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ZarCen Training Model: Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers

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Abstract

The understudy company is a multinational company with three manufacturing plants located in Biñan and Canlubang Industrial Parks in Laguna, Philippines. Being a Japanese company where continuous improvement (Kaizen) is infinite, they commonly used it as a strategy to provide solutions. The proof of Kaizen implementation is their in-house training for Mechatronics Engineers and Technicians. The company has its training facilities and programs where they could practice through experiments and researches. Employees take the training seriously because it is part of their evaluation regarding competence and qualification for promotion. It is used to harness their skills on different areas including Japanese language development and skills-based development, in this case, Mechatronics Technology. While they were doing this for years, the training departments together with the researcher were able to depict a problem on their system of implementation. The process started in developing a program for their employees suited to the company needs, followed by the implementation of training and then by doing an assessment. It seems the process is perfect, no wonder for years of implementation it is only in 2012 that they started asking, who would evaluate our training program with regards to industry standards? Are the trainers qualified to train the same level of engineers and technicians adequately? Is our assessment acceptable to local and international standards? Doing all the processes internally seems to be biased because no one coming from an external entity would qualify if they are going in the right direction.

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It is then that the researcher was asked by the understudy company to help them develop a training and assessment program where an external entity would validate the effectiveness of the program. The researcher then offered several options like ISO, ANTA and TESDA as an external standard making body who would have the mandate to give certifications as a proof of effectiveness and excellence in implementing training programs. With open mind, the management decided to embrace the idea on a locally mandated government institution - the Technical Education and Skills Development Authority (TESDA) a try. Immediately the understudy company and the researcher formed a core group composed of twenty (20) Engineers and Technicians who pioneered the use of ZarCen Training Model, a training strategy conceptualized and developed by the researcher to provide permanent solution to the problem encountered by the understudy company. After forming a group, the goal was set to develop certified Mechatronics Technicians and Engineers that would undergo Mechatronics Training NC level II, III and IV for the understudy company and at the same time test the effectiveness of ZarCen Training Model. To establish integrity and credibility in measuring the effectiveness of ZarCen Training Model two evaluative procedures were used, one is an external TESDA National Assessment and the researcher's evaluation instrument. As we go through the process, we were able to develop their skills competence and attain a stunning 100% passing rate on TESDA Mechatronics Certification Level II, III, and IV, the first in the Philippines to achieve such performance for the same group of people rendering a proof of effectiveness of ZarCen Training Model. On the other evaluative measure, The ZarCen Training Model as a strategy got the following composite mean ratings from the panels of evaluators: 4.77 for Mechatronics NC II training, 4.78 for Mechatronics NC III training, and 4.84 for Mechatronics NC IV training. All of the three composite ratings had a descriptive rating of "Excellent". The ZarCen Training Model also gained a composite mean of the combined responses of the panel of evaluator for the Content of 4.79, Organization of 4.72, Mechanics of 4.80, Comprehensibility of 4.82 and Workability is 4.78, all of these results show an excellent rating. In addition, ZarCen Training Model as a strategy gained a grand mean of 4.78, which has an equivalent descriptive rating of excellent, proving ZarCen Training Model as consistently effective. Following the success of the program, the management decided to put up a Mechatronics Department where all employees would undergo an assessment, at least, Level II for Operators, Level III for Technicians and Level IV for Engineers. Given the standing order, another two batches composed of operators and technicians were able to hurdle Mechatronics Servicing Level II and III which again showed the consistency and effectiveness of ZarCen Training Model. Finally, after acquiring relevant skills, pioneering engineers and technicians are now localizing the development of automation machines so they need not wait for the parts from their main plant in Japan, a greater impact on operations, logistics and revenue became part of the understudy company.

Keywords: Assessment; Effectiveness; Mechatronics; Skills; Technology; Training; ZarCen.

1. Introduction

The understudy company has already identified and embraces the importance of training and assessment for their employees, including [1, 2, 3, 4]. They have provided a research and training department (RTD) which include facilities that would constantly train their employees based on the needs of the company. But for several years of implementation in 2014 they come to realize the importance of assessment, accreditation and certification.

This is where the researcher started its consultancy with the understudy company through Philippine Instrumentation and Control Society, being one of the Board of Director who handles the National Chairmanship for Education Committee and a seasoned consultant on training and assessment for skills development specifically on Instrumentation and Mechatronics. Assessment and certification provide information on the capability of individuals and organizations to achieve their work and business plans. In an educational context it provides information on the extent to which a learner has achieved the required outcomes of a training program. The purpose of the Assessment and Workplace Training Competency Standards is to improve the way any organization conducts assessments and/or training, irrespective of context. The standards are designed to be incorporated into industry or enterprise competency standards through which industry or enterprise will determine how to incorporate the Standards based on their specific needs [5]. It was then identified by the researcher that there is a need for external assessment and certification to confirm the effectiveness and integrity of the training processes conducted by the understudy company. Certain options were introduced by the researcher such as International Organization for Standardization (ISO) a world renown accrediting body through ISO 29990:2010 that defined a new standard that aims to improve the quality of offerings on the global market that has grown up around non-formal education and training, such as vocational training, life-long learning and in-company training. The objective of ISO 29990:2010 is to provide a generic model for quality professional practice and performance, and a common reference for learning service providers and their clients in the design, development and delivery of non-formal education, training and development. The standard encourages a focus on the learner and the results of the process, and emphasizes the full range of options available for delivering learning services, as reflected on reference [6]. In the Philippines, training and assessment accreditation is through RA 7796 [7] otherwise known as the Technical Education and Skills Development Authority (TESDA) Act which in Section 22 states that “Establishment and Administration of the National Trade Skills Standards” of the RA 7796 known as the TESDA Act mandates TESDA to establish national occupational skill standards. The Authority shall develop and implement a certification and accreditation program in which private industry group and trade association are accredited to conduct approved trade tests, and the local government units to promote such trade testing activities in their respective areas in accordance with the guidelines to be set by the authority. In the case of the understudy company, there are no existing training and assessment accreditation from a recognized and mandated institution that would certify and verify the reliability and credibility of the inputs, processes and outputs of their training. Given the necessity to address the problem, the understudy company finally decides to subject themselves through TESDA certification and accreditation. The researcher, known to be a long time practitioner, certified trainer, certified assessor and TESDA Trainers Methodology Facilitator was tasked to exhibit his leadership and expertise on systematizing the training and assessment using ZarCen Training Model of implementation and TESDA standard.

2. Objectives of the Study

The general objective of this study was to systematize and implement the training and assessment of the understudy company using ZarCen Training Model (ZTM) of implementation and TESDA standard particularly in the area of Mechatronics Technology.

Consequently, the researcher would be able to measure the effectiveness of the training [8] by subjecting the core participants to TESDA National Assessment and using evaluative training instruments. Finally, the results would be an indicator of the effectiveness of training when participants are certified by an independent certification body. It specifically aimed to:

- Plan and organize a Mechatronics training and assessment that would enhance the competence of an industry worker using ZarCen Training Model.
- Implement Mechatronics training and assessment using ZarCen Training Model to selected industry worker of a company.
- Evaluate the effectiveness of Mechatronics training and assessment using ZarCen Training Model.

3. Scope and Limitation of the Study

This study was conducted to systematize the training and assessment process of mechatronics technology and measure the effectiveness of Zarcen Training Model. Respondents are only limited to twenty (20) industry based participants but subject to four (4) levels of implementation namely Mechatronics NC II, III and IV. The implementation also is only confine on one (1) multi – national semiconductor company. Finally, the study is only limited at the outcomes of the training and assessment not on the process or behavior of the participants during the conduct of the training and assessment.

4. Significance of the Study

This study will be beneficial to the following: Industry workers of the company in harnessing their skills thereby increasing their chance in passing the national assessment of TESDA in Mechatronics National Certification Level II to IV and translating their enhance skills into better performance and productivity.

- Training and Research Department (TRD) will be nurtured in training and assessment through ZarCen Training Model of implementation and TESDA standards. Credible training can be achieved by TRD through accreditation and certification.
- TRD trainers will be more confident on its training delivery and assessment.
- The company will benefit better productivity and performance from their employees.
- Other companies and academic institutions who wish to adopt the training implementation model.
- For future researcher who wants to benchmark on this undertaking, this would be a good point of reference for them.

5. Review of Related Literature and Studies

On reference [9], around the world, growth patterns and sources of competitiveness are changing dramatically with emerging economies becoming key players as the US, EU, and Japan continue to face slow growth. In the context of these rapidly changing global conditions, the Philippines is now seen as a new growth market. Many see the impressive 7.6% third first half growth rate in 2013 and 6.6% growth posted in 2012 as providing the

necessary momentum that would drive the country to a higher and more rapid growth path. The creation of the ASEAN Economic Community in 2015 and the emergence of regional and international production networks offer increased trade and investment opportunities. It is from this global perspective that both the government and private sector must formulate their strategies to adapt to changing market trends. Globalization also brings with it more competition and to survive and take advantage of the opportunities, industries must be competitive. The Philippines has remained competitive in classic products such as copper ores, unmanufactured tobacco, vegetable textile fibers, knitted clothing, machinery products like electric distribution equipment, radio broadcast receiver, transistors and valves; and chemical products like phenol and alcohol. The country also has emerging product champions given this product group's rising competitiveness in the 2000s. This include animal products like milk and cream; manufactured tobacco, parts of electric power machinery, parts of machinery apparatus, and parts for tractors and motor vehicles; glass and chemical products like metal salts and inorganic acid. Base on previous study [10], there are opportunities in the following "nearby" products essentially these are low hanging fruits because the requirements for operating in these products are already present in the country): complete digital processing machines, cameras, appliances and parts, woven fabrics of synthetic material, precious jewelry, refined sugar, jewelry, woven fabric of synthetic material, clocks, watches, and cameras. Foreign direct investment is crucial in moving to both "middle" and "far-away" products. To take advantage of the above opportunities that would enable us to catch up, it is crucial to formulate a strategy for technology upgrading and transformation of the manufacturing industry.

5.1. The Industrial Revolution

The Industrial Revolution was the transition to new manufacturing processes in the period from about 1760 to sometime between 1820 and 1840. This transition included going from hand production methods to machines, new chemical manufacturing and iron production processes, improved efficiency of water power, the increasing use of steam power, the development of machine tools and the rise of the factory system [11]. Textiles were the dominant industry of the Industrial Revolution in terms of employment, value of output and capital invested; the textile industry was also the first to use modern production methods. The Industrial Revolution began in Great Britain and most of the important technological innovations were British. Mechanized textile production spread from Great Britain to continental Europe in the early 19th century, with important centers of textiles, iron and coal emerging in Belgium, and later in France. Since then industrialization has spread throughout much of the world. The precise start and end of the Industrial Revolution is still debated among historians, as is the pace of economic and social changes. The First Industrial Revolution evolved into the Second Industrial Revolution in the transition years between 1840 and 1870, when technological and economic progress continued with the increasing adoption of steam transport (steam-powered railways, boats and ships), the large-scale manufacture of machine tools and the increasing use of machinery in steam-powered factories [12]. The manufacturing world has long accepted high-tech automation and control systems the current Industrial Revolution. It is almost impossible to walk through a modern manufacturing facility and not find computer controls and automated data acquisition systems. And it is becoming increasingly common to find these systems interfacing to high level business software packages, providing middle and upper management with production information, quality reports, etc.

Although many manufacturing systems before the 1970s had control systems, these systems typically utilized hardwired relay logic for sequencing and safety interlocks and pneumatic controllers for process controls [13]. This technology had many drawbacks. It was expensive to install and maintain. Modifications to the system required labor intensive wiring changes. Pneumatic controllers would drift and require continual maintenance. Production and quality reports typically consisted of an operator tracking production totals and defects on pieces of paper. Data to upper management was often inaccurate and sent too late to be useful. The development of solid-state technology and the explosion of the computer-age, however, brought new automation products and systems. In the 1980s manufacturers started using digital control systems to control their production lines and processes [14]. In the 1990s, graphical operator interfaces running on computers became commonplace. And now, in the 21st century, we see control systems so integrated into the manufacturing process that it's hard to tell where the control system stops and the business system begin [15].

5.2. Mechatronics Technology

Mechatronics [16] is an interdisciplinary field, combining in a synergistic manner the classical knowledge of mechanical engineering, hydraulics, pneumatics, electronics, optics and computer science. The aim of mechatronics is to improve the functionality of technical systems and the creation of new concepts of machinery and equipment with built-in 'artificial intelligence'. In various literature sources several definitions of mechatronics can be found, almost all of them put the emphasis on the functional integration of mechanical actuators with electronics and computer control. Mechatronics includes [15] programmable electronic devices and electromechanical systems for embedded, distributed structure of the sensors, processing signals, actuators and communications. Mechatronics was formed in the engineering environment of automation and robotics, where the 'mechanical' way of solving the design was not adequate to the expectations and opportunities that provide other areas of technology, particularly electronics, optoelectronics, materials engineering, especially computer science. Mechatronics engineering [17, 18] may be regarded as a modern approach to automation techniques for the broadly defined needs of engineering and education. It can be assumed that mechatronics is an interdisciplinary field of science and technology, dealing with general problems of mechanics, electronics and informatics. Mechatronics is among the new technologies emerging and necessary in a manufacturing company like the understudy. It is necessary for them to equip their workers in order to be relevant following modern industrial revolution. The most systematic way of equipping industry workers is by giving the skills enhancement training. It is just appropriate that the type of delivery to be used in this type of training is competency – based training.

5.3. National Assessment

TESDA Training Regulation [19], to attain the National Qualification of Mechatronics Servicing NC II, NC III and NC IV the candidate must demonstrate all the units of competency. Successful candidates shall be awarded a National Certificate level II, III and IV signed by the TESDA Director General. The qualification of Mechatronics Servicing NC II, III and IV may be attained through the accumulation of Certificates of Competency (COCs) in all the following units of competencies; Install Mechatronics Devices, Configure and Test Mechatronics Devices, Develop Mechatronics Control Circuits And Software Application Programs, Maintain

And Repair Mechatronics Devices, Commission Mechatronic System and Diagnose And Troubleshoot Mechatronic Devices.

5.4. Training Models

A training/instructional design model [20] is used to define the activities that will guide the development of learning projects. It allows you to communicate the purpose and reason behind a strategy. A framework gives you the birds-eye view of all the major components that have to be included [23, 24, 25, 26].

5.4.1. ADDIE Model

The ADDIE Model was first created for the U.S. Military during the 1970s by Florida State University. ADDIE is an acronym for a five-phase course development process. The ADDIE model generally consists of five interrelated phases—Analysis, Design, Development, Implementation, and Evaluation [21, 22].

5.4.2. SAM Model

SAM is a different approach to the development of instructional design that addresses the performance need through iterations, repeated small steps, rather than with perfectly executed giant steps. SAM challenges the notion of moving through a linear process (like ADDIE) from Analysis to Evaluation as an effective strategy for designing learning events intending to produce greater performance. Preparation: Instead of starting with a long, drawn-out evaluation of the existing or "needed" content, SAM starts with the preparation phase—where you gather information and get all the background knowledge. Iterative Design: This phase begins with the Savvy Start, the initial collaborative brainstorming meeting that establishes the foundation for a successful project. The Savvy Start focuses primarily on performance and will serve as the project kickoff meeting and the main environment for all project team members to converse. Iterative Development: As the instructional product is being developed, you continually analyze and evaluate, so that at any point if a change needs to occur, it can happen quickly and limit any risk of the project moving out of budget or time.

5.4.3. Gagné's 9 Events of Instruction

Robert Gagné is considered to be the foremost contributor to the systematic approach to instructional design and training. Gagne and his followers are known as behaviorists, and their focus is on the outcomes (or behaviors) resulting from training. Gagné created a nine-step process called the events of instruction, which correlate to and address the conditions of learning. The nine events of instruction are gain attention, inform learners of objectives, stimulate recall of prior learning, present stimulus, provide learner guidance, elicit performance, provide feedback, assess performance and enhance retention and transfer.

5.4.4. Dick and Carey Model

Dick and Carey made a significant contribution to the instructional design field by championing a systems view of instruction as opposed to viewing instruction as a sum of isolated parts.

The model addresses instruction as an entire system, focusing on the interrelationship between context, content, learning and instruction. According to Dick and Carey, "Components such as the instructor, learners, materials, instructional activities, delivery system, and learning and performance environments interact with each other and work together to bring about the desired student learning outcomes". The components of the Systems Approach Model, also known as the Dick and Carey Model, are as follows: Identify Instructional Goal(s), Conduct Instructional Analysis, Analyze Learners and Contexts, Write Performance Objectives, Develop Assessment Instruments, Develop Instructional Strategy, Design and Conduct Formative Evaluation of Instruction and Revise Instruction.

6. Conceptual Framework and Paradigm

The conceptualization of ZarCen Training Model: Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers is to plan, organize and implement training and assessment methodology that will be used as a model in an industry based set up [27,28] as shown on figure 1.

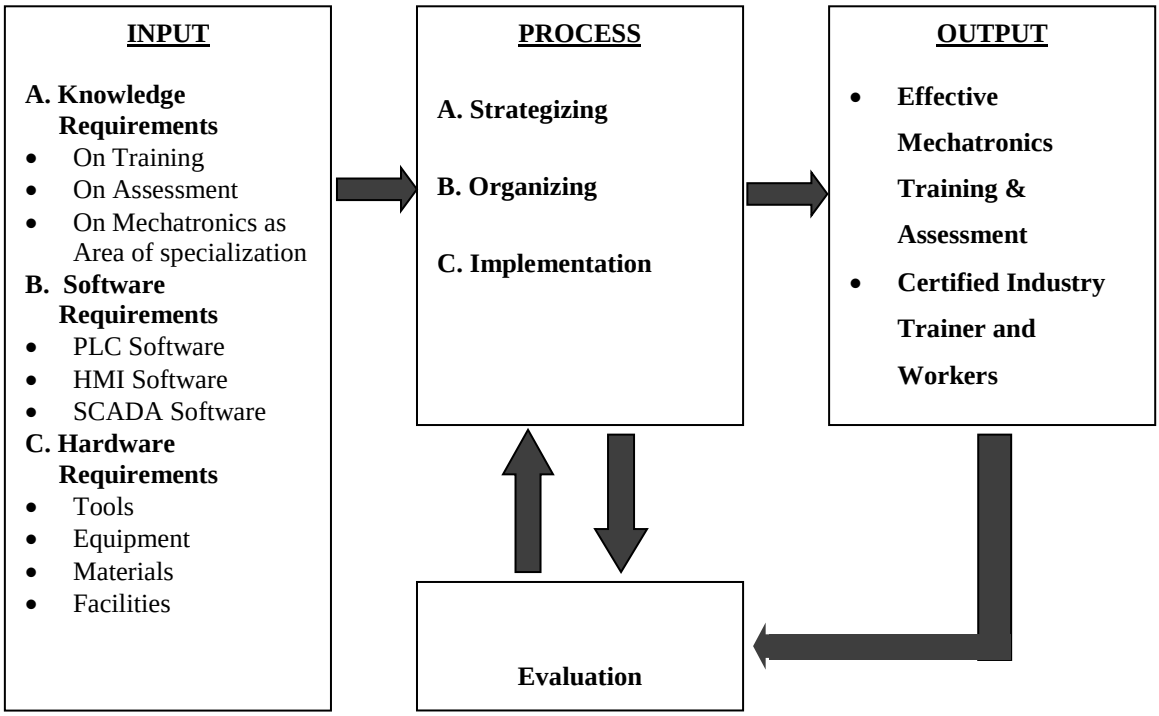

Figure 1: Conceptual model

It is also designed to improve the learning capabilities of an industry worker to effectively prepare them in passing the National Assessment level II to IV. The idea was taken in consideration upon the request of the understudy company, a multi- national semiconductor manufacturing plant located in Industrial Technological Park in Biñan Laguna. The design concept was based on the actual academe - industry experience, expertise and leadership of the researcher. Provided by the inputs the researcher started to plan, organize and implement the training and assessment model based on the specified time projection [29, 30].

7. Research Methodology

This portion basically contains information, theories and ideas from different authors and experts that are relevant to the development of ZarCen Training Model: Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers. Recent findings and development are also considered in this section to identify researches that are already in existence so that there will be no duplication or similar efforts.

8. Research Design

ZarCen Training Model: Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers was designed to provide permanent solution to the problem encountered by the understudy company in their implementation of their in – house industry based training. The training and assessment model will help the company ensure effectiveness and efficiency of training and will be measured using national assessment and corresponding evaluative instruments. The model can be used on all area of specialization after championing on Mechatronics Technology. The model can also enhance the competency of the knowledge based industry workers for them to be more productive on their respective responsibilities. Planning, organizing and implementing the training and assessment model will approximately take a total of two (2) years and six (6) months from conceptualization to the documentation process. The researcher started conceptualizing the project October 2013 based on the objective and problems encountered by the understudy company. To address the problem, the researcher undergone a though rough planning and preparation from October 2013 until January of 2014. During the planning the researcher formulated the ten point process ZarCen Training Model (ZTM) to implement the program as shown in figure 2. ZarCen Training Model is a strategy to implement technical training borne out of researcher's expertise, experience and excellence in training and assessment developed at the time of conceptualization of the project for the understudy company, therefore must be protected by intellectual property rights of the Philippines.

Figure 2: Zarcen training model

ZarCen Training Model is comparable to a well known Philippine Jeepney where its parts like the wheels, engine, headlights and backlights, etc. were acquired on existing manufacturer. But the overall concept, the process of putting everything together and the design is purely Filipino which is already an identity of a Philippine transport. Philippine Jeepney might be simple compared to other branded vehicles but can be as powerful in terms of its impact and contribution in providing transport to the Filipino people. Just like Zarcen Training Model as simple and common as it is but have been proven effective and able to showcase educational leadership in transforming Technical Training and Assessment implementation. On the second week of February 2014, the researcher started to compile his resources, industry experiences and leadership to carry out his plan. The researcher requested the person in charge from the Human and Organization Development Department to provide the list of trainees who will undergo Mechatronics Technology Training at the same time would serve as the researcher's respondents in this endeavor. After the lists of trainees were finalized the understudy company was asked to provide their personal profile. A month after the researcher got the opportunity to meet with the participants and asked them to fill out the pre – evaluation document. Given the data (Profile & Self Assessment) the researcher compare the current competencies of the trainees against the standard and started to work on with the training need analysis. Following the TNA, the researcher paved a plant visit to conduct an ocular inspection on the training facilities and make necessary suggestion and recommendation regarding the tools, equipment, materials and training rooms needed as against the standard. Simultaneously, the researcher started to look for an expert trainer who has both academe and industry experiences. On February 2014, the training was implemented as planned and afterwards an institutional assessment was conducted in preparation for the National Assessment. On February 2014, a culmination of all the processes the trainees/respondents underwent a National Assessment on Mechatronics National Certification Level II and hurdled a 100% passing rate. On October 2014, after going through the same ZarCen Training Model the same participants got a 100% passing rate on Mechatronics National Certification Level III. And finally, on September 2015, ZarCen Training Model as a guide for training implementation creates a remarkable history to be the first in the Philippines to successfully pass Mechatronics National Certification Level II, III and IV of the same group of industry workers.

9. ZarCen Training Module Implementation Procedure

The step by step procedure followed in the implementation of ZarCen Training Module in conducting Mechatronics Technology program are as follows:

Step 1: Identify Key Training Participants

In identifying training participants the researcher and the understudy company determined the minimum requirements and qualifications. In the case of the understudy company, the participants must be a regular employee, at least a graduate of engineering and technology course related to mechatronics, and has the potential to lead and to be a trainer.

Step 2: Collect and Analyze Participants Profile

After finalizing the list of participants, the researcher and Understudy Company were asked to submit a participants profile with the following information.

Step 3: Pre – Evaluation

During the pre – evaluation the understudy participants were asked to evaluate themselves by filling out the given questionnaire or checklist. Then it is correlated on the submitted participants profile in order to determine participants existing knowledge and skills on Mechatronics Technology. Recognition of prior learning takes place during this stage.

Step 4: Benchmarking

There must be a corresponding standard, regulation or policy on a certain topic or area of specialization which we should follow that is both recognized locally and abroad. In this study, we consider TESDA training regulation for Mechatronics. The results of the pre – evaluation must be compared to the existing standard in order to determine the competency needed for each participant.

Step 5: Training Need Analysis

After taking a comparative action, the researcher together with the consultants from Philippine Instrumentation and Control Society started to identify training and instructional goals and analyze learners' characteristic and necessary competencies to be delivered. Then, the group was able to develop training objectives, evaluation instruments and strategy to develop instructional materials appropriate for the implementation of the training.

Step 6: Inventory of Facilities

Another critical aspect to consider for a technical training is the facilities. It is important to conduct an ocular inspection on lecture & laboratory rooms, followed by inventory of necessary equipment, tools, and materials as against the standard.

Step 7: Identify Expert Trainers

It is also of equal importance to determine the right trainer. Considerations like competence and expertise in the field of specialization, in this case Mechatronics, long time experience on both academe and industry, recognized by known National Organization, and well verse on competency based standard implementation as define by the Technical Education Authority and Development (TESDA).

STEP 8: Training Implementation

The most challenging part of ZarCen Training Model is the implementation. This is where one puts Steps 1 to 7 together and make it a reality. Since the training is highly technical, the training delivery approach used was competency based training which focuses on competency development of the training participants.

STEP 9: Post Evaluation

There are two post evaluation conducted in this training. One is institutional where the trainer conducts the assessment and National Assessment a third party institution that will measure the effectiveness of the training.

STEP 10: Post Training Analysis and Re-evaluation

The last step in the process is the Post Training Analysis and Re-evaluation, this is where one identifies best practices and possible area of improvements. The result of this will serve as the input of the next conduct of training. ZarCen Training Model is an implementation procedure specifically applied for technical training, each step must be treated of equal importance, any omission of its part or portion would not give the same result as experience by the researcher. It is just fair also for the readers to compare ZarCen Training Model to other existing model and standards like TESDA. Basically TESDA do not have any training implementation model, what they have are just minimum requirements on trainees, trainer and facilities requirement base on training regulation (TR). ZarCen Training Model offers specific requirement more than what is required by TESDA to attain a much reliable and effective training program. The reader should also understand that in terms of skills competency, TESDA Training Regulation clearly states the basic, common and core competency and cannot be compromise over or below the requirement. This means that one can't teach more skills than what is required to prove that he is over and above of the required standard because the possibility of redundancy on the next level of competency will happen, while if it is below of what is required, the trainee in effect would have a hard time coping and understanding on the next level.

- To be able to implement the ZarCen Training Model certain policy must be followed:
- The company must assign training and technical coordinator preferably under Human Resource Department or Equivalent.
- Training Coordinator identifies key training participants through the recommendation of the supervisor and based on the minimum requirements.
- Training Coordinator informs selected participants that they are qualified to attend the training.
- If the participant agrees to join, Training Coordinator asks the participant to sign training contracts.
- If the participant refuses to join, Training Coordinator will look for a replacement.
- Training Coordinator inquires the expert trainer (in – house or outsource) of their availability and set training date (one month lead time).
- Training Coordinator provides training date to the supervisor and participants.
- If the supervisor and participants agrees with the training date, Training Coordinator informs expert trainer that the training will pursue on agreed date.
- If for some important reasons the supervisor and participants are not available, the Training Coordinator reset training date.
- When training date is final, expert trainer conducts a scheduled pre evaluation to the participants.
- Technical Coordinator prepares training facilities, tools, equipment and materials base on the recommendation of the expert trainer.
- Three (3) days before the training, Training Coordinator reminds the supervisor, participants and expert

trainer.

- During the training date, Expert trainer conducts the training in coordination with the Training and Technical Coordinator.
- Expert Trainer conducts post evaluation.
- If participant/s passes the evaluation then he/she is recommended to take the national assessment.
- If the participant/s fail to pass the evaluation, then expert trainer recommends additional reinforcement on his/her area of weaknesses until it passes the evaluation, then he/she will be recommended to take the national assessment.
- Training Coordinator calls on assessment centers (see appendix J) and set assessment dates.
- Training Coordinator informs supervisor and participants on assessment dates.
- If the supervisor and participants agrees with the schedule National Assessment will push through.
- If for some important reasons the supervisor and participants are not available, Training Coordinator request the assessment centre to reschedule the National Assessment.
- After the national assessment, expert trainer identifies area of improvements and applies on the next conduct of training as corrective measure.

10. Sample and Sampling Technique

The evaluation process was conducted through a survey using qualitative analysis method of determining the effectiveness of Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers using ZarCen Training Model (ZTM) for the understudy Company.

The panel of evaluators evaluated the effectiveness of ZarCen Traning Model (ZTM) for the understudy industry workers base on the Content, Organization, Mechanics, Comprehensibility and Workability. The evaluation instrument is answerable in a scale of one to five (1 – 5), where 5 is the highest, “Excellent”, 4 – Very Good”, 3 – “Good”, 2 – “Fair”, and 1 is the lowest, “Poor”.

There were twenty (20) evaluators, a combination of selected Engineers and Technicians, regular employees of the understudy company who have undergone Mechatronics NC II, III and IV training and assessment using ZTM as a strategy.

11. Data Gathering Procedure

The evaluation instruments were distributed personally to 20 industry practitioners. A copy of the instrument together with the letter of request was hand carried to the understudy company, and was informed about the scheduled evaluation. Before the evaluation, the respondents undergo Mechatronics Training from NC II to NC IV using step 1 – 10 of ZarCen Training Model. After they personally experience the whole training process they were asked to fill up evaluation forms as a feedback mechanism for the said training. Finally, questionnaires were collected by the researcher for the evaluative summary.

The data gathered from the evaluation instruments were summarized, tabulated, analyzed and interpreted to determine the effectiveness of "ZarCen Training Model: Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skill Based Competency of Industry Workers".

12. Results and Data Analysis

The researcher conducted a series of training for Mechatronics NC level II, III and IV. During the training the respondents were able to experience the ZarCen Training Model (ZTM), a strategy used on the delivery of their training. The final evaluation of ZTM involved twenty (20) respondents who experience firsthand the ZTM implementation. In measuring training effectiveness, the whole cycle of the conceptual framework has been considered. The Mean Rating of Trainees Evaluation for Mechatronics NC II, indicate the means of the ratings given by the respondents for Mechatronics NC II Training on different indicators for the effectiveness of ZarCen Training Model in Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skill Based Competency of Industry Workers. The results of the indicators under content, organization, mechanics, comprehensibility and workability were all rated Excellent. There were four (4) respondents who gave perfect score of 5.0; the highest mean value is 4.95 while the lowest is 4.55. The Mean Rating of Trainees Evaluation on Mechatronics NC III, respondents rated Excellent in all criteria a determinant on the effectiveness of ZarCen Training Model in Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skill Based Competency of Industry Workers. Three (3) of the evaluators gave perfect score of 5.00, Excellent in all given indicators. While all criterions are Excellent, 4.60 is the lowest mean for Mechatronics NC III training. The Mean Rating of Trainees Evaluation for Mechatronics NC IV, show that the evaluators strongly agree on the effectiveness of ZarCen Training Model in Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skill Based Competency of Industry Workers by giving excellent on descriptive rating in all areas of indicators, in addition six (6) of the evaluators gave a perfect score of 5.0, the highest compared with the two previous evaluation. The highest mean value is 4.95 while the lowest is 4.55. For the composite Mean Ratings of Trainees Evaluation for Mechatronics NC II, the mean rating of 4.77 carried a descriptive equivalent of Excellent. This means that the evaluators think that ZarCen Training Model as a strategy is an effective tool for them to harnessing their knowledge and skills in Mechatronics and would eventually help them pass the TESDA National Assessment. The composite mean obtained from the group evaluators is 4.78, which has a computed descriptive rating of Excellent for the Composite Mean Ratings of Trainees Evaluation for Mechatronics NC III. The evaluation shows consistency as an effective tool following that the same strategy is implemented for Mechatronics NC III training. Evaluation result also is coherent on the result of the assessment conducted by a third party institution giving the group a hundred percent (100%) passing rate on national assessment. As Composite Mean Ratings of Trainees Evaluation for Mechatronics NC IV, the composite mean of the evaluation from the evaluators is 4.84, the highest among the three, which has a descriptive equivalent of Excellent. The highest rating shows that even the highest level of competency develop in Mechatronics, the level four (IV) the said ZarCen Training Model as a strategy is undeniably effective in providing skills competency on industry worker. This group of evaluators gave also the most number of perfect ratings for the most criteria indicators. Aggregate Mean Ratings of the Evaluation shows the level of effectiveness of ZarCen Training Model in Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the

Skill Based Competency of Industry Workers from the panel of evaluators for each criterion are as follows:

Content

Under this criterion, the panel evaluators gave the highest level of effectiveness during the Mechatronics NC IV training with a mean of 4.85, which is equivalent to Excellent. The aggregate mean for this criterion is 4.79, which is equivalent to Excellent. This indicates that the content, are clear on its objectives, topics emanated from proper Training Need Analysis and was delivered accurately with inculcation of values.

Organization

As with the organization of the training, the panel of evaluators gave 4.78 as the highest, Excellent. The aggregate mean gained for this criterion is 4.72, equivalent to Excellent. This goes to show that the panel of evaluators testifies the logical arrangement of topics and workshops given during the conduct of training for Mechatronics NC II to IV.

Mechanics

Mechanics is one of the greatest considerations during training implementation. Presentations and demonstrations must be clear, especially in conducting a highly specialized and technical training. There must be a variety of media to offer for a wholistic approach that would cater different characteristic of learning of the trainees at the same time would catch and sustain their attention all throughout the training duration. It was evaluated the highest at 4.84 during Mechatronics NC II training, Excellent on its effectiveness and obtained an aggregate mean of 4.80, Excellent.

Comprehensibility

It is of equal importance that during the conduct of training of an industry based set up, the accuracy in grammar and technical terminologies and there must be a new concept or idea a trainee can acquire that would create a positive impact for the company. For instance, in one of the feedback written by the evaluator, they were able to save much of their resources because after the training in Mechatronics NC II to IV they are now localizing the production of a certain device, which is ordered in Japan way back when they did not take the initiative. This is the reason why the panel of evaluators gave a highest rating of 4.90, which is Excellent and an aggregate mean of 4.82, which are rated to an equivalent of Excellent.

Workability

A greater challenge in implementing a highly technical training like Mechatronics is the tools, materials and equipment needed including the technical expertise of the lecturer. It is not enough that we only guarantee the availability, what is important is that it can accommodate the needs of every trainee. For workability, the highest approval is during the Mechatronics NC IV training mean value of 4.85, Excellent and an aggregate mean of 4.78, Excellent, ratings from the panel of evaluators proves that workability is highly effective during

the training. The Grand Mean of all the ratings obtained by ZarCen Training Model from the aggregate means of the different criteria is 4.78, which has a descriptive equivalent of Excellent. The final result of the statistical analysis proves also that ZarCen Training Model is very effective in developing the knowledge and skill of the industry based workers and an effective training tool in passing the assessment that would determine the level of competence in Mechatronics.

13. Summary, Conclusion and Recommendation

13.1. Summary

a. All of the indicators of the five (5) criteria for evaluation attained a descriptive rating of Excellent.
b. The ZarCen Training Model as a strategy got the following composite mean ratings from the panels of evaluators: 4.77 for Mechatronics NC II training, 4.78 for Mechatronics NC III training, and 4.84 for Mechatronics NC IV training. All of the three composite ratings have a descriptive rating of "Excellent".
c. The ZarCen Training Model gained a composite means of the combined responses of the panel of evaluator for each of the following criteria:

Content	$\overline{X} = 4.79$ Excellent
Organization	$\overline{X} = 4.72$ Excellent
Mechanics	$\overline{X} = 4.80$ Excellent
Comprehensibility	$\overline{X} = 4.82$ Excellent
Workability	$\overline{X} = 4.78$ Excellent

d. The ZarCen Training Model as a training strategy gained a grand mean of 4.78, which has an equivalent descriptive rating of EXCELLENT.
e. The result of the evaluation shows that ZarCen Training Model in Systematizing the Training and Assessment Process of Mechatronics Technology for the Optimization of the Skills Based Competency of Industry Workers has been effective on Mechatronics training from NC II to NC IV.
f. The development of ZarCen Training Model has been proven helpful in developing industry workers competence, in effect it delivers 100% passing rate on national assessment.
g. Availability of tools, materials, equipment and expertise are well provided and essential to a highly sophisticated training.
h. Finally, ZarCen Training Model is an easy step by step process to follow to an effective training implementation and can be adopted by other multinational companies here and abroad like Intel, Samsung, Texas Instrument, ON Semiconductor, AMCOR Philippines, Sony, Fugitsu, Rohm, Panasonic, etc.

13.2. Conclusion

1. The ZarCen Training Model (ZTM) is a unique training implementation process that when followed religiously would enhance the knowledge and skills of an industry worker.
2. ZTM is a highly effective training model that can be used by the industry as well as academic institution as a tool in acquiring new skills for better performance and productivity.
3. ZTM increases the effectiveness of trainer in delivering industry based training. It will also boost their morale and would add value to what they are doing.
4. ZTM will increase probability of passing in the National Certification Exam of TESDA in Mechatronics NC II, III and IV.
5. The ZarCen Training Model is viable for use in other area of specialization.
6. ZTM on this endeavor guarantee the effectiveness of training. It was rated Excellent in all areas of criterion. It was subjected to evaluation in three (3) different hierarchical levels in Mechatronics NC II, III and IV, also used repeatedly in Mechatronics NC level II and III training producing the same excellent results.

13.3. Recommendation

1. Apply the ZarCen Training Model be applied in other areas of specialization, academic institution, Technical Vocational Institution (See appendix J) and other related industries.
2. That the understudy company must pursue training on trainer's training to develop competent trainers.
3. That the understudy company must pursue accreditation for their existing in – house training.
4. That the understudy company can use National Certification (NC II for operators, NCIII for technicians and NC IV for Engineers) as a basis for promotion and hiring.
5. That ISO documentation processes be applied in every step of ZarCen Training Model.

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