ISSN: 3116-3475
International Journal
on Education, Research, and Innovation Perspectives
Volume 2 Issue 1 (January 2026)

# Electronically Controlled Multiple Use Tire Vulcanizing Machine

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Date Submitted:
**January 2, 2026**

Date Accepted:
**January 13, 2026**

Date Published:
**January 13, 2026**

DOI:
**10.5281/zenodo.18256273**

**ABSTRACT**

This study designed, fabricated, and evaluated the operating performance of an Electronically Controlled Multiple Use Tire Vulcanizing Machine. The device was developed to address the inefficiencies and environmental hazards associated with traditional kerosene-based vulcanizing methods in Cuyo, Palawan. It features multiple pressers capable of vulcanizing three different interior tire tubes simultaneously within approximately two minutes. Key components include an electric heating system with replaceable elements, an electronic timer for precision, pilot lamp indicators, and a backup power system comprising an inverter and a 12-volt battery for operation during power interruptions. Additional utilities include a wind protection shield and a water heater attachment. Operating on a 220V AC source with a 400W power rating, the machine was evaluated by experts in terms of design, fabrication, and efficiency. Results indicated an overall "Acceptable" rating (Grand Mean = 2.99), confirming that the machine is durable, cost-efficient, environmentally friendly, and effective in enhancing vulcanizing shop productivity. The study concludes that the machine is a viable solution for improving service efficiency and income generation while reducing health and environmental risks.

***Keywords***: *Tire vulcanizing machine, electronic control, multiple pressers, environmentally friendly, efficiency evaluation*

## INTRODUCTION

Tire vulcanizing has been a problem for many years in Cuyo, Palawan. Most people in the community own vehicles like tricycles, motorcycles, bicycles and even four-wheeled vehicles. The tires of these vehicles often are flattened because of the rough roads, loose gravel and sharp objects. When this happen, vulcanizing is demandable. Usually, the traditional vulcanization process is being used which cause so much delay that consume longer time. This process emits large amount of smoke and therefore is hazardous to health.

Ideally, when vulcanizing automobile, bicycle, motorcycle and other interior tires the kerosene vulcanizer is used and this traditional process causes air pollution that will damage the environment because

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of the emitted gas that pollute the environment. The researcher come up with the idea to design and fabricate Electronically Controlled Multiple Use Tire Vulcanizing Machine

A machine used to vulcanize the rubber but it does not radiate any harmful substance that will affect the environment. Therefore, it is an environmentally friendly product.

There were inventions which create an efficient way of vulcanizing tire that were already in the market. ADMIN (2012) developed a type of vulcanizer in which the heat required is developed electrically in conductors embedded in the metal of the iron or aluminum plate or mold. The temperature of the vulcanizing surfaces is indicated by a thermometer, and is automatically maintained at the correct point by means of a thermostat within the apparatus. The thermostat interrupts the heating current when the proper temperature is exceeded and re-establishes it when the temperature is too low. In some vulcanizers a rheostat is adjusted by hand to maintain the required current strength and temperature. It consumed more electricity and is expensive if used in the remote area.

This study implies that electricity can be used in many ways such as in this multiple electric vulcanizing device. It can improve competently into other forms of energy and can be stowed because of versatility. Electricity shows an amount virtually in every aspect of modern technology. The circumstances in a vulcanizing shop can be enhanced by designing and fabricating the vulcanizing device by adding features, such as, timer and pilot lamp indicators with inverter and hole to vulcanize the tire near the cap of the tire tubes may impressively increase the efficiency and performance of the vulcanizing equipment.

**Objectives of the Study**

This study aimed to design, fabricate and evaluate the operating performance of Electronically Controlled Multiple Use Tire Vulcanizing Machine. Specifically, this study aims to

1. To design and fabricate the Electronically Controlled Multiple Use Tire Vulcanizing Machine
2. To determine the level of acceptability of Multiple Tire Vulcanizer with Electronic Heating Control System in terms design, fabricate and efficiency.

**Conceptual framework**

In order to give a clearer understanding, a conceptual framework is hereby presented in Figure 1.

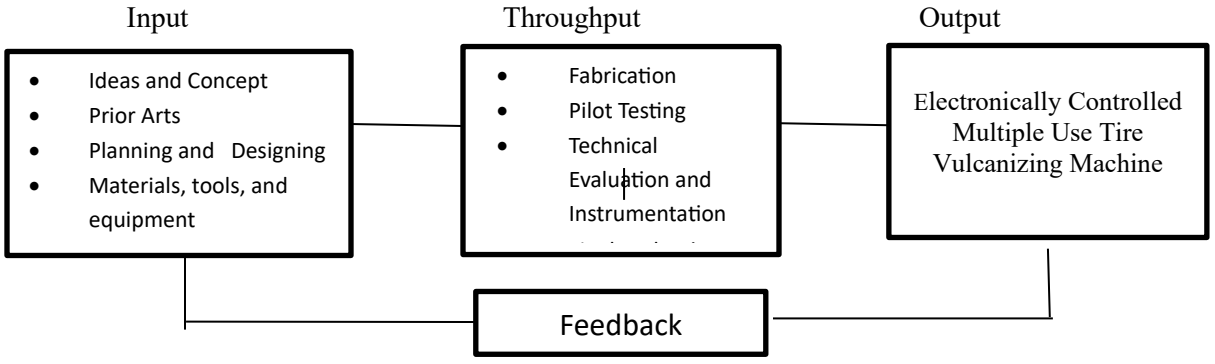


*Figure 1. The Conceptual Model of the Study showing the System Approach.*

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The paradigm shows the three processes adopted in the study. The input of the study comprises the ideas and concepts and prior arts from the present trend on the development of the gadget that is under study. Books and other references provided further clarification on the necessity to conduct this study. In addition, design, fabrication and evaluation, tools and equipment, tools and materials for the fabrication of the said gadget were secured to pursue this study.

The throughput includes design, fabrication, pilot testing, technical evaluation, instrumentation and final evaluation of the gadget by group of experts after which the gadget was subjected to evaluation in terms of design, fabrication and efficiency.

The device was subjected to two series of evaluations, the technical evaluation and instrumentation, and final evaluation. The technical instrumentation was applied to determine the efficiency and other data that answered some of the items in final evaluation to determine the acceptability of the device.

The output shows the development of Multiple Tire Vulcanizer with Heating Electronic Control System. Constant feedback was provided in the components of the conceptual model.

**Significance of the study**

The present study aimed to design, fabricate, and evaluate the Multiple Tire Vulcanizer with Electronic Heating Control System that would provide quality of efficiency and quick vulcanizing of the interior tire. Moreover, the result of the present study may be beneficial to the following:

**Vulcanizing Shop and Entrepreneurs**. The result of this study would benefit the Vulcanizing shops and their surrounded households and industries in the sense that it reduces the tasks involved in vulcanizing and increases the income of the industries.

**Vehicle owners**. The development of this device can help owner of cars, bicycle, motorcycle to have an efficient, accurate and fast vulcanizing of interior tires.

**Educational Sectors.** For the educational sectors, the information gain from this study can be used as an input in teaching Technology and Livelihood Education and Engineering in line with Automotive, Mechanical, Electrical, Electronics, Technology and Livelihood Education courses. Knowledge of vulcanizing, splicing, simple circuit wiring installation, how to construct it and its operation and maintenance are examples of the lessons that can be taught.

**Bachelor of Technical Teacher Education Department and Technology and Livelihood Education.** For the BTTE and BSED Department, the simple circuit, electronics components and devices, and other electrical fixtures can be used as laboratory material for educational purposes in subjects such as Basic Electricity and Electronics, Alternating Current, and Physics.

**Motor pool for Local Government Unit. Non-government Organizations** (NGOs and LGUs) the study will serve as a model in the pursuit for convenience, fast vulcanization process and easy to use.

**Researchers.** This study could further inspire additional researchers to design and fabricate a gadget that could be used in other jobs that require expensive and extended repair.

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## METHODOLOGY

This chapter presents the research design and evaluation, design criteria, design plan, preparation and fabrication, evaluation procedure, instrumentation, data to be gathered limitations to be analyzed and cost return analysis.

### Design Criteria

The project was completed by designing the device and evaluation of its parameters and acceptability of the design, fabrication, and efficiency.

The project was made up of several components or parts: rotatable handle, electric heater, multiple pressers, screw, heating element, timer, pilot lamp indicators, cap shield, inverter, battery and control panel.

The project was subjected to a series of evaluation namely: the technical evaluation, instrumentation and final evaluation in the acceptability of the gadget as evaluated by the group of experts in the field of BTTE Dept., Engineering and Technology experts in their field of specialization.

A researcher – made technical evaluation and instrumentation form was used in gathering the data used in determining some parameters specifically in the design, fabrication, and efficiency. In terms of efficiency, a series of test samples were conducted to determine the efficiency of the gadget in vulcanizing the interior tire tubes.

The researcher made three trials during technical evaluation. During the first trial, the hand set timer was set to one minute setting afterwards it is not so heated. For the next trial, it was set to 2 minutes but the gum was burned. The third trial was set to 1 minute and 50 seconds; it is not so heated but as per suggested by expert evaluators let the heater become cool until 2 minutes in order to give an accurate result.

During the conduct of the evaluation the following issues have been reflected as recommended by the technical experts during the testing.

1. Change the position of the control panel.

2. After 1’30” settings wait at least 30 seconds before removing the tire.

3. Make an additional test sample.

The following are considered by the technical evaluators that may affect the test accuracy of the device. According to the technical evaluators, operating such electronically control system device considered always the welfare safety of the users and operators. Another condition they considered is the condition of the test samples, since there are some test samples that might have slight damage of the tire caused by the careless operation of the device which could also affect the accuracy of the gadget.

In term of efficiency during vulcanizing a series of five trials, the procedures were conducted by actual operation of the device. The no of hours divided by sixty min. times the no, of power times 1000 in order to compute the efficiency of the product.

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The gathered data was recorded using researcher-made technical evaluation and instrumentation. All data gathered in the test was verified by the technical evaluators.

**Design Plan Preparation and Fabrication**

The construction of the Multiple Tire Vulcanizer with Heating Electronic Control System is strong enough to bear continuous treatment. The wing nut rotatable handle is used as a guide to drive for pressing the tire to be vulcanized. The electric heater is used to heat the rubber vulcanizing gum in order to vulcanize the interior tube tire. The presser is used to press the tire for vulcanizing process. The screw is strong enough to hold the presser to support the heating element for vulcanizing the flat tire. The heating element is replaceable for the purpose of replacement of other heating elements that has a unique design, used for heating the rubber vulcanizing gum. The gadget has a timer in order to give an accurate result. This device has a pilot lamp indicator to indicate that the gum was already heated when there is flow of current light indicators lighted. This gadget composed of multiple pressers has a unique design that is composed of special purpose presser to serve as water heater in order to heat water while the rest of the pressers are vulcanizing tires in order to increase the income of the industry and capable of vulcanizing tire three different interior tires at the same time with inverter that are able to vulcanize even brownout with the used of 12 volts battery with special features such as cap shield serve as wind protector of the heating element in case there is a strong wind and water heater for heating water purposes. This device operates with a high voltage 220 volts AC source, 400W power.

**Respondents of the Study**

The respondents were composed of (10) BTTE and TLE instructors/Professors from PSU-CUYO and selected Motor Shop Service Center owners. The purposive sampling was used to determine the group of respondents. The instructors and professors from PSU-Cuyo and selected motor shop owners in the Island of Cuyo, Palawan

**Instrumentation**

The instrument used to evaluate the gadget was the questionnaire made by the researcher. After the construction of the instrument was finished, this was subjected for validity and reliability testing, the instrument consisted of items and scales. Every item in the scale was provided with 3 choices with their corresponding rating value. The quantitative interpretation of the evaluators rating to determine the acceptability in terms of design, fabrication, and efficiency of the gadget, respectively given.

Scale for acceptability of the gadget.

| | | | | | | |
|---|---|---|---|---|---|---|
| 2.34 | - | 3.00 | - (3) | A | - | Acceptable |
| 1.67 | - | 2.33 | - (2) | FA | - | Fairly Acceptable |
| 1.00 | - | 1.66 | - (1) | NA | - | Not Acceptable |

R = Highest Scale – Lowest Scale

i = Range/Number of Scales

R = 3-1 = 2

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i = 2/3 = 0.66 Legend: R = Range i = interval

**Data Gathering Procedure**

The researcher distributed the instrument to the group of respondents. The researcher explained how to evaluate the design, fabrication and efficiency of the gadget.

The data to be gathered are the responses of the BTTE instructors/professors and experts who served as the evaluators during the conduct of the evaluation process of the Multiple Tire Vulcanizer with Electronic Heating Control System.

**Data Processing Technique**

The responses of the respondents were tabulated, analyzed and interpreted with the use of the statistical tools. Mean was calculated to determine the level of acceptability of the Multiple Tire Vulcanizer with Electronic Heating Control System based on the evaluations of instructors, professors and shop owner as to design, fabrication and efficiency.

**Parameters to Analyze**

The study is limited only to the evaluation of the level of acceptability as to design, fabrication of the Multiple Tire Vulcanizer with Electronic Heating Control System and evaluation in terms of efficiency. Moreover, it will be evaluated on the following function in terms of:

**Efficiency**

To evaluate the efficiency of the gadget, its ability to vulcanize, the inflatable tire in 10 minutes in order to get exact amount spend compared to the conventional vulcanizing method. The researcher is to perform five trials to determine on how efficient is the gadget.

**Evaluation Procedure**

The data-gathering instrument was the checklist designed by the researcher to evaluate the design and fabrication of the Multiple Tire Vulcanizer with Electronic Heating Control System in terms of efficiency. Items in the questionnaire established by the researchers were based on some existing competencies commonly used in evaluating a gadget.

To evaluate and determined the performance of the gadget as to design and fabrication in terms of efficiency.

During the evaluation of the operation: a demonstration was conducted by the researcher to the ITE instructors/professors and students who served as respondents together with the respected criteria for conducting the evaluation.

Acceptability testing has been determined, the instruments were used to evaluate and determined the performance of the gadget as to design, fabrication and performance in terms of efficiency.

The researchers presented the Multiple Tire Vulcanizer with Electronic Heating Control System to the ten (10) faculty of the Teacher Education, Engineering Department and BTTE instructors for evaluation.

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The checklists were divided into 3 parts. Part 1 of the checklists consisted of three criteria on design; Part 2 consisted of three criteria on fabrication; and Part 3 consisted the three criteria on efficiency; Suggestions for the improvement of the gadget were given after the evaluation.

During the evaluation of the operation, it is to demonstrate to the ITE instructors/professors and students who served as respondents together with the respected criteria for conducting the evaluation.

## RESULTS AND DISCUSSION

This invention relates multiple tire vulcanizer with electronic heating control system which is manually operable device, the researcher realized the problem on the nearest art. The original design shows some deficiency, which involves shared explanation. This is grasped by redesigning the electric vulcanizer.

The main objects of the invention were the multiple pressers used to vulcanize three tires at the same time. The invention contains aluminum plate to minimize the heat from the presser in order to avoid burning of the tire. In reinventing this device based from the known idea of the existing device, the present study was slightly changed to solve new solution. Specifically in redesigning the multiple number of pressers, with special purpose presser for specific purpose as to vulcanize the fleapit near the cap of the tire and it was also used as water heater while performing vulcanization.

Another embodiment found in the invention, the timer and lamp indicators with specific cap shield to protect the heating element during strong wind and additional features like inverter and battery which are capable of vulcanizing in case of power interruption that is not found on the latest prior art.

Table 3 presents the results of the acceptability of the Electronically Controlled Multiple Use Tire Vulcanizing Machine in terms of Design.

Table 3. Rating and Interpretation s to the Design of the Machine

| ITEMS | MEAN | DESCRIPTION |
|---|---|---|
| 1.The design possess novelty | 3.00 | Acceptable |
| 2. The parts and components of the device are properly fabricated to complement on its function. | 3.00 | Acceptable |
| 3. The device is made durable enough to endure stress during operation. | 3.00 | Acceptable |
| 4. The design meets its objective or purpose. | 3.00 | Acceptable |
| 5. The design provides safety to the user. | 3.00 | Acceptable |
| 6. Its mechanism posses technical features that will distinguish its difference from existing one. | 3.00 | Acceptable |

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| | | |
|---|---|---|
| 7. The device is easy to operate. | 3.00 | Acceptable |
| 8. The design strengthens the gadget | 3.00 | Acceptable |
| 9. The device is not expensive compared to the existing one. | 3.00 | Acceptable |
| AVERAGE MEAN | 3.00 | Acceptable |

As shown on the Table 3, the overall mean rating for the design of the machine is 3.00 which were considered as "Acceptable." This means that the device possesses novelty, easy to operate, the design provides safety to the user. Its mechanism posse's technical features that will distinguish its difference from the existing one and the device is not expensive compared to the existing one.

The evaluators likewise unanimously agreed that gadget is acceptable when it comes to evaluation of the design. The overall mean rating for the design of the gadget is 3.00 which were considered as "Acceptable." This means that the device possesses novelty, easy to operate, the design provides safety to the user. Its mechanism posse's technical features that will distinguish its difference from the existing one and the device is not expensive compared to the existing one.

This simply implies that the design of the gadget met the expectations of the research the "design fit its purpose." It is efficient and effective in the sense that it offers multiple avenues for working with vulcanizing, to perform more than two is not an ordinary gadget. Effective because that output is maintained in terms of replication due to performance vulcanizing. Meaning the gadget is very effective and efficient. Acceptability of the Electronically Controlled Multiple Use Tire Vulcanizing Machine in terms of Fabrication.

Table 4 presents the results of the acceptability of the Electronically Controlled Multiple Use Tire Vulcanizing Machine in terms of Fabrication.

Table 4. Rating and Interpretation as to the Fabrication of the machine

| ITEMS | MEAN | DESCRIPTION |
|---|---|---|
| 1.Shows conformity in the standard fabrication practice. Acceptable | 3.00 | Acceptable |
| 2.Has skillful planning. | 3.00 | Acceptable |
| 3. Utilized Appropriate Materials. | 3.00 | Acceptable |
| 4. Has major components. | 3.00 | Acceptable |
| 5. Show endurance in extreme usage. | 3.00 | Acceptable |
| 6. has good workmanship. | 3.00 | Acceptable |

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| | | |
|---|---|---|
| Grand Mean | 3.00 | Acceptable |

As shown on the Table 4, the overall mean rating for the fabrication of the gadget is 3.00 which were considered as "acceptable." This means that both the faculty, other selected shop owners of the Mechanical, TLE, and BTTE instructors and professors considered the gadget acceptable in term of Fabrication.

This means that the device shows conformity in the standard fabrication practice, has skillful planning, utilizes appropriate, materials, has major components, shows endurance in extreme usage and has good workmanship, . Its mechanism posse's technical features that will distinguish its difference from the existing one and the device is not expensive compared to the existing one.

Another invention shown in figure 2 The Electric Vulcanizer using two heating elements, with temperature timer and additional time that suit in every close to the present study equipped with heating but the present s using multiple pressers heating element with individual timer control. And additional inverter electronic device in case of brown out.

In view of this, it could be implied that fabrication of multiple tire vulcanizer with electronic heating control system durable and strong because it can also hold the weight of the thing atop of it and the person working also. If the fabrication is strong and durable working with it is as working with ease due to the kind fabrication of the gadget.

Acceptability of the Multiple Tire Vulcanizer with Electronic Heating Control System in Terms of Efficiency.

Table 5 presents the results of the acceptability of the Electronically ControllMultiple Use Tire Vulcanizing Machine in terms of Efficiency.

Table 5. Rating and Interpretation as to the Efficiency of the gadget.

| ITEMS | MEAN | DESCRIPTION |
|---|---|---|
| 1.Can minimize power consumption | 3.00 | Acceptable |
| 2. Is cost efficient. | 2.90 | Acceptable |
| 3. Can increase income to the industry. | 3.00 | Acceptable |
| 4. Can endure tire maximum tire to vulcanize. | 3.00 | Acceptable |
| 5. The weight of the device is just enough for easy to manipulate. | 3.00 | Acceptable |

| | | |
|---|---|---|
| 6. It is safe to use. | 3.00 | Acceptable |
| AVERAGE MEAN | 2.98 | Acceptable |

In Table 7, the evaluation of Electronically Controlled Multiple Use Tire Vulcanizing Machine as evaluated by the technical experts in terms of efficiency. The table reveals that the gadget is efficient and effective because the highest mean is 3.00 and the lowest mean is 2.90 and the "acceptable" This means the gadget, can minimize power consumption is cost coefficient, can increase income to the industry, meets the demand of the industry in terms of Efficiency of this device. Its mechanism posse's technical features that will distinguish its difference from the existing one this device can vulcanize three tires at the same time and can minimize power consumption compared to the existing one which is expensive if used in the remote areas and it composed one presser only.

The evaluators likewise unanimously agreed that gadget is acceptable when it comes to evaluation of the efficiency of the gadget.

In 2006 Frederic John Stann in his Study Reliability, Efficiency, and Timeliness as selectable services in wireless sensor network, states that as timeliness decrease the efficiency and reliability also decreases. While this study is different from the stated prior art because it can vulcanize three tire one at a time and it case of brown out can still vulcanized therefore it improved the income of the industry.

According to Fukuda et al. US patent document, US9156219 B2 Tire Vulcanizer and Tire Vulcanizing System the patent document discloses that a tire vulcanizer system improving production efficiency by shortening time for loading and unloading of tires are provided, whereas the present study what is similar in terms of design it has an electronic timer control for heating with pilot lamp indicators and three individual switches in every heating element.

In this study the additional number of pressers for this invention and some other features were suit to its purpose to increase the production of the industry.

This simply implies that the efficiency of the gadget met the expectations of the research the. It is efficient and effective in the sense that it offers multiple avenues for working with vulcanizing, to perform more than two is not an ordinary gadget. Effective because that output is maintained in terms of replication due to performance vulcanizing. Meaning the gadget is very effective and efficient.

Overall acceptability of the Electronically Controlled Multiple Use Tire Vulcanizing Machine in terms of Design, Fabrication, and Efficiency Electronically Controlled Multiple Use Tire Vulcanizing Machine.

Table 6 presents the overall results of Level of Acceptability of Electronically Controlled Multiple Use Tire Vulcanizing Machine in terms, Design, Fabrication, and efficiency of the gadget.

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Table 7. Overall Rating and Interpretations as to Design, Fabricate, and Efficiency of the machine

| PARAMETERS | WEIGHTED MEAN | DESCRIPTION |
|---|---|---|
| Design | 3.00 | Acceptable |
| Fabrication | 3.00 | Acceptable |
| Efficiency | 2.98 | Acceptable |
| Grand Mean | 2.99 | Acceptable |

As shown on the Table 7, the overall mean rating of the gadget is 2.99 which were considered as "Acceptable." This means that evaluators unanimously agreed that gadget is acceptable when it comes the level of acceptability for the level of the gadget has the purpo in terms of design and fabrication, and Efficiency of the gadget.

This simply implies that the level of acceptability of the gadget met the expectations of the research the "three parameters." It is acceptable, in terms of design, fabrication, and efficiency of the. Electronically Controlled Multiple Use Tire Vulcanizing Machine

**Conclusion**

1. The design of the device meets the required standards of the industry based on the evaluation of experts from the BTTE, TLE, Mechanical Engineering professors and instructors as well as in the motor shop service centers and vulcanizing shop operators/ owners.

2. The fabrication of the device meets the required standard based on the evaluation experts from the vulcanizing shop owners and from the academe experts.

3. The machine can vulcanize three tires at the same time in 2 minutes and therefore accepted by the experts. The efficiency of the machine is accepted, meaning the Electronically Controlled Multiple Use Tire Vulcanizing Machine lessen power consumption. Therefore, greater income will be achieved if used. It is an environmentally friendly piece of equipment since it does not emit gas as compared to the conventional vulcanizing process and much more benefit and has lesser health hazard to the operator.

4. In general, based on the results of final evaluation conducted, the Electronically Controlled Multiple Use Tire Vulcanizing Machine is acceptable as evaluated by group of experts it will be the basis for manufacturing suppliers to mass produced the multiple tire vulcanizer with electronic heating control system. With the findings, related literatures and prior arts disclosure, the researcher closes this research with the theory that in every machine or device should have a feature that reduces tasks involved, manpower in vulcanizing shop, entrepreneurs and increased the efficiency as well as the

income of the industries in their service of operations and most importantly it is a solution to the problem.

**Recommendations**

It is recommended that this Electronically Controlled Multiple Use Tire Vulcanizing Machine (ECMUTVM) must have mass production to be sold in the market and will be used in every welding, automotive, machine shop, vehicle owners and other motor works service centers in the sense that it reduces tasks involved, manpower in vulcanizing and entrepreneurs to increase the income of the industries in their service of operations.

The educational sectors- are encouraged to acquire this Electronically Controlled Multiple Use Tire Vulcanizing Machine so that they can use this as a model and serve as an instructional device in their field of specialization.

It is recommended also to the BTTE, TLE Departments that this study can be in their laboratory works and can improve through additional features like automatic power supply shut down or perhaps remote controll alarm or even buzzer in their laboratory activities in conducting developmental research project.

Motor pool in local government and non- government organizations for their convenience in operation, use Electronically Controlled Multiple Use Tire Vulcanizing Machinein performing their jobs easier and faster.

It is further recommended and encouraged other researchers to conduct developmental research and this will serve as a guide and reference in conducting developmental research in the field of Technology.

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