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The Role Of Product Lifecycle Cost Technology And Cleaner Production Strategy In Reducing Costs

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Abstract:

Reducing costs and protecting the environment surrounding economic unity has become the concern of many economic units and shifting their ideas towards preserving resources and protecting the environment by adopting strategies and techniques that take into account when applied reducing production costs and protecting the environment, including these strategies and techniques, the technical costs of the product life cycle and the strategy of cleaner production, as the application of the two concepts in local economic units helps to try to keep up with the countries that work to keep up with the success of their economic units by following the concepts that have been successful in Developed countries by maintaining the sustainability of the resource and environmental balance by producing environmentally friendly products, therefore the study aimed to determine the costs of the product life cycle technology and help the economic unit to reduce these costs during its life cycle using the strategy of cleaner production and in order to help preserve the environment and reduce its pollution, and the researcher concluded that the use of technology costs the life cycle of the product provides important information for the purposes of correct pricing of products and for the purposes of cost management, because it includes a range of costs, namely direct costs, indirect costs, conditional costs, intangible costs and external costs, while the traditional method includes direct and indirect costs only, in addition to the fact that cleaner production is a strategy used by the economic unit for the purpose of preserving the environment of all forms of pollution that has negative effects on society, in addition to the optimal use of unit resources, which contributes to reducing costs and increasing profitability and recommended the researcher to focus economic units on the production of economic units on the production of Environmentally friendly products as they contribute to the provision of resources and energy and do not harm the environment during use and thus increase the competitive advantage of the economic unit, in addition to the interest of the economic unit in the pre-production phase if it wishes to develop its products to suit the wishes of customers and compete with similar products in the market as this stage represents the most important stage of the life cycle of the product as it leads to a reduction in the costs of the next two stages.

keywords : cladding product life cycle, cleaner production, cost reduction

Introduction

Advanced technology and rapid developments in the industry have led to the recovery and prosperity of the global economy and this progress and development is accompanied by damage to the environment as a result of the remnants of factories that have damaged air, water and soil, as economic units, especially

production, are considered to be among the main causes of this deterioration as a result of the residues and emissions posed during the production process, which increased the environmental costs borne by the economic unit as a result of damage to the environment, that the application of cleaner production is not specified in a particular area, but is applied in the areas of Industrial, productive and service fabrication, and through the costs of the product life cycle, it is possible to apply cleaner production at every stage of the product's life cycle, thus enabling economic unity to reduce pollutants, reduce costs at all stages of the product's life cycle, preserve the resources used, improve the image of the product and increase the competitive strength of the economic unit in the markets.

First research: methodology

First: the problem:

The issue of pollution and environmental protection occupied the greatest concern of most economic units that seek to reduce the costs incurred as a result of their damage to the environment, so the beginning of this research, which seeks to determine the costs incurred by the economic unit during the life cycle of the product, including the costs it incurs as a result of its impact on the environment (obligations, taxes) and how it can be reduced through the use of a cleaner production strategy, so the problem of research was to answer the following question:

1- Can you determine the stages of the product's life cycle and limit its costs.

2- Does the cleaner production strategy help the economic unit determine the costs that can be reduced during its life cycle?

Second: the objectives:

The research aims to determine the role of product lifecycle cost technology and cleaner production strategy in reducing costs, which can be achieved through:

1. Determine the life cycle of the product.

2. Determine the costs of each stage of the product's life cycle.

3. Reducing costs for each stage of the product's life cycle using the cleaner production strategy.

4. Protect the environment by reducing the pollutants caused by production to the environment with a focus on reuse.

Third: The importance of research:

The importance of research is based on the importance of maintaining economic unity on its market share by reducing its costs while maintaining the required quality as well as preserving the environment by producing environmentally friendly products and the importance of research can be determined as follows:

1. Determining the stages of the product's life cycle and determining its costs.

2. Provide a measurement basis to determine the costs of each stage of the product's life cycle.

3. Help the economic unit determine the stage at which costs can be reduced.

4. Help reduce the pollution costs caused by the product during its life cycle and reduce waste of resources, to reach cleaner production.

5. Reduce costs through reuse and then protect the environment.

Fourth: The hypothesis:

The research is based on the basic premise that :(product costs can be reduced using product lifecycle cost technology and a cleaner production strategy by producing environmentally friendly products)

Research II: Knowledge foundations of product lifecycle costs and cleaner production strategy

First: Product lifecycle cost technology

1. Concept and definition of the product life cycle

Each product has a life cycle starting from research, development and design and ending with the product's presentation in the markets, and in light of the change of business and the entry of advanced manufacturing systems and the trend towards meeting the needs of customers by offering new products in high quality, as this requires the development of new ways to contribute to reducing costs in an orderly manner at all stages of the product life cycle. This product may fail at the beginning of its life when it is introduced to the market, and may continue to grow and beyond stages, and thus the life cycle of the product resembles the life cycle of the human being itself (Al-Akili, 2014:13).

Sharma defined the product life cycle as the best course used to explain the nature of products and markets, As a tool for planning the concept of product lifecycle to help managers identify the characteristics of the main marketing and challenges at every stage of the product's life, and develop the main alternatives to marketing strategies (Sharma, 2013:125) and define the product life cycle as one of the techniques used by management for the purpose of identifying and monitoring the costs of the final product during its lifetime, the product life cycle consists of all steps stating from product design, purchase of raw materials to the stage of delivery of finished products and the provision of accompanying service (Almaqbool, 2020:189).

The product lifecycle cost concept (PLCC) was first developed by the U.S. Department of Defense in the early 1960s to increase the effectiveness of government procurement processes, and has since been applied to a wide range of projects across a variety of sectors including transportation, energy, manufacturing and healthcare (Animah,2018:4-5) When the Institute of Logistics Management prepared a report entitled The Cost of LifeCycle in Equipment Procurement for the U.S. Department of Defense, the term life cycle cost was first used in this document (Dhillon, 2002: 126).

The literature addressed this concept by providing several definitions, known by Kadarova that the cost of the life cycle of the product is a set of money spent to support the product from design, manufacturing and operation to the end of its productive life (Kadarova, 2015:547) and defined by Estevan as a technique that supports analytical processes through which managers can make highly cost-effective decisions regarding the options offered to them at different stages of the life cycle and at different levels of cost estimate of the life cycle (Estevan, Estevan) Schaefer ,2017 :4)

2. Types of product life cycle costs

The costs of the product's life cycle are divided from this point of view into the following: (Accepted, 2020:191),

A. Initial costs: These costs include research and development costs, design, selection of models and engineering costs, which are non-refundable, and these costs are treated accounting as deferred revenue costs that are extinguished over the number of years.

B. Normal costs: Include direct and indirect production or manufacturing costs as well as marketing costs.

A. Environmental costs: these are the costs required to protect the environment, settle the site, cost departure and disposal of product and after-sales waste, such as uses, fines and compensation resulting from environmental laws.

D. Customer costs: these are post-purchase costs for the customer and are an after-sales cost from the product's point of view such as fraud, operation, maintenance and use of the product in the absence of after-sales services and the cost of the product's life cycle can be measured from the previous perspectives of my agencies:

1. From a production point of view

- Model (Fouda, 2003:327)

PLCC =RDDc +Mc +MDCSc

RDDc = Research, development and design costs (pre-production costs)

Mc = manufacturing costs

MDCSs = Marketing, Sales, and After-Sales Services (after-sales costs)

- (Dhillon) model. Product life cycle costs can be measured using the following model

2. From the customer's point of view

Model (Schau et al,2011:2276)

LCC = Ac+ Fc+ RMc+ Ic+ Dc- Salvage Value

Ac = acquisition cost

Fc = fuel cost

RMc = Maintenance and debugging costs

Ic = insurance costs

Dc = costs of disposal of the product after the end of its useful life

Salvage = rubble

3. From a societal point of view

Kumran et al, 2001: 272 finds that the economic unit can measure the costs of the product life cycle using the following model:

TC = C1 +C2 +C3 +C4 +C5 +C6 +C7 +C8

C1 = Effluent control cost

C2 = Effluent treatment cost

C3 = liquid waste disposal cost

C4 = cost of environmental management system

C5 = cost of environmental sanctions

C6 = repair costs

C7 = Energy costs

C8 = Cost savings from recycling

Second: the cleaner production strategy

1. Concept and definition of cleaner production

Cleaner production is a general concept as it is one of the most important approaches to environmental protection, which works to improve the efficiency of natural resources, efficient use of energy, reduce risks to the environment and human life, and reduce the environmental impact of manufactured products throughout their life cycle (Scarazzato et al, 2007:22).

(Nzimande, Bawinile, 2011:38) summarized the concept of cleaner production as an application that aims to reduce waste, prevent pollution, reduce the use of toxic materials, use clean technology, design environmental strategies for the economic unit, and define it as an integrated and continuous preventive strategy applied to products, processes and services , in order to enhance efficiency, which improves environmental performance and reduces costs (Wu&Chang, 2020: 167), and I defined it (Surour, Muhammad, 2021: 3) as an integrated preventive strategy aimed at increasing production efficiency through the optimal use of natural resources and the use of modern technology in production and reduction of emissions and pollutants resulting from production processes from the source instead of treating them and working to produce environmentally friendly products and recycle them, which helps reduce the costs used to treat them.

2. The importance and objectives of cleaner production

A- The importance of cleaner production

One of the reasons for adopting the concept of cleaner production due to its many benefits and importance, we summarize the most important of them:

1. Achieving financial returns / The cleaner production achieves financial savings from production processes, which pushes the economic units to adopt the cleaner production technology in their practices in order to move towards preserving their natural resources by rationalizing the consumption of resources used in

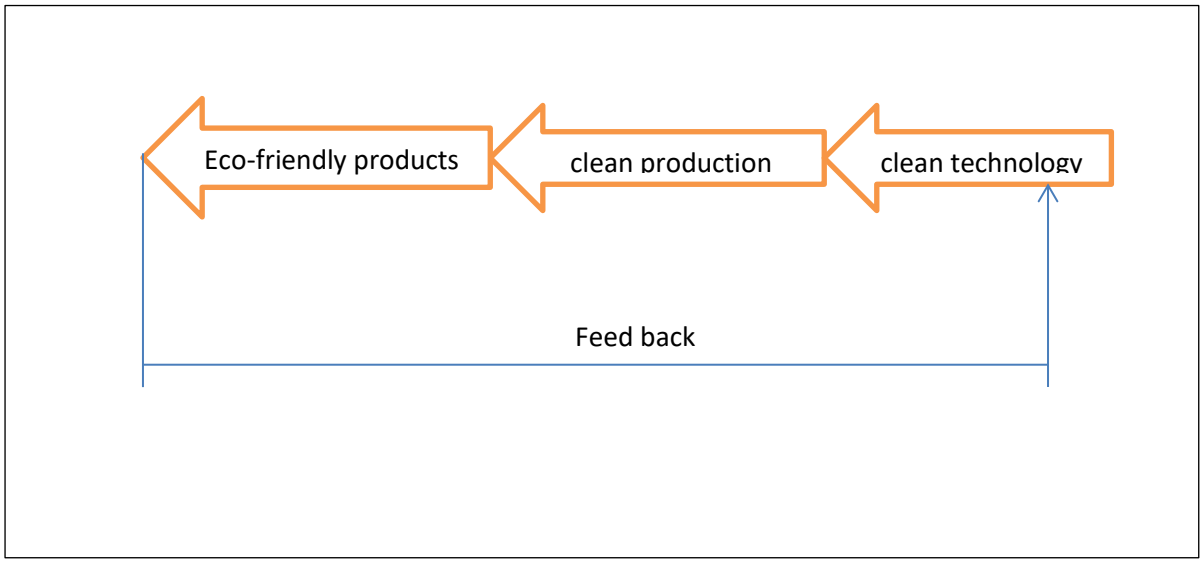
production in a way that achieves environmental and economic benefits (Asipjanov, 2004: 14)

2. Improving the level of technology adopted in production / assuming that the search for ways to implement cleaner production will encourage the economic unit to search for cleaner technologies, and thus the various research bodies, the scientific community, vocational schools and local environmental consultants will be sought, which will create a dynamic work environment for research in production technology (For my knowledge, Balghnammi, 2018:3).

3. The use of materials in the manufacturing process in a more efficient manner, which helps to reduce the amount of required inputs and the amount of unwanted outputs, ie reducing the amount of waste of resources (Schaltegger et al, 2018:7).

When the inputs of cleaner production are clean technology, then the economic units that use clean technology can benefit from relative advantages in the market, because they do not bear environmental expenses. Environment: (Handal, 2013: 86-87) as shown in the following figure:

Figure (1) Inputs and outputs of cleaner production



Source: Al-Taher, Khamara (2007) "Environmental and Social Responsibility is an

Introduction to the Contribution of the Economic Institution to Achieving Sustainable Development" published Master's thesis in Economic Sciences majoring in Economics and Environmental Management submitted to the Faculty of Law and Economic Sciences, Kasdi Merbah University - Ouargla, Algeria, pg. 97.

B- Objectives of cleaner production:

The main objective of cleaner production in economic units is to obtain financial savings and improve the environment at relatively lower costs, in addition to that, cleaner production would achieve for the economic unit the following goals: (Al-Taher, Khamara, 2007:98) (Rahmoun, Qaham, 2018: 104 (And (Al-Shawi, 2017: 32) (Boujbila, 2020: 369)

1- It contributes to reducing the depletion of natural resources, increasing productivity, saving and rationalizing energy and water consumption, improving the quality of products and increasing competitiveness.

2- Develop production methods and make appropriate adjustments to the life chain of the products, which include the extraction of raw materials, their manufacture, transportation, storage and use of the products, and then their disposal by environmentally safe means.

3- Cleaner production does not impede growth, but it confirms that growth can be environmentally sustainable, that is, growth can be achieved while preserving humans and the environment.

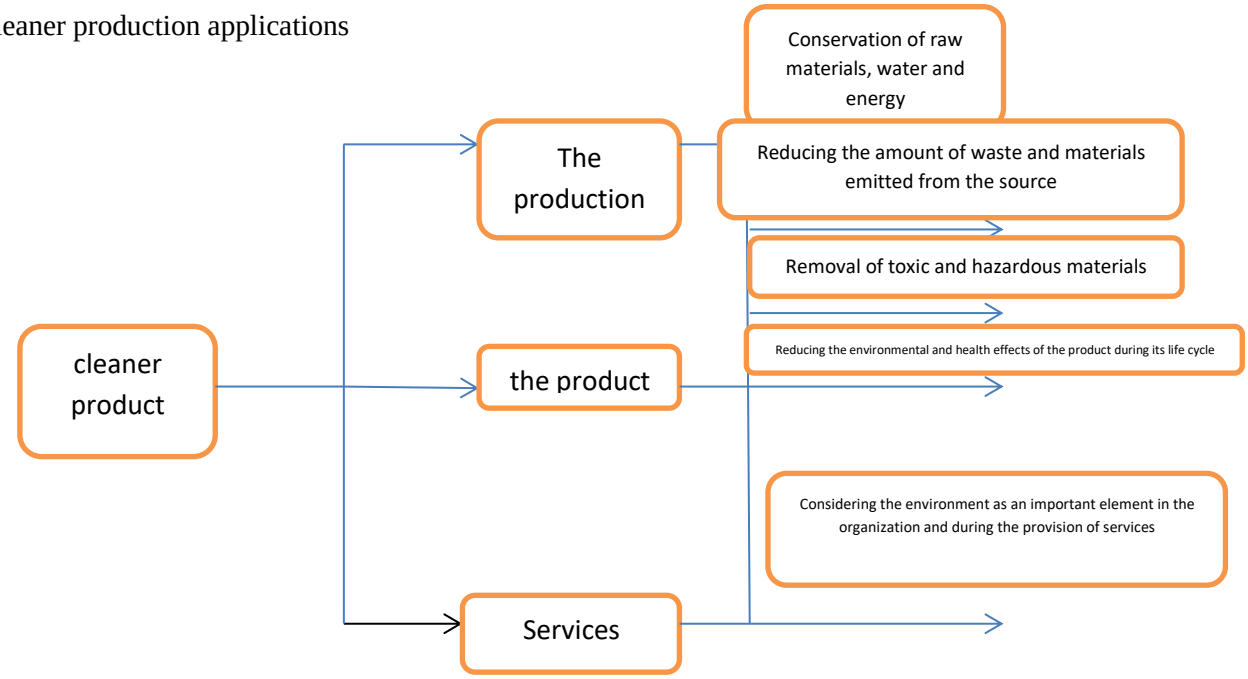
It is clear that the goal of cleaner production is directed in three directions, namely, the human being, the economic unit and society, as it aims to preserve human health, reduce waste and emissions. Through the use of raw materials that have less impact on human health and the environment, excluding raw materials that are toxic and dangerous, and achieving the highest level of efficiency and effectiveness within the economic unit by reducing pollutants in addition to increasing the market share of the economic unit (Al-Ajeebi, 2021:48)

3. Cleaner production applications

Cleaner production is applied at the level of production processes, products and services. For production processes, cleaner production represents a reduction in the consumption of raw materials and energy in the production of units, the disposal of toxic and dangerous materials, and the reduction of the amount of emissions and waste. As for products, cleaner production helps reduce negative effects on the environment during The product life cycle and the introduction of environmental measures in the stages of product design. As for services, the use of cleaner production will help to integrate environmental concerns in the organization, design and provision of services (Sirait, 2018: 2), as shown in the following figure:

shape (2)

cleaner production applications



Source: Walid, Hammach (2011) "Managing industrial waste as an entry point for achieving sustainable development in the economic enterprise" published master's thesis, submitted to the Faculty of Economics and Management Sciences, Farhat Abbas Setif University, Algeria, page 111.

Clean (environmentally friendly) products are characterized by a number of qualities, namely: (Dangelico, 2010: 1611).

1 - It is produced using a smaller amount of materials, unlike traditional products, where it has a less negative impact on the environment.

2- It uses biodegradable natural materials or recycled materials or reused parts (no environmental impact) in its production.

3 - They are designed to be reused and easily disassembled or made of materials that can be recycled, which reduces the environmental impact of products that do not require the consumption of raw materials, and thus help these products achieve financial savings for the economic unit and a positive environmental impact.

Fourth: The difference between the cleaner production strategy and the end-of-line technology

Table (1) The difference between cleaner production strategy and end-of-line technology

end-of-line technology	cleaner production strategy	Statement
Include reaction to the occurrence of waste	Include work done to prevent waste	The nature of the Statement
It is implemented at the end of the production line	It is carried out from the beginning of the production line from the design stage of the products	execution time
Waste is treated at the end of the production process	Prevents waste from occurring before it occurs in all stages of the production process	How to treat waste and emissions
It leads to increased costs and increased material consumption	Helps reduce costs and reduce material consumption	The cost effect
Lead to environmental problems during all production stages	It protects the environment by developing processes and products	Its effect on the environment
The responsibility to protect the environment lies with the experts	Everyone has the responsibility to protect the environment	Responsibility to protect the environment
Increases the risk	Reduce risk	The effect on the risks

Source: de Oliveira Santos, H., Alves, J. L. S., de Melo, F. J. C., & de Medeiros, D. D. (2020). An approach to implement cleaner production in services: Integrating quality management process. Journal of ,p4.Cleaner Production, 246, 118985.

The two researchers consider that cleaner production is a strategy to prevent the occurrence of waste, and this can apply to all stages of the production process of the product life cycle, starting from the research and development stage to the stage of use or recycling, and this helps to reduce costs and preserve the resources available for all production stages, which provides the economic unit with the possibility To reduce the selling price, which improves the competitive advantage of the economic unit in the market.

The third topic: product life cycle costs and cleaner production and their role in reducing costs

It is understood from cost reduction as a real and continuous reduction in the cost of the manufactured unit of the products or services provided without affecting their suitability for the required use (Athalye et al, 2015: 3247). Related to the costs incurred by the economic unit, and these functions include a group of activities that include forecasting future costs and estimating the financial allocations needed for each of the materials, wages and indirect industrial costs as well as preparing the estimated budgets and ending with cost control and preparing reports for the management of the economic unit, which regulates the deviations of all cost elements (Radhakrishnan & Selvan, 2017:145)

And (Kjellander) defined cost reduction as reducing costs by making physical changes to one of the components of the product by changing its design by removing unnecessary parts and using the recovered costs to develop existing products or creating new projects and offering products at competitive prices, which increases profits (Kjellander, 2015). :3) and (Akeem) defined it as a planned approach represented by the use of more acceptable and efficient means and techniques than the previous techniques and standards to control operating costs and ensure that the cost does not exceed a certain amount by eliminating lost time and achieving increased production (Akeem, 2017: 19)

The process of analyzing product life cycle costs plays a great importance in determining the costs that can be avoided during its life cycle (Al-Hawazy, 2016: 83), as well as its importance in making decisions about pricing and identifying deviations and others (El. Kelety, 2006: 437-439). Determining the costs of the product life cycle The nature and timing of costs can be determined so that they can be planned and managed effectively aiming to reduce them if possible.

And by determining the costs of the product life cycle, it is possible to determine the important costs associated with designing a particular product during the planning period (such as warranty or environmental costs of the product) and work to stimulate changes in the design to eliminate or reduce these costs, and cost analysis can help reduce the effects of increased costs when developing the product and identifying areas in which cost-reduction efforts are likely to be most effective (Dury, 2012: 544) that for each stage of the product life, there is a technology that works to reduce costs and commensurate with that stage, in the pre-production stage the appropriate technology to reduce costs is the cost target, which represents the effective entrance to cost management during the design stage (research and development) of the product life cycle, that is, before the production process. The costs incurred by the economic unit (Al-Hawazi, 2016: 99), and it also leads to improving the quality of products by reducing spoilage and waste and works on Increasing unit profits, reducing the cost of a single unit, and increasing its sales (Al-Mousawi, Kazem, 2019: 553).

The application of cleaner production also affects the costs of the economic unit through raw materials and other inputs, as cleaner production works on the efficient use of raw materials and recycled materials in the manufacture of products or from waste (waste) generated from other economic units, and the appropriate technology and selected manufacturing methods will help to reduce the materials used in production, which leads to reducing the cost of resources and then achieving profits and reducing production costs, and through water and energy, cleaner production reduces water consumption in production processes through the reuse of water, which reduces the cost of obtaining this resource reducing dependence on it, and cleaner production reduces energy consumption in the production process or uses renewable energy sources, which help reduce costs (Ferri & Urena, 2016:31-34).

(Al-Shabbasi) believes that when applying cleaner production, the following costs are excluded: (Al-Shabbasi, 2017: 119)

1. Costs resulting from avoiding environmental fines and compensation as a result of complying with environmental requirements.

2. Costs resulting from avoiding treatment of workers as a result of providing a healthy work environment.

3. Costs resulting from waste disposal and avoiding the costs of sanitary landfills as a result of replacing them with recycling.

4. Costs are reduced by the revenues of emissions reduction certificates.

5. Reducing costs with the revenues of recycling projects.

practical side

First: Measuring the life cycle costs of the product for the split air conditioner, Naseem Al-Rafidain, before development

1 - Costs of the research and development stage

Table (2) The first stage (pre-production stage)

total	partial	Stage details	s
		Pre-production costs (research and development) include	1
	1096200	Research and consulting services	a
	812000	the design	b
	406000	Development	g
	346565	Pre-production share of administrative costs	d
2660765		Total stage	

Source: Prepared by the researcher based on the data of the Costing Division

Table (2) shows the costs of the first stage of the product life cycle, which includes the costs of research, consulting, design and development of the split air conditioner (2 tons), which were obtained by the costing division data, in addition to the stage's share of administrative costs.

2 . production stage costs

Table (3) The second stage of product life cycle costs (production stage)

total	partial	Stage details	s
		production stage costs	2
	131229756	Direct material cost	a
	3653188	direct wage cost	b
	6002498	Indirect industrial costs, represented by the production stage's share of administrative costs	g
140885442		Total production stage costs	

Source: Prepared by the researcher based on the costs division

Table (3) shows the production stage, which includes the costs of direct materials used in production and the costs of direct wages for the production process, depending on the details shown in the previous tables and the indirect industrial costs represented by the stage's share of administrative costs.

3 . Post production costs

This stage includes marketing costs, warranty and maintenance costs, and my agencies:

Table (4) The third stage (marketing and after-sales services)

total	partial	Stage details	s
		Post-production costs (customer services) include	3
	1015000	Security	a
	1218000	maintenance	b
	4045790	Marketing costs 3% of manufacturing costs	g
	395084	Post-production share of administrative costs	d
6673874		Total stage costs	

Source: Prepared by the researcher based on the data of the Costing Division

Table (4) shows the costs of the post-production stage, which includes the costs of warranty and maintenance provided by the company within the customer services, the marketing costs and the administrative costs of the stage, which the researcher obtained through field coexistence and with the assistance of the director of the costs division in the company.

Second: Measure the costs of the split air conditioner after development

After making changes to the product through the application of the cleaner production strategy and replacing some parts to transform the product into an economical product that customers want to acquire as it reduces the consumption of electrical energy and thus reduces costs. The stages of the life cycle costs of the developed product are as follows:

1 . Pre-production, post-development

Table (5) The costs of the research and development stage (pre-production) after product development

total	partial	Stage details	s
		Pre-production costs (research and development)	1
	2400000	Research and consulting services	a
	913500	the design	b
	609000	product development	g
3922500		Total stage costs	

Source: Prepared by the researcher based on the information of the research and development team

We note at this stage that the costs of research, design and development services are higher than they were before the product was developed.

2 . Production stage after development

Table (6) The costs of the second stage (production stage) after development

total	partial	Stage details	s
		production stage costs	2
	98757064	Direct material cost	a
	_	direct wage cost	b
	–	The production stage's share of administrative costs	g
98757064		Total production stage costs	

Source: Prepared by the researcher based on the costs division

We note from Table (6) that the cost of direct materials after the development of the product has decreased due to the decrease in the costs of raw materials after development. Administrative costs and direct wages have also been excluded as they are non-value adding costs.

3 - The third stage after production

After product development, the costs of this stage are as follows:

Table (7) Third stage costs After-sales services after development

total	partial	Stage details	s
		Post-production costs (after-sales services)	3
	1015000	Security	a
	1218000	Maintenance	b
	987570	Marketing and distribution costs 1% of manufacturing costs	g
	–	Post-production share of administrative costs	d
3220570		Total after-sales costs	

Source: Prepared by the researcher based on the Marketing and Maintenance Department

Therefore, the difference between the total costs of the product life cycle before and after development became as follows:

Table (8) Total product life cycle costs before and after development

Ratio of increase or decrease	Costs after development	Costs before development	stages	s
%48	3922500	2660765	The first stage	1
(%30)	98757064	140885442	The second phase	2
(%51)	3220570	6564976	third level	3
(%29)	105900134	150111183	the total	

Source: Prepared by the researcher based on the previous tables

We note through Table (8) the difference between the costs of the product life cycle before and after development, that product development leads to an increase in the costs of the first stage in the short term, but in turn leads to a reduction in costs in the long term and a decrease in the costs of the second and third stages, thus reducing total costs by (29%) and this achieves the research hypothesis, where the researcher concluded that the use of the product life cycle costs technology and the cleaner production strategy leads to a reduction in costs.

Fourth topic: conclusions and recommendations

First: the conclusions

1. The use of the product life cycle costs technique provides important information for the purposes of correct pricing of products and for the purposes of cost management, because it includes a group of costs, namely direct costs, indirect costs, conditional costs, intangible costs and external costs, while the traditional method includes direct and indirect costs only.

2. The cleaner production strategy, using modern technologies and by assisting the formations of the economic unit, contributes to the production of environmentally friendly products and services by following the production process from the moment of design to the moment of benefiting from production wastes to return them to the life cycle again.

3. The pre-production stage is one of the most important stages in the product life cycle as it has a direct impact on increasing the market share of the economic unit because it takes into consideration when designing the product the desires of customers as well as their role in reducing the costs of the production stage and the post-production stage.

4. The cleaner production is a strategy used by the economic unit for the purpose of preserving the environment with all forms of pollution that have negative effects on society, in addition to the optimal use of the unit's resources, which contributes to reducing costs and increasing profitability.

Second: Recommendations

1. The company should pay attention to the post-production stage, especially the marketing process, by providing more than one marketing outlet in different geographical locations.

2. It is necessary for the economic unit to pay attention to the pre-production stage if it wants to develop its products to suit the desires of customers and compete with similar products in the market, since this stage represents the most important stage of the product life cycle as it leads to a reduction in the costs of the next two stages.

3. Economic units should focus on producing environmentally friendly products as they contribute to saving resources and energy and do not harm the environment during use, thus raising the competitive advantage of the economic unit.

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