random Utility Theory (RUM). When the coefficient is estimated from the utility function, the Willingness to Accept can be calculated. When considering the change of only the k characteristics from the equation $-\beta k/\delta$ where $\delta$ is a price coefficient, it is called Marginal Willingness to Pay (MWTP), representing the acceptance of exchange utility from money with the utility from the changed characteristics in the form of monetary value. if considering the characteristics that can compensate for the disposal price, there have been researchers who explained them in the context of the WTE service providers. Suksanguan et al. (2022) have studied factors influencing customers to select Co-Possessing services and found that ease of use factors including the potential to use Auto-E-License service, location, and the price had an influence on the service selection. This is consistent with the study that discussed the positive results on the environment with the technology of waste-to-power plants by Elfaham and Eldemerdash (2019) stating that the technology was recognized for solid waste management because it could help lower its impact on the environment. Relevant to Ghaebi et al. (2020) who have conducted a study on waste-to-energy plants by using heat from burning wastes to generate electricity. Currently, there are studies to achieve the efficiency of waste to power generation at the lowest cost (Houshfar, 2020), However, its efficiency is low due to its heat value (Tan et al. 2015) Nevertheless, the income from electricity sales and waste disposal is attractive. The operation of waste to energy conversion (WTE) uses the basic principles of incinerators to treat various wastes including the energy generating process, for example, in the form of electricity or heat, to replace the main fuel. Waste-to-energy change is one of the circular economy getting benefits from waste and maintaining resources for the longest sustainability (Malinauskaite et al. 2017) Waste energy power plant technology possesses many advantages, such as bringing it back as energy, reducing greenhouse gas emissions, preserving resources, creating energy from the benefits of the incinerator. Waste to Energy Power plants are also safely and efficiently designed to eliminate community waste. Therefore, it is considered the best choice for safety and hygienic process especially, for large cities (Cui et al.2020). In addition, the strengths of Co-Processing service provider is Zero Waste to Landfill (Kosajan et al. 2021). Therefore, according to the literature review, the characteristics of compensation for the industrial waste price potentially were concluded in the context of the WTE service providers comprising as follows: no-environmental impact on waste disposal; zero waste to landfill; Auto E-license; disposal cost; transportation cost, and transportation distance. In the event that the customer selects the service provider from a distance from the manufacturers, the industrial waste price in this study will be determined at > 80 KM and the above factors will be used to study the customer's Willingness to Accept the compensation for the industrial waste disposal price.

## 4.3 Material and methods

### 4.3.1 Questionnaire design

Questionnaire design; the questionnaire for this study can be divided into 3 parts: the first part is the respondents' general information such as gender, age, education level, province of the entrepreneurs.

The second part of the WTP question is a close-ended single bid question: the answer will be accepted or not (Yes/No), while the Double Bounded Close-Ended question is a close-ended question of the Choice Experiment (CE) with two bids: if the respondents answered that they are Willingness to Accept the initial price difference, the second bid price would increase. If they are not Willingness to Accept the initial price difference, the second bid will be reduced as shown in Figure 4.1. In addition, its second part consists of contingent valuation method (CVM) questions. The increasing industrial waste price is an assumed situation in which respondents have to choose between the Co-Possessing service provider and the WTE-Power plants.

The third part is that the WTA question is a closed-ended single-bid question. The single bid price is obtained from doing the pilot test; the answer will be

(Yes/No), comprising the price and a factor for respondents to determine the best choice of which attributes can compensate for the Willingness to Accept the disposal price.

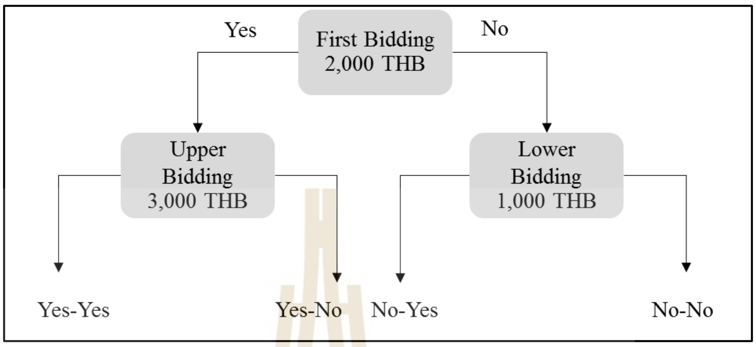


**Figure 4.1** Double bounded close-ended DCE WTP.

### 4.3.2 Data collection

The data was surveyed and collected between April 2021 and July 2021. Using a Google form via e-mail and application line, 2,000 online questionnaires were delivered by customer service agents and sales representatives to customers who used industrial waste disposal services with Co-Processing in cement kilns according to the customer registration of an industrial waste disposal service provider who is the leader in the Co-Processing in cement kilns of waste disposal management. The target group included current groups and customers who have used services such as industrial plants, warehouses, companies, government agencies, and educational institutions across national regions by proportion (%), the questionnaires were delivered according to the number of customers from the listed registration of each region, including the eastern region (65%), the central region (25%), the northeastern region (5%), the southern region (4%), and the northern region (1%), respectively.

### 4.3.3 Evaluating WTP and WTA as monetary values

The Willingness of Pay can be evaluated using the Double Bounded Close-Ended questionnaire, which comprises questions inquiring the Willingness to Pay to improve the environment with eco-friendly environmental waste disposal methods. The first question is the starting price of the initial bid (BI). If the respondents answered yes, it means that they are Willingness to Pay a starting price. The next question will propose a higher price, with a higher bid (Bh). In the case that the answer is no, it means that they are not Willingness to Pay a starting price; the next question will propose a lower price, called the Lower Bid (Bl). The WTP results can be calculated from the Double Bounded Close-Ended WTP questionnaire: No-No, No-Yes, Yes-No, Yes-Yes, multiplied by percentage in each WTP Bidding Price, and the multiplication results of each value were added together to be the MEAN WTP.

Analysis of Willingness to Accept using the method of Choice Experiment (CE) consists of the dependent variables, which are the factors for choosing the use of the WTE group service (choosing to use the service = 1, choosing not to use the service = 0) and the other 9 independent variables, which are dummy variables. Following that, they were brought to estimate with the logistic regression, as shown in Equation 4.2. and the Willingness to Accept WTE industrial waste disposal can be calculated from the Marginal Rate of Substitution (MRS) as an example shown in Equation 4.3.

$$\begin{aligned} V_1 &= \beta_0 + \beta_1(L80) + \beta_2(H80) + \beta_3(NP) + \beta_4(Auto) + \beta_5(AFR) \\ &\quad + \beta_6(ZLF) + \beta_7(PRIC) + \beta_8(TCOST) + \beta_9(DIS) \end{aligned} \tag{4.2}$$

$$WTA_{(NP)} = -\frac{\partial u / \partial (L80)}{\partial U / \partial (PRICE)} = -\frac{\beta_3}{\beta_7} \tag{4.3}$$

From the above equation, the users' Willingness to Accept (WTA) for compensating the no-environmental impact on industrial waste disposal can be calculated from Marginal rate of substitution (MRS) by comparing the $\beta_3$ and $\beta_7$ coefficients. In the same direction, if compare the Willingness to Accept Industrial waste disposal that can deliver industrial waste disposal by Auto E-license, coefficients $\beta_4$ and $\beta_7$ are compared and analyzed using SPSS Statistics 26.

## 4.4 Results

### 4.4.1 Descriptive statistics of respondents

The descriptive statistics showed the details of the 1,251 respondents: The majority of respondents are male (55%), and female (45%). 63%of them have the highest graduation at a bachelor's degree, followed by 29% at a master's degree. For job positions, they include environmental officers (26%), security officers (18%), and production workers (16%), as shown in Table 4.2.

**Table 4.2** Respondents' information.

| Characteristics | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 687 | 55 |
| | Female | 564 | 45 |
| Age | 20–30 | 293 | 23 |
| | 31–40 | 489 | 39 |
| | 41–50 | 369 | 29 |
| | 51–60 | 98 | 78 |
| | > 61 | 2 | 0.2 |
| | Senior High School/ Vocational | 4 | 0.3 |
| Educational level | certificate | 91 | 7 |
| | High.Voc. Cert/. Cert. of Tech | 791 | 63 |
| | Vocation/Dip. | 362 | 29 |
| | Bachelor's Degree | 2 | 0.2 |
| | Master's Degree | 230 | 18 |
| Position | Doctoral Degree | 321 | 26 |
| | Security Staff | 204 | 16 |
| | Environmental Officer | 85 | 7 |
| | Production | 83 | 7 |
| | Engineering | 62 | 5 |
| | Logistics | 69 | 6 |
| | Purchasing | 197 | 16 |
| | Administrator | 69 | 6 |
| | Other | 197 | 16 |

Note : n = 1,251

From the study results, the respondents chose the bidding price of waste disposal with WTE service providers at 1,000 baht with the highest frequency (No-Yes), followed by 2,000 baht (Yes-No), and 3,000 baht (Yes-Yes), respectively, as shown in Figure 4.2. The data from the pilot test statistically revealed that the prices for the disposal fee offered by the service user were: mean = 1,818-baht, mode = 2,000 baht, and median = 1,600 baht. The study also discovered that the WTP value from an assumed price situation for customers to consider choosing which industrial waste disposal between Co-Processing and WTE-Power Plant. The results showed that when the starting bidding price was at 2,000 baht, the frequency of the respondents' use of the service at Co-Processing was higher, but if the bidding price was increased to 3,000, 4,000, or 5,000, respectively, the frequency of respondents using the service at the WTE-Power Plant was higher. The details are shown in Table 4.3 and Figure 4.3 The Mean WTP was determined by referring to Kayamo (2022) which used a multiplicative method between the percentage values of the respondents, answering Yes-Yes, Yes-No, No-Yes, No-No and the bidding price of 1000, 2000,3000 baht. According to the data in Table 4.4, it can be calculated as follows: Mean WTP = (0.38*WTP-WTE) + (0.26*WTP-WTE1000) + (0.17 *WTP-WTE2000) + (0.19*WTP-WTE3000) = 1,161 Baht. The values of Willingness to Pay for industrial waste disposal to the group of WTE service providers comprise a total disposal fee that includes the rates of transportation, disposal, test, and management fees for various waste management of which the number can reflect the service users' opinions. From 479 samples answering Close-Ended Single Bid questions, or a high number of 38%, the number of No-No answers was the highest. It indicates that the disposal price of lower than 1,000 baht is accepted by the customer. From the study results, the value of WTP group WTE service providers could be revisited due to the findings of Wu et al. (2020) which stated in this regard that the maximized Willingness to Pay from customers will result in the service providers' development of better services. For example, in the event that the service quality does not meet the customer needs, the service provider could lower the price, but in case that the high service quality meets or exceeds the customer's needs, the service rate could be raised to improve the better service quality. In terms of energy, it has been discovered that households and companies are Willingness to

Pay 24–35% higher than normal rates for high-quality electricity without power outages. The Willingness to Pay more for electricity rates must go along with quality improvement as the Willingness to Pay value is lower than the impact of power outages (Deutschmann et al.2020) This is consistent with Oliver et al. (2011) who discovered that the factors of income and reliability of renewable energy electricity were significant to Willingness to Pay.

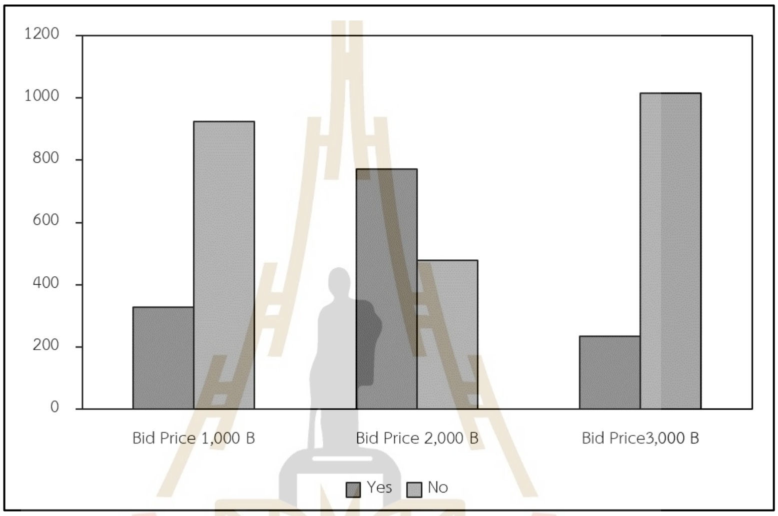


**Figure 4.2** Distribution of Bid price WTP from respondents.

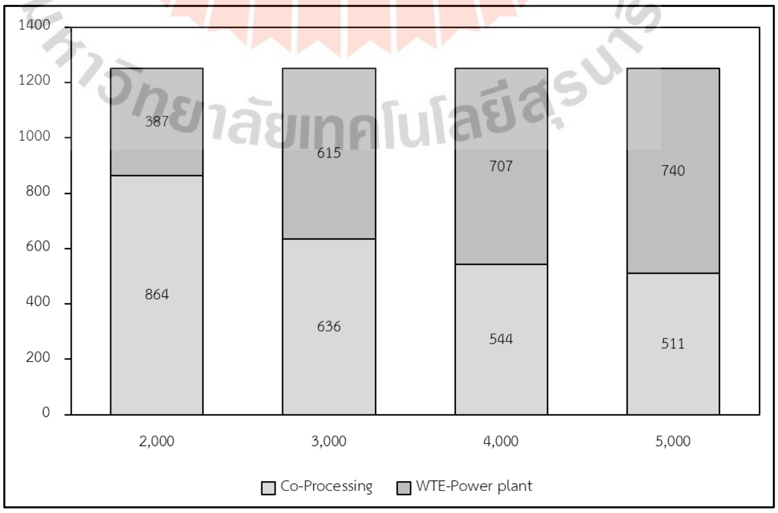


**Figure 4.3** Distribution of respondents' WTP attributes.

**Table 4.3** Data distribution of WTP compared between Co-Processing and WTE-Power Plant.

| From an assumed situation, which industrial waste disposal service would you choose between 2 service providers? | You have Willingness to Pay(WTP) baht per ton. | | | |
|---|---|---|---|---|
| | **2,000** | **3,000** | **4,000** | **5,000** |
| Co-Processing in cement kiln | 864 | 636 | 544 | 511 |
| Industrial waste-to-energy power plants | 387 | 615 | 707 | 740 |

**Table 4.4** Bidding price for industrial waste disposal.

| Answer | WTP | Frequency | Valid Percent (%) |
|---|---|---|---|
| No-No | 0 | 479 | 38 |
| No-Yes | 1,000 | 327 | 26 |
| Yes-No | 2,000 | 210 | 17 |
| Yes-Yes | 3,000 | 235 | 19 |
| Total | | 1,251 | 100 |

#### 4.4.2 Assessment of factors affecting WTA in monetary values

The analysis results based on the Discrete Choice investigated which are important factors affecting the decision to use the service of waste-to-energy service providers. The coefficient values of various attributes indicate the attributes having a statistically significant impact on the service selection. If considering the service users who are Willingness to Accept the disposal price which can compensate for the factors related to their selection, the study results from the respondents revealed the orderly frequency of the factors. From Figure 4.4, the first order or the highest frequency factor is using waste as an alternative, followed by disposal price, transportation price, non-environmental impact during the disposal time, industrial waste disposal by Auto E-license delivery, and transportation distance > 80 km respectively. The transportation cost and the effectiveness of the mentioned attributes can be calculated as "Willingness to Accept," representing the amount of money the users are Willingness to Accept a disposal price to compensate for the characteristics mentioned above: the attributes of industrial waste and the customer's location. Logistic regression was used to estimate the regression results, as shown in Table 4.5.

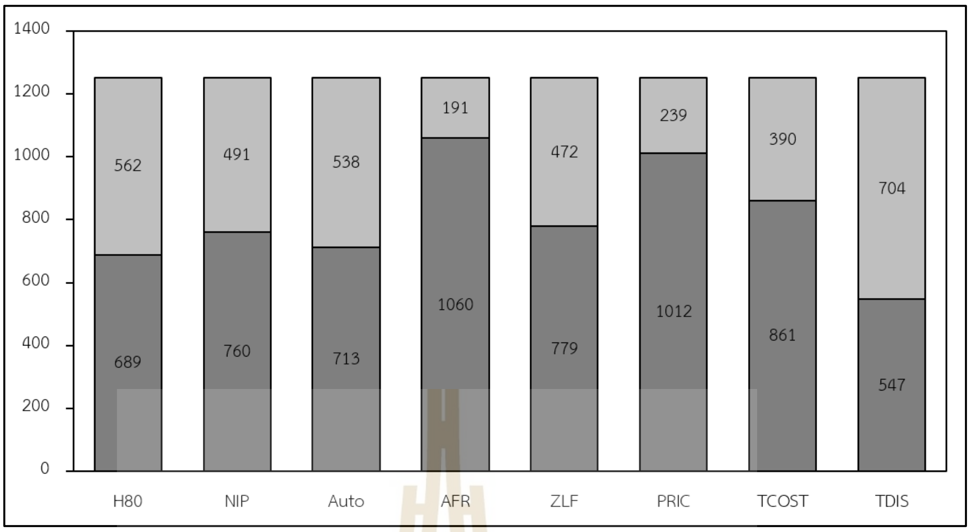


**Figure 4.4** Distribution of attributes of respondents' Willingness to Accept.

In this study, the dependent variable was the choice of service. Waste to Energy service provider groups consist of Co-Processing and WTE-Power Plant (service selection = 1, no service selection= 0) and other 9 independent variables, which were dummy variables. The estimated results showed that the factor of non-environmental impact during the disposal time was statistical significance at 0.001 % confidence level (Li et al.2020), followed by the transportation distance > 80 Km (Anastasopoulos et al.2017), Based on the coefficients value at statistical significance, the researchers have calculated the amount of money of Willingness to Accept (WTA) from the ratio of the coefficients of statistically significant attributes to the coefficients of disposal price value in exchange for those of the consumer's industrial waste and the transportation distance. Calculating the monetary amount of Willingness to Accept (WTA) based on (Chu et al. 2020; Tadesse et al.2021) can be calculated from the marginal rate of substitution, which is equal to the difference rate of the ratio of non-environmental impact during the disposal time, divided by the coefficient of disposal price. WTA would be (-0.519/-0.743) *2,000 = 1,397 baht (2,000 is a value derived from value of mode price from the questionnaire in this study). Thus, it can be explained that the Willingness to Accept the WTE Group service provider rates is due to the acceptance of the factor of non-environmental impact during the disposal time and transportation distance of > 80 km. Therefore, from a statistically significant factor, it can be concluded that the customer is Willingness to Accept the non-environmental impact factor of the industrial waste disposal to compensate for the disposal cost at the value of WTA = 1,397 baht per ton, and the customer is Willingness to Accept the disposal factor of long-distance transportation to compensate for the disposal cost, the value of WTA = 1,440 baht per ton, while the WTP of this study was 1,161 baht. The results are consistent with the Close-Ended Single Bid question that respondents are Willingness to Pay for industrial waste disposal below 1,000 baht as the highest price per ton. Therefore, based on the price the user is Willingness to Pay and the service price the user is Willingness to Accept , the non-environmental impact on waste disposal and transport distance factors are higher than the disposal price. As a result, the WTE-Power Plant group services close to the service users would give customers a statistically significant percentage point of choice due to lower shipping costs than Co-Processing service users in a farther location. If transporting industrial waste from the eastern part of Thailand to the central part of the country, the transportation distance is more than 200 km. Therefore, considering only the disposal cost, due to low transportation costs, the WTE-Power Plant group will have an advantage over the Co-Processing service provider group. The findings of this study are in line with Yacob et al. (2015) which studied waste management, in consensus that users are more Willingness to Accept the price of waste disposal service according to academic principles to reduce the impact on the environment. The findings are additionally consistent with Triguero et al. (2016) who discovered that the factors influencing Willingness to Accept were: Environmental awareness, gender, education level. In addition, it was also found that the higher awareness of the environment, the higher the Willingness to Accept it. He suggested that the WTA results can be used to formulate a proactive waste management policy and create the participation of all stakeholder groups.

**Table 4.5** Factors that service providers consider for Willingness to Accept (WTA) industrial waste disposal.

| **WTA for industrial waste disposal with the following factors:** | $\beta$ | SE | p-value | WTA {Baht) |
|---|---|---|---|---|
| WTA (Yes = 1, No = 0) | -0.743 | 0.149 | 0.000** | - |
| H80: Transportation distance > 80 Km (Yes= 1, No = 0) | -0.535 | 0.139 | 0.000** | 1,440 |
| NIP: No environmental impact on disposal (Yes = 1, No = 0) | -0.519 | 0.142 | 0.000** | 1,397 |
| AUTO: Transport industrial waste by Auto E-license (Yes = 1, No = 0) | -0.167 | 0.144 | 0.000** | - |
| AFR: Your disposal can be used as a renewable energy. (Yes= 1, No = 0) | 0.188 | 0.191 | 0.345 | - |
| ZLF: "The waste disposal that reduces landfills (Yes= 1, No = 0) | -0.060 | 0.148 | 0.376 | - |
| PRIC: Considered by the disposal price (Yes= 1, No = 0) | 0.030 | 0.207 | 0.888 | - |
| TCOST: Considered by the transportation price (Yes= 1, No = 0) | -0.052 | 0.182 | 0.823 | - |
| TDIST: Considered by the transportation distance (Yes= 1, No = 0) | 0.029 | 0.158 | 0.663 | - |
| Constant | 1.564 | 0.130 | 0.962 | - |
| Log likelihood | 1,438.810 | | | |
| Nagelkerke R Square | 0.136 | | | |
| Cox & Snell R Square | 0.097 | | | |
| Forecast accuracy (Step 1 Constant) | 71.6% | | | |

## 4.5 Conclusion

Waste disposal currently has a variety of service providers such as landfills, specialized incinerators. But now the circular economy approach is the one that wants to maximize the use of waste. Therefore, there are users who are interested in taking advantage of waste. Due to the emergence of the industry, WTE service providers, including Co-Processing and WTE-Power Plant were chosen to study in this research. The study results found that service users made decision to use industrial waste disposal service with WTE group in order to achieve the disposal of industrial waste and use it as a renewable fuel. The disposal rate and the factors that compensate for the disposal price were studied. From the study results, the user's Willingness to Pay will be 1,161 baht per ton of disposal, and the factor that compensates for the disposal price is the non-effecting environmental disposal. Additionally, the distance reflected the transportation price of 1,440 baht per ton at a distance of more than 80 km. The factor that compensates for the disposal price of non-affecting environmental disposal during the operation is estimated to be 1,397 baht per ton. The mentioned factors have a statistical significance to the customers' decision, strongly confirming that customers who use the service pay attention to the impact of eradicating industrial waste generated by its own business, and also think of the cost of transporting waste from the generators to the disposal service providers. When considering only the Co-Processing service provider, whose service has been additionally developed by the cement producer group, it is found that in Thailand, most of them are located in the central region of the country. Therefore, from the study results, the customer underestimated WTP than that of the WTA, but if considering the WTA value, the service users assessed the actual disposal price lower than the transportation price. Therefore, if the disposal price is increased, the service users probably choose the WTE-Power Plant service. This is confirmed from the results of this study stating that the group of power plant's location are closer to the industrial sites than Co-Processing manufacturers and are distributed throughout the country with their constantly developed technology and services. As a result, the findings of monetary value can be used to review disposal price of the current service. In addition, the service providers should develop factors potentially enhancing the attraction to use their service in the future.

Referring to the study results as summarized above, this study has some recommendations for Co-Processing service providers to create a policy that intensifies competition with the WTE-Power Plant service providers regarding industrial waste and waste disposal services to meet the needs of service users. Due to the ability to dispose of various types of waste in high volumes, Co-Processing is a large group service provider in Thailand and has international management standards in addition to service strength, called Zero Waste to Landfill. As waste and industrial waste will be eradicated and be instantaneously renewable energy in cement kilns, where ash from incineration will be mixed as raw material without anything to be disposed of. As a result, differentiation strategies should focus on niche markets, with a focus on customers who want to eliminate waste with zero waste to landfill. The study results revealed that the transportation rate of industrial waste disposal significantly influences customers' decision-making. Even though the transportation distance is farther, the customer still has the alternative industrial waste disposal service to use more than one industrial waste disposal service. Therefore, the Co-Processing group should revise the transportation price to be competitive in the long-distance transportation service as well as the consideration of other industrial waste types that can be used as a renewable energy source and alternative raw materials in cement kilns. Thus, the Co-Processing group should focus on waste service by providing a total solution for customers.

The limitations of this research: This study examines the Willingness to Accept service rates based on the worthy attributes for compensation as well as the Willingness to Pay for industrial waste disposal to WTE service providers. It is an overview study, not a specifically individual company study. Therefore, in future studies, other factors still need to be studied to meet customer expectations, such as factors influencing the selection of services involved in business, factors influencing technology adoption, and factors forecasting service selection.

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# CHAPTER V

# PREDICTION ON SELECTION OF INDUSTRIAL WASTE DISPOSAL SERVICE IN CEMENT KILN USING CUSTOMERS'EMPIRICAL DATA, ANALYZING BY RANDOM PARAMETERS WITH HETEROGENEITY IN MEANS AND VARIANCE

## 5.1 Abstract

Industrial waste disposal is conducted by Co-Processing in the Cement Kiln. This process can save resources and dispose of industrial waste in a way that is beneficial to the environment by using renewable energy and being a viable alternative to the cement industry in several countries. Nowadays, there is competition among industrial waste processors due to their increasing numbers. Therefore, this study aimed to investigate the significant factors related to forecasting the selection of industrial waste disposal services in Cement Kilns by developing random parameters with heterogeneity in means and variances. To our knowledge, there are no studies analyzing the selection of industrial waste disposal in Co-Processing. Thus, this analysis is a novel approach, able to reduce the least bias and incorrect inference that may lead to operation on effective dealing measures to explain individual relationships based on the differences of several customers. The questionnaires were completed by the customers. According to our findings, a statistically significant factor that customers considered was the image of industrial waste disposal processors by Co-Processing in Cement Kiln, and factors of distances from the waste processors had a significant role in customer decision, whereas the logistics job position may choose the service due to the E-license convenience. The limitation of the study is findings in Thailand. Co-Processing in other countries can use the research results and incorporate them into their strategic business plan in the future to ensure the sustainability of their service by Co-Processing in Cement Kilns.

## 5.2 Rationale of the research

Recently, sustainable industrial waste disposal tends to be managed through a circular economy with value-adding by turning waste into energy (Malinauskaite et al. 2019). While Waste to Energy refers to the use of waste heat as a renewable and primary fuel for power plants. Cement manufacturing companies can provide industrial waste disposal services in the form of Co-Processing in Cement Kilns. This operation is to take industrial waste into renewable fuel (Malinauskaite et al. 2017) which can reduce main fuel (coal) usage, conserve the resource, and dispose of industrial waste, to positively benefit the environment in the meantime. This is a good alternative for industrial waste disposal that is environmentally friendly, reduces landfills, and can be used to generate renewable energy for the cement industry in many countries.

In Thailand, there is a major strategic energy plan by the Ministry of energy (Energy Regulatory Commission, 2020) that has provided five master plans during the year 2018–2037 to promote the use of renewable energy for electricity production, leading to increasing numbers of waste energy power plants. There are also capable waste energy power plants that can handle industrial waste disposal and have the advantage of being close to manufacturing areas in terms of transportation distance. This is why there is an increasing number of waste energy power plants springing up across the country. According to data of industrial waste amount being disposed under control of Industrial waste Management Division, Department of Industrial Works (Department of industrial works, 2020b), it found that industrial waste amount in the year 2019 and 2020 which was legally disposed of did not tend to be increased. It is also claimed that the amount of industrial waste produced each year remains consistent, but there are more industrial waste disposal processors, resulting in intense competition in Thailand's industrial waste disposal market.

According to Table 5.1, we found that previous research had studied the possibility of waste disposal in Cement Kiln (Baidya et al. 2016; Kaddatz et al. 2013; Samolada & Zabaniotou, 2014; Viczek et al. 2020), waste management (Chen, 2019; Jin et al. 2006; Ku et al. 2009; Pek & Jamal, 2011; Rai et al.2019), and the study on renewable energy (Komarek et al.2011; Plum et al.2019; Siyaranamual et al. 2020). However, no studies have been conducted on the factors that are used to evaluate the possibility or predict the customer's choice of industrial waste disposal service in

Cement Kiln. In recent years, most research has focused on method, statistics, and advanced econometrics by utilizing unobserved heterogeneity to reduce the least bias and incorrect inference that may lead to operation on effective dealing measures. The study employs a random parameter model to account for heterogeneity in means and variances, as well as the variance of a random parameter to account for an unobserved difference, and there is the possibility of consideration. About the random parameter model, we will consider the difference of mean and variance, as well as model estimation by recommending functions to specify the probability of optional results for the prediction (Se et al. 2021). So, this research purpose would like to describe in-depth in business terms from customers' empirical data, which is individually different, to forecast industrial waste disposal service selection in a Cement Kiln This study will reduce the least amount of bias and incorrect inference. As a result, we used random parameters with heterogeneity in means and variances for the study to have a properly completed model for prediction. The research results will partly fulfill customer's business factors toward consideration on the selection of industrial waste disposal service by Co-Processing in Cement Kiln among the competition of various industrial waste disposal service providers in Thailand, which is the identity of this study. Processors of industrial waste disposal by Co-Processing in Cement Kiln can also implement research findings into their strategic business plans to create sustainability in their industrial waste disposal business operations and to generate future material resource sustainability (industrial waste).

**Table 5.1** Summary of previous studies on optional consideration of waste and energy management.

| Authors | Methodology | Type | Findings |
|---|---|---|---|
| Rai et al. (2019) | Choice Experiment | Household Waste | The study had done in Nepal regarding household waste disposal options since in many large cities, the private processors have received fees from each household. But in small towns, this service cannot be enabled because private processors cannot make a profit due to most of the waste is not being gathered together. The study had surveyed the options to determine a method of household waste gathering in a municipal area of eastern Nepal. Research result found that considerate factors are service price, distance, and frequency of service provision. |
| Pek and Jamal (2011) | Choice Experiment | Waste Disposal | Researchers had done the study in Malaysia because there is waste disposal, which has no control of pollution caused by the waste in this country where it is a source of this research. Referring to the purpose, researchers aimed to study the options of waste disposal to use as a strategic method. They began to study three recent waste disposal technologies, including 1. nonhygienic landfill, 2. hygienic landfill, and 3. kiln, using the choice experiment along with Compensating surplus (Cps), which mentioned the quality of recent and improved waste disposals. Factors used in the study are wastes disposal technology, prices, environment, pollution, and transport distance from waste generators to waste processors, consisting of 423 samples. Research result found that people wanted to have the waste disposal method without environmental impact by selecting hygienic landfill and kiln for waste disposal, while factors of wastes disposal technology and transport distance are significant toward the selection of waste disposal. |

**Table 5.1** Summary of previous studies on optional consideration of waste and energy management. (Continued)

| Authors | Methodology | Type | Findings |
|---|---|---|---|
| Siyaranamual et al. (2020) | Choice Experiment, Mixed logit (MXL) | Electricity Suppliers | Research was conducted in Bandung, Indonesia by studying on four Electricity suppliers who have different levels of voltage, duration of an outage, the electricity mix ratio of power planting, and monthly electricity bill, by analyzing Discrete choice experiment (DCE), in comparison between Mixed logit (MXL) and Latent class logit (LCL). Considering factors are rural electrification, electricity mix, monthly electricity bill, and the duration of an outage. The research result regarding the determining factors found that consumers are willing to pay more for an improvement of the electricity system. |
| Plum et al. (2019) | Choice Experiment | Renewable Energy Source | The research was conducted in Switzerland as turning energy into a sustainable system, including various energy resources; such as solar cell and wind energy, is the challenge. The research purpose is to study human behavior toward a selection of renewable energy source from recent technology using Choice Experiments (CE) for determining conditions and characteristics' priorities as follows: Electricity source, the location of electricity production, the operator of the plants, landscape impact, and the increase of monthly electricity bill, by letting respondents select such factors. The research result found that the key factor selected by questionnaire respondents is electricity source, and latent variables can be classified after rotation as follow: Pro renewables, pro Switzerland, moderates, contra status quo, and pro landscape |

**Table 5.1** Summary of previous studies on optional consideration of waste and energy management. (Continued)

| Authors | Methodology | Type | Findings |
|---|---|---|---|
| Komarek et al. (2011) | Choice Experiment | Relevant Characteristics of Renewable Energy | The study had done in America due to different affecting environmental changes such as Green House gas. Currently, energy use is an issue that needs to study and makes an attempt to reduce carbon emissions. So, the research objective is to study relevant characteristics of renewable energy as the part of environmental impact reduction. Studying factors are fuel portfolio mix, energy conservation effort, and carbon emissions reduction, analyzing by choice experiment (CE) to let questionnaire respondents do tradeoffs between condition's characteristics assigned by Strategies A and B, which determine the percentage of different renewable energy (Coal, biomass, wind, and solar), and different reduction ratio of carbon emissions. The research result found that respondents selected Strategy B, which reduced more carbon emissions. This result can be used to create policy-relevant renewable energy to plan for solar cell installment along with such plan later. |
| Samolada and Zabaniotou (2014) | Feasibility Study | Co-Processing | According to strict regulation of law by raising people's awareness on Municipal Solid Waste (MSW) disposal without environmental impact, waste disposal in Cement Kiln is an option with no environmental impact while disposing of, and it is more accepted by people rather than building new waste disposal manufacture. |

**Table 5.1** Summary of previous studies on optional consideration of waste and energy management. (Continued)

| Authors | Methodology | Type | Findings |
|---|---|---|---|
| Viczek et al. (2020) | Feasibility Study | Co-Processing | Solid Recovered Fuel (SRF) Waste disposal in Cement Kiln has no ash after Co-Processing, which turns to be material of cement production. It is popular and acceptable for environmental impact reduction while disposing of, as well as having the capacity to dispose of landfill waste. |
| Kaddatz et al. (2013) | Feasibility Study | Co-Processing | The use of industrial lubricants can reduce coal, which is the main fuel. There is no environmental impact while disposing of. It is alternative industrial waste disposal and renewable energy of Cement Kiln. |
| This study | Heterogeneity in the means of Random Parameter | Co-Processing | Factors used by customers to consider the service selection of industrial waste processors in Cement Kiln from the business aspect. |

## 5.3 Literature review

About the description of factors affecting a selection of industrial waste disposal services, for starters, we will mention customer service selection by using the behavioral model to explain human options. Each option will be evaluated for maximum utility, and the decision will be made based on Random Utility. The Utility Function, which is divided into two components, can be used to measure selection satisfaction. The first component is the Determinant Component (Train, 2009), and second is Random Component. Several researchers use these with the study on customer's options such as Reference (Yingkui et al. 2016), who studied customer's options using Utility Function on customer's selection of electrical power resources by renewable energy, mentioning that they had used Utility Function in the study because it is an economic theory. Reference (Revelt & Train, 1998) said that Mixed Logit (Random parameter logit) would have limited prediction result because it could not be freely described in the terms of the individual. That is conformed to Reference (Mannering et al. 2016) who stated that if unobserved heterogeneity is not taken into consideration whereas observe variable is limited, or individually different, which may affect study variables, the model will be evaluated insufficiently and incorrectly. As a result, the model will be incomplete and unsuitable for prediction. A random parameter model will be used, and the possibility of heterogeneity in means and variance, as well as correlated random parameter with heterogeneity in means, will be considered (Se et al. 2021). Referring to previous studies, it found that there are Unobservable factors that affect the bias of consideration e.g., (Chauhan & Singh, 2021) who studied the selection of hospital waste disposal by using Analytic network process, taking into account economic, social, and environmental factors according to the study's findings, the respondents' subjective biases may influence casual relationships and the study's criteria set. While (Vu et al. 2021) had used Neural Network models (RNN) to study waste disposal during the COVID-19 epidemic. The study's findings also revealed that it concentrated on the model of waste dumping ratio. Furthermore, there was no change in waste generation behavior, although the bias and the data variance of analysis was mentioned. If we considered renewable energy, it was found that (S. Li & Shao, 2021) had studied the innovation of renewable energy factor by using the negative binomial mode, due to the expected variable will be different from actual variance which is not according to model assumption. If we only consider previous studies on industrial waste disposal in Cement Kiln, there is no finding of a study on factors usage in the prediction of service selection, such as a study on the possibility of industrial waste disposal in Cement Kiln by (Aldrian et al.2020; Bogush et al.2020; Güereca et al.2015). However, there was a study mentioned about customer's options toward the selection of waste disposal service in Cement Kiln by considering two characteristics, consisting of waste disposal and the use of waste as renewable energy (Güereca et al. 2015; Guimarães et al.2018; Kosajan et al. 2021). As a result, it can be summarized that the purpose of this research is to examine customers' various empirical data using random parameters with heterogeneity in means and variances, because it is the most effective analysis on unobserved heterogeneity, and it can explain marginal utility, as well as support research on the relationship of various factors in the study. (Ye Li et al. 2021; Mannering et al. 2016) which is considered as identity of this study, regarding industrial waste disposal in Cement Kiln in term of business.

The purpose of this study is to identify factors used by customers when deciding on industrial waste disposal services by Co-Processing in a Cement Kiln. The following previous research will be fulfilled by the study. Reference (Baidya et al. 2016) mentioned that process of industrial waste disposal service by Co-Processing in Cement Kiln comes with a universal waste disposal system, and it can reduce environmental impact toward industrial waste disposal with Zero wastes to landfill, which are strengths of this service provision. It is conformed to (Bogush et al. 2020) who said that we should communicate to let customers know about the strength of Zero wastes to landfill, along with marketing promotion. It is by (Stafford et al. 2015); Viczek et al. (2020) who mentioned that encouraging intention to dispose of industrial waste in Cement Kiln should begin with waste disposal policy by promoting waste disposal image that can reduce environmental impact and cause no harm to waste disposal operators while disposing of, as well as encouraging intention on customers' benefit, which is they can turn waste into renewable energy. This is conformed to Reference (Elfaham & Eldemerdash, 2019), who said that wide recognition on solid waste disposal in Cement Kiln due to its environmental friendliness tends to grow for waste disposal in Cement Kiln. Reference (Xu et al. 2019) mentioned that the waste disposal problem is a considerate issue since there is more and more waste every year while disposing of Facility is not enough. Because cement production is widespread throughout the country, this characteristic of waste disposal in Cement Kiln is a better alternative to other waste disposal options. The disposal method in Cement Kiln is recognized, and it can reduce disposal impact. Another factor that should be mentioned is that Thailand's processors of industrial waste disposal by Co-Processing in Cement Kilns have a standard management system that is constantly being developed. This let them have the privilege to be allowed by the Department of Industrial Works to have an Auto E-license system (Department of industrial works, 2020a). Customers can use Auto E-license to automatically transport sewage or unused materials out of the manufacturing area. Customers can reduce waiting and approval time by the Department of Industrial Works by transporting industrial waste for disposal outside of the manufacturing area using this method. In comparison to the standard approval system, which takes 30 days, it is reduced to two official working days. Department of Industrial Works will only issue an Auto E-license system for waste disposal processors who meet the required standard, Reference of processors can be found at (Department of industrial works, 2020a). As a result, it can be concluded that these study factors will include customer basic factors of service selection decision (distance, customers can transport industrial waste disposal via Auto E-license, their waste can be used as renewable energy in Cement Kiln, reduce waste to landfill while disposing of, consider using service by disposal and transport fees), a factor of selecting industrial waste disposal by considering environmental aspect, as well as a factor of processor, previous experience on service usage, and processors’ image on industrial waste disposal by Co-Processing in Cement Kiln, as presented in Table 5.2.

**Table 5.2** Descriptive statistics and Variable description.

| Code | Variable | Value | Adapted from |
|---|---|---|---|
| | *Customer Selected (Dependent Variable)* | | |
| DV | Consider to select Co-Processing | 1 | - |
| | Not consider to select Co-Processing | 0 | - |
| | *Job position characteristics (1 = Yes, 0 = Others)* | | |
| O0 | Purchase | 1,0 | - |
| O1 | Engineering | 1,0 | - |
| O2 | Logistics | 1,0 | - |
| O3 | Environment | 1,0 | - |
| O4 | Production | 1,0 | - |
| O5 | Safety | 1,0 | - |
| O6 | Admin | 1,0 | - |
| O7 | Owner | 1,0 | - |
| O8 | Account | 1,0 | - |
| O9 | Government | 1,0 | - |
| O10 | Executive | 1,0 | - |
| | *Basic factors on cosideration of service selection (1 = Yes, 0 = Others)* | | |
| A1 | Consider to use service due to it is close to customer's location (< 80 km). | 1,0 | (Plum, Olschewski et al. 2019) |
| A2 | Consider to use service even though it is far from customer's location (> 80 km). | 1,0 | (Plum, Olschewski et al. 2019) |
| A3 | You can dispose industrial waste by Auto E-license. | 1,0 | (Cheunkamon, Jomnonkwao ,2020) |
| A4 | Your waste can be used as renewable energy. | 1,0 | (Baidya, Ghosh et al. 2016) |
| A5 | Reduce waste disposal to landfill. | 1,0 | (Baidya, Ghosh et al. 2016) |
| A6 | Considering by disposal cost. | 1,0 | (Menegaki 2012) |
| A7 | Considering by transport cost. | 1,0 | (Sheau-Ting, Mohammed et al. 2013) |
| A8 | Considering by transport distance. | 1,0 | (Plum, Olschewski et al. 2019) |

**Table 5.3** Descriptive statistics and Variable description.

| Code | Variable | Value | Adapted from | Mean | SD |
|---|---|---|---|---|---|
| | *Factor of Selection on Industrial Waste Disposal by considering Environmental Issue* | | | | |
| B1 | Your entrepreneur's environmental policy is a determining method for industrial waste disposal. | 1 - 5 | (Baidya, Ghosh et al. 2016, Ndebele 2020) | 4.578 | 0.018 |
| B2 | There is Zero Wastes to the landfill on the industrial waste disposal policy. | 1 - 5 | (Stafford, Viquez et al. 2015) | 4.443 | 0.022 |
| B3 | Do not want your industrial waste to affect the environment. | 1 - 5 | (Emmerich, Hülemeier et al. 2020) | 4.693 | 0.026 |
| B4 | Considering to select industrial waste disposal that can reduce environmental impact while disposing. | 1 - 5 | (Emmerich, Hülemeier et al. 2020) | 4.676 | 0.016 |
| | *Factor of Consideration on Service Providers Group* | | | | |
| B5 | Consider to select service by Reliability of Waste Disposal Processors. | 1 - 5 | (Basfirinci & Mitra, 2015) | 4.396 | 0.019 |
| B6 | Consider to select service by Management Standard of Waste Disposal Processors. | 1 - 5 | (Emmerich, Hülemeier et al. 2020) | 4.410 | 0.013 |
| B7 | Consider to select service by Reputation of Waste Disposal Processors. | 1 - 5 | (Basfirinci and Mitra 2015, Emmerich, Hülemeier et al. 2020) | 4.290 | 0.021 |
| | *Factor of Previous Experience* | | | | |
| B8 | From experience of service usage, you are impressed by sales representative's service. | 1 - 5 | (Komarek, Lupi et al. 2011) | 4.077 | 0.021 |
| B9 | From experience of service usage, you are impressed by transporter's service. | 1 - 5 | (Pomering and Johnson 2018) | 4.015 | 0.023 |
| B10 | From experience of service usage, you are impressed by industrial waste disposal manufacture's service. | 1 - 5 | (Bukova, Brumercikova et al. 2017) | 4.144 | 0.017 |

**Table 5.3** Descriptive statistics and Variable description. (Continued)

| Code | Variable | Value | Adapted from | Mean | SD |
|---|---|---|---|---|---|
| | Factor of Image of Waste Disposal Processors by Co-Processing in Cement Kiln. | | | | |
| B11 | Industrial waste disposal by Co-Processing in Cement Kiln is a good image in customer's point of view. | 1–5 | (Chonsalasin, Jomnonkwao et al. 2020) | 4.326 | 0.013 |
| B12 | Always impressive while disposing industrial waste by Co-Processing in Cement Kiln. | 1–5 | (Chonsalasin, Jomnonkwao et al. 2020) | 4.301 | 0.020 |
| B13 | Trust in the image of Industrial waste disposal by Co-Processing in Cement Kiln. | 1–5 | (Chonsalasin, Jomnonkwao et al. 2020) | 4.307 | 0.024 |

## 5.4 Methodology

About the probability of service selection, it can be considered by observed numbers being used in the survey on relevant factors of literature review. It found that the results of individual customers presented discrete outcomes. According to this research, we use the random parameter model method to consider the chance of heterogeneity in means and variance, along with correlation random parameter of heterogeneity in means, to analyze empirical data of random parameter, to seek the possibility of extraneous variables. For starters, we consider heterogeneity in means and variance to seek the probability of customer service selection on industrial waste disposal by Co-Processing in Cement Kiln, from Equation 5.1 (Revelt & Train, 1998).

$$S_{jm} = \beta_j X_{jm} + \varepsilon_{jm} \tag{5.1}$$

where $S_{jm}$ is chance to generate service selection on industrial waste disposal by Co-Processing in Cement Kiln with unobserved heterogeneity. While j denotes the level of selecting chance of the m factor. $\beta_j$ is vector for evaluation of Coefficients Xjm will present vector, which will describe different variables of this study such as customers will consider using service because it is close to their location, their waste can be converted into renewable energy, disposal by reducing waste to landfill, able to transport industrial waste disposal by Auto E-license, reliability of waste disposal processors, and previous experience on service usage, and so on. The mentioned factors will affect to chance of service selection. Also, $\varepsilon_{jm}$ is a standard error. We may say that such an equation is a chance of random parameter logit model to consider unobserved heterogeneity, which results in a possible chance of service selection from random parameter logit model. It can be found in Equation 5.2 (Washington et al. 2020)

$$P_m(i) = \int \frac{EXP(\beta_j X_{jm})}{\sum_{\forall j} EXP(\beta_j X_{jm})} f(\beta|\varphi) d\beta \tag{5.2}$$

When Pm(j) is the probability of service selection j, industrial waste disposal by Co-Processing in Cement Kiln m. While $f(\beta|\rho)d\beta$ presents density function of $\beta$, and $\rho$ is vector of the parameter (mean and variance). Referring to the possibility of unobserved heterogeneity in random parameter means and variances, we consider $\beta_{jm}$, which is a vector for parameter estimation of various factors toward service selection, as shown in Equation 5.3. (Washington et al. 2020)

$$\beta_{jm} = \beta_j + \gamma_{jm} Z_{jm} + \sigma_{jm} EXP(\omega_{jm} W_{jm}) V_{jm} \tag{5.3}$$

When $\beta_j$ is a mean parameter that evaluates various factors of service selection, Zjm is a vector describing several variances of heterogeneity in mean, influencing customer's consideration on service selection from j level. While $\gamma_{jm}$ presents a vector that will estimate a parameter. Also, Wjm is a vector of the customer's considering factor, which explains the variance of $\sigma_{jm}$ by considering heterogeneity which is relevant to vector $\omega_{jm}$, and $V_{jm}$ presents a disturbance term. Referring to each correlation of random parameter, standard error and t-statistics of standard deviation ($\sigma_m$) can be calculated from Equation 5.4 (Washington et al. 2020).

$$SE = \frac{S\sigma_m}{\sqrt{N}} \tag{5.4}$$

When $S\sigma_m$ is a standard deviation of observation-specific, and N is the number of examples of studying model, as presented in Equation 5.5.

$$t_{\sigma r} = \frac{\sigma_r}{SE_{\sigma R}} \tag{5.5}$$

The Akaike Information Criterion was used to calculate the overall image of goodness-of-fit in this study, which used the Simulated Maximum Likelihood Estimation method with 200 Halton (AIC), Akaike Information Criterion corrected (AICc), McFadden

$\rho^2$, and Chi-square test ( $\chi^2$), details as shown in Equation 5.6–5.10 (Washington et al. 2020).

$$AIC = -2LL(\beta) + 2K \tag{5.6}$$

$$AIC_c = AIC + \frac{2K(K+1)}{(N-K-1)} \tag{5.7}$$

$$\rho^2 = 1 - \frac{LL(\beta)}{LL(0)} \tag{5.8}$$

$$Corrected\,\rho^2 = 1 - \frac{LL(\beta) - K}{LL(0)} \tag{5.9}$$

$$\chi^2 = -2\left[LL(\beta_A) + -2LL(\beta_B)\right] \tag{5.10}$$

When LL ( $\beta$ ) is Log-Likelihood of convergence, K is the numbers of parameters, N is the numbers of a sample of this study, *LL (0)* is log-likelihood by considering only constant, $LL(\beta_A)$and $LL(\beta_B)$are log-likelihood, which will consider the convergence of Model A with Model B, about a value presenting the degree of freedom that is equal to the number of parameters of Models A and B in comparison, and presents a degree of freedom that is equal to the number of parameters of Models A and B in comparison.

## 5.5 Survey design

The survey design has taken factors relevant to service selection on industrial waste disposal in Cement Kilns, which are the results of a literature review, and applied them to a questionnaire study on customers. Each question will inquire about the overall characteristics of industrial waste processors by Co-Processing in Cement Kilns, rather than specific questions for each processor. The questionnaire is divided into three parts. Part one is general information of respondents consisting of gender, age, education level, and job position. Part two consists of factors that customers consider when selecting a service, with a 2-choice answer, 1 being considering and 0 being Not considering, as well as 8 latent variables. (1) Service consideration due to its proximity to the customer's location (> 80 Km); (2) Consideration of using industrial waste disposal service by Co-Processing in Cement Kiln despite its distance from the customer's location (> 80 Km), (3) Your waste can turn into renewable energy, (4) Waste disposal by reducing waste to landfill (5) Service consideration by disposal cost, (6) Service consideration by transport cost, (7) Service consideration by transport distance, and (8) Service consideration due to it can be transported via Auto E-license. Part three requires you to respond using a 5-point Likert scale (5 = Most agree, 1 = Least agree), and includes four factors: (1) factor of selection on industrial waste disposal by considering environmental aspects, including latent variables as follows: Environmental policy of your entrepreneur is a method to determine industrial waste disposal, There is the policy of Zero Wastes to landfill for industrial waste disposal, Do you want your industrial waste to have an impact on the environment? Consider choosing industrial waste disposal that can reduce environmental impact while disposing of. (2) Consideration factor for processors, including latent variables, as follows: Service consideration based on waste disposal processor reliability, service consideration based on waste disposal processor management standards, and service consideration by the reputation of waste disposal processors, (3) Factor of previous experience on service usage, variables consisting of from your experience, you are impressed by sales representative’s service, You are impressed with the transporter's service based on your experience. You are impressed by the service provided by industrial waste disposal manufacturers based on your experience, and (4) Factor influencing processors' perceptions of waste disposal by Co-Processing in Cement Kiln, including in the eyes of customers, industrial waste disposal service through Co-Processing in Cement Kiln has a positive image. Always impressed when disposing of industrial waste by Co-Processing in Cement Kiln, and believe in the image of industrial waste disposal service by Co-Processing in Cement Kiln. Also, dependent variable in this study is selecting industrial waste disposal service by Co-Processing in Cement Kiln, including 2-choice answering: 1 is considering to use service, and 0 is not considering to use service.

Data collection is done by online questionnaire via Google form. Following customer listings of one industrial waste processor who is the leader of waste disposal management by Co-Processing in Cement Kiln, 2,000 questionnaires were sent via Email and Line Application by customer service sections and sales representatives to customers who have used industrial waste disposal service by Co-Processing in Cement Kiln. Target groups are recent customers and ex-customers including manufacture, cargo, company, government sector, and educational institute, covering all regions of Thailand. Questionnaires are divided by the number of customers from customer lists in each country region, along with customer proportion. The survey and data collection took place between April and July of 2021. This study was approved by the Suranaree University of Technology's Human Research Ethics Committee, COA No13/2564, and NLogit Program version 6 was used to analyze data from the questionnaire.

## 5.6 Model result

Table 5.3 demonstrates the capability of five models: 1. Fixed Effect Model (FEM), 2. Random Effect Model (REM), 3. Random Parameter Model (RPM), 4. Random Parameter Heterogeneity in Means, and 5. Random Parameter Heterogeneity in Means and Variances (RPMHMV). The outcomes considered Log-likelihood ( $\beta$ ) of each model which is approaching 0 the most, as well as considering $\rho^2$ and corrected $\rho^2$ of a model with the highest value, then considering AIC and AICc of the lowest values of each model. According to the study results, the RPMHMV model is the best of all models in this study. As a result, conforms to Se et al. (2021),Ye Li et al.(2021) Referring to the study results in Table 5.4 we discovered that the constant is significant when we consider the characteristic factor of respondents' job positions. The job position has significant. According to the attitude found significant variable including two variables of environment issue, two variables of Service Providers issue, one of Previous Experience issue and two variables of Image of Waste Disposal Processors by Co-Processing in Cement Kiln.

**Table 5.4** Statistic-fit and likelihood ratio test.

| | FEM | REM | RPM | RPMHM | RPMHMV |
|---|---|---|---|---|---|
| *Model-fit statistic* | | | | | |
| Number of observations | 1251 | 1251 | 1251 | 1251 | 1251 |
| Number of estimated parameters, k | 28 | 29 | 29 | 32 | 34 |
| Likelihood at zero, LL(0) | -777.814 | -777.814 | -777.814 | -777.814 | -777.814 |
| Likelihood at convergence, LL(B) | -619.026 | -619.026 | -613.608 | -605.909 | -601.648 |
| McFadden, $\rho^2$ | 0.2041 | 0.2041 | 0.2111 | 0.2210 | 0.2265 |
| Adjust-McFadden, $\rho^2$ | 0.1681 | 0.1669 | 0.1738 | 0.1799 | 0.1828 |
| Akaike Information Criterion | 1294.052 | 1296.052 | 1285.216 | 1275.818 | 1271.296 |
| Corrected Akaike Information Criterion | 1295.381 | 1297.477 | 1286.641 | 1277.552 | 1273.253 |
| *Likelihood ration test* | | | | | |
| | FEM vs RPMHMV | REM vs RPMHMV | RPM vs RPMHMV | RPMHM vs RPMHMV | |
| Degree of freedom | 6 | 5 | 5 | 2 | |
| Resulting, $\chi^2$ | 34.76 | 34.76 | 23.92 | 8.52 | |
| Level of confidence | 1.00 | 1.00 | 0.9998 | 0.9859 | |
| Statistically superior model | RPMHMV | RPMHMV | RPMHMV | RPMHMV | |

*Noted: FEM = Fixed parameter estimation model, REM = Random effect model (random intercept only), RPM = Random parameter model, RPHM = Random parameter Heterogeneity in the means, RPHMV = Random parameter Heterogeneity in mean and variances.*

- The following are the primary factors to consider when deciding on a service: This factor should be studied to see if there are any factors that customers consider when choosing an industrial waste disposal service in a Cement Kiln. Study results as shown in Table 5.4 found that factors of close or far distances from the group of industrial waste disposal processors by Co-Processing in a Cement Kiln to customer's company have significance toward customer's decision.
- The factor of selection on industrial waste disposal: Study result on environmental issue consists of two variables with a statistical significance, which is that there is a zero-wastes to landfill policy in place for industrial waste disposal, and it is being considered to choose industrial waste disposal that can reduce environmental impact at 0.05 statistical significance.
- Accountant went the Factor of Consideration on service Providers; it was discovered that two significant variables, including considering to select service by Reliability of waste Disposal Processors and considering to select service by reputation of waste disposal processors, were significant variables.
- The factor of previous experience on service usage found that variable of from previous experience on service usage, you are impressed by transporter's service, with 0.10 statistical significance.
- The factor of processors' image on industrial waste disposal by Co-Processing in Cement Kiln found that there are two factors with 0.01 significance which are: Always impressive when disposing of industrial waste by Co-Processing in Cement Kiln and believe in the image of industrial waste disposal by Co-Processing in Cement Kiln.
- Means for random parameters found that only one variable with a statistical significance is Auto E-license.
- Scale parameters for the distribution of random parameters: Study results found that the variable of you can transport industrial waste to dispose of via Auto E-license has 0.1 statistical significance. Furthermore, while means for random parameters (0.734) and the variance of scale parameters for the distribution of random parameters (0.873) were used to plot the normal distribution curve, it was discovered that customers chose service because they can transport industrial waste to be disposed of by Co-Processing in Cement Kilns with a 79.99% chance of success (above zero).

• Heterogeneity in the means of random parameter: the results found that three factors could reduce the parameter mean of the Auto e-license, which includes considering disposal cost, Logistics Job Position. While Engineering Job Position can increase the mean.

**Table 5.5** Result of RPMHMV.

| Code | Parameter Estimate | t-stat | Marginal Effect |
|---|---|---|---|
| Constant | -5.582 | -8.13 | |
| O4 | 0.643 | 2.86 | 0.0862 |
| O6 | 0.547 | 1.85 | 0.0729 |
| A1 | 0.677 | 5.50 | 0.1026 |
| A2 | 0.775 | 6.15 | 0.1162 |
| A8 | 0.325 | 2.26 | 0.0467 |
| B2 | 0.168 | 1.98 | 0.0243 |
| B4 | -0.360 | -2.19 | -0.0522 |
| B5 | -0.315 | -2.02 | -0.0457 |
| B7 | 0.231 | 2.25 | 0.0334 |
| B9 | 0.212 | 1.93 | 0.0307 |
| B12 | 0.503 | 3.72 | 0.0728 |
| B13 | 0.787 | 5.09 | 0.1141 |
| *Means for random parameters* | | | |
| A3 | 0.734 | 2.73 | |
| *Scale parameters for distribution of random parameters* | | | |
| A3 | 0.873 | 1.79 | |
| *Heterogeneity in the means of random parameters* | | | |
| A3:A6 | -0.696 | -2.53 | |
| A3:O1 | -0.704 | -2.24 | |
| A3:O2 | 1.248 | 2.17 | |
| *Heterogeneity in the variances of random parameters* | | | |
| A3:B11 | 0.566 | 4.67 | |
| A3:B8 | -0.398 | -4.14 | |

• Heterogeneity in the variances of random parameters: the results found that “Industrial waste disposal by Co-Processing in Cement Kiln is a good image in customer’s point of view” increasing variance of the parameter of Auto-E-License.

While the "from experience of service users you are impressed by sales representative's service" reduce the variance.

## 5.7 Discussion

To study factors customers use for considering selection on industrial waste disposal service in Cement Kiln, the studying factors consist of customer's basic factor on the decision of service selection (distance, ability to transport industrial waste to dispose of via Auto E-license, customer's waste can be used as renewable energy in Cement Kiln, it is zero waste to landfill, and service considering disposal and transport costs), a factor of considering to select industrial waste disposal by environmental issue, a factor of considering by processors group, a factor of previous service usage experience, and factor of image of industrial waste disposal processors by Co-Processing in Cement Kiln.

### 5.7.1 Factor of considering to select industrial waste disposal by environmental issue

The factor with statistical significance that customers consider on industrial waste disposal service by environmental issue consists of two variables; the variable of "industrial waste disposal by Zero Wastes to landfill policy" is more likely to choose waste disposal service in a Cement Kiln (WDSCK). It is conformed to Baidya et al. (2016); Kosajan et al. (2021); Samolada and Zabaniotou (2014); Viczek et al. (2020) who also said that it is industrial waste disposal that reduces the amount of waste to landfill.

While another statistically significant variable that "customers consider by environmental issue is considering to select industrial waste disposal which can reduce environmental impact while disposing of" is less likely to select WDSCK. It is in consists of Aldrian et al. (2020); Hasaballah et al. (2021); Kosajan et al.. (2021); Kosajan., et al. (2021); Viczek et al. (2020) who stated that waste disposal by Co-Processing in Cement Kilns is an environmentally friendly method. The possible reason could be that each company's environmental action is different; there are many ways to respond to this policy, such as Material-cycling Society, Reducing, and Reusing for some products. As a result, WDSCK is not a strong choice for a manufacturer's environmental action.

**5.7.2 Factor of previous experience on service usage**

According to the findings of the study, the variable with statistical significance in terms of customer decision are impressed by the transporter's service based on previous service usage. It is by the customer suggestion described in the questionnaire response that "Appropriate cost and quality of waste transport vehicle are a reputation of waste disposal company." Also, there is a customer suggestion under this, saying that "Assign middle person, work on marketing to shorten transport distance, and use every cement manufacture in Thailand to utilize every kiln from all manufactures." It is harmonized with research on renewable energy by Reference (Abaecherli et al. 2017) who mentioned that industrial waste can be used as renewable energy. If the distance between a power plant and the industrial waste source is short, it will save a lot of money on transportation. The majority of cement manufacturers in Thailand are concentrated in the central region. It necessitates the transportation of industrial waste from provinces and regions where customers are located to a Cement Kiln in the central region. Due to the long-distance, it results in high transportation costs for industrial waste. However, the study result can confirm that customers are impressed by the industrial waste disposal service of transporters from their previous experience on service usage.

**5.7.3 Factor of considering on service usage by the image of processors**

Regarding the factor of considering to use service by the image of processors, it was discovered that there are two significant factors, which include variables such as always impressive while disposing of industrial waste by Co-Processing in Cement Kiln, and trust toward the image of industrial waste disposal by Co-Processing in Cement Kiln. A factor of processors is used to consider along with the factor of Perceived benefit and technology acceptance, which is following the study of Huijts et al. (2014). While there are nine processors of industrial waste disposal by Co-Processing in Cement Kilns are mainly located in central Thailand (Department of industrial works, 2020a; Energy Regulatory Commission, 2020). Along with its continuous development, there is a standard management system of the processor's group of industrial waste disposal by Co-Processing in Cement Kiln. (Department of industrial works, 2020a) which is also conformed to (Baidya et al. 2016) who said that industrial waste disposal by Co-Processing in Cement Kiln has been accepted for its image, and there is also spreading of industrial waste disposal by Co-Processing in Cement Kiln worldwide. As a result, the purpose of this study is to demonstrate that customers intend to use service by taking into account the factor of the image of industrial waste disposal processors from the processor's group of industrial waste disposal by Co-Processing in Cement Kiln.Factor of customers can transport industrial waste to dispose of via Auto E-license Concerning the study's findings, it can be confirmed that a variable of able to transport industrial waste to dispose of via Auto E-license has statistical significance toward the customer's decision because there is a standard management system of processors group of industrial waste disposal by Co-Processing in Cement Kiln, as well as its continuous development. This lets processors have privilege on the Auto e-license system by the Department of Industrial Works. By this system, customers can automatically transport sewage or unused materials out of the manufacturing area through an e-system. Customers can reduce the amount of time they have to wait for approval from the Department of Industrial Works to transport industrial waste outside of the manufacturing area by using this method of industrial waste disposal transport. In comparison to a standard approval process, this will take only two official working days rather than 30-days, and the Department of Industrial Works will only issue an Auto e-license system to waste disposal processors who meet the Department's standards. Reference of processors can be found at (Department of industrial works, 2020a).

**5.7.4 Factor of transport distance**

According to the findings of this study, there is a significant number of customers who consider selecting industrial waste disposal service in Cement Kiln (WDSCK) based on the distance variable, which is conformed to Reference (Menegaki, 2012) who stated that factor of processor’s location which can respond to consumer’s behavior by accessibility and convenience. While the location is highly important to customers who will use the service, and distance is one of the transport costs as well (Oflac et al. 2015).

### 5.7.5 Factor of consideration on service providers group service providers

"Consider selecting service based on waste disposal processor reliability" is less likely to select WDSCK. As a result, (Samolada and Zabaniotou., 2014) remain convinced that the WDSCK is widely accepted. The European Cement Industry allows for water disposal through cement Co-Processing to reduce environmental impact. While the "considering to select service by reputation of waste disposal processors" is more likely to select WDSCK. When compared, this result shows that the customer values reputation more than reliability. This is consistent with Emmerich et al. (2020), who discovered that reputation is one of the factors influencing public acceptance of energy technology integration.

## 5.8 Conclusions and strategic management

Previous studies toward industrial waste disposal in Cement Kilns found no study on factors used for prediction on the selection of industrial waste disposal service in Cement Kiln. As a result, this study will investigate business-related factors to forecast the selection of industrial waste disposal services in Cement Kilns. To reduce bias and incorrect inference, the predicting model was studied using random parameters with heterogeneity in means and variances. This study results will partly fulfill business factors of the previous studies on industrial waste disposal in Cement Kiln, which is considered as the identity of this research. Furthermore, the study results strongly confirm the factors generated from the literature review that affect customer service selection, as it can predict service selection by significant factors of this study, and it can be used for strategic management planning of processors as follows.

About study result on seeking for factors that are used by customers to select industrial waste disposal service by Co-Processing in Cement Kiln, for starter, we examined the job position and discovered that it is positively and statistically significant toward the customer's decision, which includes officers from Logistics, Production, and Administration. While basic factors to consider for service selection include a factor of transportation distance, a factor of choosing industrial waste disposal based on environmental concerns, including customer's industrial waste disposal policy is Zero Wastes to landfill, and considering to dispose of industrial waste, which can reduce environmental impact while disposing of. Considering by waste disposal service provider's reliability, and considering by waste disposal service provider's standard management are two factors that customers consider when selecting a processor. Also, if customers have previous experience with service usage, it was discovered that they are impressed by the transporter's industrial waste disposal service, and a statistically significant factor that customers consider is the image of industrial waste disposal processors by Co-Processing in Cement Kiln. According to the study, it found that customers are always impressed while disposing of industrial waste by Co-Processing in Cement Kiln, and they trust in the image of industrial waste disposal by Co-Processing in Cement Kiln.

Strategic planning of industrial waste disposal processors through Co-Processing in Cement Kilns can be considered using the study results to plan for a Competitive Strategy of service provision. According to the findings of this study, customers consider the following factors when choosing industrial waste disposal service by Co-Processing in Cement Kiln. If we consider the Marginal Effect, it found that first, customers will consider the reputation of waste disposal processors. As a result, processors should concentrate on improving their reputation, such as through the Department of Industry Works' improvement project for industrial waste disposal processors, in which waste processors will be selected, as well as an assessment of their level. If the processors meet the criteria, they will be awarded bronze, silver, and gold medals. The processors can take these rewards for their advertisement and communicating channels toward customers, to build their reputation of industrial waste management standards on customers. Furthermore, for a factor of reputation of waste disposal processors by Co-Processing in Cement Kiln, we should focus on customers who have zero-wastes-to-landfill policy or Niche Market Strategy, emphasize on the specific market group by creating value of industrial waste disposal service that responds to demand of specific customers group. Customers can take the number of wastes which is decreased from landfill and they can take the number of waste disposal by renewable energy method following circular economy as well. These proposed issues will be used to improve the reputation of waste disposal processors through Co-Processing in Cement Kilns. The convenience they have received by using Auto E-license, which is much time saving, from regular 30-day to 2 official working days approval, is the next factor that customers consider when selecting service. By considering a normal distribution curve (from the number which is over zero), it found that customers decide to select service because they can transport waste to dispose to processors by Co-Processing in Cement Kiln via Auto E-license, with the chance as high as 95.32%. However, 4.68% may not choose the service due to the convenience of the E-license. As a result, waste processors should focus on communicating with customers to inform them of the benefits of using the Auto E-license service when transporting industrial waste to be disposed of in a Cement Kiln. Furthermore, the study results confirm that customers consider selecting service because industrial waste disposal is a positive image in their sight. Therefore, if waste processors can make customers realize more about the image of waste disposal processors by Co-Processing in Cement Kiln toward Zero Wastes to landfill, it will affect more to their image toward customers as well. It is conformed to several researchers such as (Baidya et al. 2016; Bogush et al. 2020; Gu et al. 2021; Güereca et al. 2015; Guimarães et al. 2018; Yeqing Li et al. 2012) who mentioned that processors of Co-Processing in Cement Kiln have a strength of Zero Wastes to landfill. Also (Kosajan et al. 2021) described that an increase in urban population causes limitation on kiln building in such areas. Furthermore, based on previous experiences, such as waste disposal to landfills, there is a waste volume capacity limitation. Many landfills must halt waste disposal because they have reached their maximum landfill capacity. As a result, waste disposal in Cement Kilns can reduce landfilling while also being environmentally friendly. There is also a remark from study result that found the factor of considering to select industrial waste disposal that can reduce environmental impact while disposing of is statistically significant but it has negative Marginal Effect which is conformed to customer suggestion in the questionnaire, saying that "They should increase online promotion, and easy accessibility to gain recognition and knowledge of this disposal method." This result indicates that customers continue to be unable to distinguish the differences and strengths of each group of service providers. According to the study findings, the representative plays an important role in communication and creating a true understanding of the customer. Furthermore, the respondent's comment suggested that the representative must be good at cooperating with the customer to ensure that they can solve all of the obstacles during the Co-Processing process.

Currently, there is high competition among Thailand industrial waste processors who have similar standards. Recently, waste energy power plants have received a lot of attention due to their proximity to customers and short distances. Customers have also expressed concern about the environmental friendliness of disposal. These become an issue that industrial waste disposal processors should consider, emphasizing the importance of developing a differentiation strategy for industrial waste disposal. Differentiation strategy is to operate the business by focusing on value-adding to product or service, to make the industrial waste disposal service by Co-Processing in Cement Kiln different or outstanding from other waste processors in the market, to emphasize the importance of informing customers about the strength of industrial waste disposal services by Co-Processing in Cement Kilns, which can reduce environmental impact while disposing of Finally, a transport factor that helps customers save money on transportation is that Milk runs transport for small-size customers who have less industrial waste but still want to use industrial waste disposal service in Cement Kiln, which requires long-distance transport. So, we can manage by having one vehicle pick up industrial waste from several small-size customers by identifying and distinguishing types of industrial waste and waste Generators from the vehicle. Customers will be able to reduce their transportation costs by sharing with other customers under such management. There is also a transport method known as backhaul, in which customers transport ash to be disposed of in a Cement Kiln. Backhauling allows us to transport cement products on the way back. That management will save customers' transport costs, and reduce backhaul driving. About such strategy, industrial waste processors in Cement Kiln can take it into strategic planning toward service provision while they can manage the priority from Marginal effect, and consider factors with empirical data significance of this study, to enable processors for the highly competitive situation among various processors nowadays, as well as to generate business sustainability in future.

This research results mentioned customers' various individual business factors toward consideration to select industrial waste disposal service by Co-Processing in Cement Kiln. While this study is a model referring to the Thai study, researchers from other continents can use the research results to study further other dimensions and factors using it as a model in their future study, because industrial waste disposal by

Co-Processing in Cement Kiln is a technology that can dispose of waste while also converting it into renewable energy in Cement Kiln. It is also well-known and reputable in many different parts of the world.

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# CHAPTER VI

# CONCLUSION AND RECOMMENATIONS

Cement manufacturing companies can provide industrial waste disposal services in the form of Co-Processing in Cement Kilns. This operation is to take industrial waste into renewable fuel which can reduce main fuel (coal) usage, conserve the resource, and dispose of industrial waste, to positively benefit the environment in the meantime. This is a good alternative for industrial waste disposal that is environmentally friendly, reduces landfills, and can be used to generate renewable energy for the cement industry in many countries. Recently, competitors who are waste energy power plant could also take industrial waste into energy by having close transport distance to industrial waste source so they can save much cost of transportation. However, it found that amount of industrial waste was not increased yearly so it caused high competition among service providers of industrial waste disposal in the country.

The objectives of this research, 1). Develop model for Structural Equation Model of factors influencing the selection of industrial waste disposal service in Cement Kilns. 2). To study Factors affecting to acceptance of Industrial Waste Disposal Service in Cement Kiln. 3). To Study WTP and WTA. 4. To study prediction on Selection of Industrial Waste Disposal Service in Cement Kiln. This study is therefore divided the studies into 4 dimensions which can be summarized as follows.

Study 1: Result from model of factors influencing the selection of industrial waste disposal service in Cement Kilns. The results showed that the factors of price, place, promotion, people, and physical of Marketing mix theory potentially explained the causal relationship to the Intention to choose the service. At the same time, the intention to choose the service was mutually studied with subject norm, attitude of the Theory of Planned Behavior, and supplemented by the factors of perceived ease of use and perceived usefulness in using the service. The Technology Acceptance Model can explain a causal relationship to attitude factor.

In addition, the overview of statistics in this study potentially confirms that the empirical data and the established model from the literature review are consistent Strategic planning should focus on customers who have Zero Wastes to landfill policy because of The study found that customers' intention to utilize the service from factor customers gave importance to being a waste disposal with zero waste to landfill in Cement Kiln and used the service because of its relevance to the circular economy.

Study 2: Result Factors Affecting to Acceptance of Industrial Waste Disposal Service in Cement Kiln, this research is to study and confirm relation between factor of Customer acceptance on using industrial waste disposal service by Co-Processing in Cement Kiln, and relevant factors from hypotheses obtained by literature review in comparison to the empirical data. Research result found that statistical significance of variables used in this study is 0.001 which confirms that the observed variables of this study can strongly and causally explain the factors affecting to customer acceptance toward industrial waste disposal service by Co-Processing in Cement Kiln. Study result found that latent variable of factor of Perceived value on industrial waste disposal service by Co-Processing in Cement Kiln positively influences to factor of Acceptance on using industrial waste disposal service by Co-Processing in Cement Kiln is the highest. While factor of Perceived risk from service usage is the second. Then factor of Zero waste to landfill policy positively influences to factor of acceptance service usage is the least. Also, all factors are statistically significant, Service providers. Strategic planning should focus on Niche Market which has policy on Zero waste to landfill, we found that factors of Customer Trust in Industrial Waste Disposal Technology by Co-Processing in Cement Kiln, and Service Provider Group have the highest factor loading. It is to confirm that customers trust in Service Provider Group so they should particularly place importance on this factor to build Customer's Trust. Next, factor with high factor loading is Value Perception of Service Usage of Industrial Waste Disposal

Technology by Co-Processing in Cement Kiln which can also confirm that customer place importance on this factor as priority.

Study 3: The study results found that service users made decision to use industrial waste disposal service with WTE group in order to achieve the disposal of industrial waste and use it as a renewable fuel. The disposal rate and the factors that compensate for the disposal price were studied. From the study results, the user's willingness to pay will be 1,161 baht per ton of disposal, and the factor that compensates for the disposal price is the non-effecting environmental disposal. Additionally, the distance reflected the transportation price of 1,440 baht per ton at a distance of more than 80 km. The factor that compensates for the disposal price of non-affecting environmental disposal during the operation is estimated to be 1,397 baht per ton. The mentioned factors have a statistical significance to the customers' decision, strongly confirming that customers who use the service pay attention to the impact of eradicating industrial waste generated by its own business, and also think of the cost of transporting waste from the generators to the disposal service providers. When considering only the Co-Processing service provider, whose service has been additionally developed by the cement producer group, it is found that in Thailand, most of them are located in the central region of the country. Therefore, from the study results, the customer underestimated WTP than that of the WTA, but if considering the WTA value, the service users assessed the actual disposal price lower than the transportation price. Therefore, if the disposal price is increased, the service users probably choose the WTE-Power Plant service.

Study 4: Result Prediction on Selection of Industrial Waste Disposal Service in Cement Kiln, about study result on seeking for factors that are used by customers to select industrial waste disposal service by Co-Processing in Cement Kiln, for starter, we examined the job position and discovered that it is positively and statistically significant toward the customer's decision, which includes officers from Logistics, Production, and Administration. While basic factors to consider for service selection include a factor of transportation distance, a factor of choosing industrial waste disposal based on environmental concerns, including customer's industrial waste disposal policy is Zero Wastes to landfill, and considering to dispose of industrial waste, which can reduce environmental impact while disposing of. Considering by waste disposal service provider's reliability, and considering by waste disposal service provider's standard management are two factors that customers consider when selecting a processor. Also, if customers have previous experience with service usage, it was discovered that they are impressed by the transporter's industrial waste disposal service, and a statistically significant factor that customers consider is the image of industrial waste disposal processors by Co-Processing in Cement Kiln. According to the study, it found that customers are always impressed while disposing of industrial waste by Co-Processing in Cement Kiln, and they trust in the image of industrial waste disposal by Co-Processing in Cement Kiln. Strategic planning of industrial waste disposal processors by Co-Processing in Cement Kiln can be considered by taking this study result to plan for Competitive Strategy of service provision. Referring to this study result, it can strongly confirm that customers consider selecting industrial waste disposal service by Co-Processing in Cement Kiln from the following factors. If we consider the Marginal Effect, it found that first, customers will consider the reputation of waste disposal processors. Strategic planning should focus on customers who have Zero Wastes to landfill policy or Niche Market Strategy, if consider the study result it is confirmed that the representative play important role for the communication and creating the true understanding of customer. Moreover, the comment by the respondent suggest that the representative must be good for the cooperate with the customer, to assure they can solve all of obstacle during the Co-Processing process.

# APPENDIX A

# LIST OF PUBLICATIONS

## List of Publications


Suksanguan, U., Siwadamrongpong, S., Champahom, T., Jomnonkwao, S., Boonyoo, T., & Ratanavaraha, V. (2022). Structural Equation Model of Factors Influencing the Selection of Industrial Waste Disposal Service in Cement Kilns. Sustainability, 14(7), 4109. Retrieved from https://www.mdpi.com/2071-1050/14/7/4109.

Suksanguan, U., Champahom, T., Jomnonkwao, S., Se, C., & Ratanavaraha, V. (2022). Predicting the Selection of Industrial Waste Disposal Service in Cement Kiln Using a Random Parameters Approach with Heterogeneity in Means and Variances. Process Safety and Environmental Protection.

# BIOGRAPHY

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