

Recycling Gypsum Waste into Eco-Friendly Buddhist Stucco Interior Design for Small and Medium-Sized Enterprises

By

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Abstract

Recycling can improve construction waste. This study developed prototypes of recycled gypsum into eco-friendly interior designs for creative SMEs, adopting local Buddhist stucco patterns as artistic models. A mixed-methods research design revealed these key findings. The recycling and recreating of gypsum waste for interior decoration yields four prototypes (namely, a cone pattern, a lotus pattern, a swan pattern, and a rhombic pattern). In terms of market viability, the potential customers were highly satisfied with all prototypes: swan pattern ($\bar{X}=4.89$), lotus pattern ($\bar{X}=4.85$), rhombic pattern ($\bar{X}=4.80$), and cone pattern ($\bar{X}=4.77$). The SWOT analysis revealed that the prototypes' strengths lie in aesthetics, uniqueness, attractiveness, colors, price, exclusiveness, stylishness, and fit for decoration. Weaknesses lie in the cone pattern's usability, beauty, and safety and maintenance. Opportunities lie in the 11,824 selling points nationwide and eco-friendly products. The potential threat lies in the slow economic recovery.

Keywords: eco-friendly products, gypsum waste, interior design, Buddhist stucco patterns

1. Introduction

Environmental sustainability is critical in interior design. Recycling potential is one of the interior design features that can help ensure long-term environmental sustainability. The construction sector is one of the key sectors of Thailand's economy because it consumes most of its natural resources and generates a lot of waste. At present, waste management in this country is still inefficient. The application of recycling concept can help improve construction waste management and reduce environmental problems in other ways as well.

It is necessary to encourage the recycling of construction waste (namely, gypsum, as in this study) for interior decoration to generate income for local businesses and integrate local art into the design. By doing so, the recycling of gypsum waste not only generates income but also creates pride for the local people. However, the recycling of gypsum waste for all aforementioned purposes has not been acknowledged by the local government. Various sectors, especially academic ones, are required to aid in the development and experimentation of recycled gypsum waste as a case study. Gypsum was chosen because the building industry makes extensive use of it and there will be a considerable increase in gypsum waste from building. This study therefore investigated how to recycle gypsum waste into eco-friendly interior designs to develop prototypes and provide best practices for small and medium-sized enterprises (SMEs).

The contents of this paper consist of six parts. The first part introduces the background of the study. The second one outlines the related literature review, the research gap, the framework of the study, and the research questions (RQs). The third describes the research approach. The fourth section presents the results of the study. The fifth incorporates the conclusion of the study, discussions, limitations, and implications of the study.

2. Literature Review

2.1 Prior research

2.1.1 The relationship between eco-friendly markets and consumer behaviors

Several scholars (Jeong et al., 2014; Pahlevi & Suhartanto, 2020) explored the relationship between eco-friendly products and services and consumer perceptions and behaviors. Current studies incorporate these issues, such as customer behavior and environmental sustainability in the travel and hospitality sectors (Han, 2021), what encourages restaurants to embrace green products and services (TM, et al., 2021), whether travelers' own beliefs have an impact on whether they want to visit environmentally friendly places (Ahmad et al., 2020), and the moderating effect of millennials on green perception and consumer desire to spread the word in the green hotel industry (Wang et al., 2018).

2.1.2 Environmental trends and shifts in consumer perceptions and behaviors

Current studies indicate that this eco-friendly trend has changed customer behaviors both in the service and manufacturing industries. In the hospitality industry, Han et al. (2011) reveal that consumers' expressed intentions to stay at a green hotel are often highly connected with their green beliefs. Similarly, in the manufacturing industry, Soegoto (2018, November) found that customer satisfaction was significantly affected by eco-friendly choice and eco-friendly product quality.

2.1.3 Factors that influence customers' choices

Due to the increasing popularity of eco-friendly trends, several studies (Chan & Hsu, 2016; Martnez Garca de Leaniz et al., 2018; Tsai et al., 2020) found that eco-friendly marketing positively affects consumers' purchasing choices. González-Rodríguez et al. (2019) discovered that customers' environmental concerns were more significant than their opinions of the environmental initiatives. Therefore, as indicated in the study of Chekima et al. (2016), producers, marketers, and policymakers are curious about the factors that influence customers' choices to buy green products and services in all sectors, including interior design.

2.1.4 Eco-friendly interior design and concept

Currently, an eco-friendly concept plays a vital role in innovative product design and creative business worldwide. Prior research has paid attention to these issues: art and design as a competitive advantage and creative businesses in the western United States (Rosenfeld, 2004), spatially-oriented entrepreneurship research challenges (Trettin & Welter, 2011), the intricate connection between creative sectors and location (Comunian et al., 2010), Anhui's entrepreneurial state in its creative industry growth (Zheng, 2010), and the impact of creative industry clusters on Shanghai's cultural and creative industry development (Zheng & Chan, 2014), cultural heritage and entrepreneurship–inspiration for the formation of new businesses (Summatavet & Raudsaar, 2015), and manufacturing by design (Rosenfeld, 2018), a commercial and branding plan for Lodz as a neoliberal city that emphasizes the arts and creativity (Cudny et al. 2020; Woods, 2012, June; Campbell, 2009). These eco-friendly attempts in the design business have also provided not only models but also best practices for waste management, especially recycling.

2.1.5 Recycling as a solution to gypsum waste management

Utilizing recycling principles can effectively help in other ways to enhance construction waste management and lessen environmental issues in general, such as recycling waste (Robotics, 2018), minimization of waste and recycling (National Environment Agency, 2019), and construction and dismantlement waste recyclability (Jeffrey, 2011). Specifically, recycling of gypsum, which is the focal substance in this study, is verified as effective in these studies: recycling of gypsum plaster waste focusing on analysis of calcination time (de Moraes Rossetto et al., 2016), an investigation on the recycling of gypsum plaster waste as an eco-friendly substance (Camarini et al., 2016), recycling gypsum plaster waste as a possible environmental and industrial solution (Geraldo, 2017), life cycle assessment of the production of natural and recycled gypsum (Pedreño-Rojas et al., 2020), and characteristics of recycled gypsum from gypsum plasterboards and commercial gypsum during recycling cycles (Erbs et al., 2018).

2.2 Research gap

Collectively, drawing upon the prior study, this present study has three distinctive features. First, this study expands on the recent criticism of construction waste (namely, gypsum) for interior design that incorporates the local arts and creativity for practical purposes. Duxbury and Campbell (2009) indicate that incorporating the local arts and creativity can help make sure that the local arts and creativity, culture, history, and traditions will be around for a long time. Second, this study expands on the previous study by providing a more detailed explanation of how local SMEs can use creative local arts and gypsum waste for environmentally conscious customers through the recycling process of gypsum waste products for interior design. Lastly, in order to consider how investments in the arts and creativity at a local level affect not only design promotion and marketing but also public relations and corporate social responsibility, new production, research, and innovation. This recycled gypsum waste product for interior design inspires new creative eco-friendly products while also strengthening local human resources for SMEs and the local economy. In short, this study translated the arguments frequently used in the literature on corporate investment in art creation. Gypsum waste was employed in this study as a case study. To achieve the purpose of the study, the framework of the study was determined, as shown in the next part.

2.3 Framework of the study and research questions

2.3.1 The framework of the study

The framework of the study could be photographically illustrated as follows.

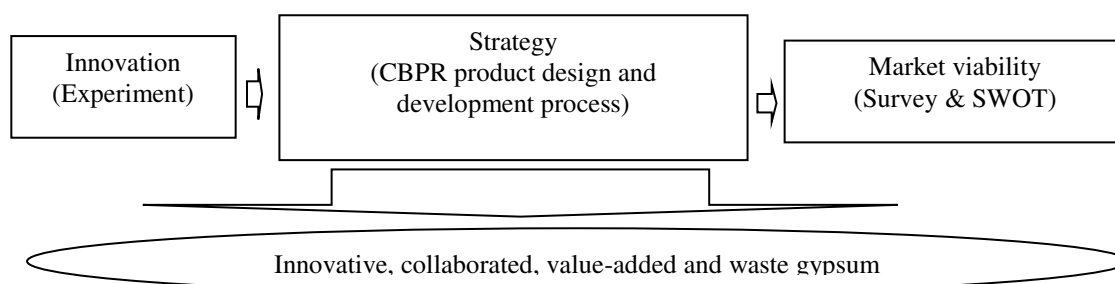


Figure 1 *The theoretical framework of the study*

Figure 1 shows the study's theoretical framework. In this product design and development method, researchers work directly with the community as partners to experiment with materials using simple technology and design prototypes. The goods were

then evaluated for market viability and SWOT to determine if they met market demands. These techniques target novel, collaborative, value-added, and waste goods.

2.3.2 Research questions

In response to the study's theoretical framework, three RQs were constructed.

RQ 1: How should gypsum waste be recycled and recreated for interior decoration?

RQ 2: Do newly developed prototypes match market viability?

RQ 3: What are the results of the SWOT analysis of the developed prototypes?

.3Research methods

Design

This mixed-methods case study was conducted. The samples of 105 potential customers were chosen by purposive sampling. The sample size was calculated using the Krejcie and Morgan formula.

Instruments

The instruments for data elicitation in this study include the following:

Site survey

The site survey of the stuccos at the Chulamani Temple, the source of the inspiration, was part of the artistic development of prototypes, which were the goals of this study. On the site survey, observations of other artistic patterns were also made. This survey yielded ideas for the prototype design.

Recordkeeping

Records of the site survey and observations were kept, and photographs of the stuccos at the temple were also taken as models for developing the prototypes.

Experiment

This study used simple manufacturing technology and composite materials for experimentation and prototype development, with the goal of eventually transferring the manufacturing process to locals.

Survey

Three questionnaires with a five-level rating scale were developed. Below are details for each questionnaire.

Evaluation of prototype development

The evaluation of prototype development includes these items: suitability for usage, suitability of wall decoration, suitability of material texture, attractive design, suitability of function, modern style, outstanding when installed, novel and local identity, suitability for manufacturing, aesthetics, producibility in the community, and producibility for business.

Evaluation of the prototypes by experts

The evaluation of the prototypes by experts comprises three major items (namely, usability, beauty, safety, and maintenance) and twenty indicators altogether.

Evaluation of the prototypes by potential customers

Potential customers judged the prototypes based on how beautiful they are, how unique their shape is, how attractive the pattern and colors are, how reasonable the price is, how unique and stylish they are, and how well they fit into their home decor.

Interviews

To gain insight into the marketing viability, in-depth interviews with some potential customers were conducted.

SWOT analysis

Drawn upon the evaluation of the prototypes by experts and the evaluation of the prototypes by potential customers. This instrument analyzed the prototypes' strengths, weaknesses, opportunities, and threats.

Data collection

The data collection followed these steps. To begin with, a site survey was conducted. Next, twelve sketches of prototypes were developed. Then, the prototypes were evaluated. The four best were then developed into prototypes. Later, the prototypes were installed as interior decorations. The installed prototypes were then evaluated by the experts and the potential customers for market viability. In-depth interviews with some potential customers were conducted for insights. Lastly, SWOT analysis was drawn upon the results of the evaluations by the experts and the potential customers and the in-depth interviews. The conclusion of the study was qualitatively and quantitatively drawn upon the results of the aforementioned instruments.

Data analysis and validity check

Data analysis

Since this was a mixed-method study, all data from a site survey, record keeping, experimentation and manufacturing, surveys, interviews, and SWOT analysis were triangulated, interpreted, and compared. The survey data was statistically analyzed. All qualitative and quantitative data were analyzed to draw the conclusion of the study.

Check for reliability and validity

Five academics with expertise in this subject assessed the questionnaires, and adjustments were made based on their advice. The reliability of the questionnaires was verified by the Alpha Cronbach test. The value of 0.80 is a solid, trustworthy one. The satisfaction of the questionnaires was divided into 5 levels: the lowest (1.00–1.50), low (average 1.51–2.50), moderate (2.51–3.50), high (average 3.51–4.50), and the highest (average 4.51–5.00).

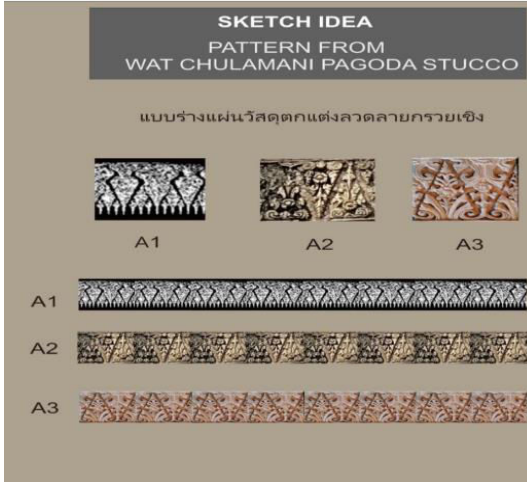
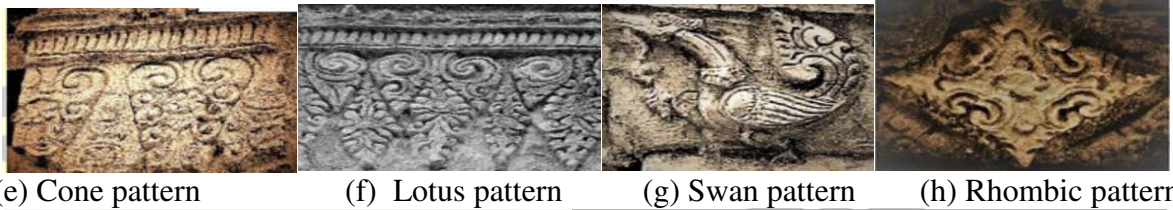
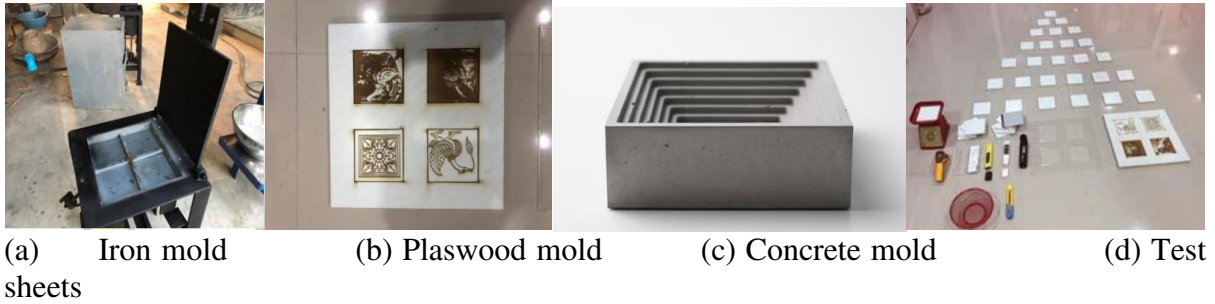
4. Results of the study

The study's findings are reported as follows in response to the research questions.

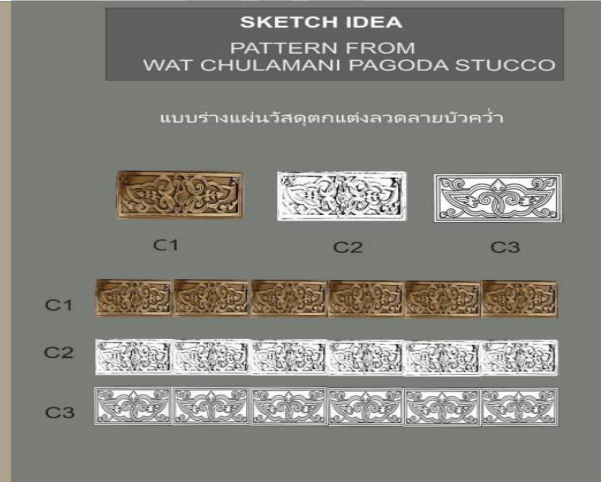
4.1 Recycling and recreating gypsum waste for interior decoration

Drawing upon the results of the research instruments (namely, site surveys and the experiment), the results of RQ 1 (How should gypsum waste be recycled and recreated for interior decoration?) fall into two parts: developing prototypes and evaluating the results of the prototypes.

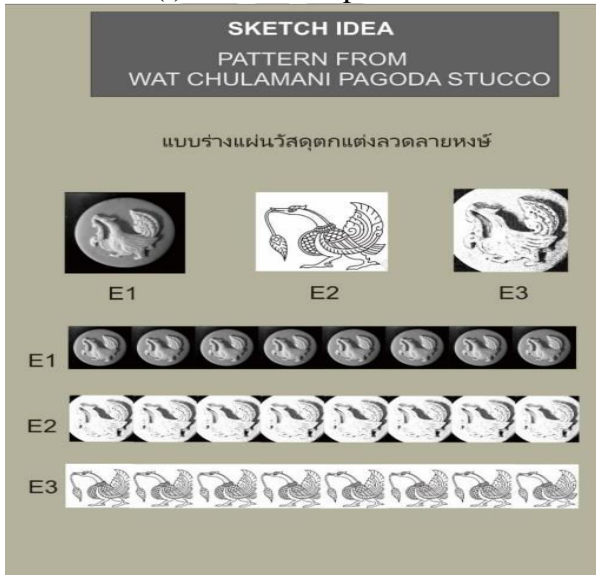
4.1.1 Developing prototypes



(i) Three cone patterns



(j) Three lotus patterns



(k) Three swan patterns



(l) Three rhombic patterns

Figure 2 *Prototype development process*

Figure 2 presents the prototype development process. Tools used in the manufacturing process included three different types of molds (namely, (a) an iron mold, (b) a plaswood mold, and (c) a concrete mold) and (d) test sheets. After the manufacturing process, the

experiment yielded four major patterns (namely, (e) a cone pattern, (f) a lotus pattern, (g) a swan pattern, and (h) a rhombic pattern). Then, the four major patterns were expanded to include additional minor patterns, each of which had three minor patterns and twelve minor patterns altogether.

All twelve minor patterns were then evaluated by experts. The results of the evaluation are shown in the next part.

4.1.2 Evaluations of the prototypes

The results of the prototypes are presented in Table 1.

Table 1 Evaluation of prototypes

	Cone Pattern			Lotus Pattern			Swan Pattern			Rhombic Pattern		
	a	b	c	a	b	c	a	b	c	a	b	c
Suitability for usage	4.60	4.40	4.80	4.60	4.40	4.00	4.80	4.80	4.60	4.80	4.80	4.80
Suitability of wall decoration	3.80	4.00	4.40	4.80	4.20	3.40	4.80	4.80	4.40	4.60	4.60	4.40
Suitability of material texture	4.80	4.00	4.80	4.60	4.20	3.60	4.60	4.40	4.40	4.80	4.80	4.80
Attractive design	4.20	4.20	4.60	4.80	3.80	3.60	4.80	4.80	4.60	4.40	4.40	4.80
Suitability of function	4.20	4.00	4.80	4.60	4.20	3.80	4.60	4.40	4.20	4.80	4.80	4.80
Modern style	3.80	3.60	4.80	4.40	3.60	3.80	4.80	4.80	4.40	4.80	4.80	4.80
Outstanding when installed	4.40	3.60	4.40	4.80	4.40	3.40	4.60	4.80	4.80	4.80	4.80	4.80
Novel and local identity	4.60	3.80	4.60	4.80	3.80	4.20	4.80	4.80	4.40	4.80	4.80	4.80
Suitability for manufacturing	4.60	4.20	4.60	4.60	4.80	4.80	4.60	4.80	4.80	4.80	4.80	4.80
Aesthetics	4.00	3.80	4.40	4.80	4.20	3.80	4.80	4.80	4.80	4.40	4.40	4.40
Producibility at the community	4.60	4.60	4.80	4.80	4.60	4.20	4.80	4.80	4.80	4.80	4.80	4.40
Producibility for business	4.60	4.60	4.80	4.80	4.60	4.20	4.60	4.40	4.60	4.80	4.80	4.40
Total	4.35	4.07	4.65	4.70	4.23	3.90	4.73	4.70	4.55	4.72	4.72	4.67
Levels of satisfaction	high	high	highest	highest	high	high	highest	highest	highest	highest	highest	highest

Table 1 presents the mean scores of the evaluation of the drafts of four major prototype patterns (namely, the cone, lotus, swan, and rhombic patterns). Each major pattern has three minor patterns. The mean scores of the three minor patterns of each major pattern were as follows. The results of the three minor cone patterns were arranged from the highest to the lowest as follows: the c pattern ($\bar{X}= 4.78$), a pattern ($\bar{X}= 4.35$), and b pattern ($\bar{X}= 4.07$). The results of the three minor lotus patterns were arranged from the highest to the lowest as follows: a pattern ($\bar{X}= 4.70$), b pattern ($\bar{X}= 4.23$), and c pattern ($\bar{X}= 3.90$). The results of the three minor swan patterns were arranged from the highest to the lowest as

follows: a pattern ($\bar{X}= 4.73$), b pattern ($\bar{X}= 4.70$), and c pattern ($\bar{X}= 4.55$). The results of the three minor rhombic patterns were arranged from the highest to the lowest as follows: a pattern ($\bar{X}= 4.72$), b pattern ($\bar{X}= 4.72$), and c pattern ($\bar{X}= 4.67$) respectively. The respondents were satisfied with all patterns at high and very high levels. This indicates that these draft patterns were effective for further development.

The minor patterns with the highest mean score of each major pattern were chosen for developing prototypes. The four chosen patterns were then installed on the wall for interior decoration. The results were shown in Figure 3.

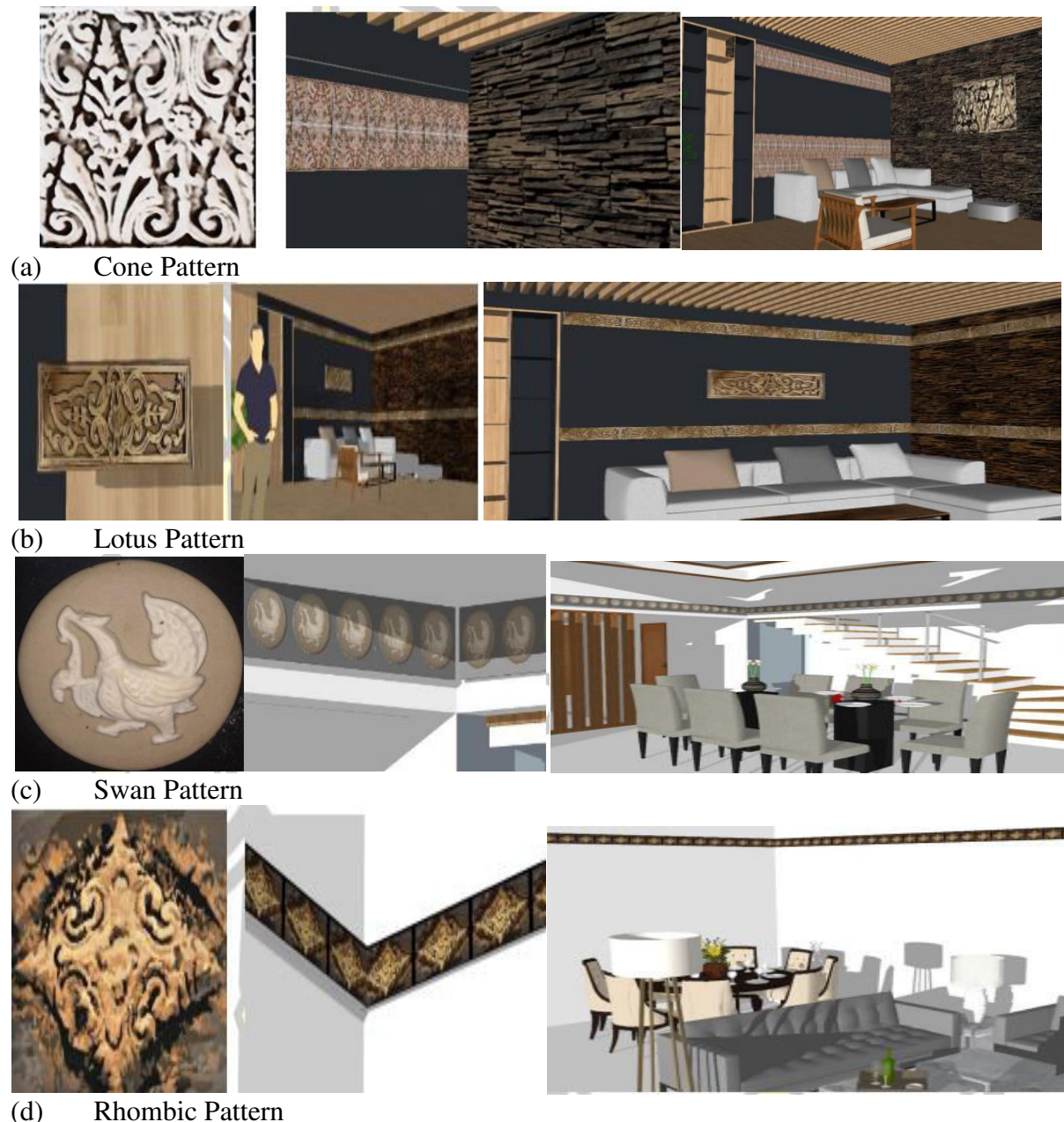


Figure 3 *The four prototypes on wall decoration*

Figure 3 shows how the four prototypes were put up on the walls of a living room and a dining room to decorate them.

The four installed prototypes were then evaluated for market viability. The results are shown in the next part.

4.2 Market viability of the prototypes

Drawing upon the results of the created prototypes and the results of the evaluation of the prototypes, the results of RQ 2 (Do newly developed prototypes match market viability?) fall into two parts: evaluations of the prototypes by experts and evaluations of the prototypes by potential customers.

4.2.1 Evaluation of the prototypes by experts

The results of the evaluation by experts are shown in Table 2.

Table 2 Evaluation of the developed prototypes by experts

Items of Evaluation	Cone Pattern		Lotus Pattern		Swan Pattern		Rhombic Pattern	
	Mean	Level of satisfaction	Mean	Level of satisfaction Usability	Mean	Level of satisfaction	Mean	Level of satisfaction
The product has patterns and structures that are suitable for usage	3.80	High	4.60	Highest	4.60	Highest	4.40	High
The overall product is suitable and convenient to use.	4.00	High	4.60	Highest	4.60	Highest	4.80	Highest
The product has a form or structure that is not harmful when used.	4.00	High	4.60	Highest	4.60	Highest	4.60	Highest
The product has a form and structure that are strong for use.	3.00	Moderate	4.60	Highest	4.40	High	4.80	Highest
The size of the product is suitable for use.	4.00	High	4.40	High	4.60	Highest	4.40	High
The product is suitable and convenient to install.	3.40	Moderate	4.60	Highest	4.60	Highest	4.40	High
The product has a form suitable for decoration.	4.00	High	4.40	High	4.60	Highest	4.40	High

The form is suitable for use as a living product.	4.00	High	4.60	Highest	4.80	Highest	4.40	High
Practical, appropriate for modern living	3.40	Moderate	4.20	High	4.60	Highest	4.00	High
Total	3.73	High	4.51	Highest	4.53	Highest	4.47	High
Beauty								
The product's design is beautiful.	4.00	High	4.00	High	4.80	Highest	3.80	Highest
The design of the product is novel and unique.	4.20	High	4.20	High	4.80	Highest	3.60	High
The product's design is modern and not outdated.	3.40	Moderate	3.60	High	4.60	Highest	3.60	High
The overall product is beautiful and appealing to those who come across it.	3.80	High	3.80	High	4.60	Highest	3.80	High
When installed, the product is unique and beautiful.	4.00	High	3.60	High	4.60	Highest	3.60	High
Colorful products that attract the attention of onlookers	3.20	Moderate	3.80	High	4.00	High	3.60	High
The product has lovely designs and shapes.	4.20	High	3.80	High	4.60	Highest	3.60	High
Total	3.83	High	3.83	High	4.57	Highest	3.71	High
Safety and maintenance								
The form of the product is simple and easy to clean.	3.40	Moderate	4.20	High	4.20	High	4.40	High

The layout of the product is easy to repair.	2.80	Moderate	4.40	High	4.00	High	4.00	High
The form is not dangerous to use.	3.60	High	4.60	Highest	4.60	Highest	4.40	High
The product has a form and structure suitable for transportation.	2.60	Moderate	4.60	Highest	4.20	High	4.60	Highest
Total	3.10	Moderate	4.45	High	4.23	High	4.35	High
Material and production								
The materials that are durable for use.	3.80	High	4.60	Highest	4.20	High	3.80	High
The product shows the suitability for using gypsum chips.	4.00	High	4.40	High	4.60	Highest	4.20	High
Product form and structure suitable for production	3.00	Moderate	4.60	Highest	4.00	High	4.60	Highest
The product can be produced at the community level.	4.00	High	4.60	Highest	4.80	Highest	4.80	Highest
The form of the product can be used for business.	3.80	High	4.60	Highest	4.80	Highest	4.60	Highest
Total	3.72	High	4.56	Highest	4.48	High	4.40	High
Grand total	3.72	High	4.37	High	4.50	High	4.26	High

Table 2 presents the evaluation of the four developed prototypes by experts and the mean scores of each evaluated item (namely, usability, beauty, safety, maintenance, and material and production). The overall mean scores of the four prototypes were arranged from the highest to the lowest as follows: swan pattern (\bar{X} = 4.50), lotus pattern (\bar{X} = 4.37), rhombic pattern (\bar{X} = 4.26), and cone pattern (\bar{X} = 3.72). All respondents were satisfied with all patterns at high levels. In details, the results of each evaluated item were as follows: First, the mean scores of the swan pattern were as follows: beauty (\bar{X} = 4.57), usability (\bar{X} = 4.53), material and production (\bar{X} = 4.48), and safety and maintenance (\bar{X} = 4.23), respectively. All respondents were satisfied with all patterns at the highest levels. Second,

the mean scores of the lotus pattern were as follows: usability (\bar{X} = 4.51), material and production (\bar{X} = 4.56), safety and maintenance (\bar{X} = 4.45), and beauty (\bar{X} = 3.83), respectively. All respondents were satisfied with all patterns at the highest levels. Third, the mean scores of the rhombic pattern were as follows: usability (\bar{X} = 4.47), material and production (\bar{X} = 4.40), safety and maintenance (\bar{X} = 4.35), and beauty (\bar{X} = 3.71). All respondents were satisfied with all patterns at a high level. Lastly, the mean scores of the cone pattern were as follows: beauty (\bar{X} = 3.83), usability (\bar{X} = 3.73), material and production (\bar{X} = 3.72), and safety and maintenance (\bar{X} = 3.11). All respondents were satisfied with all patterns at high and moderate levels. This indicates that, based on the grand total scores, these prototypes met the experts' criteria.

Potential customers also evaluated the prototypes to ensure their marketing viability.

4.2.2 Evaluation of the prototypes by potential customers

The results of the evaluation by potential customers are shown in Table 3.

Table 3 Evaluation of the prototypes by potential customers

Items of Evaluation	Cone Pattern		Lotus Pattern		Swan Pattern		Rhombic Pattern	
	Mean	Level of Satisfaction	Mean	Level of Satisfaction	Mean	Level of Satisfaction	Mean	Level of Satisfaction
Attention-grabbing beauty	4.64	Highest	4.84	Highest	4.88	Highest	4.84	Highest
Unique form	4.84	Highest	4.76	Highest	4.92	Highest	4.88	Highest
Attractive pattern	4.60	Highest	4.92	Highest	4.84	Highest	4.76	Highest
Attractive colors	4.76	Highest	4.76	Highest	4.76	Highest	4.56	Highest
Reasonable price	4.88	Highest	4.92	Highest	4.92	Highest	4.80	Highest
Exclusiveness	4.84	Highest	4.84	Highest	5.00	Highest	4.76	Highest
Stylishness	4.64	Highest	4.76	Highest	4.92	Highest	4.88	Highest
Fit for home decoration	4.92	Highest	4.84	Highest	4.92	Highest	4.92	Highest
Total	4.77	Highest	4.85	Highest	4.89	Highest	4.80	Highest

Table 3 presents the overall mean scores of the evaluation of the four prototypes by potential customers and the mean scores of each evaluated item (namely, attention-grabbing beauty, unique form, attractive pattern, attractive colors, reasonable price, exclusiveness, stylishness, and fit for home decoration). The overall mean scores of the four prototypes were arranged from the highest to the lowest as follows: swan pattern (\bar{X} = 4.89), lotus pattern (\bar{X} = 4.85), rhombic pattern (\bar{X} = 4.80), and cone pattern (\bar{X} = 4.77). All respondents were satisfied with all patterns at the highest level. This indicates that these prototypes met the criteria for marketing viability.

4.3 SWOT analysis

Drawing upon the results of the evaluation of the developed prototypes, the results of RQ 3 (What are the results of the SWOT analysis of the developed prototypes?) fall into four parts: strengths, weaknesses, opportunities, and threats. Below are the results of the SWOT analysis of the developed prototypes.

Drawing upon the results of the evaluation of the developed prototypes, in response to RQ 3 (What are the results of the SWOT analysis of the developed prototypes?), the results fall into four parts: strengths, weaknesses, opportunities, and threats. Below are the results of the SWOT analysis of the developed prototypes.

4.3.1 Strengths

From the perspective of the potential customers, the four developed prototypes have strengths in all the items evaluated (namely, attention-grabbing beauty, unique form, attractive pattern, attractive colors, reasonable price, exclusiveness, stylishness, and fit for home decoration). All respondents were satisfied with all patterns at the highest level. Similarly, from the perspective of the potential customers, the four developed prototypes have strengths in all the items evaluated by the experts (namely, usability, beauty, safety, maintenance, and material and production). All respondents were satisfied with all patterns at high levels.

4.3.2 Weaknesses

The design of the cone pattern has weaknesses, including: usability (namely, "the product is suitable and convenient to install," "practical, appropriate for modern living," "the product has a form and structure that are strong for use"); beauty (namely, "the product's design is modern and not outdated"; "colorful products that attract the attention of onlookers"); safety and maintenance (namely, "the form of the product is simple and easy to clean," "the layout of the product is easy to repair," and "the product has a form and structure suitable for transportation"); and as evaluated, the experts were moderately satisfied with them. This means that these items need to be improved.

4.3.3 Opportunities

There are two prospective opportunities. On one side, in Thailand, there are 11,824 community-level OTOP selling points that could be channels of nationwide distribution for these developed prototypes. Online channels, in addition to the previously mentioned distribution channels, can increase sales opportunities. On the other side, the created goods offer value that justifies the use of natural resources. According to interviews with potential and target customers, customers who cared about the environment were most likely to like the products.

4.3.4 Threats

The potential threat lies in Thailand's economic crisis. The recovery of the Thai economy is slow. One key threatening characteristic of the recovery is its high level of uncertainty. It is unclear when the global, regional, and national economies will return to normal levels. Uncertainty is a significant barrier to economic recovery. Many economic activities that should have been able to return did not happen because everyone chose to wait for a clear signal. This slow economic recovery poses a threat to all new products, including the newly developed product in this study.

5. Conclusion and Discussion

5.1 Conclusion

Three conclusions could be drawn, as follows:

First, the recycling and recreating of gypsum waste for interior decoration yields four prototypes (namely, a cone pattern, a lotus pattern, a swan pattern, and a rhombic pattern).

The evaluations of the developed prototypes revealed that all prototypes were highly satisfactory to the respondents.

Second, the evaluations of the developed prototypes when installed for market viability by experts were as follows: swan pattern (\bar{X} = 4.50), lotus pattern (\bar{X} = 4.37), rhombic pattern (\bar{X} = 4.26), and cone pattern (\bar{X} = 3.72). Similarly, the evaluations of the developed prototypes when installed for market viability by potential customers were consistent with the results of the experts' evaluations as follows: swan pattern (\bar{X} = 4.89), lotus pattern (\bar{X} = 4.85), rhombic pattern (\bar{X} = 4.80), and cone pattern (\bar{X} = 4.77). Both evaluations revealed that all prototypes were well received by the respondents.

Lastly, the SWOT analysis revealed that the strengths of the four developed prototypes lie in these items: attention-grabbing beauty, unique form, attractive pattern, attractive colors, reasonable price, exclusiveness, stylishness, and fit for home decoration. The cone pattern is the weakest of the four prototypes because experts were satisfied with it at a moderate level. The items to be improved are its usability, beauty, safety, and maintenance. The developed prototypes have at least two prospective opportunities. There are 11,824 community-level OTOP selling points nationwide, apart from online channels. Also, the developed products are eco-friendly and suit the future trends of environmental sustainability. The potential threat lies in the economic crisis and the slow recovery of the Thai economy with high levels of uncertainty.

5.2 Discussion

The recycling and recreation of gypsum waste for interior decoration in this study lends support to the prior studies (Rosenfeld, 2004; Trettin & Welter, 2011; Comunian et al., 2010; Zheng, 2010; Zheng & Chan, 2014) that eco-friendly concepts play a vital role in innovative product design and creative business. Prior research has shown that cultural heritage can inspire entrepreneurship and business practices for waste products (Summatavet & Raudsaar, 2015; Rosenfeld, 2018; Cudny et al. 2020; Woods, 2012, June; Campbell, 2009). Unlike the prior study (de Moraes Rossetto et al., 2016; Camarini et al., 2016; Geraldo, 2017; Pedreo-Rojas et al., 2020; Erbs et al., 2018) that was based on scientific, environmental, and industrial solutions, this present study recycled gypsum from construction waste to manufacture creative, artistic products for interior decoration.

In terms of marketing, prior studies (Jeong et al., 2014; Pahlevi & Suhartanto, 2020; Han, 2021; TM et al., 2021; Ahmad et al., 2020; Wang et al., 2018) found a relationship between eco-friendly markets and consumer behaviors. Like those studies, this present study also found a similar positive relationship. In this study, the evaluations of the developed prototypes for market viability by potential customers revealed that the respondents were highly satisfied with all prototypes (namely the swan pattern, lotus pattern, rhombic pattern, and cone pattern). This finding was consistent with the findings of other studies (e.g., Soegoto, 2018; November; González-Rodríguez et al., 2019), that customer satisfaction was greatly impacted by environmentally friendly product quality and choice. Unlike the prior study (Chan & Hsu, 2016; Martnez Garca de Leaniz et al., 2018; Tsai et al., 2020), which found that eco-friendly advertising favorably influences customers' purchase decisions of actual products, the results of this present study pertain to developed products.

5.3 Limitation

This study was limited by the number of samples. As there are 11,824 community-level OTOP selling points nationwide, a future study needs more samples to verify the market's viability.

5.4 Implication

The implication of this investigation is as follows: It creates a database of material combinations made from leftover gypsum board that may be processed into materials with forming properties for use in different kinds of artistic applications. It produces prototype materials that can be utilized to create works of applied art so that the community can expand commercially. By using gypsum waste, it produces new knowledge that can be used further. The local community will benefit from this knowledge in terms of its economy, society, culture, and general quality of life. Pollution and other related consequences decrease.

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