Motorcycle Anti-Theft And Safety Device

Dr. Jeffrey P. Maranan, Dr. Shirley E. Maranan, Jerome Z. Macalindong, John Carlo M. Payas, Ivanna Shane B. Furto

Batangas State University – Gov. Pablo Borbon Main II
College of Industrial Technology
Alangilan, Batangas City, Batangas, 4200 Philippines
jepmaranan@gmail.com, shirleyejemaranan@gmail.com, mackhiedo16@gmail.com, payasjc@gmail.com, Yvanajyll_16@yahoo.com

Abstract: Security of one's property has long been a concern of people throughout the world. Beyond hiding the objects or constantly guarding them, the most frequently used option is to secure them with a device. Today, there are circumstances where security and safety has been tested whether at home, in the office, or any public or private places. Reports showed that motorcycle stealing was rampant and the number of motorcycle accidents in the Philippines were high as they expose the driver and passenger/s to twice as much risk than in four-wheel vehicles. Although there have been laws implemented on motorcycles, accidents have been declared as one of the leading causes of death in the Philippines. These scenarios prompted the researchers to develop a device which will secure human lives and property using Arduino technology in a motorcycle anti-theft and safety device.

Keywords: anti-theft, Arduino technology, computer programming, micro-controller

1. Introduction

Today more than ever, there are circumstances where security and safety has been tested whether at home, in office, and in other places even public or private become the object of theft. Due to these to be saved, to be protected from harm and to be secured have been concerns of every individual, this gives an option to find ways to secure the motorcycles, through the aid of technology. Safety is a prime concern in our day to day life [1]. Everyone wants to be as secured as possible. Security is the degree of protection against danger, damage, loss, and crime. Security is a form of protection that includes structures and processes that provide or improve security as a condition. Many people do not think about safety and security in motorcycles until it is too late and they have become victims of car napping and accidents. The number of motorcycle accidents in the Philippines is increasing but studies have not been done to assess its causes. This study considered the separate and interactive effects of environment and driver-dependent factors namely gender, helmet usage, risk taking behavior, day, time and month of the accident, junction type, movement, road character, surface condition, weather, traffic sector, and lighting conditions in predicting motorcycle accidents in the Philippines. According to the Metro Manila Development Authority (MMDA), motorcycles are more prone to accidents as they expose the driver and passenger/s to twice as much risk than in four-wheel vehicles [2]. Although there have been laws implemented on Traffic Laws Regulations, specifically on motorcycles, accidents have been declared as one of the leading causes of death in the Philippines. The alarmingly growing number of motorcycle accidents can be attributed to a number of environment and driver dependent factors specifically variables found in the Philippine Police Report form. Among the environment factors in the form are day, time and month of the accident, junction type, movement, road character/type, surface and lighting conditions [3]. This prompted the researchers to develop a device which will secure human lives and property. This objective can be attaining through the use of knowledge and competencies acquired and skills developed from their course, Bachelor of Industrial Technology major in Instrumentation and Control Technology. These will help the researchers in developing an Arduino operated Motorcycle Anti-Theft and Safety Device that will provide the best security and safety for motorcycle and its owner. With this device, security and safety for people and the property they possess will be provided in a more technological way. This study is about Arduino operated motorcycle anti-theft device. This system is designed to secure and protect the motorist from accident. It comprised the following stages: project design, project development processes, and the construction procedures. It also covered testing and evaluation to determine the reliability and the functionality of the project. Also included in this study is the list of the supplies and material, tools, and equipment used in constructing the device, the cost of its production and the procedures of operation. In addition, the study utilized electronic devices and the diagram of their application. Given due consideration is the simplicity of the design which is possibly the most important criterion in designing a project. In this study, the biometric is located under the handle of the motor and the sensor is placed on top of the helmet. The study consists of the process on developing an Arduino operated motorcycle anti-theft device which operates using biometrics and sensors programmed in the microcontroller (Arduino). The study is limited only for motorcycle users and owners. The biometrics entry is also limited to 200 persons. The other drawback of the device is its power source. If the battery runs out of charge, the device will cease functioning. On the other hand, the project is delimited to the components of the helmet since this function as the sender and switch of the motorcycle. Motorcycle Anti-Theft and Safety Device is design and operated with Arduino (MCU). A micro-controller unit MCU can be compared to a small standalone computer, it is a very powerful device, which can execute a series of pre-programmed tasks and interacting with other hardware devices [3]. Being packed in tiny integrated circuit (IC) whose size and weight is usually negligible, it is becoming the perfect controller for robots or any machines requiring intelligent automation. A single micro-controller can be sufficient to control a small mobile robot, an automatic washing machine or a security system. Any micro-controller contains a memory to store the program to be executed, and several input/output lines that can be used to interact with other devices, like reading the state of a sensor or controlling a motor. Nowadays, micro-controllers are so cheap and easily available that it is common to use them instead of simple logic circuit like

counters for the sole purpose gaining some design flexibility and saving some space [4]. Some machine and robots will even rely on a multitude of micro-controller "In system without removing the micro-controller from its place. Today, micro-controllers are an indispensable tool for the robotics hobbyist as well as for the engineer [5]. Starting in this field can be a little difficult, because they usually cannot understand how everything works inside that integrated circuit, so they have to study the system gradually, a small part at a time, until they can figure out the whole image and understand how the system works. [6] Micro-controllers are used in automatically controlled products and devices, such as automobile engine control system, implantable medical devices, promote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, micro-controllers make it economical to digitally control even more devices and processes. Mixed signals micro-controllers are common, integrating analog components needed to control non-digital electronic system. Some micro-controllers may use four-bit words and operate at clock rate frequencies as low as 4 KHz, for low power consumption (mill watts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interruptions; power consumption while sleeping (CPU clock and most peripherals off) maybe just Nano watts, making many of them well suited for long lasting battery applications. Other micro-controllers may serve performance- critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speed and power consumption. [7] Arduino/Genuino UNO is the best board to get started with electronics and coding. The Arduino UNO is the most robust and documented board of the whole Arduino family. Moreover, it is a micro-controller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. [8]

2. Objectives

The general objective of the study is to develop motorcycle anti-theft and safety device which can help people to protect their property and lives. Specifically, this study will be able:

1. To apply the knowledge and skill used in industrial technology major in Instrumentation and Control Technology;
2. To develop the device in terms technical, and material specification;
3. To test and evaluate the project in terms of accuracy, durability, and safety;
4. To analyze the social acceptability, technical feasibility, financial/economical viability, environmental soundness, and political acceptability; and
5. To develops an operation manual of the device.

3. Methodology

This research used the project development study approach and come up with a prototype of the device. The proponents used planning, analyzing, designing, assembling and testing/evaluating.

4. Results and Discussions

In the design and development of the motorcycle anti-theft device the following have been achieved:

4.1 Design Stage

This stage shows the system design layout of Motorcycle Anti-Theft and Safety Device. The researchers will be able to come up with a working layout. Figure 1 presents the system design lay out of the device. The figure shows how the device will function using the helmet with RC receiver inside, Arduino UNO, and the finger print scanner that will give the signal to start the motorcycle engine.

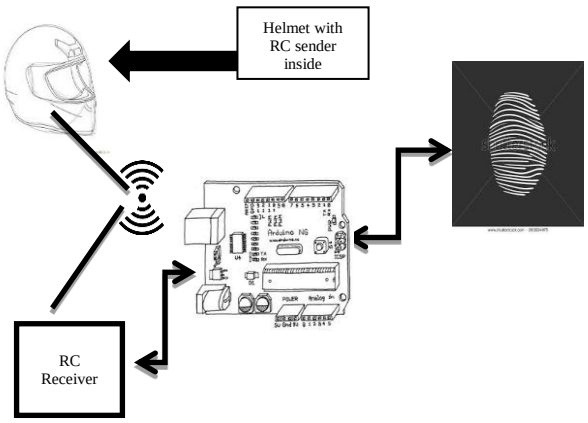

Figure1: *System Design Lay-out*

On the other hand, figure 2 presents the circuit diagram of Motorcycle Anti-theft and Safety Device. The figure shows the relays and sensors of the device with AT mega 328 circuit board that will process and communicate signals to the motorcycle and the helmet.

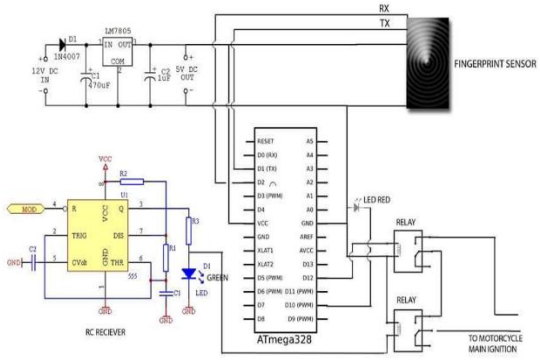

Figure2: *Circuit Diagram*

Furthermore, table 1 presents the system components and their functions. Basically, there were seven principal components for the device namely Arduino UNO, remote control sensor, power supply, finger print scanner, helmet, LED, and wire. These components were used for the receiving and sending of information for the device.

Table 1: *System Components and their Functions*

Parts	Functions
Arduino UNO	Used to control and manipulate the entire process ant it was incorporated with a programmable who served as brain of the entire project.
Remote Control Sensor	A miniaturized sensor used for receiving various kinds of modulated IR signal.
Regulated Power Supply	Used as a regulator of the voltage supply of the device.
Finger print scanner	Used in security systems of biometrics.
Helmet	A hard hat that is worn to protect the head.

Table 2 presents the material specifications in the development of the device. It can be gleaned from the table that electrical materials were used in the study.

Table 2: *Material Specifications in the Development of Motorcycle Anti-Theft Device*

Materials	Specifications
Silicon	Dow Corning 995 Silicone Structural Glazing Sealant has been internally tested and is designed to meet or exceed the test requirements
Electrical tape	Thickness: 7 Mil/0.18mm Physical Properties Elongation: 200% Tensile Strength: 26N/cm Peel Adhesion (N/cm): 1.8N/cm Voltage Breakdown: 8kv
Cable tie	Tensile strength in accordance with mil 2319OE. Good resistance to chemicals, gamma and UV radiation. Black version for outdoor use.
Glue sticks	Flexible and temperature resistance for light production bonding assembly.
Acrylic	A device that lights up and displays information when electricity passes through it.
Insulation	mechanical insulation is one or more sections in Divisions 21–Fire Suppression, Division 22–Plumbing, and Division 23–Heating, Ventilating, and Air Conditioning (HVAC).
Aluminum sheet	Thickness:0.20mm-350mm Width:8mm-2400mm
Rivet	Body Diameter: 0.1250 inch Grip Length: 0.1260 to 0.2500 inch

Table 3 presents the tools and equipment used in the device. The hand drill, screw driver, soldering iron, multi-tester, glue gun, metal scissor, pliers, de-soldering pump, riveter, and silicon sealant were used for the fabrication, testing, and troubleshooting purposes.

Table 3: *Tools and Equipment*

Tools	Functions
Hand Drill	Used to create cylindrical holes.
Screw Driver	A tool with a flattened, cross-shaped tip that fits into the head of the screw
Soldering Iron	Used for melting solder and applying it to metals.
Multi-tester	Used to measure voltage, current, and resistance.
Glue Gun	Used to utilize and dispense hot melt adhesives
Metal Scissor	Used to cut sheet metal and other tough webs.
Pliers	Used for splicing the wires, and for gripping small object or bending.
De-soldering Pump	Used to remove solder from a printed circuit board.
Riveter	Used to drive rivets.
Silicone Sealant	Designed to be used to seal out water around a bath tub and fiber glass.

The technical specifications of the device was presented in table 4. This device used nine (9) technical parts from Arduino UNO, sensors, relay, battery, LED and wires.

Table 4: *Technical Specifications in the Development of Motorcycle Anti-Theft Device*

Parts	**Specification**
Arduino UNO	Atmega328P microcontroller, 5V operating voltage, recommended input voltage is 7-12V (6-20V limit), 14 I/O pins (6 PWM), 6 analog input, 20 mA DC current per I/O pin
Remote Control Sensor (Sender)	M27 serial type/ 3volts/ JKN1114A
Remote Control Sensor (Receiver)	M27 serial type/ 6volts input DC. / Model no. LN480R
Regulated Power Supply	12 Volts DC input/ 5 volts DC output/ Generic coil type
Finger print scanner	Supply voltage: 3.6 - 6.0VDC Operating current: 120mA max Peak current: 150mA max Fingerprint imaging time: <1.0 seconds
Helmet	With ICC sticker, a hard hat that is worn to protect your head.
Relay	HLS8L DC 12v-S-C/ 3amp./ 5v. Coil
LED	Diffused type LED (red, green,)
Wire	#18 stranded wire.

4.2 Preliminary Testing and Modification

The following materials and system components were used in the motorcycle anti-theft and safety device: Figure 3 shows the UNO is microcontroller board based on the ATmega328.

Figure 3: *Arduino UNO ATmega328P*

This Arduino has 14 digital input/output pins, a 16MHz quartz crystal, a USB connection, a power jack and a rest button. This serve as the brain of the project Motorcycle Anti-theft Device.

Figure 4: *Fingerprint scanner*

On the other hand, figure 4 shows the Arduino compatible fingerprint scanner which is a security system for biometrics used in Motorcycle Anti-Theft Device. Figure 5 is a typical helmet where the device was placed. The proponent also asked experts on the safety feature of the helmet so that the device will not cause any danger on the part of the user.

Figure 5: *Helmet*

The helmet has a protective head covering usually made of a hard material to resist impact were the RC sender was mounted. Another material was shown in figure 6. A semiconductor diode that emits light when a voltage is applied to it and that is used especially in electronics devices [9]. It is used as an indicator in the project.

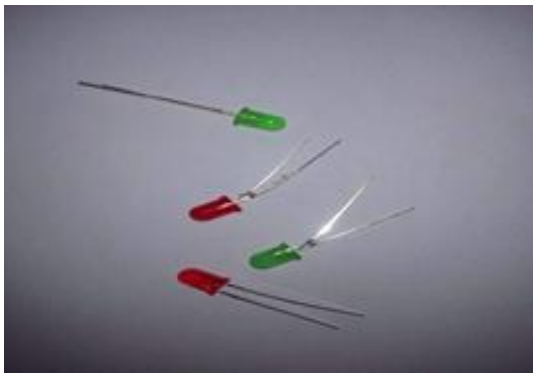

Figure 6: *LED*

Lastly, figure 6 shows wires that connects system components of the device. It is used as a connector of voltage supply for the devices.

Figure 7: *Wire*

The components of the motorcycle anti-theft device were preliminary tested based on material and technical specification.

Figure 8: *Fabrication of the Device*

This figure shows the fabrication of the case of the Arduino and other devices. It can be seen from figure 8 that the proponent is drilling a piece of metal that is used for the housing of the component.

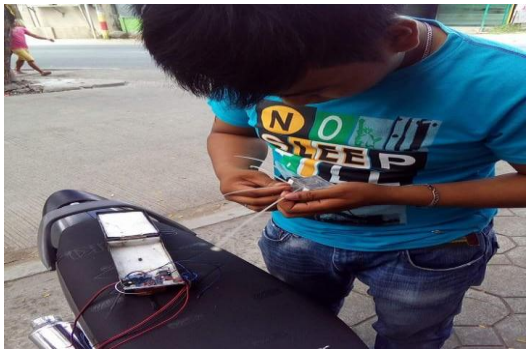

Figure 9: *Wiring of the Device*

Figure 9 shows inserting of cable tie for the case of Arduino. It can be seen that the proponent is installing and preparing the wiring components of the device. Careful installation is used to secure that the wires were properly crimped and wired [10].

Figure 10: *Installation of the Sender of the Device*

This figure shows the researchers while testing the connections of power supply. It can be seen that the component parts were installed in the motorcycle.

Figure 11: *Installation of the Receiver of the Device*

This figure shows the connecting the wire to Arduino from the sender to the receiver of the device. This also shows the proper wiring installation of the Arduino.

Figure 12. *Final Set-up of the Device in the Motorcycle*

Figure 12 shows the final set up of the Motorcycle Anti-Theft and Safety Device. This shows the actual motorcycle and the helmet of the device.

4.3 Final Testing and Evaluation

The Motorcycle Anti-Theft and Safety Device, the proponents test first all of the components of this study to assure that all of the device to be used are in good condition and functioning. After fabrication, the proponents tested the device. An indicator light using an LED (red and green) which is located on the top of the aluminum case indicates that the system is functioning. Once the scanner read the fingerprint of the owner the red LED turned off. And when the owner wears the safety helmet the green LED turned on and the motorcycle can be turned on. The safety feature of the device is that the motorcycle cannot be turned on when the owner is not wearing the helmet that is specifically programmed with the device. The proponents asked experts from Philippine National Police, motorcycle enthusiast, riders, and Land Transportation Office to evaluate the device in terms of accuracy, durability, and safety. Table 5 shows the accuracy of the motorcycle anti-theft device.

Table 5: *Accuracy of the Motorcycle Anti-Theft and Safety Device*

Criteria (The device…)	Mean	Verbal Interpretation
1. Accurately scan the finger print of the owner of the motorcycle.	4.00	Highly Acceptable
2. The project has an indicator that shows that the system is on process	3.74	Highly Acceptable
3. Precisely set-up based on the program required.	3.68	Highly Acceptable
Composite Mean	3.81	Highly Acceptable

From the table it can be gleaned that all the criteria of accuracy were highly acceptable with means ranging from 3.68 to 4.00. The composite mean of 3.81 also suggests that the device is highly acceptable. On the other hand, table 6 presents the durability of the device.

Table 6: *Durability of the Motorcycle Anti-Theft and Safety Device*

Criteria (The device…)	Mean	Verbal Interpretation
1. Has a modified system box that fits and protect the components of the system.	3.63	Highly Acceptable
2. Is made of materials with good condition without significant deterioration.	3.79	Highly Acceptable
3. Has durable component parts.	3.74	Highly Acceptable
Composite Mean	3.72	Highly Acceptable

It can be gleaned from the table that the modified system box, materials, and component parts are highly acceptable with mean ranging from 3.63 to 3.79. The same interpretation was also derived from the composite mean of 3.72. This suggest that the motorcycle anti-theft and safety device was durable enough to be used by motorcycle riders. Durability is the ability of a physical product to remain functional, without requiring excessive maintenance or repair, when faced with the challenges of normal operation over its design lifetime. Several units may be used to measure the durability of a product according to its field of application, such as years of life, hours of use, and operational cycles [11] Lastly, table 7 presents the safety of the motorcycle anti-theft device in three criteria.

Table 7: *Safety of the Motorcycle Anti-Theft and Safety Device*

Criteria (The device…)	Mean	Verbal Interpretation
1. Has safety feature since it is made up of insulating materials.	3.84	Highly Acceptable
2. Has protective equipment to avoid short circuits.	3.74	Highly Acceptable
3. Provides troubleshooting and control measures.	3.78	Highly Acceptable
Composite Mean	3.79	Highly Acceptable

Based on the means from the abovementioned table, all criteria were highly acceptable. The composite mean of 3.79 also suggest that the project is safety highly acceptable. A safety device like this prototype is a piece of equipment that reduces loss or damage form accident. [12]

4.4 Significance of the Findings

Social Acceptability. The Motorcycle Anti-Theft and Safety Device was evaluated to determine the social significance of this technology to target end-users. The safety of the motorcycle riders was the main concern of the device and helmet was the main form of safety. It is also a device that makes the user more secured since the device used scanner and finger prints of the user/owner.

Technical Feasibility. In terms of the technical feasibility the student researcher considered that the required technology is available together with the resources. Future researchers and project developers can buy the trainer's components in Manila or even in Batangas City [13]. More importantly, manpower, programmers, testers, debuggers, software and hardware were available in the market either branded (made from Italy or US) or local/generic (made in the Philippines).

Financial/economic Viability. The financial/economic viability was used to examine the financial/economic soundness of promoting the use of Motorcycle Anti-Theft and Safety Device. This NPV was further justified by the internal rate of return (IRR) of 17 percent. The said percentage suggest that the higher a project's internal rate of return, the more desirable it is to undertake the project. IRR is uniform for investments of varying types and, as such, IRR can be used to rank multiple prospective projects a firm is considering on a relatively even basis. Since the trainer has 19 percent IRR this further indicates that the project should be considered by the stakeholders.

Environmental Soundness. This factor assessed to understand the ecological implications of introducing the device. The project will not use any form of smoke or harmful emissions that will pollute the air. Moreover, there will be sound produce only if the electric buzzer and ultrasonic sensor will be activated. [14] In term of land pollution, the materials used can be recycled or be part of the Material Recovery Facility of the university since most of them can be used for applications purposes. Lastly, water pollution will not be feasible since no wastes will be placed on water system.

Political acceptability. This was used to assess the political relevance of promoting the technology among Land Transportation Office and other stakeholders. In assessing the political acceptability of the device, the student-researchers conduct a survey and unstructured interview to the stakeholders found out the trainer is highly acceptable.

4.5 Operations Manual of the Motorcycle Anti-Theft and Safety Device

The Operations Manual of the device includes its part, operational procedures, safety, and contact information of the proponents.

5. Conclusions

Based on the findings of the study, the following conclusions have been drawn:

1. The knowledge learned in the construction of the project were related in computer programming, micro-controller, and Arduino technology.
2. The material and technical specifications of the device was based on standards of micro-controller and Arduino technology.
3. After careful testing and evaluation of the project, it was found that accuracy, durability and safety were highly acceptable.
4. The device was found to be socially acceptable, technically feasible, financially/economically viable, environmentally sound, and politically acceptable.
5. The Operations Manual will be used by the motorcycle riders for ease of operation and safety of the developed device.

References

[1] Fisher, Scott R. Electronics Lock Box Multiple Modes and Security State Germany: Springer Heiledberg, 2005

[2] MMDA. Traffic Rules and Regulations. 2015

[3] Banzi, Massimo, Getting Started with Arduino Second Edition, O' Reillymedia Inc., USA, 2011

[4] Graf, Rudolf., Moderd Electronics 7th Edition, Newnes, Woburn MA., 2000

[5] Mercado, Ed. C., Hands-on Inventory management, CRC press, sound Parkway, NW, 2007

[6] Kamal, Raj., Microcontroller Second Edition, Pear Education, 2005

[7] http://en.wikipedia.org/wiki/security#securityconcepts (Date Retrieved: February 21, 2016)

[8] http://en.wikipedia.org/wiki/microcontroller (Date Retrieved: February 21, 2016)

[9] Arsenio, Eugene Francis V., Landicho, John Junel D., Malaluan, Angel Mae LSecured Lock System., Project Development Study, Batangas State University, April 2012.

[10] Dadau, Ivy Quirubin A. Jr., De Ocampo, Sheena M., Dimalibot, Norilyn C., Torino, Zyrhil meneses F., RFID Based Door Lock with monitor system, Undergraduate, and Thesis. Batangas State University, 2013.

[11] Dimaano, Dimuell I., Doronilal, Lovely C., Macatangay, Kimberly M., Patali, Rizalle G., Biometric Security Locker; Undergraduate, and Thesis. Batangas State University, 2008.

[12] Illustre Margielyn A. Samantha, Catherine C., Bagsic Edmundo E, MCU-Based Keyboard Logger, Undergraduate, Thesis, Batangas State University, 2008.

[13] http://wwww.howstuffworks.com/caralarm.html (Date Retrieved: February 21, 2016)

[14] www.yahoo.com/fingerprintsscanner (Date Retrieved: February 21, 2016)

Author Profile

Dr. Jeffrey Perez Maranan received the Bachelor of Science in Chemistry and Bachelor of Secondary Education from University of the Philippines Los Baños and Golden Gate Colleges, respectively. He also studied her Master in Business Administration and Doctor of Business Administration both from Batangas State University. His local and international experiences both in academics and private organizations nurtured him professionally and competitively. Presently, he is a full-time faculty member at Batangas State University and completed academic requirements for his Doctor of Technology.

Dr. Shirley Eje Maranan received the Bachelor of Industrial Technology major in Mechanical and Bachelor of Secondary Education from Pablo Borbon Memorial Institute of Technology and Golden Gate Colleges, respectively. She also studied her Master in Business Administration and Doctor of Business Administration both from Batangas State University. Moreover, she has worked in multi-national corporations for production planning, management, and technology-related works. Her academic experiences both in local and international universities made her a globally competitive professional. She is now a full-time faculty member at Batangas State University and taking-up Doctor of Technology.