

Designing Typical Malang Handicraft Products Through the Utilization of Sawdust at Micro and Small Enterprise

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ABSTRACT: This article examines the use of sawdust as a souvenir product with resin material at MSEs Berdikari Meubel Nusantara, a furniture manufacturer specializing in high quality products made from mahogany, pine, and teak. The author describes the process of making souvenir products using sawdust and resin, including map and text planning and modeling, map area coloring, map pasting, text, and legends on frames. The article also discusses challenges encountered during the design process, such as the difficulty of creating detailed designs for small-sized objects and the need for knowledge of abstract art and frame sizes. In addition, the authors examine the limitations of the production process, including the risk of damage during map formation and the length of time it takes to complete the work. This article provides valuable insights into the use of sawdust as a souvenir product and the challenges encountered during the design and production process, making it a useful resource for those interested in making high-quality souvenir products.

KEYWORDS: Handicraft Products, MSEs, Sawdust, Souvenir, Utilization

I. INTRODUCTION

Micro and Small Enterprise Berdikari Meubel Nusantara (MSEs BMN) is a furniture manufacturing company that produces a wide range of high quality furniture products, mainly made of mahogany, pine, and teak. Table 1 shows sawdust produced during periods of high and low production.

Table 1. Amount of Sawdust

Production Period	Wood Powder produced (in one month)
High	180 – 200 m ³
Low	9 – 10 m ³

If not managed properly, this not only impacts the environment [1], but can also waste its economic potential. Therefore, it is necessary to analyze the potential utilization of sawdust waste and reduce harmful environmental impacts, such as sawdust carried by the wind and into the respiratory system. The value-added product in question is that sawdust waste can be used as souvenirs [2]. At MSEs BMN, sawdust waste processing is still limited to efforts to reduce waste, for example, sawdust is sold in raw or unprocessed form. In addition to selling, MSEs BMN is also still in the trial stage to compost sawdust and process the waste into something useful for the surrounding community.

Hence, the research that conducted by [3] points to evaluate the affect of social media utilization, Russo-Ukrainian war fear, consumers' green values, seen quality, utilization delight, and item picture on consumers' buy

deliberate toward reused electronic items. Comes about affirm that social media utilization, consumers' green values, and the Russo-Ukrainian war fear do upgrade consumers' picture of reused electronic items, in this way driving to their expanded purchase deliberate. Municipal solid waste generation rates are expected to increase to 2.1 billion tons per year by 2024 worldwide. However, in developing countries waste collection, transportation, and disposal remain a challenge, and in developed countries new technologies are being used to generate various by-products such as heat, electricity, compost, and biofuels.

This study evaluates the various waste-to-energy technologies that have been developed since the invention of converting waste for recycling into renewable energy to date [4]. Handicraft MSMEs can emerge as a backbone of the economy and contribute in a valuable way to GDP growth, provided the right set of strategies, assistance, and enabling framework is in place. Amongst numerous challenges impeding the growth and development of MSMEs, limited access to financial resources, lack of infrastructure support, and inadequate linkages to domestic and global markets are a few of the bottlenecks that make these enterprises vulnerable, particularly in this period of economic downturn. Handicraft clusters and independent artisans are today connected to the world and operate in the global market, and seek better support from the government. Handicraft MSMEs were already facing numerous financial and international existence challenges, and the COVID-19 pandemic has added to them [5].

However, there are some problems that exist in the handicraft production process, namely in production factors such as the scarcity of labor and the lack of working capital owned by workers in handicraft processing. Low labor productivity is a major problem in the industrial sector, so the means of small industry development in 2000 and above is the achievement of increased industrial growth, both in terms of added value, employment opportunities and exports, which in turn becomes a more effective small industry as a driver of economic development supported by increased technological capabilities and optimal resource utilization [6]. A notable trend in the area is the establishment of collaborative partnerships with souvenir shops and online markets. This collaboration is indicated by a proactive approach to broaden market penetration and augment product sales [7].

Therefore, this research will design a model for the development of sawdust waste products produced by MSEs BMN into unique souvenir products. The results of this study are expected to provide information and recommendations regarding value-added products that can be produced by MSEs BMN from sawdust waste. In addition, this research is also expected to contribute to the research and development of alternative products from sawdust waste in factories.

II. METHODS

A. Research Methods

The rational design method encompasses various ways for designers to design in a systematic way, such as goal classification, goal setting, specification, characterization, alternative generation, alternative evaluation, and design refinement. The Objective Tree is used to categorize goals. The aim is to clarify the purpose of the design and sub-design as well as the relationship between them. Cross N. states that there are several steps that can be taken to create a Objective Tree [3], namely preparing a list of product design objectives, listing top and bottom level design objectives and drawing a tree diagram showing the hierarchy of relationships and their relationships.

Then the Black Box method is a method for conducting functional analysis. In other words, a black box is the simplest and most basic way to represent a product design, including all the functionality needed to display desired inputs and outputs and to convert inputs into outputs [8]. And it will be broken down into smaller sub-topics, called decomposition [9]. Where the function of the transparent box is to reveal the functions described in the black box in more detail.

In addition to the Objective Tree and Black Box, morphological diagram techniques are also used in the product design process; Cross N. states that the purpose of morphological diagrams is to generate all alternative design solutions and potential new solutions for a product [8]. Once a list of alternatives is created for each feature and design, it becomes difficult to choose the best one; Cross N. explains

that the selection of alternatives can be based on guesswork, intuition, experience, or arbitrary judgment [8].

After completion of the selection stage, the materials needed to produce the specified product design must be recorded using the Bill of Material method. Bill of Material is defined as a collection of bill of material components for a product [10].

B. Collecting Data and Validation Technique

Primary data collection in this study was collected through interviews with MSEs Berdikari Meubel Nusantara and with artisans in Malang City. Data collection at MSEs Berdikari Meubel Nusantara aims to obtain data on the sawdust produced, while in Malang City handcrafters such as MSEs GS4 Woodcraft, data will be used as consideration and direction about the products developed.

Then secondary data obtained from the results of literature reviews and previous research are used to submit research with existing theories and conclusions from previous research that will be used as a reference in determining the composition to make composite materials.

III. RESULTS AND DISCUSSION

A research journal by Saiful Arif, Dani Irawan and Muhamad Jainudin explained about the conversion of teak sawdust into a composite reinforcement filler. But the study showed that as the ratio of resin in the composite increased, the hardness value also increased [11]. Then, in a research journal written by Darwin Sugan Dalsa and Muhammad Rizqi, it was mentioned that the research showed that the composite materials made had unique properties. The mass of the resulting composite material decreases with increasing percentage of sawdust also another conclusion results stating that the addition of sawdust as a filler tends to increase the crystallinity value of the composite, improve mechanical properties, and give a darker and less translucent appearance to the composite [12].

Then in the next research, there are several inputs about the design of a souvenir product that needs to be considered, namely as shown in figure 1 and This research will use the characteristics of the Malang City in the form of monuments in the city of Malang and sawdust as souvenirs of the Malang City.

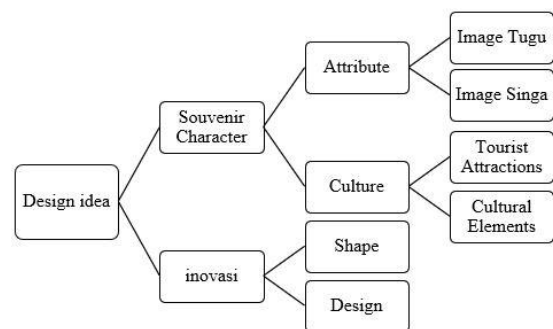


Figure 2. Product Design Input

The input to the design is a summary of previous research put together in a chart. Product design for MSEs is encouraged to utilize the characteristics of the city of a tourist spot in the design of handicraft products [13]. Cultural elements that characterize tourist attractions and tourist attractions [14]. The monotonous souvenir model makes tourists lose interest

because of its monotonous design [15]. From the results that have been collected both composite material data and design input materials. The next stage is the interpretation of the data.

Source	Summary	Interpretasi	Grouping
Previous Research	Sawdust can be used as souvenir crafts	Sawdust can be used as raw material for souvenirs	Composite souvenirs
	Solid and sturdy material strength Material characteristics light weight and less likely to be translucent	Products made from solid, light weight, and opaque composites	Durable
	Attributes of tourist attractions Cultural elements of tourist attractions Flexibility Creative Design Innovation	Products have identities that are closely related to tourist attractions and are flexible. Creating products that are practical in their application	Design
Results and Discussion	Flexibility Creative Materials are easy to process	Materials that can and are easily processed using conventional machines	Practical

The subject of the study was a wall hanging, a prototype of souvenirs made of composite sawdust. The transformation of sawdust into wall hangings with epoxy resin is a simple example of the many possible uses of sawdust as souvenirs discussed with craftsmen. So, from the interpretation of the data that has been done, the objective tree can be depicted in Figure 2.

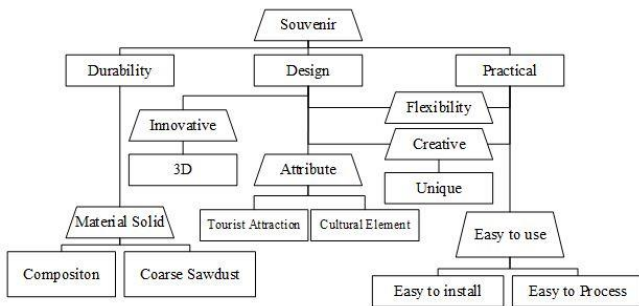


Figure 2. Objective Tree

Then, because of the objection tree above, the next process is to translate the function of wall decorations by using inputs in the form of Malang map images as a reference in making embossed maps, written designs, composite materials, legends, and frames.

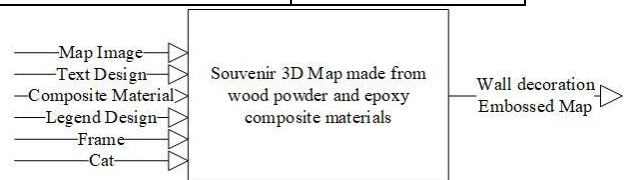


Figure 3. Black Box of Souvenir

Based on the illustrations given in the Black Box figure, it can be observed that the process in which the results to be achieved are not detailed. As a result, to increase clarity, the function of embossed map wall decoration requires the division into various detailed functions.

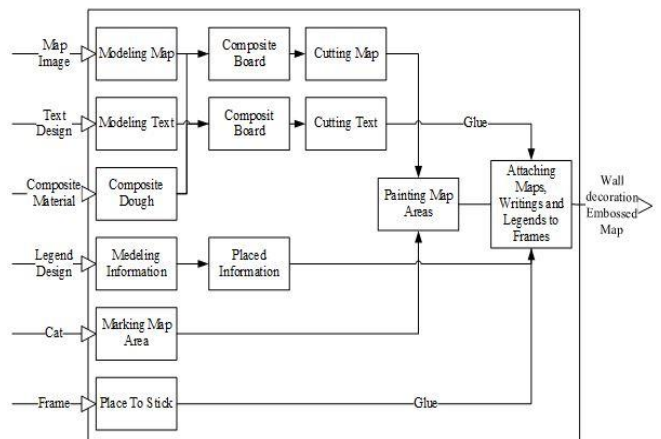


Figure 4. Transparent Box of Souvenir Products

Based on the interpretation of the Objective Tree, Black Box, and Transparent Box above, the results of brainstorming with MSE’s owner resulted in several alternative wall decoration products that can be an option.

Number	Characteristics	Alternative			
		1	2	3	4
1	Sawdust	Wood Shavings	Coarse Sawdust	Fine Sawdust	
2	Composition	40:60	45:55	50:50	
3	Text Color	Natural	Black	White	Grey
4	Map Style	Embossed Silhouettes	Perforated Colored	Appear Colored	Abstract Appear
5	Map Color	Natural	Bright		
6	Place of Malang Symbols	Besides Map	Inside Map	Inside Text	Upside Text
7	Map Image	Map Malang City	Area Map Subdistrict Malang City	Malang City Map per District	
8	Hook	One Hook	Two Hook		

Figure 5. Morphology Diagram

Figure information:

The Black line indicates alternative 1.

The Yellow line indicates alternative 2.

The Red line indicates alternative 3.

The Green line indicates alternative 4.

The next stage is to choose a prototype souvenir design based on the morphology diagram submitted to the MSEs. At MSEs GS4 Woodcraft, employees who are proficient in scroll saw machine operation and employees who are proficient in paint will be talked about the possibility of making products from existing combinations. It is expected that prototype souvenir products can be made easily and quickly. The results of discussions with this MSE's employees showed that the combination of alternative design 1 for product manufacturing received a less positive response. Employees said that the design required a lot of raw materials to make maps, poor monuments, and poor writing. They also explained that the small details on the monument were difficult to cut with a 2 mm scroll saw and that the color did not match the color of the frame.

Based on findings from interviews with employees, the second alternative design also faces the same problem. The map frame that makes a hole in the middle to form a frame with a map shape and the monument frame placed in the middle are both at risk of breaking during sawing. Sawing with a manual saw or with a reduction in speed will take quite a long time. However, employees state that this design is a good idea.

Employees said that the alternative design 3 faced problems because the unfortunate monument had too little detail, so it had to be made into a silhouette only without a small hole in the middle. They say that the design of the map and other letters does not face any problems at all because the design is not too complicated and does not require a lot of raw materials to make. Furthermore, employees state that lack of knowledge about abstract art and the size of frames that may be required is a fourth alternative problem. In addition, the constraints associated with parts of the monument remain unchanged: the formation of parts of the monument becomes less possible and the risk of fracture remains high. In addition,

the time required to complete the work will be extended if the map of the area per sub-district is reduced.

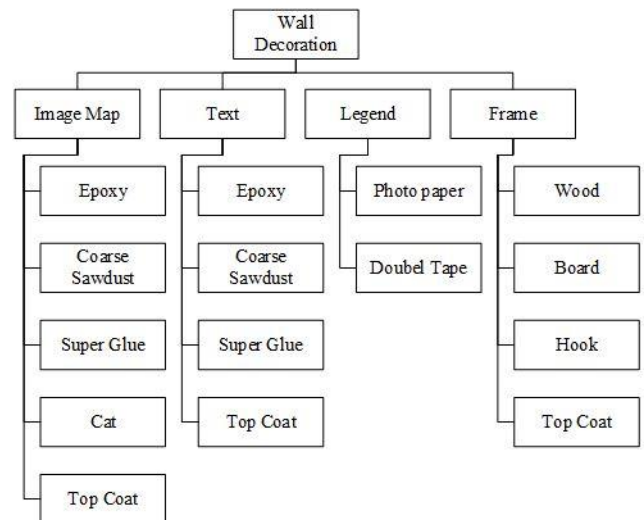


Figure 6. Bill of Material Product

So, by evaluating the 4 possibilities, the third alternative is an alternative with a lower risk possibility and the alternative prototype is carried out in MSEs GS4 Woodcraft with the necessary materials as in figure 6 with the design in figure 7.



Figure 7. Souvenir Prototype Design

CONCLUSION

Thus, alternatives that are selected and adjusted to tools conditions and employee experience become preferred alternatives. This is because Alternative 3 has a low risk, short processing time and does not use many raw materials. Coarse sawdust is used epoxy for composite materials, and materials for composite base materials are developed with a ratio of 1: 1 between sawdust using epoxy. As a result of product development, there are 3D map souvenirs that serve as wall hangings.

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REFERENCES

1. O. L. Rominiyi, B. A. Adaramola, O. M. Ikumapayi, O. T. Oginni, and S. A. Akinola, “Potential Utilization of Sawdust in Energy, Manufacturing and Agricultural Industry; Waste to Wealth,” *World J. Eng. Technol.*, vol. 05, no. 03, pp. 526–539, 2017, doi: 10.4236/wjet.2017.53045.
2. I. S. Aisyah, “Pelatihan pemanfaatan limbah serbuk kayu dan perca kain untuk kerajinan souvenir.” *Pros. Semin. Nas. Unisla*, pp. 305–309, 2018.
3. D. R. Obadã, D. C. Dabija, and G. I. Fârte, “Consumer perception towards electronic products from recycled components in the current geopolitical context: A structural equation modelling approach,” *Heliyon*, vol. 10, no. 4, Feb. 2024, doi: 10.1016/j.heliyon.2024.e26475.
4. M. Taufiqurrohman and M. Yusuf, “Pemanfaatan Energi Terbarukan dalam Pengolahan Daur Ulang Limbah,” *J. MENTARI Manajemen, Pendidik. dan Teknol. Inf.*, vol. 1, no. 1, pp. 46–57, Sep. 2022, doi: 10.33050/mentari.v1i1.141.
5. V. Agarwal, K. Mathiyazhagan, S. Malhotra, and B. Pimpunchat, “Building resilience for sustainability of MSMEs post COVID-19 outbreak: An Indian handicraft industry outlook,” *Socioecon. Plann. Sci.*, vol. 85, Feb. 2023, doi: 10.1016/j.seps.2022.101443.
6. C. Raditya Konore, I. F. Pingkan Rorong, H. FDjSiwu, J. Ekonomi Pembangunan, and F. Ekonomi Dan Bisnis, “KAJIAN PRODUKSI KERAJINAN TANGAN SERAT PISANG ABAKA DI DESA ESANG KABUPATEN KEPULAUAN TALAUD,” 2022.
7. L. A. G. Pieter, A. Sudomo, Suhartono, A. Widiyanto, and M. M. B. Utomo, “Application of silvicultural treatments to improve local Gigantochloa apus (Schult. & Schult.f.) Kurz ex Munro stands for supporting handicraft industries in Gunungkidul region, Indonesia,” *Adv. Bamboo Sci.*, vol. 7, May 2024, doi: 10.1016/j.bamboo.2024.100076.
8. C. Nigel, *Engineering Design Methods: Strategies for product design*, Fifth Edition. 2021.
9. K. . & E. S. Ulrich, *Product Design and Development; Sixth Edition.*, Sixth Edition. 2016.
10. F. B. Watts, *Bill of Material (BOM) Process,* in *Configuration Management Metrics.*, Elsevier, 2010.
11. S. Arif, D. Irawan, and M. Jainudin, “ANALISIS SIFAT MEKANIS PERBANDINGAN CAMPURAN KOMPOSIT SERBUK GERGAJI KAYU JATI DENGAN Matrik EPOXY UNTUK MATERIAL KAMPAS REM CAKRAM,” *J. Technopreneur*, vol. 7, no. 2, pp. 58–63, Nov. 2019, doi: 10.30869/jtech.v7i2.385.
12. D. Sukan Darsa and M. Rizki, “KARAKTERISASI KOMPOSIT RESIN EPOKSI SERBUK KAYU”, [Online]. Available: <http://snf-unj.ac.id/kumpulan-prosiding/snf2015/>.
13. M. Rofieq, S. Soeparmanb, and S. Herminingrum, “HANDICRAFT PRODUCT DESIGN FOR MICRO AND SMALL ENTERPRISE IN MALANG TOURISM,” 2018.
14. Y. Stephanie and P. Wisnu Anggoro, “RANCANG BANGUN SUVENIR TEMPAT KARTU NAMABERCIRI KHAS YOGYAKARTA,” *Simp. Nas. RAPI XIII-2014 FT UMS*.
15. B. R. SUSANTO, “Perancangan Prototype Souvenir Umbul Ponggok,” Universitas Atma Jaya Yogyakarta, Yogyakarta, 2018.