

Technology Assessment of a Lubao Engineered Bamboo Production in Pampanga Exploring the Adoption of New Bamboo Splitter Machine

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Abstract: - This research intends to help the bamboo craft business, specifically Lubao bamboo hub located at Lubao, Pampanga by introducing a new technology assessment for the new bamboo processor that is capable in splitting and removing the nodes of the bamboo in a more efficient way. The objective of the study is to fabricate and innovate a design that provides high output and low damage to the split bamboo. The participants or the subjects of the study are the workers of Lubao bamboo hub using the old splitter machine and remove the nodes of bamboo manually. The study presents the steps to be followed in gathering data and testing for results. The researchers came up with this project to help the workers of Lubao bamboo hub with the process of splitting and node removing processes in less time. The installation of a motor on a pushing device that pushes the bamboo to the splitting die makes the process of splitting faster.

Key Words— *Technology assessment, Sustainability, Bamboo, Splitter machine, Engineered, Bamboo Production.*

I. INTRODUCTION

Lubao, a large municipality in Pampanga, is known as the Cradle of Kapampangan Civilization and has become a center of agriculture. However, its low-lying land and narrow streams and rivers have caused soil erosion. To combat this problem, the local government has initiated a bamboo plantation along riverbanks to protect and strengthen the areas. The government aims to promote bamboo as an alternative to commercial lumber and boost the local bamboo industry through the

proposed Lubao Bamboo Hub project. This project includes a research and processing facility, retail spaces, a multi-purpose hall, processing and workshop spaces, laboratories, and accommodation buildings. The establishment of the facility will increase locals' skills and knowledge in agro-industrial, provide employment opportunities, and increase awareness of the importance of bamboo as an alternative renewable material. The project is part of the whole Lubao Bamboo Hub complex, which includes a linear park, bamboo plantation, materials recovery facility, bamboo briquetting facility, and river tourism development [1].

The Lubao Bamboo Hub (LBH), also known as the Sta. Catalina Bamboo Negosyo Village, was established by the Local Government Unit of Lubao in the Province of Pampanga in collaboration with DTI and DOST countryside development programs. Its main purpose is to provide raw materials to other handicraft makers, develop local products, increase the role of MSMEs in economic development, and provide recreational and educational activities. The LBH's operations serve as a

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source of livelihood and income for the Barangay Santa Catalina Island.

R&D centers play a crucial role in ensuring the quality and effectiveness of R&D activities. They serve as technology developers and providers, and their work is connected to both science and academia, as well as industry. R&D centers are an essential part of the R&D chain, acting as a bridge between these different fields. Technology assessment (TA) is the process of identifying and evaluating the potential impacts of technological change and applications in their early stages. This is done as a service to aid policy making and decision making in a broader sense [2].

The Bamboo Hub and Eco Village, unlike other natural eco-parks in the region, are manmade. The property is managed by the Lubao Municipal Government and has become a favorite tourist destination attracting families and health buffs that avail of amenities like covered pathways, bike lanes, and even its own fish spa. Most of the visitors are fascinated by the prospects of gentle strolls under the forest-like canopy from the hundreds of bamboo clumps that line the eco-park. The eco-park attracts an average of 600 people on weekends according to Lubao Mayor Mylyn Pineda-Cayabyab. The mayor said that 325 fully-grown clumps of bamboo are planted inside the six-hectare ecological park. Thousands more will be planted inside a 30-hectare village that the municipal government is developing. "Just imagine using bamboo in making furniture and even floor parquets. The engineered bamboo is flat, and nodes are removed so that the bamboo can be fashioned as slots," Myrna Bituin, former Pampanga Chamber of Commerce and Industry Bamboo program coordinator and furniture exporter said [3].

According to the given information, the current bamboo splitter machine being used by the Lubao Bamboo Hub (LBH) has certain limitations in terms of safety, operating procedures, productivity, and the labor-intensive nature of the process. The LBH has acquired two new bamboo splitters with the help of DTI, but each machine can only split around 100 poles per day, and it takes 4 to 5 minutes to completely split each pole. This leads to concerns over potential physical injuries, poor work posture, and a loss of opportunities.

The adoption of new technology is crucial in order to stay competitive, improve efficiency, and increase productivity. It can lead to new products or services and improve existing ones. Adopting new technology can also reduce costs, increase profits, and provide a competitive edge in the market. Furthermore, new technology can often provide better solutions to complex problems and help to address challenges faced by

businesses or industries. Overall, the adoption of new technology can lead to a range of benefits, making it an important consideration for any organization seeking to remain relevant and successful.

At present, the part capacity is performed by customary blades and saws, so the bamboo parts are scattered. In any case, with this new device the bamboo parts fall in a similar sweep making it simple to assemble those split bamboos. According to Xia utility model relates to bamboo processing machinery, especially consistently splitting the bamboo into pieces. The split bamboo products have almost all of the first process, the process currently relies on manual processing [4]. The utility model aims to give evenly split pieces of bamboo that can process a variety of diameters and different bandwidth necessities. A study by Abate shows that their machine request is higher, and it is the level to answer for the bamboo furniture workers' problem. It can resolve the wearing manual bamboo [5].

process which saves time and aids products. This bamboo processing machine has three main functions, namely the manual splitting, bamboo knot grinding and smoothing bamboo splitter. The aim of this research work is to design and develop a model that can bridge the methodological gap by addressing the technology assessment and selection phase in technological development. The facility bamboo splitter machine is considered as the main technology that provides production in engineered bamboo.

This research was conceptualized to increase the productivity and efficiency of producing bamboo slabs since the manual method is accomplished by health and security risks and is time-consuming which also requires great amount of manual effort. With the multi-purpose bamboo slab processor, the risk and hazards are lessened, also the increase of productivity rate of producing bamboo strips due to the automation of splitting and removal of nodes.

Figure 1 shows the conceptual framework of the multi-purpose bamboo processor. The machine itself is a great innovation in bamboo – craft -manufacturing businesses not only making the process faster but also makes the production cheaper and safer compared to the existing methods used at Lubao Bamboo Hub which is a rotating circular blade for manually splitting the bamboo. It is, therefore, prone to accidents that may compromise the safety of the workers. As for the node remover, our machine will not plan the bamboo strips as fine as a thickness planer, but it will help reduce the times of the bamboo strips to undergo the thickness planer. Nevertheless, the Multi-purpose Bamboo Processor will be beneficial for both the

worker and the employer. Due to the automation of the process and the production, expenses can be minimized.

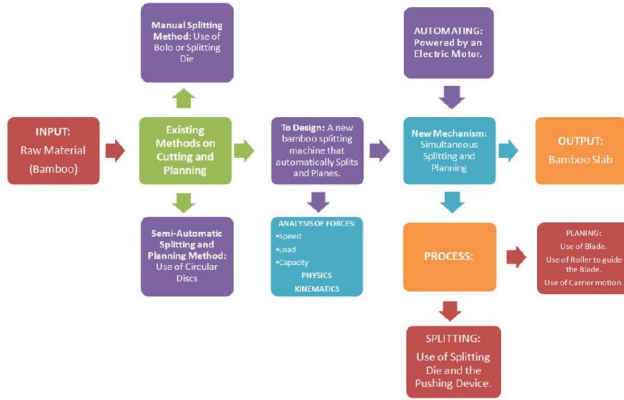


Fig.1. Conceptual Framework

Therefore, it needs to be assessed its sustainability and production output. The research attempts to determine the impact of high output splitter machines on the production performance of the industry while also maintaining the safety of the workers are crucial factors. The following questions are addressed in this study:

1. How can the existing bamboo pole output be used to analyze the technology of the LBH?
2. How can the existing bamboo splitter machine influence the safety of the workers?
3. What impact does the existing bamboo splitter machine have on LBH management?

II. METHODOLOGY

The purpose of this study was to create a model prototype that could objectively represent the evaluation and adoption of new technology decision-making processes at an R&D center. The model must account for the scientific-technological aspects of the technology itself as well as the unique characteristics of the center in order to guarantee the observance of all the factors that characterize the success of the decision and the impact on the sustainability of the center. However, it cannot ignore the aspects relating to potential customers, which are crucial for ensuring the success and sustainability of the commitment to technology.

The researcher used quantitative methodology. It utilized the use of questionnaire as the researcher instrument. By

undertaking survey, it was likely possible for the researcher to gather data in relation to the practices, process, conditions, and views of the participants through series of questionnaires. A survey helps the researcher to classify further variables one at a time than it is achievable through field experiments while the data is being collected by the researcher. The data collection was based on the questionnaire distributed/ assigned to the respondents. The questionnaires were designed and used to acquire enough information pertaining to the objective of the study.

The researcher also includes prototyping. The prototype consists of a splitter, planer, set of blades, chains, pulleys, gears, rollers, and a 2-horsepower electric motor. The study focused on automating the process of splitting and removing internal and external nodes of bamboo.

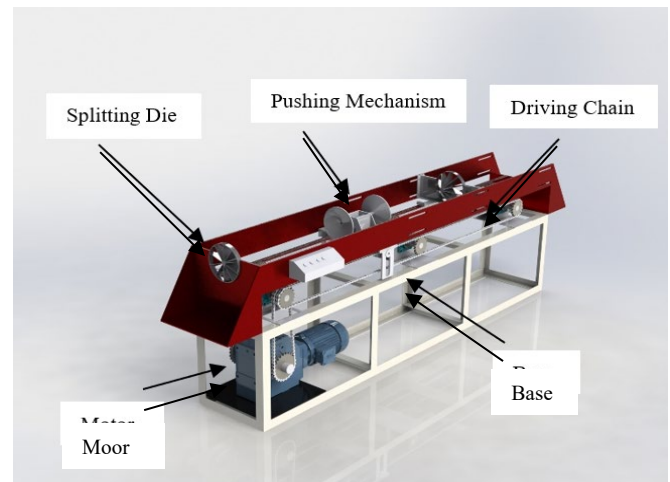


Fig.2. Conceptual Design

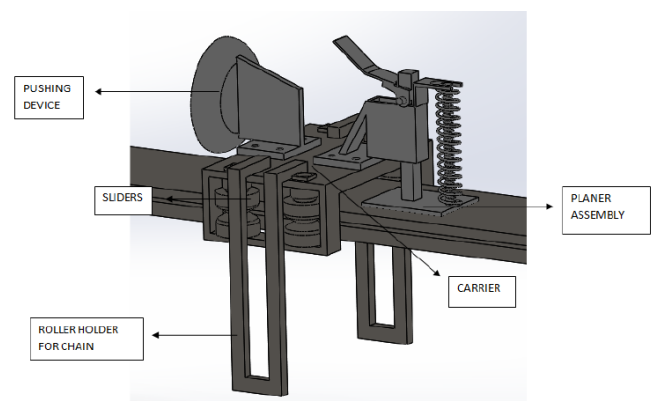


Fig.3. Mechanism Design

The researcher also includes prototyping, and the model was created in the solid works application and was simulated the motion of the prototype the major components are follows:

- Electric Motor- used to convert electrical energy to mechanical energy that generates the rotational force used to power the Multi-purpose Bamboo Processor.
- Sprocket- is a wheel with teeth around the outer edge that fit into the holes in a chain to move it around.
- Splitting Die- holds the stainless-steel blades that are used to split the bamboo.
- Carrier- moving part of the machine that holds the pushing plate and the node remover assembly.
- Pushing Plate- used to grip the bamboo that is to be split.
- Node Remover Assembly- used to remove the nodes of the bamboo.
- Base- used to support the mechanism.
- Chain- used for the transmission of mechanical power.

In the collection of data, the researchers used a timer in measuring the average time needed to completely split and remove the nodes of the bamboo. After, a Vernier Caliper was utilized to measure the width of the bamboo strips produced by the machine. In gathering necessary information, researchers both used online and hard-bound references about the machine. The primary stage for the conceptual method is the collection of data which was done by interviewing the workers of Lubao Bamboo Hub. These data are then examined to attain significant results and findings that will be used to conclude the general impact of the study. To conclude whether the machine will save electricity on producing bamboo strips, several trials have been conducted by the researchers. assessing the performance of the machine, was hypothesized that the allotted time during the production and the load carried by the motor affect the consumed electricity on producing bamboo strips.

The researchers initially performed measuring average diameters, length of the bamboo by using a Vernier caliper to verify if the thickness of the bamboo will affect the time that the Multi-purpose Bamboo Processor will consume, a measuring tape to ensure that the bamboo will fit the prototype and also a timer was utilized to gather the time consumed in splitting this datum were used to determine the average time and cost per 5 feet of bamboo.

The researchers performed bamboo splitting and node removal processes with the Multi-Purpose Bamboo Processor and the

current machine that the Lubao Bamboo Hub uses. Finally, the data gathered was recorded.

III. RESULTS AND DISCUSSION

The table below shows the result of the trials in determining the time consumed on splitting and planning the bamboo using the three machines. The table shows the results for the motor (horsepower), Time Consumed (seconds), Electricity Consumed (KWS/Bamboo) and Cost per Bamboo (Peso/Bamboo) for the computation.

Table.1. Average Time Consumed in Splitting the Bamboo

Trial	Outer Diameter (cm)	Inner Diameter (cm)	Length (ft)	Time (sec/s)
1	9	7.5	5	1.68
2	8.5	7	5	1.64
3	8.5	7.5	5	1.66
Average	8.67	7.33	5	1.66

Table.2. Total Cost of Producing Bamboo Strip using the Old Machine

	Motor (HP)	Time consumed (sec)	Electricity Consumed (KWS/ bamboo)	Cost per Bamboo (Php/ bamboo)
Splitter	3	84.87	189.94	₱ 0.52
Node Remover	5	186	693.78	₱ 1.92
Total Cost per Bamboo				₱ 2.44

Table.3. Total Cost of Producing Bamboo Strip using the New Machine

	Motor (HP)	Time consumed (sec)	Electricity Consumed (KWS/ bamboo)	Cost per Bamboo (Php/ bamboo)
Splitter	2	1.68	2.51	₱ 0.0069
Node Remover	2	176.76	263.73	₱ 0.72

Total Cost per Bamboo				₱ 0.73
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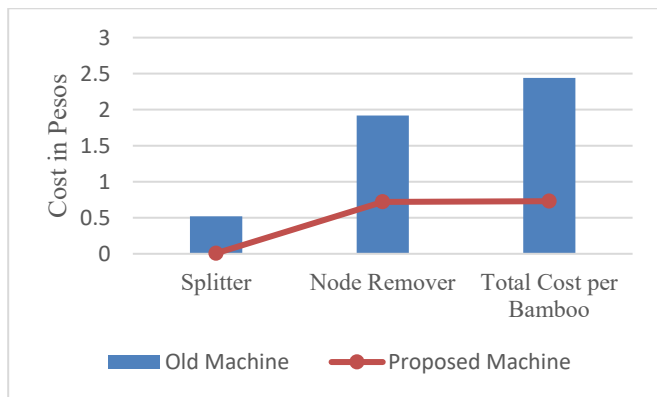


Fig.4. Old Splitter Vs Proposed Splitter Machine

Figure 4 shows the comparison of the existing and propose bamboo splitter, the blue represents the cost per bamboo of using the existing machine in producing bamboo strips while the orange one represents the cost per bamboo using the new machine in producing a bamboo strips. The gray represents the amount of money that the bamboo can save upon using the new machine, Multi-Purpose Bamboo Processor. The proposed machine can achieve up to 70.49 % of savings versus the existing splitter machine.

Splitting and removal of nodes takes time, and it is hazardous especially with manual and traditional way. When splitting the bamboo into strips it is dangerous due to factors such as the tools that are being used to split have sharp edges and is operated with bare hands. Also, the process of removing nodes may cause harm and danger to workers. The Multi-purpose bamboo processor machine requires you to load the bamboo and it will automatically perform the splitting process. Same with the node removal process the machine will perform the operation. Several experiments and revisions on the prototype were done to come up with a working prototype that will satisfy our objectives. First of all, to have a durable and stable frame the researchers selected a metal-based foundation that can handle the stress that is being produced in operating.

The researchers also conducted a test, it was to determine the type of bamboo that can be used on the prototype. The experiment shows that both fresh and dry bamboo can be split by the machine. While with the node removing process only fresh bamboo can undergo the process due to it ruptures the dry bamboo but a fresh bamboo strip will have an acceptable result.

IV. CONCLUSION

The machine is faster than the existing machine with an average of 1.66 seconds versus 180 minutes in a way that the electric consumption is less due to the time consumed in using splitting the bamboo will be

faster and can achieve greater production output versus in the exciting splitter machine. Also, instead of purchasing a separate node removing machine, the researchers added a node remover assembly to the splitter.

The researchers conclude that the adaptation of the new proposed Bamboo Processor is convenient in terms of time consumed on splitting the bamboo mechanically compared to the existing bamboo splitter machine. The workers have options to split the bamboo into six bamboo strips at a single loading using the bamboo splitter instead of using their old machine that splits the bamboo in halves.

The machine is capable of doing a single cycle operation and because of this it lessens the exposure of the workers to the hazards present in the process of splitting. The researchers experienced using chain and belts combination and due to the high-power input, it makes the belt slip and increases the losses. For the research to minimize noise, vibration, and agony that the machine is unsafe to use the researcher suggests that it is better to use other types of drivers such as pneumatics or hydraulics to drive mechanism this will minimize the noise and the vibration compared to a chain driven mechanism.

Also, the researcher concludes that in the removal of nodes the blades should be stationary, and it is the strip that will move and go through the blades. This will eliminate the limit in removing the nodes. This should enable the prototype to remove the nodes of dry bamboo without rupturing the strip.

Also, the removable part of our prototype should be quick-release and not bolted, this will make sure that it will make the operation smooth and easier.

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