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Preserving Betawi Culture: Introducing Additive Manufacturing for Ondel-Ondel Souvenirs in Micro, Small, and Medium Enterprises (MSMEs/UMKM)

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Abstract: *The contributions of campus as a technology hub to the society need to be increased. One of the way is to help micro, small, and medium enterprises (MSMEs) or Usaha Mikro, Kecil, dan Menengah (UMKM) to improve their process, capability and product. In this study, a team consisted of students and lecturers from Faculty of Engineering and Technology Sampoerna University led a community service project on one of MSMEs in Jakarta area. Over eight months, the team introduced innovative manufacturing techniques like 3D printing and mold-making to one of the MSMEs called Jawara Peci. Jawara Peci sells traditional souvenir, Ondel-ondel miniature. The purpose of this activity is to help Jawara Peci to have a unique ondel-ondel miniature product with the use of technology in order to preserve the cultural heritage of Betawi. The activity includes, socialization and introduction of the program, 3D design and product development, prototyping and delivery. The activity was successfully producing a new method to produce an Ondel-ondel souvenir using 3D printing and casting. The proposed method is expected can be implemented by the Jawara Peci to improve the uniqueness of the Ondel-ondel souvenir so that can contribute to economic growth and cultural awareness. This activity highlighted the potential of merging technology and heritage in improving inclusive economic development.*

Introduction

All people aspire to live in a welfare state with stable economic conditions. Raising the social and economic standards is necessary to achieve stability. Humans can engage in multiple activities to achieve those prosperity and wellness. An instance could involve establishing a micro small medium enterprise (MSME), or *Usaha Mikro, Kecil, dan Menengah (UMKM)* as

it is known in Indonesia, which would result in an Indonesian-built company, either individual or collective. As the backbone of Indonesia's economy, UMKM play a pivotal role in driving economic growth and fostering local development. Micro, small and medium enterprises are a fairly large part of the country's economy, because they play a very important role in improving the community's economy especially in Indonesia (Aliyah, 2022). In the Indonesian economy, MSMEs are people's economic activities whose presence dominates, namely more than 99% of the national economy. This business is the choice of many people because of its simple business management, requiring relatively small capital, and flexibility in its activities (Fajrin Novi Anugerah, 2021). On the other hand, the economy is negatively impacted by rising graduate unemployment rates in addition to having detrimental effects on individuals (Laila & Cahyanti, 2019). In contrast, MSME has a visible role to absorb labor, in other words reducing unemployment, particularly for graduates. Apart from that, the role of MSME is in increasing people's income so that they can improve living standards, meaning reducing poverty.

In order to improve MSME prospects in the market, marketing strategy is crucial to MSME's future. The era of globalization requires tighter marketing strategy (Hakim & Listiani, 2017). In relation to that, digitalization has the potential to simplify every facet of human needs. One of the most beneficial aspects of digitalization for MSME is the digital information which can be the strategy to generate more income and public awareness (Gisheilla Evangeulista, 2023). Based on the report's data from The Role of Digital Platforms Development of MSME in Indonesia, MSME might rise in revenue from e-commerce and other digital information signifactly (INDEF, 2024). All the successes that have been achieved have weaknesses that must be resolved immediately to make an improvement and effective work. The weaknesses faced by MSME entrepreneurs in improving business capabilities are very complex and include various indicators, one of which is interrelated, including; lack of capital both in amount and sources, operating skills in organizing and limited marketing. In fact, the demand is that MSME must be able to compete with the free market in Indonesia (Suci, 2017; Husnurrosyidah, 2019).

MSMEs are trying to create, develop, and market their products at a lower cost in the current Industry 4.0 age as a result of implementing technology. As smart machines increasingly take over tasks traditionally performed by humans, it's crucial to prepare and guide the younger generation, ensuring they understand the competencies to acquire before entering society (Noorfi Azizah Rahim, 2023). A frequently employed tactic has to do with cutting instruments and molds. Some manufacturers choose to simplify the production process by avoiding the use of cutting tools or molds in order to produce at a reduced cost (Michael Evan, 2023). From that, the use of additive manufacturing (3D printing) will be very helpful for MSME to have more effective way of production. With the presence of 3D printing, also called rapid prototype technology, the process of creating innovation in prototyping will be faster and more precise compared to the conventional way (Abdullah, 2022). Additionally, it has the potential to be employed in product development, enabling enhancements to both simple and intricate designs to ensure greater durability and functionality (K. Saptaji, 2022). There will be

a transformation in the production process of prototyping, as the process of prototype reproduction using 3D printer will be faster when there is an error, and there is a need to revise the previous prototype. Thus 3D printer may be used to do production with a proper design thinking.

Utilizing suitable technology in MSME and home industries has the potential to enhance both productivity and efficiency in production. Moreover, integrating project-based learning (PBL) into the Manufacturing Process course can boost student engagement and improve learning outcomes (Arya Smara Dyota, 2023). As a result, this initiative involves students, particularly those from Sampoerna University's mechanical engineering program, in the Manufacturing Process class. The aim is to acquaint them with additive manufacturing technology and encourage them to help others, particularly in supporting MSME. This community service or PBL initiative focuses on introducing additive manufacturing, particularly 3D printing and resin mold techniques, to facilitate streamlined production processes.

The community service initiative aimed to leverage the potential use of 3D printers within a broader community, particularly targeting micro, small, and medium enterprises (MSME) around Jakarta. The overarching goal was to introduce these businesses to the benefits of 3D printing technology and empower them to integrate it effectively into their manufacturing processes.

Method

Figure 1. Methodology Flowchart.

In order to complete the activity, a plan was made as shown in the diagram of methodology (Figure 1). The community service activity spanned a period of eight months, running from May to December 2023. Throughout this duration, a structured methodology was implemented to ensure the successful execution of the initiative. The steps are explained below:

1. Socialization and introduction of the program

The initial step involved was to identify a MSME for the community service activity. The idea is to help the MSME with the main objective to preserve the traditional heritage especially in Jakarta area. In addition, the activity should also relate to the background of Faculty Engineering and Technology lecturers involved in this community service especially related with the use of 3D printing technology. Once the MSME is obtained, initial discussion needs to be perfomed in order to agree with the topic, target and timeline.

2. 3D Design and Product Development

In order to create a part using 3D printing, the design needs to be created using 3D design software. In this step, the Sampoerna University team started to develop the 3D design and fabrication process to produce the final product. This step involved creating 3D design based on the existing product and exploring the method to fabricate the prototype. Students were actively involved in this step especially those have studied courses related to this process.

3. Prototyping

Once the 3D design was accepted and the method to fabricate the prototype was decided, the next step was to produce a prototype. This process was conducted in the Mechanical and Integrated Manufacturing Lab that equipped with the equipments and facilities to support this step. The applications of engineering background especially related with the Manufacturing Processes were applied in this step.

4. Delivery

The final step is to delivery the prototype to the MSME. The prototype needs to be applicable and easy to be repeated by the MSME. The socialization and explanation of the process must be conducted so that the MSME can understand how to repeat the same product.

Result

The community service activity was conducted according to the timeline. The first step is to identify suitable MSME that could benefit from this activity especially within the Jakarta area.

1. Socialization and introduction of the program.

The initial step involved acquainting MSME, with Jawara Peci selected as the representative. Jawara Peci was a small business or a home-made business that produce and sell Betawi cultural souvenirs such as *bir pletok* and various ondel-ondel miniature which is normally made using recycle plastics and cloths. This souvenir normally displays in various carnavals or events especially around Jakarta area. Ondel-ondel itself is recognized as a symbol of Jakarta. This Ondel-ondel is frequently involved in a variety of traditional Betawi events or national festivals (Farhan Bukhori, 2018). Approximately five meters high and no more than eighty centimeters in diameter, the shape resembles a huge puppet constructed of plaited bamboo, designed to allow people to move more freely within. The person using the ondel-ondel custom or puppet shakes or dances in time with the song (Indonesia, 2005).

Figure 2. Lecturer and lab. engineers visiting Jawara Peci store and workshop on May 2023,

the entrance (left), various souvenirs (middle), discussion (right).

The lecturers and the representatives from Jawara Peci were met and discussed about the possibility for collaboration in May 2023. The lecturer and lab. engineers met in the Jawara Peci store and workshop in the Condet area, East Jakarta. Figure 2 shows the documentation during the visit. From the discussion, the idea was initiated to assist and support the Jawara Peci in making a brand new type of ondel-ondel souvenir made using 3D printing and casting methods. In this phase, the representative from Jawara Peci was introduced about the technologies by visiting the Mechanical and Integrated Manufacturing Laboratory (MIML) in Sampoerna University. This activity was also to familiarize with the process.

2. 3D Design and Product Development

In this step, the Sampoerna University team started to develop the prototype of ondel-ondel souvenir based on the sample given by Jawara Peci (Figure 3). The prototype was started by creating a 3D design of the ondel-ondel souvenir closed to the existing product. The design process was assisted by a student from Visual Communication Design Program Study.

Figure 3. The Ondel-ondel souvenir to be prototyped. The original souvenir was made of recyle plastic bottle and cloths.

The proposed design was shown in Figure 5. The design was created to be as close as the original souvenir and must make use of the 3D printing advantages. Therefore, the design is prepared as a one part with no additional components.

Figure 4. 3D design of the Ondel-Ondel souvenir.

In order to produce the ondel-ondel souvenir based on the proposed design, a master pattern of the ondel-ondel souvenir and master mold casing called master mold need to be created. In addition, the fabrication process to be used are 3D printing combined with epoxy resin casting. A set of master pattern and master mold casing were produced using 3D printing. Subsequently, the mold was made of silicone by pouring a liquid silicone into the set of master mold. Once the silicone was solidified, the master mold can be removed. Hence the silicone mold can be used repeatedly to produce the epoxy resin ondel-ondel souvening whereas the master pattern can also be used repeatedly to make silicone mold, once it is damage.

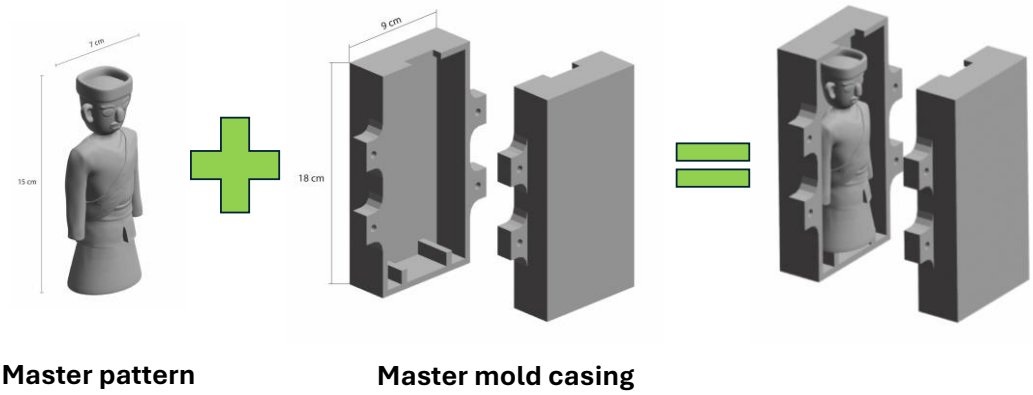

Figure 5. A set of master pattern and mold casing to produce ondel-ondel souvenir using 3D printing technique.

There are some considerations need to be taken when creating the design especially to be used for epoxy resin casting. The master mold design must be easily to be removed after the silicone solidified. The master pattern must be designed in such a way that when the liquid silicone poured, it can fill the cavity completely. The master mold casing must be easily to be tighthend and dismantled and no leak presence. In addition, the materials used have to be optimized to make sure the final product is lightweight, no material waste while make sure the design acceptable.

1. Prototyping

Once the design was approved, the next step is to produce the prototype. In order to produce the prototype, a 3D printing Anycubic i3 Mega was used. The materials used for making the souvenirs are: polylactic acid (PLA) filament for making the master and the master mold casing, silicone for the mold, epoxy resin and catalyst for the souvenir and lastly silicone mold release. The first attempted of the master pattern produced by 3D printing is shown in Figure 6. Some defects were observed after it is finished such as weak structure and unfinished design. Therefore, some modifications of the 3D design need to be conducted.

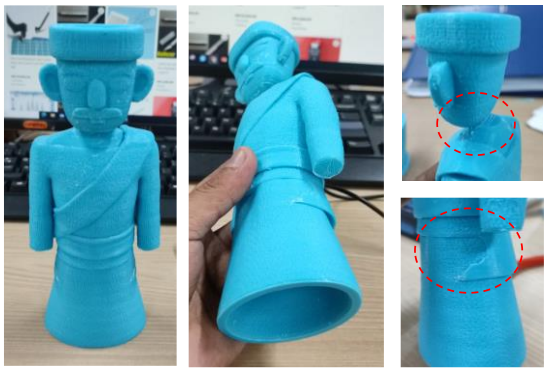

Figure 6. First attempted of the master pattern. Some defects were observed in the result (dashed red circle) such as a weak structure and unfinished design

Once the 3D design of the master pattern was revised, the final master pattern design was 3D printed together master mold casing (Figure 7). The 3D printer parameters were shown in Table 1. The parameters used were the common parameters for 3D printing PLA material.

Table 1. 3D printing parameters

No	Parameter	Value
1	Printing speed (mm/s)	50 mm/s
2	Infill density (%)	25 %
3	Layer height (mm)	0.2 mm
4	Printing temperature	210 ^{o}C

The next step is create a silicone mold using the master set. The silicone mold was then used to produce the epoxy resin ondel-ondel souvenir. Figure 8 shows the steps in performing the casting process to produce the silicone mold. Firstly, the master casing with the master mold inside was tightened. Secondly, the silicone liquid was prepared. Once the liquid ready, the silicone liquid was then poured into the master mold. Lastly, the master mold was closed and settled for about 3 hours.

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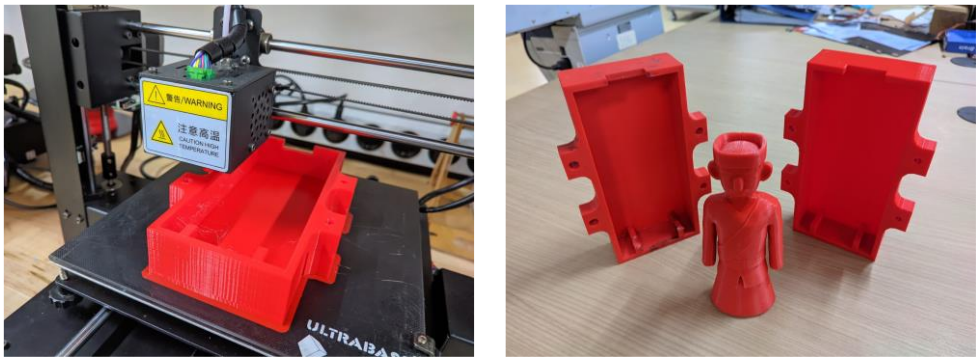

Figure 7. 3D printing process of master mold casing (left) and the final master set consists of master pattern and master mold casing (right).

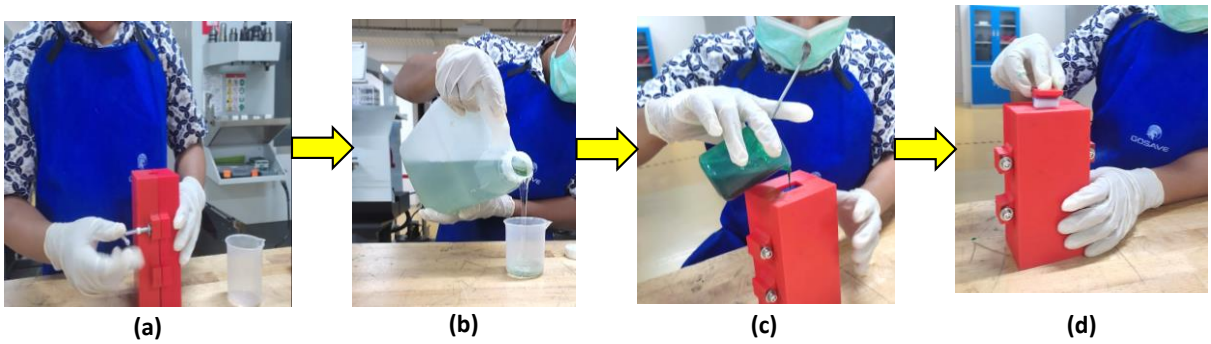

Figure 8. Steps in performing casting of the silicone mold, (a) tightening the master casing with the master mold inside, (b) making a silicone liquid, (c) pouring the silicone liquid into the master mold, (d) closing the master mold.

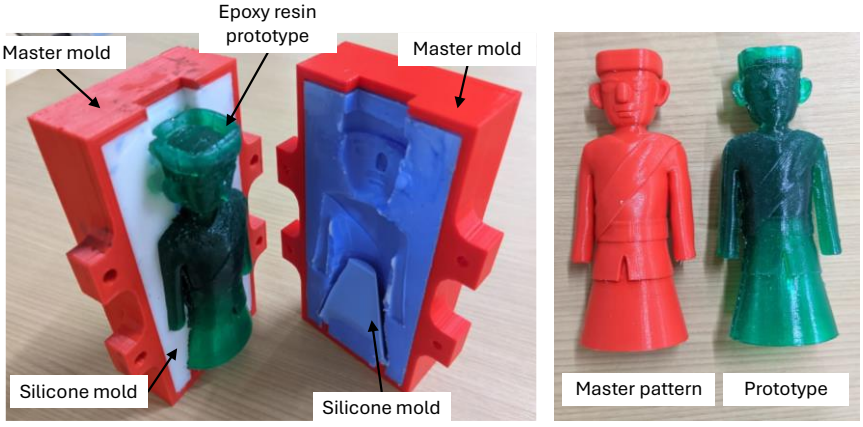

Figure 9. Finished casting process of the ondel-ondel souvenir (left) and the comparison between the master pattern and the prototype (right).

Figure 9 shows the final result of the ondel-ondel souvenir made using epoxy resin. The final product of the ondel-ondel souvenir was then compared with the master pattern in order

to examine the quality. It is observed that the design was similar with the master pattern, the dimensions is also comparable and the surface quality is also excellent with no defects implying that the design was successfully replicated onto the epoxy resin.

2. Delivery

According to the final result shown in Figure 9, it is confirmed that the result show a good quality of the ondel-ondel souvenir prototype. The result was also consulted with the Jawara Peci representation. A team from Sampoerna University consists of lecturers, lab engineers and students was visited the Jawara Peci place during the delivery session. Figure 10 shows the socialization about the project especially the procedure to create the ondel-ondel souvenir.

Figure 10. The explanation for the making of ondel-ondel souvenir using 3D printing and casting to the Jawara Peci representation.

The Jawa Peci representation showed enthusiastic with the new ondel-ondel souvenir model and the procedure to produce it. Figure 11 shows the documentation of the hand over process of the complete set of tools to produce ondel-ondel souvenir. The set included master pattern, master casing, silicone mold, epoxy resin ondel-ondel souvenir prototype, raw materials and the procedure to create the souvenir from Sampoerna University team into the Jawara Peci representative.

Figure 11. Master mold and pattern, silicone mold, final prototype and the procedure to produce the ondel-ondel souvenir were handed over to Jawara Peci.

It is expected that the new ondel-ondel souvenir can then be marketed and sold within their respective markets, offering a competitive advantage through cheaper and faster manufacturing processes. The proposed method used to produce a new variation of Ondel-ondel souvenir can offer an alternative for the MSME community to market their souvenir. This community service activity can also help the students to engange with the real problem in the society.

Discussion

After the silicone mold was finished, we can then use it to create the ondel-ondel souvenir. The preparation was similar with the process to make the silicone mold. The difference is that the master pattern was removed from the setup and now the cavity will be filled with the epoxy resin. The epoxy resin was prepared by mixing resin With katalis/Hardener and settled for sometime to eliminate bubbles. Once it is ready, then the liquid is poured into the master casing with the silicone mold inside

Conclusion

In conclusion, the community service initiative undertaken by Faculty of Engineering and Technology Sampoerna University team has demonstrated a tangible contribution to Indonesia's economy, particularly in supporting micro, small, and medium enterprises (MSME). Through the application of 3D printing technology and mold manufacturing, the community service has facilitated effective and rapid production processes, enabling MSME like Jawara Peci to enhance their ondel-ondel souvenir product. Moreover, the final products generated through this initiative not only hold commercial value but also serve as cultural ambassadors, promoting awareness of Betawi culture through iconic symbols like Ondel-ondel. The success of this community service activity highlighted the potential of collaborative efforts between educational institutions and local communities in driving sustainable economic

development.

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