

# Impact Assessment of Cleaner Production and Energy Audit Programs on MSMEs Assisted by the Department of Science and Technology in Region IV-A of the Philippines

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**Abstract:** This paper expounds on Cleaner Production (CP) as an environmental management approach that seeks to improve the environmental performance of products, processes, and services by looking at the causes or sources of environmental problems rather than the symptoms. It also discusses the related concept of Energy Audit (EA), a process that identifies where energy is consumed and how much energy is used in an existing facility, building, or structure in order to provide information in the preparation and adaptation of energy conservation measures. It then describes the implementation of CP and EA program among the MSMEs in Region IV-A of the Philippines through the technical assistance provided by the region Regional Office of the Department of Science and Technology (DOST) in Region IV-A. The focus of this paper is the assessment of the impacts of the DOST-assisted CP and EA programs on the productivity and competitiveness of the MSMEs in Region IV-A using the descriptive research method and the qualitative approach in data collection and evaluation.

**Keywords:** Cleaner Production, Energy Audit, Sustainable Development, Impact Assessment, MSMEs Department of Science and Technology (DOST), Region IV-A, the Philippines.

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## 1. INTRODUCTION

The background to this research is discussed in **Section 2.1** where the concepts of Cleaner Production (CP) and Energy Audit (EA) and their practice in the Philippines are explained. Then in **Section 2.2** the importance of implementing CP and EA programs among the Micro-, Small-, Medium-scale enterprises (MSMEs) in Region IV-A of the Philippines are explained. Then **Section 2.3** elaborates on how the DOST has been implementing CP and EA programs among the MSMEs in Region IV-A of the Philippines. This is followed by the exposition of the research problem and the objectives of the research in **Section 2.4**. A review of the previous work and studies on CP and EA programs are then discussed in **Section 3**. **Section 4** then gives an explanation of the methodology used in the research. The results of the research are presented in **Section 5**, after which the conclusions and recommendations of the research are discussed in **Section 6**. Finally, the list of references used in the research is given in **Section 7**.

### 1.1 Background of the Research:

Sustainable development is now the byword among the economists and environmentalists, who have realized that current trends in population growth and industrialization have resulted in some irreversible damages to the environment that are now threatening the very existence of humankind. Pollutants are released at a rate faster than the earth can absorb while natural resources are extracted and consumed at an unimaginable pace, putting the life of the future generations at risk and in doubt. To abate the environmental stress that human activities bring, a better way of producing products and services must be explored such that a higher degree of productivity is achieved. This entails efficient utilization or conversion of inputs such as raw materials and energy into high quality products, in other words, with minimal or zero

wastage along the production chain. This concept of effective and efficient production process is better known as “Cleaner Production” or CP.

CP is an environmental management approach, the goal of which is to improve the environmental performance of products, processes and services by looking at the causes or sources of environmental problems rather than the symptoms. Unlike the traditional approach to pollution control wherein the focus/action is “after-the-event” or reactive, commonly known as “end-of-pipe” action, CP is based on proactive or the “anticipate-and -prevent” perspective. It is commonly applied in production process through conservation of raw materials/resources, elimination of toxic raw materials, cutback on energy use and reduction of wastes and emissions. The CP concepts can be applied throughout the life cycle of a product or service starting from the initial design phase until the consumption and disposal stage. Strategies to implement may include one, or a combination of the following: improved housekeeping practices, process optimization, raw materials substitution, new technology and new product design.

The adoption of the CP concept will not only bring environmental benefits but financial gains as well. Through prevention of inefficient use of resources and avoidance of unnecessary generation of wastes, the organization can benefit from reduction of production as well as overall operating costs by cutting expenses on cost of raw materials and waste treatment and disposal. Problems in compliance with environmental regulations can also be addressed. Although the practice of CP entails costs, the benefits it provides can offset the implementation expenses much better than relying on end-of-pipe solutions.

Related to the concept of Cleaner Production is the practice of Energy Audit (EA), which is a process that identifies where energy is consumed and how much energy is consumed in an existing facility, building or structure. The result of EA provides relevant information/inputs in the preparation and adoption of energy conservation measures (ECM). Energy audits identify economically justified interventions to reduce the amount of energy input into the system.

The adoption of EA followed by the implementation of ECMs can also provide environmental benefits and economic rewards to the organization. Improving energy efficiency and conservation are some of the effective ways to reduce greenhouse emissions and consequently diminish the occurrence of smog and acid rain. For the organization, ECMs directly translate to monetary savings, since less energy consumption means less expense.

In the Philippines the practice and adoption of CP started only in the 1980s for in the 1970s the environment was not yet a serious concern, and wastes were indiscriminately disposed of either to land, water and air. It was only during mid-1970s to early 1980s when the country, specifically the Marcos government, started to give importance to the environment by promulgating environmental laws and regulations. Among the prominent laws enacted during this “environmental revolution” period of the 1970s to 1980s were Presidential Decree (PD) 984 (Pollution Control Law), PD 1586 (Environmental Impact Assessment Law), PD 1151 (Philippine Environmental Policy) and PD 1152 (Philippine Environmental Code).

Nevertheless, even after long years of having these environmental laws and regulations in place, pollution in the country has remained unabated, making the government and industry realize the need to change the approach to waste management. This has led to the paradigm shift in the role of the government from the traditional command-and-control regulatory role to that of a developmental role. Because of this new approach, the concept of Cleaner Production has gained wide acceptance among the firms as well as the government. The two previously opposing parties have now become partners in exploring options that will both address their respective interests.

### **1.2 The Importance of CP and EA to MSMEs:**

The need for environmentally sound technologies (ESTs) arises at a rate directly proportional to the growth and development of a country. The challenge for an industrializing or even already industrialized nation is to have sustainable development, a state wherein the impacts of economic activities to the environment remain at tolerable levels or within its carrying capacity.

In a paper presented by the Philippine contingent to the “ASEAN Experts Meeting on the Establishment of a Centre/ Network for Environmentally Sound Technologies” held on January 27-29, 2004 in Singapore, it was mentioned that based on the various environment-related projects implemented in the Philippines, the common observation was that the MSMEs generally do not employ ESTs.

The barriers or obstacles in the promotion and use of ESTs were also identified in the abovementioned paper as follows:

**Financing.** Most of the MSMEs do not adopt ESTs due to lack of funds. Company owners view ESTs as additional expense which would not provide commensurate returns on their investments. On the part of the regulatory agencies, their complaint was that they lack the resources (manpower and equipment) to fully enforce the law.

**Technical Capability.** Due to limited or lack of funds, MSMEs cannot hire capable and competent technical personnel to handle the implementation of the ESTs applicable to the company. Hence, even though the technologies appropriate for them would not cost so much to the company still they cannot implement due to lack of internal expertise to carry out highly technical activities.

**Operability of the Technology:** Since most of the EST-related equipment are imported, companies were having problems with their operation and maintenance. Thus, once these malfunctioned, repairs became too costly since parts and services had to be outsourced abroad. Normally, after experiencing these hassles, the company would cease to operate their equipment especially if the cost of running the equipment would be higher or even comparable to the penalties they would have to pay for not complying with the environmental regulations.

**Effectiveness of the Technology:** Since investments on ESTs are not priority of the MSMEs, their tendency was to minimize costs and sacrifice some of the auxiliary parts such as process controls thereby reducing the efficiency of the equipment. Also, because the equipment are imported, sometimes they are not compatible with the high temperature and humid environment of the country resulting in their shortened service life. Some of the imported equipment cannot be supported by the fluctuating power supply in the provinces and in some cases the working capacity (under or over) is not appropriate to the size of the firms.

**Public Perception of ESTs:** A classic example of this is the incineration technology. Due to bad publicity the public had gotten the impression that all forms of incinerators are banned. Hence, as per Supreme Court decision, the Department of Environment and Natural Resources (DENR) had to issue a Memorandum Circular clarifying that only those incinerators that generate toxic wastes are banned.

**Economics of the ESTs:** In some cases certain conservation options are not applicable, such as for example, recommendations on water recycling may not be appropriate when the cost of water supply where the firm is located is relatively cheap.

**Apathy to the Environment:** It is a common observation among developing nations like the Philippines that firms do not give importance or priority to environment. For them, protection and conservation of the environment means unprofitable investment and hence not a concern of the organization. Little do they know that eventually their neglect of the environment could have direct or indirect impact on them through effect on health of the workers, depletion of their raw materials, or even natural hazards such as flooding (climate change caused by the indiscriminate release of greenhouse gases (GHGs))

**Regulatory Framework on Market-Based Instrument:** Although the Philippine regulatory framework had already shifted from the command-and-control to market-based-instruments (MBIs) approach in terms of waste management however, some of the enforcement personnel's outlook remained traditional.

**Regulatory Framework on the Promotion of Cleaner Production:** Although it is evident that legislation had already recognized the importance of cleaner production, there is still a need to improve the policy support framework. This is to promote use or voluntary adoption of cleaner production by the MSMEs.

**Lack of Access to Information on Appropriate ESTs:** Despite the widespread use of internet, most MSMEs remain to have no access or in some cases not accessing the vast information available in the web-based information repositories. Also, in some cases the MSMEs do not have enough knowledge to filter which among the many technologies available would be applicable to the company.

The MSMEs are significant players in the Philippine economy. In the paper of Santiago (2010), she cited that MSMEs comprise about 99.7% of the business establishments in the country, 91.3% of which are classified as micro-enterprises. In terms of employment generation, MSMEs account for about 69.4% of the total employment: micro (37.6%), small (24.9%), and medium (7.0%), while, large enterprises account for only 0.3% of the total number of establishments and generate 30.6% of total employment. Table 1 presents the 2005 data on micro, small and medium enterprises.

**Table 1. Micro, Small and Medium Enterprises Statistics (NSO, 2005)**

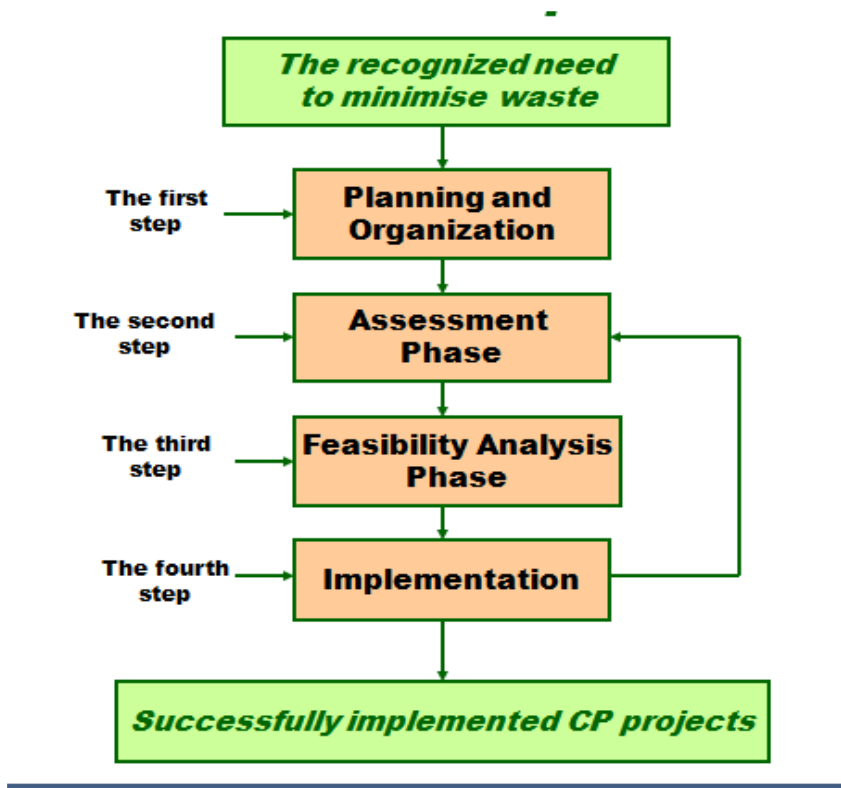
	Number of		Capitalization (P		Establishments		Employment	
	Employees	Million)	Number	% Share	Number	% Share		
Micro	1 – 9	less than 3	714,675	91.3	2,057,388	37.6		
Small	10 – 99	3 – 15	62,811	8.0	1,363,007	24.9		
Medium	100 – 199	15-100	2,851	0.4	384,295	7.0		
Large	200&above	100 & above	2,643	0.3	1,674,607	30.6		
			782,980	100.0	5,479,297	100.0		

Because of the economic importance of MSMEs, government and even non-government institutions are focusing assistance on them. There are programs and projects geared towards maximizing their contributions to the wealth generation of the nation. In the case of DOST, it is pushing for technological interventions that would enhance the productivity and competitiveness of these MSMEs.

**1.3 Implementation the CP Program by DOST:**

The implementation of the CP can be done through many options, one of which is the use of the so-called “appropriate technologies”. It is in this context that the Department of Science Technology (DOST) got involved in the program of CP Technologies, a national program of its Industrial Technology Development Institute (DOST-ITDI) that aims to promote wider use of CP technologies among MSMEs, as one of the means for them to achieve industry competitiveness.

DOST - ITDI launched the CP program in 1999 and even included it as one of the institute’s six special programs under its Medium-Term Plan (1999-2004) The program provided for the extensive training of CP assessors (international, local and under OJT arrangement with foreign consultants) which were initially composed of ITDI technical personnel. The trained personnel conducted CP assessment of volunteer MSMEs all-over the country. CP implementation followed the schematic diagram below: (<http://www.un.org/esa/sustdev/sdissues/technology/cleanerproduction.pdf>)



**Fig 1. Schematic diagram of the CP procedure**

**Planning and organization:** The initial step is where the firm’s management commitment is sought or obtained and the CP team is organized. Here, the plant-wide environmental goals are set, potential barriers to its attainment are identified and possible solutions explored.

**Assessment:** This is the “heart” of the process where the overall operations of the plant are observed and analyzed to identify all the activities or processes that generate wastes. The production process is assessed to look for any or the combination of the following possible causes of wastes generation: 1) choice of production technology, 2) Technical status of the equipment, 3) product specification, 4) Process efficiency, 5) Choice & quality of input materials, 6) Management planning and Information Systems, 7) Personnel Skills and Motivation and 8) Wastes and Emission. It is also during this stage that the possible CP options are generated and studied.

**Feasibility Studies:** After generating the possible CP options, the stage of feasibility studies ensues, during which these options are evaluated or screened in terms of technical, economic and environmental soundness and relevance. This is to ensure that options to be presented to the firm are practical, applicable, useful, and will ultimately improve their productivity.

**Implementation and Continuation:** It is during this step where the CP options are transformed into a CP plan to facilitate their implementation according to the timeframe set or agreed upon between the CP team and the firm’s management. Here, the company is supposed to comment on the recommended CP options and decide which will be implemented based its resources and capacities. Technical discussions on how to go about the implementation especially on the adoption of certain technologies should also be tackled. The CP implementation plan should also include monitoring schedules since CP process is a continuing activity and must be sustained to reap the full benefits that it can offer to the firm.

Through the CP program, the production processes of the firm are assessed or evaluated to look for sources of wastage in terms of inputs (raw materials, manpower, etc) as well as product/s. Afterwards, the CP Assessment Team comes up with recommended/proposed technology options on how to address the wastage at point of generation to minimize, if not prevent end-of-pipe treatment, which is costly for the firm.

Energy Audit (EA) has been another initiative of the DOST-ITDI, the objective of which is to help MSMEs become energy - efficient and to enhance their competitiveness. It involves examination of energy-consuming facility/ies of the firm and then ultimately the development of comprehensive suggestions for Energy Conservation Measures (ECMs).

Recognizing the importance of micro, small-scale-and medium-scale enterprises (MSMEs) to regional economic growth, DOST Region-IV-A has been implementing programs and projects aimed at enhancing operational efficiency, and boosting productivity and competitiveness of the 122,562 MSMEs in Region IV-A or CALABARZON (NSO,2005). However, studies have also noted that the MSMEs are the ones not complying with the environment and standards set by the regulatory bodies due to their lack of funds and technical know on how to make their company compliant with the laws and policies of the government.

To assist the MSMEs, DOST Region IV-A started the implementation of the Cleaner Production, (CP) program in 2006 and the Energy Audit program in 2009, to improve productivity of the MSMEs by reducing wastes generation at the source and maximizing effience use of energy. To demonstate that DOST is really committed to providing appropriate terchnologies to MSMEs that would abate environmental problems, the CP and EA have already been considered as technology interventions under the DOST’s Small Enterprise Technology Upgrading Program (SETUP) since 2012.

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As pointed out in the references, CP should be a sustainable process and thus requires commitment from the firm beneficiary and consistency of the program implementer in monitoring the progress. The benefits of adopting the CP

options may or may not be observed immediately and may require some more adjustments before the set environmental goals can be achieved. One of the most effective ways to determine the success of the CP program is by comparing the target and the accomplished goals also known as outputs measurement. Taking off from the program outputs, the next stage would be to measure its impact to the company and to society which is called the outcomes.

Benefits from CP can take various forms: (1) in monetary form like savings in utilities (electricity and water), raw materials, other inputs such as man-hour, reduction in regulatory compliance cost, (2) quality of product, (3) quality management awards (ISO 9001, ISO14000) and (4) prestige or good image of the company that could lead to customers' patronage. (TLBGI Terminal Report, 2005)

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#### **1.4 The Problem and Objectives of the Research:**

Inasmuch as the DOST had already been investing so much resources (manpower and money) to provide CP and EA assistance to the MSMEs in Region IV-A, it was but natural to undertake a study to answer the question of whether DOST's CP and EA assistance programs have benefited the MSMEs' in the region in terms of enhanced productivity and competitiveness. In particular, the study sought to determine (a) the MSMEs' adoption rate of the CP and EA recommendations, (b) the perceived benefits and significance of the CP and EA programs from the perspective of the beneficiaries, and (c) the factors that hinder or facilitate adoption of the CP/EA recommendations and finally to come up with recommendations on how to improve implementation of the CP and EA programs.

## **2. REVIEW OF PREVIOUS RESEARCH ON CP AND EA PROGRAMS**

The use of CP as a tool to improve the MSMEs' productivity while protecting and conserving the environment has been extensively promoted in many parts of the world and espoused by various international organizations like the Asian Development Bank (ADB), United Nations Environmental Programme (UNEP), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and other environmentalist NGOs. They have already sponsored numerous CP programs in many developing as well as developed countries. The reports of their assistance document the success stories of the outstanding CP beneficiary. In the success story of Kenya's implementation of the CP program, the report featured three companies who were recognized as the outstanding CP assistance beneficiaries. Chandaria Industries Ltd, a paper manufacturer was reported to have generated annual savings of USD 0.6336 million from the various CP options that the company had adopted. Their efforts also facilitated their attainment of ISO 9000:2001 certification and several awards. In addition the recognition that they had gained as CP champion enabled them access to a larger market share and to become the sole supplier of various paper products to UN agencies and several multinational organizations. In the case of Haco Industries, which was a producer of stationery, shavers, personal care and household hygiene products, the company recorded annual savings of more than USD 0.548 million. Other benefits gained were improved product quality and safety and the use of closed loop effluent treatment plants which was expected to further upgrade the company's environmental performance. The last company featured in the report was Pwani Oil Products Limited, a manufacturer of edible oils and fats as well as laundry bar soaps. As part of the CP program adopted by the company it installed new technology that enabled an expansion of its production capacity and improvement in its process efficiency. The said intervention gained annual savings for the company of around USD 623,768 which the company used to start new business ventures thereby creating more job opportunities.

As already mentioned, technically speaking Energy Audit (EA) is part of CP, focused also in reduction of wastage through efficient use of energy. In fact, many of the goals and options cited in the CP reports are energy related, for example % reduction in electricity consumption. In some cases, however, because EA normally covers also a wide area in a plant, production warehouse, and even office, it is more advisable to conduct a separate thorough assessment. Also, EA results are inputs to the preparation of an Energy Conservation Plan, which is as elaborate as that of a CP Plan, and hence deserve a more focused study. Basically the EA process follows the same procedure as that of CP which is

understandable because the two are actually both concerned with improving the MSMEs' productivity without compromising environmental quality.

A review of previous studies on CP and EA programs, however, shows that no paper has yet been published that document the companies that had failed in the implementation of these two concepts. Although there have been general discussions on the barriers of their implementation, no specific case study has been presented to support these identified hindrances. It must also be noted that most of the benefits cited were qualitative in nature and lacked a mathematical computation of the monetary gains. Though monthly/annual savings were mentioned in the report, data supporting these claims, however, were not shown, and hence, traceability could not be easily established.

### **3. RESEARCH DESIGN AND METHODOLOGY**

This research utilized the descriptive research method as well as qualitative and quantitative approaches in data collection. Twenty (20) out of the 38 MSMEs assisted were purposively chosen as respondents to the Impact Assessment Survey Questionnaire. Both the primary and secondary methods of data collection were utilized, and with the primary data gathered through the use of survey questionnaire and interview of key informants, and with secondary data obtained from the review of CP/EA program proposals and reports of CP/EA Assessment Teams.

The gathered data were then analyzed using descriptive, qualitative, and some quantitative methodologies

#### **Sampling:**

Based on the review of the CP and EA documents, twenty (20) out of the thirty eight (38) firms assisted were purposively chosen as the respondents to the Impact Assessment Survey Questionnaire. Selection of the samples was based on the quality and completeness of the CP and EA Assessment Reports.

#### **Methods of Data Collection:**

The study utilized both the primary and secondary method of data collection. Primary data was gathered through the use of Survey Questionnaire and Key Informants Interview. The selected firm beneficiaries of the CP and EA programs were surveyed while the implementers (CP and EA Assessment Teams) were interviewed.

The secondary data were obtained from the review of CP and EA programs proposals, the Assessment Reports and other related documents available.

#### **Methods of Data Analysis:**

The gathered data were analyzed using descriptive, qualitative and some quantitative methodologies. Basic profiles of the respondent companies were evaluated to determine their relationship to the success or failure factors of the CP and EA programs. As one of the measures of the CP and EA outputs, the percentage of the implemented CP and EA recommendations/options over the total number of recommendations/ options proposed or suggested by the Assessment Team was calculated. The perception of the programs' beneficiaries on the benefits and significance of the CP and EA were also probed and their responses ranked.

### **4. RESULTS AND DISCUSSION**

The CP and EA programs are DOST Programs designed at the DOST National office for implementation by the regional offices of the agency. As such, a uniform set of framework, objectives and implementation strategy has been followed. Recognizing that implementation plans and strategies largely determine the success or failure of the program, this research reviewed how the CP and EA programs were implemented by DOST Region IV-A.

#### **Assessment of the Survey Results:**

Based on the List of CP and EA assisted firms provided by the program's coordinator since 2006, DOST Region IV-A was able to provide technical consultancies to 47 firms. However, upon review of available reports, both electronic and hard copies, it was learned that only 38 firms have CP/EA Assessment Reports, showing that there were nine firms that were assessed but with no reports prepared. Out of the 38 reports reviewed, the 20 most well prepared/complete reports were chosen as survey respondents. Details of the Survey findings can be found in Bagsit (2014) which can be summarized as follows:

1. Most of the respondents learned about the CP and EA programs through DOST personnel and by attending seminars/trainings/workshops which were more likely organized or co-sponsored by DOST. Only two availed themselves of the programs by means of referral or by endorsement/promotion by former recipients of the CP or EA assistance. This observation was not quite consistent with the answers gathered when the respondents were asked if they would recommend the programs to other companies for out of the 16 survey participants 11 indicated that they would endorse the program. Using Narayanan's elements of technology diffusion, it can be said that DOST Region IV-A has not yet fully "propagated" CP and EA programs to their intended users/adaptors.
2. Most of the CP recommendations implemented by the beneficiaries required 6 months or less to implement. These recommendations were relatively simple and easy to implement and did not require costly investments. There were also companies which, despite the time elapsed, still failed to implement the CP recommendations of the assessment team.
3. For the Short-term recommendations, the highest rate of implementation was 79% which was recorded by Pacific Isles International Trading, but the company failed to implement any of the long-term recommendations. Analysis of the long-term recommendations showed that most of them were not implemented. It was only New AM Miki Factory that implemented the highest number of recommendations with the percentage rate of 50%. If the total number of recommendations is to be evaluated, the highest rate (62%) of implementation of the CP recommendations was recorded by the firm, Bugong.
4. Most of the CP and EA recipients believed that implementation of the recommendations of the Assessment Team resulted in reduction of their companies' power consumptions.
5. Most of the respondents also identified compliance to government regulations as the second most important benefit they got from implementing the CP/EA recommendations.
6. It can be said that beneficiaries of both CP and EA programs felt that they were able to reduce their energy requirements by adopting the CP and EA recommendations. Also, there was one EA beneficiary that identified EA recommendations helped their company to comply with government regulations.
7. The CP and EA recipients considered the CP and EA programs to be highly significant to the company, which can be said that their implementation of the recommendations brought positive impacts to them. It is also notable that all respondents found the CP and EA assistance significant, only at different degrees.
8. The major factor which prevented CP and EA beneficiaries from implementing some of the recommendations proposed by the Assessment Team was cost followed by the lack of knowledge and then lack of follow-up visits.
9. These responses from the companies show that most of the long-term recommendations were not implemented. Because these recommendations require investments on infrastructure, such as facilities improvement, purchase of additional equipment, and provision of supplies like personal protection equipment (PPE). The lack of knowledge can be related to the feedback of the program implementers that one of the challenges of the CP and EA assessments was the limited technical knowledge/capability of the companies especially those micro and small enterprises which have a relatively smaller workforce. As related by the CP and EA team members, they have shortcomings when it comes to monitoring and evaluation of the EPIS and ECMs which is reflected in the response that one of the factors that led to the low implementation of the recommendations was lack or minimal follow-up visits. It can also be noted that there were two respondents which said that they do not agree with the CP and EA recommendations, which can be due to the challenge cited by the implementers that felt the team lacked some technical knowledge which limited their ability to provide highly significant S&T based recommendations.
10. The limiting factors in implementing CP and EA recommendations were in accordance with Mohr's "Factors affecting adoption of Innovation". As mentioned above, cost was the most important consideration which could mean that companies failed to realize that there were returns or benefits from their investments in implementing the recommendations of the CP/EA team. Lack of knowledge or information on how to implement the recommendations, ranked second highest limiting factor.

## 5. CONCLUSION AND RECOMMENDATIONS

This research shows that CP and EA programs are highly important technical assistance programs of DOST Region IV-A. Based on the survey results, the MSME beneficiaries recognized the benefits of adopting the CP and EA recommendations despite the challenges in implementing the CP and EA programs. They have attributed or at least



related the improvements in the efficiency of their production processes or general operations to the recommendations of the CP and EA teams. These ultimately led to outcomes such as savings and increased profit from the reduction of power consumption, less wastages of raw materials and products (less rejects), more efficient production processes and reduced costs of other utilities such as water. They have also identified compliance of the companies to government regulations as one of the important impacts of the assistance provided. Overall, it can be said that the adoption of the CP and EA recommendations generally improved the productivity and competitiveness of the assisted companies.

In terms of programs implementation, it was very evident that there were improvements that needed to be done. The technical capabilities of the CP and EA teams were quite limited due to their basic educational background. According to them, their recommendations could have been much better if the technical knowledge and experiences of their members were wider. Because of the heavy workloads of the CP and EA teams, there were some lapses in report preparation and submission such that some companies assisted more than two years ago have not been reported on until now. There was also a case in which the report was already available but was not given to the company.

It can also be concluded that implementation of the CP and EA recommendations requires application of “technology management” concepts such as the framework of technology adoption and diffusion. There are limiting and facilitating factors that determine the adoption rate of the recommendations, like their relative advantage which, in the case of this study, was related to cost of implementation and the benefits that could be derived by the company. Another factor learned from technology management regarding technology adoption is compatibility and complexity which, for this research, can be related to the following limiting factors: (1) lack of knowledge/information on how to implement and (2) disagreement with the recommendations.

The results of this study emphasize the importance of feedback mechanism as a concept of project management. Monitoring and evaluation are important in project implementation, since feedbacks can provide basis for adjustment of the management plan. The impacts or the success rate of the programs could have been much improved if the monitoring and evaluation steps of the CP and EA assessments were implemented.

### **Recommendations:**

Though CP and EA programs are worthwhile undertakings of DOST IV-A, however based on this study there are still many improvements that could be done to maximize their benefits to firm beneficiaries of these technical assistance. The recommendations are classified into (1) Management of the Program and (2) Improvements of its Technical Aspect.

#### **1. Management of the Program:**

**Manpower:** As recommended by the CP and EA Teams their composition must be increased or expanded to include more diverse fields or disciplines such as industrial engineering, food science, chemistry, financial administration in addition to the existing engineers and physicists in their group. Through this, more comprehensive and relevant recommendations could be crafted which would not only address the technical concerns but will have a more realistic cost-benefit analysis. Also, the workload of the team should be looked into and management should not only focus on the number of accomplishments but also the quality of outputs.

**Implementation:** we are recommending that the DOST IV-A management review its existing consultancy programs and possibly integrate related ones to reduce cost of providing services and come up with a more encompassing assistance to maximize benefits to the firm beneficiaries. CP and EA could be integrated as focus areas of the Manufacturing Productivity Extension (MPEX) Program and should not be conducted independently as a separate technical assistance. Since MPEX is being outsourced, the expertise of the consultants can be tapped to come up with much improved recommendations. Also, this strategy will have a holistic assessment of the company for a more comprehensive improvement plans. Since the one of the reasons or factors cited by the beneficiaries why they failed to implement the CP and EA recommendations was cost, DOST IV-A should use CP and Programs as opportunities for SETUP assistance. The recommendations involving acquisition of technology could be funded under SETUP. Lastly the programs’ implementers should also engage the beneficiaries in hand-holding during the implementation of their recommendations, especially those companies that have zero or limited technical background. This is in to ensure that recommendations would be implemented correctly and effectively.

**Monitoring Evaluation and Feedback Mechanisms:** Since both CP and EA programs are aimed at achieving sustainable impacts on and continual improvements of the companies’ productivity and competitiveness, it is but imperative to reinforce the monitoring, evaluation and feedback mechanisms. As related by the program implementers,

they failed to do follow-up visits to the assisted companies to monitor their progress on the implementation of the CP and EA recommendations. In the survey, the companies even indicated that there should be more scheduled or regular visits (some even suggested quarterly monitoring) to follow-up their activities and performance.

## 2. Recommendations on Improvements of the Technical Aspects:

**Program sustainability:** Just like in CP wherein recommendations of implementation are supposed to be maintained through the EMS, the EA protocol should indicate what specific strategies like Energy Conservation and Management System on Energy Management Plan, for the recommendations to be sustained and continuously improve.

**Education and Training:** As per suggestion of the companies, continuous education and training on CP and EA should be provided by DOST IV-A for them to effectively adopt the recommendations. Management and most importantly the staff implementing these recommendations should be trained on how to do actual implementation. The companies should be also updated on the latest trends on CP and EA to sustain innovations hence these engagements should be long-term.

Likewise implementers of the CP and EA programs must be continuously capacitated through trainings to keep them updated on the latest technologies not only program-related but also on manufacturing and operations management. This would provide them knowledge source to come up with better and comprehensive CP/EA recommendations.

**Provision and Maintenance of Equipment:** Equipment being used in the conduct of CP and EA must be properly maintained and calibrated for more accurate and reliable results. The sophistication of the CP/EA equipment must be matched to that of the companies being assisted hence possibility of upgrading must be looked into.

**Establishment of Demonstration Company/ies:** As proposed by one of the respondents, the companies would be more encouraged in implementing the CP and EA recommendations should there be demonstration companies to prove that these technical assistance really works and can be actually observed. Success stories on CP and EA must also be documented as another avenue to communicate the benefits of the programs.

**Follow-up Study:** As a follow-up to this study, the DOST 4a management may consider conducting a more quantitative research protocol utilizing statistical methodologies such as correlation. This would facilitate a more scientific analysis that would reduce if not eliminate biases.

## REFERENCES

- [1] Bagsit, Emelita (2014), Capstone Project Paper for the Master of Technology Management, Technology Management zcenter, University of the Philippines - Diliman
- [2] Larson & Gray, C.F. (2011). Project Management: The Managerial Process. 5<sup>th</sup> Edition. New York: McGraw-Hill Irwin.
- [3] Schindler, P.S. & Cooper, D.R. (2011). Business Research Methods. 11<sup>th</sup> Edition. Asia: McGraw-Hill.
- [4] ASEAN (2004). Proceedings of the ASEAN Experts Meeting on the Establishment of a Center/Network for Environmentally Sound Technologies. Singapore.
- [5] The Louis Berger Group, Inc. (2005). Project Final Report: Promotion of Cleaner Production in the Philippines.
- [6] DOST-Region IV-A. (2009). Cleaner Production Assessment Report: Farmtech Foods Incorporated.
- [7] Thomson Learning. (n.d.) Chapter 8: Project Quality Management accessed on September 14, 2013 thru: <http://www.slideshare.net/KishanPhadte/chap08-project-quality-management>.
- [8] <http://www.dti.gov.ph/dti/index.php?p=321>.
- [9] <http://www.unep.fr/shared/publications/pdf/2480-CpDairy.pdf>.
- [10] [http://en.wikipedia.org/wiki/Energy\\_audit](http://en.wikipedia.org/wiki/Energy_audit).
- [11] [http://www.powermin.nic.in/distribution/energy\\_audit.htm](http://www.powermin.nic.in/distribution/energy_audit.htm).
- [12] <http://icett.or.jp/techinfo.nsf>.
- [13] <http://www.un.org/esa/sustdev/sdissues/technology/cleanerproduction.pdf>.
- [14] [http://www.greenindustryplatform.org/wp/content/uploads/2013/07/RECP\\_Kenya.pdf](http://www.greenindustryplatform.org/wp/content/uploads/2013/07/RECP_Kenya.pdf).