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Implementing 3D Printing in Business Incubator: A SWOT Analysis

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Abstract. Sustainable development is a big issue that is important to be considered by various sector, especially in the business sector. In this case, both large and small companies (SMEs) need to think about the right strategy and technology to be applied in their business processes. The manufacturing industry has now evolved with 3D printing technology that makes it easy for business people to make prototypes quickly and cheaply. This study tries to look at the University as an institution that teaches entrepreneurship and incubates business through a Business Incubator. The focus is on what opportunities and strategies exist if Business Incubator in university implement 3D printing as a form of support and education for SMEs to make products and businesses more sustainable. The research method used is SWOT and TOWS analysis. The object of the research is the Business Incubator from a private university in Bandung, Indonesia. The result of this research is the identification of opportunities and positive impacts of using 3D printing in the Business Incubator. In addition, there are strategies that need to be implemented to implement them, in order to accommodate strengths and minimize constraints. This research is useful for universities to make policies and beneficial for SMEs to utilize 3D printing technology in their business processes.

Keywords: 3D printing, Business Incubator, University, SMEs, Sustainable

INTRODUCTION

Focus on business that pays attention to environmental sustainability continues to be a major issue. The production process is an area that is focused on because it has a role in the number of products that are made and become waste. Technological developments continue to increase in the realm of manufacturing. Now there is 3D printing which is a solution for small businesses to be

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able to make products quickly with the desired shape. They have the opportunity to create and deliver products quickly to customers.

Findings from studies, some brands use 3D printing to turn waste into useful products, so they can reduce waste and utilize existing resources as long-term environmental protection. The use of environmentally-friendly materials is a priority focus in the development of 3D printing to support a sustainable business [1].

The important role of small business can have a positive impact not only economically but also on social development [2]. 3D printing provides the opportunity to make small scale productions to reduce the assembly process with the support of computer programs [3]. In the market, customers often ask for samples for the product to be ordered. The existence of 3D printing can help small businesses deliver products to the mark faster [4]. Companies need to have capabilities that focus on making quality products, short interactions and delivering products to the market as faster as they can [5]. The use of 3D printing in the creative industry provides opportunities for small businesses to create personalized products, create objects with complex forms and become a trigger for innovation [6].

In a study conducted by Goraczkowska, it was found that there was a positive impact of incubators on campus. The incubator can increase the innovation ability of the incubated business [7]. In improving the creative ability of students, universities need to facilitate students to be stimulated [8]. The program in the business incubator has a significant positive impact on the sustainability of the incubated business and entrepreneurial intention [9,10]. Business incubators have an important role in creating a more sustainable entrepreneurship ecosystem and more innovative companies [11]. Therefore, the existence of a business incubator at the university can be reviewed whether its role can have a positive impact on innovation from student-owned small businesses, and can help business students to focus on sustainable development through the application of technology, especially 3D printing in this study.

There has been no research that has specified the impact of implementing 3D printing in the Business Incubator to support sustainable development. This study aims to examine how the opportunities for implementing 3D printing in the Business Incubator are, whether the implementation of 3D printing in the Business Incubator can have a good impact on the business managed by the business incubator and how it influence on sustainable development.

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LITERATURE REVIEW

3D Printing

3D printers have the advantage of using less raw materials, reducing waste, and using less energy to support long term sustainability [1, 12,13]. In general, the 3D printing process begins with the use of computer-aided engineering (CAE) and computer-aided design (CAD). Then, the laser forms a pre-designed item [14]. After designing and producing objects, 3D printing users also have the habit of sharing with their rapidly growing community [15].

3D printing that can create objects directly, providing a new experience in spatial and also provoke imagination for various ages [16]. 3D printing can make the learning process more interesting and interdisciplinary, especially with regard to STEAM (Science, Technology, Engineering, Art, and Mathematics) [17]. The use of 3D printing can provide good motivation for students and lecturers to conduct scientific and skill experiments [18]. The goal is to give students and teachers learning about 3D printing, to support learning activities, learn prototyping, and use technology [19].

Some of the benefits of using 3D printing are to increase students' spatial abilities, students can create real objects, develop creativity, and problem-solving skills that manifest in collaboration [20]. The results showed that there was a positive impact on the spatial perception of students from the use of 3D printing in the learning process [21]. Students can learn complex concepts through 3D printing with a low-cost innovation strategy [22]. The benefits for students in using 3D printing are getting real experience, understanding the structure and process of object production, and embodiment of digital data in the form of objects [23].

There are several advantages to using 3D printing such as no need to cut objects because the technology directly shapes the object, the production process is fast and the life cycle is short, suitable for various shapes, as well as the ability to mass production. There are several weaknesses, such as high cost and high power consumption, limitations in form and materials, and relatively weak strength. [24] Some of the challenges of using 3D printing are lower costs, greater use in manufacture, use and choice of more environmental-friendly materials, IP, and the mindset of users about how it can be used in many industries for various product needs. [25].

There are several examples of the use of 3D printing in various industries, such as marketing (displaying products), Fashion Technology (designing fashion material), Music Training (designing musical instrument), Architecture (designing building mock up), Food Technology (creating food, designing food sample), Graphic Design (designing 3D objects) and etc [23]. The use of 3D printing has continued to grow in the past few years. In the field of fashion and education, nowadays, we are learning more about how to produce fashion products. using 3D printing.

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However, there is also a need to develop eco-friendly materials for environmental sustainability [26]. As part of the manufacture process, 3D printing is excellent because of its ability to be used on a small scale, such as use for creative home products [27]. limitations of materials, costs that are still expensive, food safety and printers, perceptions from buyers of the food they will buy through uifood 3D printing. However, there is a lot of potential for development and prospects in the realm of 3D printing, especially food. Starting from the reduction of food waste, its relation to the manufacture of healthier and allergy-free food, reducing the production and delivery process, and forming a more unique food texture [28].

ENTREPRENEURSHIP EDUCATION

In supporting sustainable development in the manufacturing sector, planning is needed in the learning process. Starting from teaching how the process is greener and providing an understanding of its impact on the environment, society and economy. With the industrial 4.0 approach, students can prepare a sustainable business by using technology that is more environmentally friendly [29]. Higher education has an important role in human development in education, social welfare and the environment [30]. The important role of innovative approaches in supporting education will have a good impact on the competitiveness of universities and can develop human potential [31]. The role of academics and business incubators can be a catalyst to implement industry 4.0 on campuses that highlight entrepreneurship [32].

Education 4.0 requires the application of innovative methods to support learning in universities where people and machines can work together for problem solving and innovation [33]. It is important to involve various stakeholders to build a culture of collaboration in order to strengthen the focus of universities' entrepreneurial targets [34].

Universities play a role in supporting sustainable entrepreneurship. First, the key person in the university as a mover and actor to stimulate awareness and behavior. Second, the support and facilities for projects and research that support sustainable business is also an important key [35]. Higher education institutions need to apply internal collaboration and competition to form innovative research related to sustainable entrepreneurship. Universities also need to cultivate creativity and innovation skills in order to create sustainable products [36].

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BUSINESS INCUBATOR

The most important mission in the incubator program is how to make tenants more independent [37]. Business growth and self-actualization in entrepreneurs can be developed and grown through the incubator program through good support, resources and services to support their business activities [38]. The results of other studies indicate the role of the business incubator in creating jobs, as well as better performance in growth and also return on assets from business tenants [39, 40].

Lack of entrepreneurial skills, access to markets and select main product and design are some of the factors that affect the business development of the tenants in the Business Incubator [41]. Alishiri et.al, found that there are factors that influence the success of a business incubator. Starting from human resources, business environment and investment, support and services from the business incubator program, management, and location [42]. The efficiency of the incubator can be seen from three aspects such as economic contribution, human capital and organizational structure. One of the organizational structures is about the infrastructure available to support the incubator program [43]. One of the patterns in the incubator is providing workspace, shared facilities and other business support to support business development [44]. Providing access to technological facilities is one of the keys to a successful business incubator and an important element in the entrepreneurial ecosystem [45, 46].

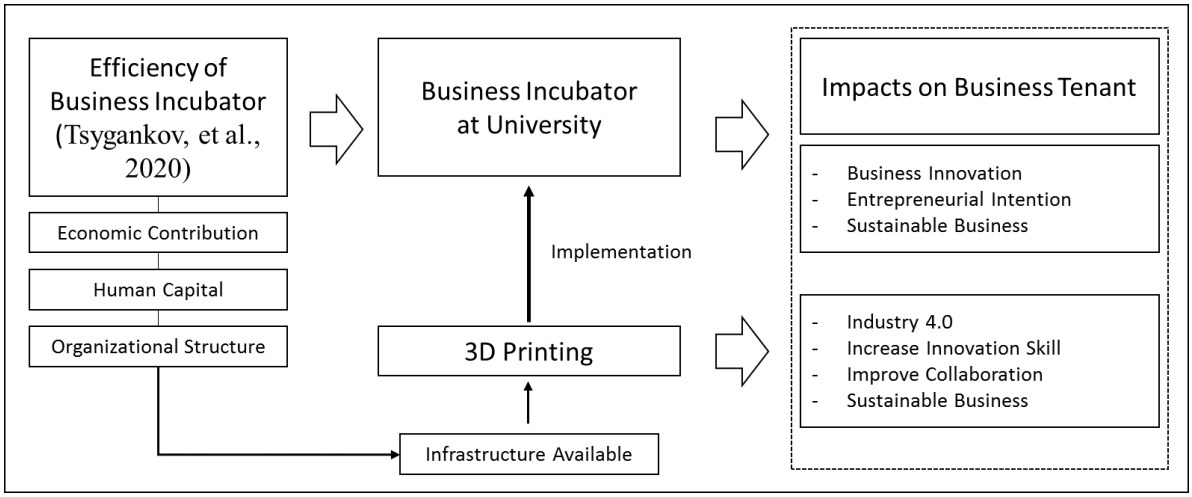

Figure 1. Conceptual Model

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METHODOLOGY

This study aims to explore the potential in the application of 3D printing in a Business Incubator at a private university in Bandung. SWOT (strengths, weaknesses, opportunities, and threats) analysis is an analytical approach that will be used to assess the potential and strategic plans of the Business Incubator in the use of 3D printing. The data is processed from the study of literature and internal data of the Business Incubator. Then proceed with TOWS (Threats, Opportunities, Weaknesses and Strengths) matrix analysis to create implementation strategy. This analysis will later be used as consideration for taking strategic steps in implementing 3D printing in the Business Incubator.

RESULTS AND DISCUSSION

The Business Incubator studied in this study is part of a unit at a private university in Bandung, Indonesia. The purpose of this Business Incubator is to help student businesses to grow through the assistance of the program. There are hundreds of tenants every year to be assisted through mentoring activities, sharing sessions, pitching days, access to investors. Currently, Business Incubator focuses on creative and technology, where currently F&B and salty fashion are the most common categories. This student-owned small business needs support to be able to apply technology and make its business have environmental friendly products.

Table 1. Strengths

Strengths
Have tenants from creative and technology
Have a place for 3D printing lab
Have a collaboration and innovation program
Multi-disciplinary (business incubator participants)
Networks between small businesses, academicians, universities, and communities

From Table 1, it can be seen that there are several strengths in the application of 3D printing in the Business Incubator such as ownership of facilities that support 3D printing, the large number of tenants, the existence of programs that support student business development, as well as networks between entrepreneurs, academics, universities and related communities. In this case, another important strength is the availability of multi-disciplinary knowledge from Business

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Incubator participants which will enrich the level of collaboration, innovation and information exchange.

Table 2. Weaknesses

Weaknesses
Don't have a 3D printing tool yet
Don't have a module for learning with 3D printing yet
There is no one who can be a facilitator yet
There are not many special materials available for the 2 most categories in the Business Incubator (Fashion and F&B)

Weaknesses in the application of 3D printing at the Business Incubator refer to the unavailability of supporters both in terms of curriculum, program, and facilitators related to 3D printing. In addition, weaknesses were also found on the 3D printing side, which could not fully accommodate the 2 most categories in the current Business Incubator.

Table 3. Opportunities

Opportunities
Can explore the product 3D production process
Increase creativity and innovation skills
Improve collaboration
Enhance 4.0 technology capability
Be a provision for small business to become a sustainable business
Reduce production costs for sample products

Many opportunities will be obtained by the Business Incubator in the application of 3D printing. This opportunity can be useful for the hard skills and soft skills of students to develop their business. Starting from the opportunity to understand new technology, have tools for sustainable products, and also reduce production costs. On the other hand, opportunities appear in soft skills for individuals to improve their abilities in collaboration, creativity and innovation.

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Table 4. Threats

Threats
Cost of purchasing tools, operations, and maintenance
The number of materials to buy
Material limitations with the large number of small businesses
Only certain products can be made with the current availability of materials
Intellectual property

There are things that need to be considered because they will be a threat to the implementation of 3D printing in the Business Incubator. Especially regarding financing, which will focus on 3 aspects, purchasing the right and affordable equipment in terms of price, then operating and maintenance costs. Another thing that needs to be considered is the determination of what materials, because there are many industrial categories in the Business Incubator. This also raises the issue of the balance of the availability of materials and the number of small businesses in the Business Incubator. Intellectual property is also a consideration, regarding the preparation to protect IP during the production process.

The next analysis is related to the strategy that will be applied using TOWS analysis to compare and create strategies based on SWOT Analysis

. The first is implementing an SO strategy, which is a combination of internal strengths and external opportunities. The second stage is the WO strategy, which is a strategy to overcome internal weaknesses by using opportunities from external factors. The third is the ST strategy, which is to anticipate the threat of external factors by using the strength of internal factors. The last is the WT strategy, which is how to overcome the problems of weaknesses and threats that arise.

Table 5. TOWS Strategy

TOWS Matrix	Strategy
SO	• Using 3D printing that is affordable with the ability to • Using environmental-friendly materials for 3D printing • Create a program using 3D printing in developing students' business at the Business Incubator

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	• Involving all elements of lecturers, students, and the community
WO	• Create curriculum and modules for 3D printing program for sustainable development • Create usage procedures • Train facilitators • Focus on understanding the use of 3D printing for categories that have limited materials • Create a certain schedule for product production using 3D printing so that it is structured in the learning process
ST	• Choose 3D printing products with affordable prices and cheap and easy maintenance • Provide quotas for production for tenant business incubators to overcome the problem of limited materials • Data collection and assistance by universities for Intellectual property to be made by small businesses • Focus on learning in the use of 3D printing
WT	• Minimize the use of many materials • Strengthening knowledge about the use of tools for facilitators

Opportunities to apply 3D printing. From the results of the analysis, it was found that there were many good opportunities for the application of 3D printing in the Business Incubator. This application is in accordance with the characteristics of the Business Incubator, with facilities, programs, and the number of small businesses run by students. Many small businesses are tenants of the Business Incubator that require supporting technology to accelerate their business.

Impact of 3D printing implementation. The application of 3D printing will not only help businesses understand 4.0 technology and also create sustainable products. However, there are many positive impacts on all stakeholders, both from universities that can make their institutions an entrepreneurial ecosystem through the Business Incubator. Then there are lecturers who can do research, and students with their businesses will get opportunities for business development through 3D prototyping.

Impact on the sustainability of nature. With the implementation and learning that will be carried out in the Business Incubator. The university as its parent can make the application of 3D printing one of the programs for . In previous studies, although the materials for 3D printing are still limited, they have led to environmentally friendly materials. As well as 3D printing technology which can be a solution for sustainable development, it can be seen from its various functions and benefits in reducing waste, saving production costs, etc.

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CONCLUSION

From the results of the study, it can be concluded that the opportunity to use 3D printing in a business incubator is very possible because it makes it easier for small businesses to prototyping with a faster process and reducing waste. There are several factors to consider in its implementation. First, there is a lot of potential in the application of 3D printing in the Business Incubator because it will provide a good learning experience for students to develop their business. Second, regarding environmental friendly materials that will be the focus in implementing 3D printing. There are various industrial categories in the Business Incubator, so a strategy is needed in determining materials and scheduling the production process. One thing that is most important is how the Business Incubator does not only look at the tools, but also prepares the human factor, namely the facilitator who will accompany the learners, with the support of the curriculum and learning modules.

The benefits of this research are useful for business incubators who are the object of research. First, this research can be used as a reference for making strategies in providing 3D printing facilities in the Business Incubator program. Second, SMEs players can get information about opportunities from using 3D printing in their business. This study has limitations in terms of the object of research which only involves one Business Incubator at a private university in Bandung, Indonesia. Suggested further research is how to create curriculum and modules for the 3D printing program at the Business Incubator as well as the selection of appropriate 3D printing tools and materials for the needs of SMEs.

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