

# The role of sustainable reverse engineering to improving competitive advantage

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## Abstract

The research aims to study the strategy and costs of sustainable reverse engineering and to explain the reasons for the shift from traditional production to sustainable production through the statement of the knowledge bases of sustainable reverse engineering technology and the development of a proposed framework to reduce costs through sustainable reverse engineering that contributes to the production of environmentally friendly products and the role that can contribute to it In improving the quality of those products as well as assisting the management of the economic unit in improving it for the sustainable competitive advantage and maintaining it, and to achieve this, the researcher relied on the inductive approach in writing the theoretical framework for the research and by relying on foreign and Arabic books, theses, research, periodicals, and Arab and foreign articles related to the research topic.

The researcher reached a set of conclusions, the most important of which is that the application of sustainable reverse engineering and measuring its costs contributes to improving the quality of the product by reducing the replacement of materials harmful to the environment and human health with other materials that are less harmful and polluting to the environment and reduce the rates of damage as a result of excluding activities that do not add value to the product or customer, which led to To reduce the cost of the product, reduce its consumption of electrical energy, meet environmental requirements, increase productivity to meet social requirements, improve the reputation and image of the economic unit to meet economic requirements and improve its competitive advantage.

**Keywords:** Sustainable reverse engineering, competitive advantage.

## Introduction

The business environment has witnessed many transformations, represented by the great openness in trade and investment, and

from local to international business, all countries of the world have become a single market affected by its variables, producers

and consumers alike, which has increased great challenges with regard to meeting the needs and desires of customers for goods and services at a low cost. While maintaining product quality levels, as well as the challenge of environmental degradation caused by increased environmental pollution and global warming, which imposes more awareness, especially on the industrial side, with regard to environmental protection and control of environmental pollution resulting from various production and industrial processes, in recent years, there has been a global trend to change the way the industry interacts with the environment, as the focus has been on reducing the impact of production processes on the environment and the subsequent pollution and depletion of natural resources. Sustainable competitiveness, as environmental issues have become the focus of attention of investors, customers and non-governmental organizations as well, which prompted economic units to pay attention to environmental issues and to adopt techniques that contribute to reducing the harmful effects of their activities and products on the environment.

From this point of view, the use of sustainable reverse engineering, which works on the sustainable analysis of the competing product, was directed to determine its functions, design and manufacturing costs, to improve the product of the economic unit by introducing modifications that were observed in the light of the sustainable environment, and then increase its durability and quality while reducing its costs. Which leads to achieving

value from the customer's point of view, as well as achieving a competitive advantage for the economic unit (Tennor, 2015:6), as well as helping to cooperate between buyers and suppliers to carry out cost-reduction activities, where information sharing is necessary to achieve that reduction, for the purpose of increasing the profitability of resources and effectively through the application of reverse engineering technology to maximize the value of the product and reduce losses that occur in the supply chain so it is necessary that they share together the model of reverse engineering technology and cost information as well as an understanding of the manufacturing process components of competitors in the market and discover solutions or alternatives that lead to improving the value of the product. (Nakajima et al., 2015:1310).

#### **Study problem:**

The increase in global competition and the acceleration of technological progress and the resulting results represented by diversity, renewal and innovation in providing high quality products at low prices with rapid response to the change in customer tastes, made the outputs of the Iraqi manufacturing environment suffer from a wide competitive industrial gap between it and the products offered in the market and it was one of the characteristics of the Iraqi manufacturing environment. that gap:

- 1-The weakness of industrial companies keeping pace with the continuous changes in customers' tastes and the high quality of competing products led to the reluctance of customers to

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purchase their products and weaken their competitive position.

- 2-The weak environmental and social performance of the facility in addition to the economic performance
- 3-The weakness of traditional cost management techniques in responding to customer requirements by achieving competitive prices, which negatively affected the dimensions of competitive advantage
- 4-In light of this presentation of the research problem, the researcher puts several questions to the problem, namely: Is the process of product design and development carried out according to a scientific methodology, or is it done in the form of product updates away from the use of modern scientific methods?
- 5-Does the use of sustainable reverse engineering improve competitive advantage?

### Study importance:

The importance of the research is manifested in that it deals with one of the modern topics, namely, sustainable reverse engineering, resulting from the possibility of reducing those costs, as the sustainable reverse engineering technique works to determine the features of the image of the characteristics of the product of the economic unit at an early stage of the product life cycle, by relying on evaluating the value of the characteristics of competing products in an integrated process between the two inputs, and as a result, the information obtained will be useful and

useful and help in promoting the process of improving the value of the product of the economic unit and improving the competitive advantage.

### Study Objective:

Highlighting mainly the positive results that result from sustainable reverse engineering technology in terms of drawing a picture of the features of the product characteristics at an early stage of its design and in a way that is reflected in improving the value of the product by reducing its cost, increasing its quality, increasing customer satisfaction, and as a result achieving competitive advantage Measuring the cost of the product during each stage of its life cycle.

### Studyhypothesis:

The research is based on a basic hypothesis: (Sustainable reverse engineering affects the improvement of competitive advantage in economic units).

### Knowledge bases for sustainable reverse engineering technology:

#### The concept of sustainable reverse engineering technology:

The concept of sustainable reverse engineering is a contemporary terminology, and the following is an explanation of the most prominent opinions that included this term:

Definedthe sustainable reverse engineering technique as a technique that works on the sustainable analysis of the competing product to determine its functions, design and manufacturing costs, to improve the product of the economic unit by introducing modifications that have been observed in the

light of the sustainable environment, and then increase its durability and quality while reducing its costs, which leads to Achieving value from the customer's point of view, as well as achieving a competitive advantage for the economic unit (Tennor, 2015:6)

Boyd defined it as a unique way to gather information about competitors and their products and get other competitors' products to see how those products are designed and assembled sustainably. For example, reverse engineering technology is applied to high-tech software used in computers, smartphones, cars, etc. Competitors' products and seeing how these competing products operate sustainably (Boyd : 2013:199).

It is clear from the above that the sustainable reverse engineering technique is to disassemble the parts of a product for one of the leading facilities, and try to design it again in a sustainable manner (with the need to introduce a new intellectual component on it), so that the facility can compete with those pioneering facilities, either by reducing the cost of the product and reducing the selling price To compete (cost leadership), or by increasing the quality of the product, or by increasing the operational or complementary performance specifications of the product (excellence) and thus achieving the perceived value of the customer.

**The role of sustainable reverse engineering technology in enhancing cost management with economic information:**

In many cases, most enterprises are unaware of the actual costs of material losses, and therefore often face difficulty in extracting

information related to those losses, especially when applying traditional management accounting systems, while the reverse engineering technique enables management to keep pace with the diversity requirement for its ability to collect financial and non-financial information. Financial (design, operational). ( Kwah,2014:56).

The study (Fakoya& Van der poll, 2013:136) showed that the lack of integration between the databases of the different departments within the facility is caused by the failure to activate the reverse engineering technique to obtain cost data related to waste, waste and defective products. Whereas, the reverse engineering technique is considered a method of planning product costs and determining the losses and defects, being the most important and most complex components in terms of design, installation and function (Michele, 2013:23).

Through the aforementioned opinions about the importance of reverse engineering technology information in enhancing the economic aspect of cost management, it is clear that reverse engineering technology will contribute significantly to providing economic and accounting information that enhances the work of cost management information systems, in reducing costs, and this is not limited to internal costs. Not only, but also extended to costs related to activities outside the facility such as reducing supply chain costs.

**The role of sustainable reverse engineering technology in enhancing cost management with environmental information:**

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Cost management information systems is a broad concept, and the information they provide to management is basic information that managers need to effectively manage their facilities, which includes two types of information, the first category is financial information about costs and revenues, and the second category is non-financial information that includes all the success factors needed by the enterprise, including information related to the environment and its preservation.

Reverse engineering technology information is considered as a basis for developing environmentally concerned activities that include environmental impact assessment and short- and long-term environmental budgeting (Christ & Burritt, 2015: 1378).

In order to enhance cost management information systems, a gradual method of reverse engineering technology must be followed and its integration with investment evaluation methods, to improve productivity achieved through three other methods:(Rains,2009:7)

1-Leadership for the part focuses or works (dismantling the matrix) on reducing the parts used in the product, and benefiting from the parts shared on different products.

2-Standardization of the production process (dismantling the process), focusing on the use of general parts and common processes (prototypical) contributes to the development of the process by reducing or reducing time and process errors, which results in fewer investments and a reduction in the costs of parts and in this the speed

of introducing the product to the market.

3-Collecting and filtering ideas (static disassembly) the basic element in the reverse engineering technique presented by Mr. Sato, dismantling the parts of components or components of the product and highlighting them for comparison and verification on an ongoing basis to reduce their costs.

The results of the reverse engineering technique can form the basis for obtaining performance indicators within the management control systems of the facility, in cooperation with the system of comprehensive evidence indicators, as they can be used as potential performance measurement tools, especially for continuous control and evaluation. (Rieckhof et al., 2015: 1274).

The researcher believes that environmental cost management represents a link between environmental management and economic activities of the facility, and the existence of a common denominator sought by environmental cost management is to improve environmental and economic performance and develop human capabilities to achieve sustainable development, so this goal is somewhat similar, with what it seeks to reach Reverse engineering technology, so it can be said that it is possible to support the environmental cost management with the information it needs to help it better manage the environmental cost using the information provided by the reverse engineering technology.

**The role of sustainable reverse engineering technology in enhancing cost management with social information:**

Sustainable reverse engineering technology information is a broad concept, and the social information it provides to the following areas: (Adams, 2010: 355), (Tennor, 2015:6).

- 1-**Management area:** helping to improve the value of the product from the point of view of both the economic unit and the customer.
- 2-**Owners field:** helping to achieve competitive advantage over others.
- 3-**The field of workers:** Achieving good working conditions, incentives and fair wages, developing workers' skills and abilities, and achieving industrial security for them.
- 4-**Customer domain:** Achieving customer satisfaction by satisfying their needs and requirements about the products of the economic unit.
- 5-**Community field:** Improving the welfare of community members, or as it is called improving the quality of life, by providing goods and services that meet the unsatisfied needs of community members, and contributing to building schools, hospitals, and others.

Thus, the importance of sustainable reverse engineering technology in enhancing cost management with social information through the following (2010:62:, (Gray:):

- 1-The impact on society as a whole through the preservation of wealth and natural resources.
- 2-Knowing the social costs incurred by the company on its employees.
- 3-Increasing production as a result of designing products and related processes and thus improving the welfare of community members.
- 4-It achieves cost and time savings and improves quality, thus achieving competitive advantage.

**Factors affecting the success of sustainable reverse engineering technology:**

There are several factors that play a major role in the success of sustainable reverse engineering technology, which can be categorized as follows:

- 1- **Sustainable organizational culture:** The organizational culture of the economic unit is one of the determinants in implementing environmental strategies, the organizational culture depends on the history of the economic unit, the fields in which it operates, its headquarters and its branches, and it plays a major role in achieving competitive advantage. The senior management should inculcate cultures and environmental applications among workers to form a green culture and continue to compete with other units. (Küçükoğlu&Pinar,2015: 80).
- 2- **Sustainable management:** It is part of the processes carried out by the



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administration to achieve environmental sustainability and reduce waste. This is done through continuous education and development. There should be an environmental management system that assists the administration in carrying out its duties related to the environmental aspect. (Loknath&abdulAzeem, 2017: 689).

3- **Sustainable human resources:** This concept refers to the increased awareness of workers about environmental initiatives and their commitment to the issues of the environmental aspect of sustainable development (Mishra, 2017: 763). To achieve this factor, human resources management should take into account the following:

A. Sustainable employment: It includes attracting workers who enjoy an environmental culture and preferring them over their peers who do not enjoy this culture.

B. Evaluating sustainable performance: it includes environmental considerations and discussing environmental objectives with employees, noting that many economic units have included the environmental aspect in the performance evaluation process.

C. Training and sustainable development: It includes the inclusion of workers in courses for their development in a more

sustainable environmental society, and these courses are in the field of health, safety and environment.

4- **Sustainable customer:** a person who is characterized by being worried about environmental changes and who wants to buy natural or sustainable products that do not harm the environment.

5- Reinforce the conviction of sustainable reverse engineering technology among the parties and individuals responsible for decision-making, whether political, economic, planning or executive, the administration should ascertain the material and human capabilities available to it and whether it is able to carry out this process, and it should also complete and prepare these capabilities in order to devote itself and work on applying the technique of deconstructive analysis in various fields with competence, efficiency and effectiveness.

### Knowledge bases for competitive advantage:

#### Concept of Competitive Advantage:

Competitive advantage is the focus of many economic units. In order for the economic unit to be successful in the long term, it must have different advantages relative to its competitors. This competitive advantage is obtained when the economic units develop or acquire a set of characteristics that allow them to outperform their competitors. And when the activities of the economic unit are more profitable than the activities of its competitors in the market or exceed them

with regard to the results of those activities such as technological progress, product quality and market share. (2016: Cegliński).

(Ferdousi) and others refer to the competitive advantage as: the appropriate situation of the economic unit that makes it different from competitors in the market because of its special capabilities. (Ferdousi et al,2017:4).

Pederzini also defines competitive advantage as “the concept of basic strategic management that is linked to two main issues: superior performance and relative standing against competitors.” (Pederzini, 2017:8).

According to AbuNaser (& Al Shobaki) that the competitive advantage is “being the best competitor in one or more dimensions of strategic performance (cost, flexibility, creativity...)(AbuNaser,2017:144 & Al Shobaki).

Maury sees competitive advantage as “a set of capabilities or resources that can give an economic unit an advantage over its competitors, leading to a relative increase in profits.” (Maury, 2018:101))

### **Dimensions of competitive advantage:**

That there are several dimensions of competitive advantage linked to the achievement of competitive advantage, and they are as follows:(Diab,2014:140)

- 1-**Perceived value to the customer:** economic units seek, by exploiting their various resources and capabilities, to improve the value of the products and services they provide to customers, which contributes to

building a competitive advantage for them.

- 2-**Excellence:** Competitive advantage can be achieved by producing and providing distinguished products and services that competitors cannot easily imitate.

- 3-**Cost:** Low cost is the most important competitive dimension that economic units seek to achieve by reducing costs while maintaining the level of quality compared to competitors. This dimension often allows the economic unit to impose its control over the market and outperform competitors at low cost.

- 4-**Quality:** Economic units seek to provide high quality products that work to achieve customer satisfaction and make it more related to the product or service provided through quality design and performance. Quality contributes to creating a good reputation for the economic unit and reducing the time, effort and cost used in repairing defective products.

- 5-**Flexibility:** Flexibility is a competitive dimension that includes the ability to produce and introduce new products and the ability to quickly change and modify existing products in response to changes in customers' needs and desires, and design products according to customers' expectations.

### **Developing competitive advantage through sustainable reverse engineering:**

To achieve a competitive advantage, each economic unit must manage the product life



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cycle better than its competitors. This means that the economic unit reduces its costs while increasing the competitive advantage. Which means that all costs that do not negatively affect a competitive advantage can and must be reduced, as follows:(Akenbor&Okoye, 2011: 190-192)

**1-Determining the competitive advantage (cost leadership or differentiation):** The analysis of the technical activities of the product life cycle helps the management to better understand the competitive strategy of the economic unit.

**2-Identifying value-adding opportunities:** The product life cycle helps identify activities that add value to customers. For example, food processing and packaging factories are located near huge population centers and crowded city centers in order to provide the fastest delivery services at the lowest transportation cost.

**3-Identifying opportunities to reduce costs:** Sustainable reverse engineering can help an economic unit to identify those parts of the product life cycle that are considered non-competitive, some economic units have found that relying on some economic units to supply them with some parts leads to lower costs. Instead of manufacturing, economic units began to rely on direct purchase.

### Conclusions and Recommendations:

#### Conclusions:

1. The commitment of the economic unit to achieving the dimensions of

sustainable development will enable it to achieve economic, social and environmental benefits and contribute to the superiority and enhancement of the performance of the economic unit and distinguish it from its competitors.

2. Sustainable reverse engineering is one of the most important methods that help the company identify opportunities to develop products and reduce their costs by evaluating and analyzing competitors' products and knowing their specifications and components in order to reach conclusions about the process by which those products were manufactured and presented.

3. Sustainable reverse engineering has translated the customer's requirements (price, quality, innovation, after-sales services) at the design stage, so it is one of the most important methods used in facing competitive prices.

4. The application of the sustainable reverse engineering method depends on two important things that the company possesses competent cadres with high experience and financial capabilities represented in the purchase of goods to be dismantled, inspection materials, inspection devices.

#### Recommendations:

1. The company shall, when initiating the implementation of reverse engineering operations, focus on the following:

- In the first step, the focus should be on value engineering processes

with conducting a market study on the original product

- The second step: It is preferable for the company under study to acquire 3D printers, which will be integrated with what it possesses of measuring means that make its designs of high quality.
  - In order to achieve the most effective application, the third step must focus on using the standard procedures available in the local market.
  - The company's capabilities are largely compatible with the fourth step, but it must focus on providing ways to transport products without damaging them and using better packaging methods.
  - Finally, the fifth step should focus on greater documentation of the causes of failure in previous products in order to be avoided when designing new products.
2. Working on developing the creative and innovative skills of employees and involving them in training courses to spread awareness of sustainable reverse engineering and motivate them financially and morally and provide them with the opportunity to share their ideas and innovations to improve the quality of products and develop the company's competitive capabilities.
  3. In order to improve the competitive position and performance of companies, environmental modifications should be made to the

company's products through the application of sustainable reverse engineering that contributes to reducing waste and pollutants resulting from its production processes and products.

4. Developing production and mechanization techniques to increase sustainable production capacities and quality levels, and working on diversifying the type of production for products, as follows:
  - Sustainable products at low prices and appropriate quality.
  - Sustainable products at reasonable prices and high quality.

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