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The Impact Of Concurrent Engineering (CE) Technique On Improve Value Of Product

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Abstract

The objective of this research is to examine the influence of concurrent engineering on enhancing product value in industrial firms located in the Kurdistan region. The study delves into the conceptual aspects of concurrent engineering, encompassing strategies for allocating manufacturing overheads within industrial firms and outlining roles that contribute to enhancing product quality, reducing costs, and expediting product development. By employing a mixed-method approach, this research investigates the influence of concurrent engineering techniques on the improvement of product value. The primary data for this study was collected through the distribution of questionnaires to 275 industrial firms located in the Kurdistan region. A total of 215 valid responses were obtained, which were then subjected to statistical analysis using SPSS 25 software. The purpose of the analysis was to examine the correlation and regression between the dependent and independent variables of the study. The findings of the analysis demonstrate a positive and statistically significant correlation and regression between concurrent engineering and the improvement of product value. This implies a positive and significant relationship between concurrent engineering and various dimensions of product value improvement, such as cost reduction, customer satisfaction, productivity, product quality, and competitive pricing. The regression analysis further confirms the positive and significant relationship between concurrent engineering and product value improvement across the dimensions of cost reduction, customer satisfaction, productivity, product quality, and competitive pricing. The study recommends that industrial firms and future researchers embrace concurrent engineering techniques in product development, focus on individual or closely related products, and investigate and analyze their impacts on product

Keywords: Concurrent Engineering, Value of Product, cost reduction, customer satisfaction.

1. INTRODUCTION AND IDENTIFICATION OF THE PROBLEM

1.1 Introduction

The present study examines the limitations of the traditional approach used to determine manufacturing factory overhead costs in a sample company. It highlights how these limitations impact the product value by influencing quality enhancement and cost reduction within the company. The study emphasizes the need for an objective allocation and distribution of manufacturing factory overhead costs by integrating concurrent engineering techniques and time-driven activity-based costing.

Reducing costs has become a significant focus for many companies, as it is considered a crucial factor for success. It has garnered attention from various economic units due to its potential to improve the value of the company's products. The study delves into the concept of concurrent engineering (CE) and its tools, recognizing it as a critical aspect in product design, development, customer satisfaction, and competitive advantage. Developing new products poses challenges for companies, and the ability to consistently improve their quality is crucial for success (Fatah & Jaf, 2023). To aid in these aspects, the study aims to develop methodologies and software that assist in product development and design. One such methodology is concurrent engineering, which aims to enhance overall quality while shortening development time by enabling simultaneous development. By comparing the company's development process with that of the researcher, the study seeks to reduce development costs, minimize the time required for development, and expedite market entry.

1.2 Study Problem

As a result of the research study, this study figured out some challenges related to improving product value by concurrent engineering

Q1. What is the role of applying the concurrent engineering to Improve Value of Product (Cost reduction, customer satisfaction, productivity, product quality, competitive price) industrial company in Kurdistan region?

Q1.1 what is the role of applying the concurrent engineering to Improve Value of Product by Cost reduction at industrial company in Kurdistan region?

Q1.2 what is the role of applying the concurrent engineering to Improve Value of Product by customer satisfaction at industrial company in Kurdistan region?

Q1.3 what is the role of applying the concurrent engineering to Improve Value of Product by productivity at industrial company in Kurdistan region?

Q1.4 what is the role of applying the concurrent engineering to Improve Value of Product-by-product quality at industrial company in Kurdistan region?

Q1.5 what is the role of applying the concurrent engineering to Improve Value of Product by competitive price at industrial company in Kurdistan region?

1.3 Study objective

The primary aim of this study is to examine the impact of concurrent engineering techniques on the enhancement of product value in companies within the Kurdistan region. It explores how the implementation of concurrent engineering techniques influences the development of new products and the improvement of existing ones. In order to address the research problem, the study has specific objectives outlined as follows:

To provide a theoretical overview of concurrent engineering techniques, their application in the sample company, their impact on enhancing product value and the competitiveness of the researched plant.

To demonstrate the effect of concurrent engineering (CE) techniques on improving product value by utilizing the outputs of concurrent engineering as inputs to reduce time. The study aims to showcase the impact of concurrent engineering in achieving time savings in the design process by employing models such as the Lexmark model to quantify the time savings.

To identify crucial factors that serve as the fundamental justification for implementing cost determination techniques based on concurrent engineering within the sample company.

To explain the influence of concurrent engineering techniques on the cost of the product, with the ultimate goal of advancing the industrial sector, which is considered the backbone of society. The study explores the potential for collaboration to develop and manage product costs.

1.4 Significance of the Study

The primary significance of this study lies in examining how various concurrent accounting techniques impact the enhancement of product value. It aims to investigate the influence of concurrent engineering techniques on improving product value in an industrial company in Kurdistan, focusing on variables that affect product value improvement.

Through the application of concurrent engineering techniques, this study aims to achieve cost reduction, competitive pricing, increased productivity, improved product quality, and customer satisfaction.

Scientific importance: This study addresses a relatively unexplored topic, offering valuable findings that can serve as a foundation for further research and development in the field. It contributes new recommendations for future studies, suggesting the utilization of novel methodologies and techniques to enhance the understanding and improvement of product value.

Practical importance: The practical significance of this study lies in its potential to improve organizational revenue. The findings have significant implications for increasing profits and advancing companies by providing valuable information to managers and decision-makers. It aids in the application and better understanding of managerial accounting tools to enhance product value.

Hypotheses:

H0: The role of applying concurrent engineering technique in improving the value of the product (cost reduction, customer satisfaction, productivity, product quality, competitive price) at industrial companies in the Kurdistan region is not statistically significant.

H1: There is a statistically significant relationship ($\alpha \leq 0.05$) between the application of concurrent engineering and cost reduction in improving the value of the product at industrial companies in the Kurdistan region.

H2: The application of concurrent engineering has a statistically significant impact ($\alpha \leq 0.05$) on cost reduction in improving the value of the product at industrial companies in the Kurdistan region.

H3: There is a statistically significant relationship ($\alpha \leq 0.05$) between the application of concurrent engineering and customer satisfaction in improving the value of the product at industrial companies in the Kurdistan region.

H4: The application of concurrent engineering has a statistically significant impact ($\alpha \leq 0.05$) on customer satisfaction in improving the value of the product at industrial companies in the Kurdistan region.

H5: There is a statistically significant relationship ($\alpha \leq 0.05$) between the application of concurrent engineering and productivity in improving the value of the product at industrial companies in the Kurdistan region.

H6: The application of concurrent engineering has a statistically significant impact ($\alpha \leq 0.05$) on productivity in improving the value of the product at industrial companies in the Kurdistan region.

H7: There is a statistically significant relationship ($\alpha \leq 0.05$) between the application of concurrent engineering and product quality in improving the value of the product at industrial companies in the Kurdistan region.

H8: The application of concurrent engineering has a statistically significant impact ($\alpha \leq 0.05$) on product quality in improving the value of the product at industrial companies in the Kurdistan region.

H9: There is a statistically significant relationship ($\alpha \leq 0.05$) between the application of concurrent engineering and competitive price in improving the value of the product at industrial companies in the Kurdistan region.

H10: The application of concurrent engineering has a statistically significant impact ($\alpha \leq 0.05$) on competitive price in improving the value of the product at industrial companies in the Kurdistan region.

1.5 Limitation of the study

This study's limitations are divided into two parts.
-The duration time of this study represents the fiscal years of 2022–2023.
-application of the study: This study's application on industrial factory in Iraq's Kurdistan region, such as (name of company), is producing goods and has a significant impact on the market.

2. Methodology of the study and theoretical review

2.1 methodology and data collection

This study adopts both qualitative and quantitative methods to describe the impact of managerial accounting technique like concurrent engineering on improving product value. This study range includes new work and innovation to provide a general framework for future study. In addition, the qualitative method involves reviewing a range of studies in order to construct a number of available studied theoretical models that provide a general framework for this study. But with the quantitative method, it uses a statistical data analysis program (SPSS 25) to measure and analyze the data it gets from questionnaires and surveys that it is distributed on industrial firm in the Kurdistan region. This study distributed 275 forms on industrial firms and collected 215 forms that were used to indicate results and analysis.

Concurrent engineering is a managerial and operational approach that aims to enhance product and process development, production, and operation and maintenance. It involves the participation of professionals from various fields (such as marketing, design, process planning, production, cost reduction, and assembly) in the entire product development process. The concept emphasizes the simultaneous generation of product and process designs in the early stages of development.

The main objectives of concurrent engineering are continuous and sustainable product improvements, as well as responsible environmental management, which provide companies with a competitive advantage and create products with greater added value while minimizing environmental impact. This approach considers economic profitability and the social impact throughout the product life cycle, moving beyond traditional profit-driven approaches. It also focuses on selecting environmentally friendly materials and technologies that optimize the use of natural resources and minimize harm to the environment.

2.2 The Impact (role) of Concurrent Engineering on Improve Value of product

2.2.1 Definition and Goals of Concurrent Engineering.

Concurrent engineering represents an updated business strategy compared to traditional product development project management. It replaces sequential engineering with concurrent engineering

by incorporating three key strategies: parallelism in implementation, process standardization, and process integration. Effective organization of project participants is achieved through interdisciplinary and cross-functional teamwork, enabling the simultaneous execution of smaller work components that are complete in terms of content and organization. These work components, referred to as tracks, represent specific activities such as product development and design-related solutions, which are interconnected in concurrent engineering loops.

The primary goal of implementing concurrent engineering is to improve product value by exercising control over costs, including production costs, life cycle costs, error costs, and time-to-market costs. By effectively managing these costs, concurrent engineering contributes to increased profitability.

In summary, concurrent engineering represents a modern approach that emphasizes the integrated design and development of products, leading to time savings, accelerated product delivery to the market, cost reduction, and the ability to maintain a high level of quality and responsiveness to customer demands.

2.2.2 Dimensions of Concurrent Engineering Technique

To bring about the necessary changes, it is essential to transform forces into resources and establish a dynamic environment. The achievement of this objective is facilitated through four interconnected dimensions: parallelization, standardization, integration, and optimization. When describing these dimensions, they can be classified into both philosophical and methodological components.

1- **Parallelization**

The objective of parallel product development is to save time by implementing processes that are not dependent on one another. If there is a dependency, subsequent processes can start before the completion of previous operations. The ability to initiate subsequent processes relies on the availability of sufficient information once the preceding process has commenced. The completion of tasks within a shorter timeframe is linked to the increasing complexity of problem resolution and the transfer of information across relevant departments.

2- Standardization

Standardization refers to the establishment of independent rules governing different aspects of the product development process. This includes technical aspects such as standard units and components, as well as aspects related to the life cycle or stages of development and regulatory considerations (e.g., project interactions, sections).

3- Integration

Integration involves working in multidisciplinary teams and adopting a process-oriented mindset. The team members should have a comprehensive understanding of the entire process in order to

effectively perform their tasks within their defined scope. Information technology plays a crucial role in enabling integration by processing and storing large volumes of data. Integration, both in terms of mind-set and vision, is a key factor in problem-solving. It entails multidimensional work, thinking, and action focused on the process and the achievement of a common goal, rather than specific departmental goals. Leadership and prompt decision-making are also essential components of integration.

4- Optimization

In the context of concurrent engineering, optimization entails continuous improvement of each element related to time, cost, quality, customer needs, and compliance requirements. The primary objective of concurrent engineering in manufacturing companies is to bring new products to the market faster and at a lower cost compared to the competition, while also improving quality. Quality Function Deployment serves as a mechanism for achieving this goal. It provides a means of translating customer requirements into appropriate technical requirements at each stage of product development and production, including marketing strategy, planning, product design and engineering, prototype evaluation, production process development, production, and sales.

2.2.4 Needs of Concurrent Engineering

During the process of improving and developing a product through the application of concurrent engineering techniques, there are several reasons why concurrent engineering is needed:

1- Enhanced Productivity and Competitive Advantage: Concurrent engineering provides manufacturing companies with effective communication, collaboration, and management procedures, resulting in cost-effective and timely design and production of high-quality products. This leads to enhanced productivity and a competitive edge over competitors. By exceeding customer expectations and fostering innovation, concurrent engineering helps companies gain a competitive advantage (Anup Kumar Dey, 2012).

2- Highly Innovative Solutions: The overlapping of development facets and skills of employees in concurrent engineering allows for valuable inputs from different departments, resulting in the generation of innovative solutions. By involving professionals from various disciplines in the design stage, concurrent engineering minimizes mistakes, saving both time and money. Collaboration and effective communication among departments help in reducing errors and waste during manufacturing processes (Anup Kumar Dey, 2012; Charles & Jude, 2017).

3- Lead-Time to Market: Shortening the product development time or lead time is a primary motivation for adopting the concurrent engineering approach. Addressing all aspects of the product life cycle in the design phase reduces the overall lead time. With intense competition and evolving customer requirements, reducing the product lifecycle is crucial to ensure profitability. Concurrent engineering enables companies to bring products to market more quickly, thereby gaining a competitive advantage (Echtelt, 2004).

4- More Demanding Customer Satisfaction: Customers today have higher expectations and demand products that are closely tailored to their needs. In addition to cost and quality, customers expect customized products. Concurrent engineering enables companies to fulfill these demands by promoting innovation and introducing new products to the market. By meeting customer requirements and increasing profitability, concurrent engineering helps attract and retain customers (Sanjay Raheja, 2011).

In summary, concurrent engineering is necessary for enhancing productivity, fostering innovation, reducing lead time, and meeting the demanding expectations of customers. By

2.3 Concurrent engineering related to improve product value

The concurrent engineering process involves various stages, including Market Investigation, Product Design Specification, Conceptual Design (which includes Concept Generation, Concept Evaluation, and Concept Development), and Detail Design. This approach promotes continuous improvement in operations and product development, leading to better quality products at reduced costs and ultimately increasing the product's overall value. By adopting concurrent engineering, companies can significantly reduce product development time and hasten the time to market. This method enables the design of high-quality products while minimizing production costs and design changes in later stages. Moreover, it streamlines production processes, leading to cost savings that positively impact the product's value. Concurrent engineering also helps in minimizing errors during production by improving redesign and classification processes. Manufacturing corporations can achieve various objectives by implementing concurrent engineering, such as improving value through reduced selling prices and lower costs. The focus on quality and continuous improvement ensures that customer requirements are met, resulting in increased customer satisfaction and improved profitability.

However, a traditional serial development process without concurrent engineering may lead to extended development lead-times due to the lack of parallel information processing. Late feedback from different technical disciplines can also cause iterative design loopbacks, increasing development costs and lead-times as errors discovered later are more costly and time-consuming to rectify.

In conclusion, adopting concurrent engineering offers several advantages, including enhanced product value, efficiency, and customer satisfaction, making it a crucial methodology for success in today's competitive market.

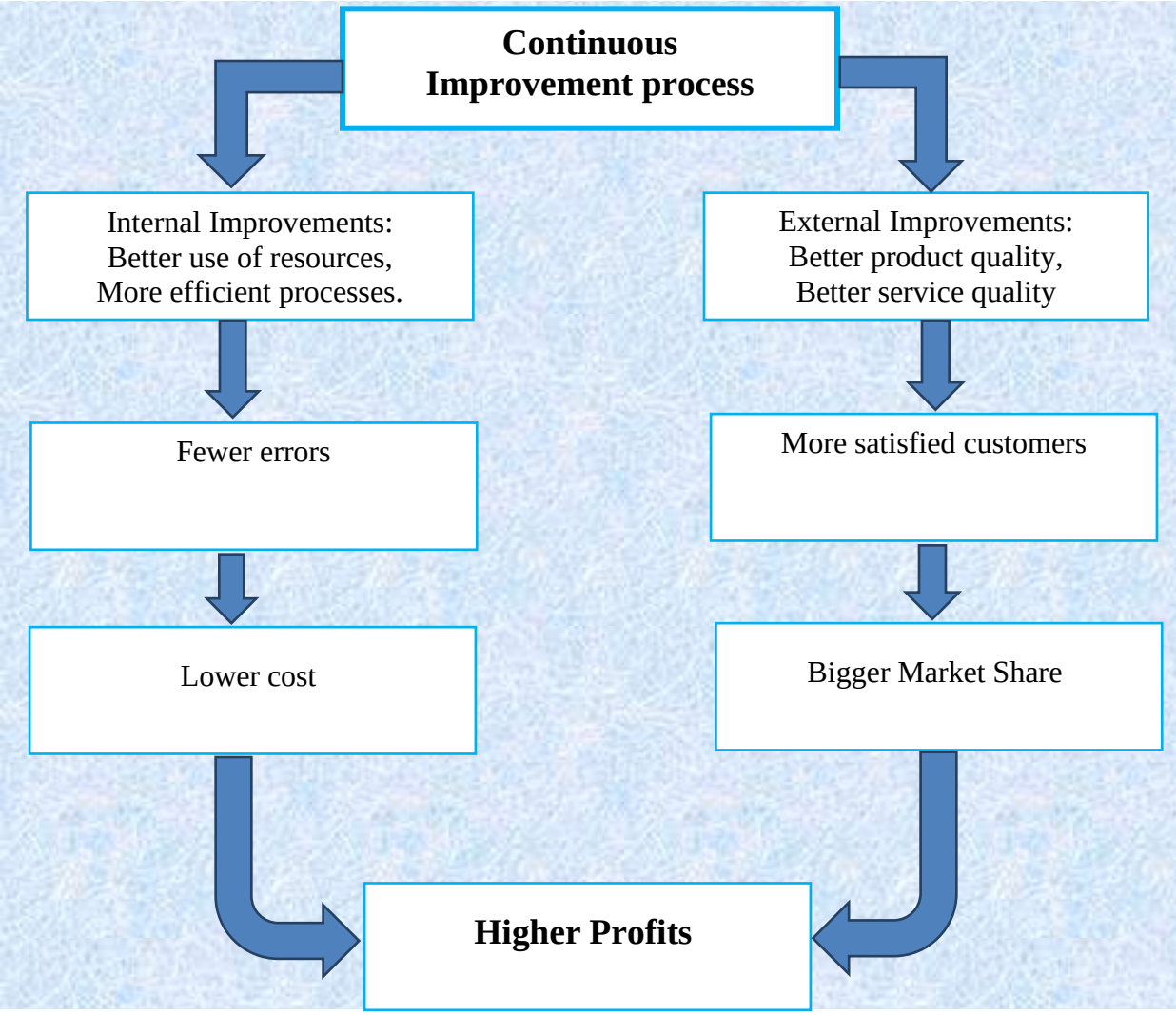

Figure 1 QMS Cycle to improve profits [NORM APNE, 2004]

To overcome the communication gaps between manufacturing departments, the concept of Integrated Product Development emerged through the implementation of concurrent engineering, aiming to improve product value. It recognizes the interdependencies among lead time, expenses, economic conditions, and technical performance, providing a comprehensive framework for industries. Concurrent engineering, in general, is linked to enhancing product value by reducing production costs, shortening time to market, and addressing costs throughout the production life cycle, including those associated with errors.

In the context of this study, concurrent engineering is considered an independent variable that examines its role in improving product value within corporations. According to Helms and Remok (2002), the application of concurrent engineering techniques helps achieve target profits and cost reduction by minimizing waiting time, also known as time to market. Consequently, it can lead to

significant reductions in production time (ranging from 30% to 70%) and the time required bringing a product to market (reduced by 20% to 90% or more).

2.4 Dimensions of improve product value

2.4.1 Cost reduction

Cost reduction is a crucial strategy for companies aiming to maintain competitiveness in the long term. It is an effective way to compete in the global market economy, and managers need to prioritize cost reduction to ensure profitability (Ben-Caleb et al., 2019). However, implementing cost optimization programs can be challenging, and it is important to focus on value potential rather than solely on volume or cost. Some tough choices may be required, such as withdrawing from unviable markets, shifting business models, or automating and eliminating certain processes (Stephen, 2022).

Cost reduction and cost control are always top priorities for companies, as they are essential for long-term competitive advantages (Fatah & Jaf, 2023). This strategic approach integrates competitive strategy, technology strategy, human resource management strategy, and organizational design considerations (Burcu, 2018). Cost reduction is a planned and continuous process that involves critically examining all cost elements and aspects of the business to improve efficiency. It is a corrective function aimed at cutting down costs to increase profitability. Value analysis is a major technique used in cost reduction, which involves identifying and eliminating unnecessary costs associated with products or services by analyzing the function of each component (Ben-Caleb, 2019).

2.4.2 Product quality

It plays a vital role in determining a company's sales and profits. It has become a major concern for organizations and is considered one of the key indicators of management success (Omar, 2020). Product quality serves as a guide and a selling point for customers, alongside price (Rashid, 2020). While the concept of quality can be broad and challenging to define precisely, it has a direct impact on customer satisfaction and their perception of value (Ismael et al., 2020; Ismail et al., 2016). Improved product quality, along with competitive pricing, can lead to increased customer satisfaction and repurchase intentions (Malik et al., 2012; Zahra & Ehsani, 2015).

2.4.3 Customer satisfaction

Customer satisfaction plays a vital role in company development and increasing the value of products. It is crucial for maintaining long-term customer relationships, which are essential for a firm's success (Budur et al., 2023). Customer satisfaction is defined as the response of customers when their expectations are met or exceeded by a company (Budur et al., 2023). Meeting customer expectations leads to positive outcomes such as word-of-mouth support and repeat purchases, making customer satisfaction a significant predictor of these behaviors (Qingyu et al., 2019).

Customers hold a pivotal position in a company's microenvironment, and the entire value delivery system revolves around serving target customers and building strong relationships with them (Rashid, 2017). The survival and prosperity of a business organization hinge on ensuring customer satisfaction with its products or services. Customer satisfaction is not only tied to generating profits and revenue but also contributes to cost reduction efforts (Ahmad et al., 2016; Mohammad & Mohd, 2020; Nurnajihah & Syafiqah, 2020; Jaf et al., 2012).

In summary, customer satisfaction is of utmost importance for a company's success and the value of its products. By meeting or surpassing customer expectations, businesses can foster customer loyalty, positive word-of-mouth, and repeat purchases. Thus, prioritizing and guaranteeing customer satisfaction is crucial for driving growth and enhancing the value of products.

2.4.4 Productivity

Productivity can be defined as a measure of production efficiency, representing the ratio of output to the resources utilized in the production process (Budur et al., 2018). It is a measure of how effectively inputs are transformed into outputs. At a national level, productivity growth is crucial for improving living standards. As productivity increases, people's real income rises, enabling them to afford goods and services, enjoy leisure activities, enhance their housing and education, and contribute to social and environmental initiatives. For companies, productivity growth is of utmost importance as it signifies their ability to fulfill obligations to customers, suppliers, employees, shareholders, and governments, while also enhancing their competitiveness in the market. A company's ability to achieve productivity growth is vital for meeting customer demands, optimizing resource utilization, and maintaining or improving its position in the market. Therefore, companies strive to enhance productivity as it has far-reaching implications for their overall performance and success (VIKASH, S.K. SHARMA, 2021; Budur, 2020).

2.4.5 Competitive price

Companies employ various strategies to determine the pricing of their products in the market. One significant approach is competitive pricing, which involves pricing products in line with similar offerings from other companies (IET, 2022). Price is a highly flexible element in the marketing mix that directly impacts a company's profitability and cost effectiveness in the short term (Budur et al., 2023; Jaf et al., 2015; Rashid & Sabir Jaf, 2023). Strategic pricing necessitates a strong collaboration between the marketing department and other sectors of the company. To enhance economic and financial performance, pricing policies should be defined based on internal capabilities and a systematic understanding of customer needs and preferences, as well as market conditions such as economic factors and competitive landscape (Deonir et al., 2017; Rashid, 2018; Sabir, 2022).

"A competitive price" refers to a pricing strategy employed by businesses to establish a market value for their products that aligns with similar offerings from competitors. Companies analyze

competitors in the market with comparable products and set a price that is competitive, aiming to encourage consumers to choose their product (IET, 2022).

It can be concluded that factors such as product quality, time to market, new product development, and product design significantly influence the ability to achieve a competitive price. The implementation of new cost accounting techniques like concurrent engineering and time-driven activity-based costing in industrial companies leads to improved product quality and other factors that contribute to enhancing competitive pricing (Rashid, 2019; Sabir et al., 2011).

The design phase is particularly critical for enhancing product quality, as it influences the final outcome. Designing high-quality products is a key determinant of overall product quality (Karim et al., 2020). The quality of design and manufacturing processes directly affects the final product quality. The relationship between design, manufacturing, and product quality is interconnected and should be effectively managed (Yanmei et al., 2009).

In conclusion, product quality is a significant dimension of product value. It contributes to customer satisfaction, repeat purchases, and competitiveness in the market. Implementing new cost management techniques, utilizing high-quality raw materials, leveraging technology, and focusing on effective design all have a significant impact on improving product quality.

Concurrent engineering, on the other hand, is a strategy, method, technique, and tool that contribute to product sustainability. It is an approach applied to achieve the main goals of product realization projects at lower costs (Lidija & Janez, 2021). Cost reduction is a fundamental aspect of improving product value, as it directly impacts target profits and sales. By focusing on cost reduction, companies can enhance their competitive pricing and meet the increasing demand for products.

3. Analysis and Results

3.1 Testing the hypotheses of the correlation between the study variables

In this part of the study, examining the test results and analyzing the relationship between the study variables are discussed, and according to the main hypotheses and sub-hypotheses arising from them, as stated in the research methodology, they are tested consecutively according to the hypothetical research plan. In order to identify the nature of the correlational relationships between the study's key variables and interpret its results, this required inference with a correlation coefficient consistent with the descriptive data, and this is what the nature of the study data embodied.

1- Concurrent engineering and improve product value by dimensions (cost reduction- customer satisfaction- productivity- product quality- competitive price) in industrial firms in Kurdistan region

This part of the study is identifying the nature of the correlations between CE and IPV by dimensions of (cost reduction, customer satisfaction, productivity, product quality, competitive price), in the sense of verifying the first main hypothesis that states: There is a statistically significant correlation relation between the CE and IPV by dimensions of (cost reduction, customer satisfaction, productivity, product quality, competitive price) in the industrial firms in Kurdistan region.

Independent variables	Dependent variables (CE)		
	Correlation	**Sig.**	**Sample**
CR	0.526	0.000	210
CS	0.594	0.000	210
PRO	0.512	0.000	210
QU	0.550	0.000	210
CP	0.479	0.000	210
Note: *, **and ***indicate significance at the 10%, 5%, and 1% levels, respectively			

Table (1) A correlation between independent variables (CE) and dependent variable (IPV) by dimensions of (CR, CS, PRO, QU, CP). (Authors primary data)

H1: There is a positive and significant correlation between the CE and IPV dimensions by (cost, time, quality, innovation)

Based on the first main correlation hypothesis above between CE and IPV, In the light of the sub-hypotheses of the first hypothesis, Table (1) shows the results of the statistical analysis of the correlation relationships between the dimensions of the dependent variable (CR, CS, PRO, QU, CP) and the independent variable (CE) separately as follows:

First: interpreting the correlation test result between CE and improving product value by dimensions of CR

H1: There is a positive and significant correlation between the CE and IPV by CR in industrial firms in Kurdistan region

The findings obtained from Table (1) reveal a noteworthy positive correlation (0.562) with a high level of statistical significance (p-value = 0.000, less than 0.05) between Concurrent Engineering (CE) and Improving Product Value (IPV) by Cost Reduction (CR) in industrial firms within the Kurdistan region. This significant and positive correlation supports the acceptance of the alternative hypothesis (H1), indicating a strong relationship between CE and IPV by CR. The results suggest that implementing Concurrent Engineering techniques in industrial firms can lead

to improved product quality and reduced costs, ultimately enhancing the value of products in the market.

Second: when examining the correlation between CE and improving product value by dimensions of Customer Satisfaction (CS), the specific details were not mentioned in the provided text.

H1: There is a positive and significant correlation between the CE and IPV by CS in industrial firms in Kurdistan region

The findings from Table (1) demonstrate a positive and statistically significant correlation (0.594) between Concurrent Engineering (CE) and Improving Product Value (IPV) by Customer Satisfaction (CS) in industrial firms located in the Kurdistan region. The significance value of 0.000 is less than 0.05, indicating a high level of statistical significance. This positive and significant correlation supports the acceptance of the alternative hypothesis (H1), suggesting a strong relationship between CE and IPV by CS.

The results imply that implementing Concurrent Engineering techniques in industrial firms can lead to improvements in product quality and increased customer satisfaction, ultimately enhancing the value of products in the market. Encouraging industrial economic units to adopt this technique can result in better products that meet customer expectations, thereby reducing costs and increasing customer satisfaction levels. As a result, Concurrent Engineering is an effective approach to enhance the overall value of products in the market by focusing on improving product quality and customer satisfaction simultaneously.

Third: interpreting the correlation test result between CE and improving product value by dimensions of PRO

H1: There is a positive and significant correlation between the CE and IPV by PRO in industrial firms in Kurdistan region

Results showed in Table (1) that there is a statistically significant correlation between (CE and IPV by PRO dimensions in industrial firms in the Kurdistan region).Then, the value of the correlation coefficient between (CE and IPV by PRO) is equal to (0.512) at a significant level (0.05), as it reached (0.000), and by comparing the significant value, the value results is less than (0.05), which means that it is a statistical function and that there is a relatively strong correlation between the two variables (CE and IPV by PRO), and this confirms the acceptance of the sub-hypothesis. In other words, it means accepting the alternative hypothesis and rejecting the null hypothesis.

Fourth: interpreting the correlation test result between CE and improving product value by dimensions of QU

H1: There is a positive and significant correlation between the CE and IPV by QU in industrial firms in Kurdistan region

The results presented in Table (3.1) show a positive and statistically significant correlation (0.550) between Concurrent Engineering (CE) and Improving Product Value (IPV) by Quality (QU) in industrial firms operating in the Kurdistan region. The significance value of 0.000 is less than 0.05, indicating a high level of statistical significance. This positive and significant correlation supports the acceptance of the alternative hypothesis (H1), indicating a strong relationship between CE and IPV by QU.

The findings suggest that implementing Concurrent Engineering techniques in industrial firms can lead to improvements in product quality, ultimately enhancing the value of products in the market. Encouraging industrial economic units to adopt this technique can result in better products with improved quality, which in turn may lead to cost reductions. Consequently, Concurrent Engineering serves as an effective approach to enhance the overall value of products in the market by focusing on improving and increasing product quality.

Fifth: interpreting the correlation test result between CE and improving product value by dimensions of CP

H1: There is a positive and significant correlation between the CE and IPV by CP in industrial firms in Kurdistan region

The results indicate from Table (1) that there is a positive statistically significant correlation between the (CE and IPV by CP in industrial firms in the Kurdistan region), which is equal to (0.479), and that the significance value is equal to (0.000) and it is less than (0.05). A positive and significant correlation between the (CE and IPV by CP in an industrial firm in the Kurdistan region), in other words, means accepting the alternative hypothesis (H1). This result confirms that there is a correlation between the two variables, from which it can be concluded that encouraging industrial economic units by applying this technique leads to improving the quality of products on the market by reducing costs. The (CE) technique aims to improve the value of products on the market by reducing costs.

3.2. Testing the hypotheses of the regression between the study independent and dependent variables dimensions

In this part of the study, indicating the test results and analyzing the impacts between the study variables are discussed, and according to the main hypotheses and sub-hypotheses arising from them, as stated in the research methodology, they are tested consecutively according to the hypothetical research plan. In order to identify the nature of the regression model relationships between the study's key variables and interpret its impact results, this required inference with a regression model coefficient consistent with the descriptive data, and this is what the nature of the study data embodied.

Analyzing the Regression between the independent variables of CE and dependent variables of IPV by dimensions (CR, CS, PRO, QU, and CP)

o examine the nature of the regression model between Concurrent Engineering (CE) and Improving Product Value (IPV) by dimensions of Cost Reduction (CR), Customer Satisfaction

(CS), Productivity (PRO), Quality (QU), and Competitive Pricing (CP), and to determine the impact of CE on IPV through these dimensions, the first main hypothesis is tested. The hypothesis states that there is a statistically significant impact, at a significance level of $\alpha \leq 0.05$, of applying Concurrent Engineering on Improving the Value of Product by dimensions (CR, CS, PRO, QU, and CP) in industrial firms operating in the Kurdistan region.

Specifically, the first part of the study focuses on examining the impact of applying Concurrent Engineering on improving the value of the product through the dimension of Cost Reduction (CR) in industrial firms in the Kurdistan region. The analysis will determine whether there is a statistically significant relationship between CE and IPV by CR.

In summary, the first part of the study aims to investigate and establish whether the application of Concurrent Engineering has a statistically significant impact on improving the value of the product through Cost Reduction (CR) in industrial firms in the Kurdistan region, with the significance level set at $\alpha \leq 0.05$.

Model	**Coefficients**				**Model Summary**		**ANOVA Table**	
	Unstandardized Coefficients		**T Test**	**Sig**	**R^2**	**Adj.(R^2)**	**F Test**	**Sig.**
	B	**Std.Error**						
Constant	1.965	0.227	8.641	0.000	0.277	0.274	79.716	.000
CE	.507	0.057	8.928	0.000				

Table (2) regression model results between CE and IPV by dimension CR. (Authors primary data).

H1: There is a significant impact of applying the CE on IPV by CR in the industrial firms in the Kurdistan region

The results presented in Table (2) demonstrate a significant effect between Concurrent Engineering (CE) and Improving Product Value (IPV) by Cost Reduction (CR) in the industrial firms operating in the Kurdistan region. The simple linear regression model shows that the independent variable CE has a significant impact on the dependent variable IPV by CR, specifically by reducing costs

The F-test results indicate the statistical significance of the regression model, with a p-value of 0.000, which is less than 0.05. This suggests that the regression model effectively predicts the outcome variable, and there is a significant effect of CE on IPV by CR in the industrial firms in the Kurdistan region.

The consistency result (B0) in the regression model is positive and significant, with a coefficient of 1.965. This indicates that even if CE is equal to zero, there is still an IPV by CR in the industrial firms amounting to 1.965. This finding suggests that IPV by CR in industrial firms in the Kurdistan region is influenced by the application of CE.

The marginal slope coefficient (B1) is 0.507 and significant at the 0.05 level, indicating that a one-unit change in the CE technique leads to a change in IPV by CR in industrial firms in the Kurdistan region by 0.507. This significant change explains the effect of the independent variable CE on IPV by CR, where the application of CE helps eliminate unnecessary stages in the product life cycle and accelerates the production process, resulting in lower product costs.

The R2 value of 0.27 indicates that approximately 27% of the change in IPV by CR is attributed to the CE technique. In other words, the explanatory value of the independent variable (CE) in relation to the dependent variable (IPV by CR) accounts for 27% of the observed variation. The remaining 77% is influenced by other variables.

In conclusion, the data from Table (2) support the acceptance of the main hypothesis (H1) that Concurrent Engineering (CE) has a significant impact on Improving Product Value (IPV) by Cost Reduction (CR) in the industrial firms in the Kurdistan region.

Second: There is statistically significant impact at the level of ($\alpha \leq 0.05$) of applying the concurrent engineering has an impact on Improve Value of Product by customer satisfaction in industrial firms in the Kurdistan region?

Model	Coefficients				Model Summary		ANOVA Table	
	Unstandardized Coefficients		T Test	Sig	R^2	Adj.(R^2)	F Test	Sig.
	B	Std.Error						
Constant	1.661	0.219	7.571	0.000	0.353	0.350	113.166	.000
CE	.583	0.055	10.657	0.000				

Table (3) regression model results between CE and IPV by dimension CS. (Authors primary data).

H1: There is a significant impact of applying the CE on IPV by CS in the industrial firms in the Kurdistan region

The findings from Table (3.3) demonstrate a significant effect between Concurrent Engineering (CE) and Improving Product Value (IPV) by Customer Satisfaction (CS) in the industrial firms operating in the Kurdistan region. The simple linear regression model reveals the impact of the independent variable, CE, on the dependent variable, IPV, by CS as follows:

The results of the F-test indicate the statistical significance of the regression model, with a p-value of 0.000, which is less than 0.05. This indicates that the regression model effectively predicts the outcome variable, and there is a significant effect of the independent variable (CE) on the dependent variable (IPV by CS) in the industrial firms in the Kurdistan region. Based on the f-test result for the regression model, there is a significant effect of the independent variable CE on the dependent variable IPV by CS. This suggests that the reliance of the researched industrial firms on

the application of CE influences IPV by CS in the industrial firms in the Kurdistan region. The analysis at the macro level indicates the following:

The result of consistency (B0), as shown in the regression model, is positive and significant with a coefficient of 1.661. This indicates that even if CE is equal to zero, there is still an IPV by CS in the industrial firms amounting to 1.661. This result can be attributed to the fact that IPV by CS in industrial firms in the Kurdistan region benefits from the application of (CE) in the studied industrial firms. The marginal slope coefficient (B1) has a value of 0.583 and is significant at the 0.05 level based on the t-test value. This indicates that a one-unit change in the CE technique leads to a change in IPV by CS in industrial firms in the Kurdistan region by 0.583, which is a significant change that explains the effect of the independent variable (CE) on the dependent variable IPV by CS in industrial firms in the Kurdistan region. This suggests that during the product redesign or innovation process, CE application leads to a reduction in the product development time, meeting customer demands, improving product quality, and lowering manufacturing costs, ultimately leading to improved customer satisfaction. The R2 value of 0.35 indicates that approximately 35% of the change in IPV by CS can be attributed to the CE technique. In other words, the explanatory value of the independent variable (CE) in relation to the dependent variable (IPV by CS) accounts for 35% of the observed variation. The remaining 65% is influenced by other variables.

In conclusion, the data from Table (3) support the acceptance of the main hypothesis (H1) that Concurrent Engineering (CE) has a significant impact on Improving Product Value (IPV) by Customer Satisfaction (CS) in the industrial firms in the Kurdistan region.

Third: There is statistically significant impact at the level of ($\alpha \leq 0.05$) of applying the concurrent engineering has an impact on Improve Value of Product by productivity at industrial firms in Kurdistan region?

Model	**Coefficients**				**Model Summary**		**ANOVA Table**	
	Unstandardized Coefficients		**T Test**	**Sig**	**R^2**	**Adj.(R^2)**	**F Test**	**Sig.**
	B	**Std.Error**						
Constant	2.296	0.214	10.264	0.000	0.262	0.259	74.032	.000
CE	.459	0.053	8.604	0.000				

Table (4) regression model results between CE and IPV by dimension PRO. (Authors primary data).

H1: There is a significant impact of applying the CE on IPV by PRO in the industrial firms in the Kurdistan region

The findings from Table (4) indicate a significant effect between Concurrent Engineering (CE) and Improving Product Value (IPV) by Productivity (PRO) in the industrial firms operating in the

Kurdistan region. The simple linear regression model reveals the impact of the independent variable, CE, on the dependent variable, IPV, by PRO as follows:

The results of the F-test show that the regression model was statistically significant, with a p-value of 0.000, which is less than 0.05. This indicates that the regression model effectively predicts the outcome variable, and there is a significant impact of the independent variable (CE) on the dependent variable (IPV by PRO) in the industrial firms in the Kurdistan region.

Based on the f-test result for the regression model, there is a significant impact of the independent variable CE on the dependent variable IPV by PRO. This suggests that the reliance of the researched industrial firms on the application of CE influences IPV by PRO in the industrial firms in the Kurdistan region. The analysis at the macro level indicates the following:

The result of consistency (B0), as shown in the regression model, is positive and significant with a coefficient of 2.296. This indicates that even if CE is equal to zero, there is still an IPV by PRO in the industrial firms amounting to 2.296. This result can be attributed to the fact that IPV by PRO in industrial firms in the Kurdistan region benefits from the application of (CE) in the studied industrial firms. The marginal slope coefficient (B1) has a value of 0.459 and is significant at the 0.05 level based on the t-test value. This indicates that a one-unit change in the CE technique leads to a change in IPV by PRO in industrial firms in the Kurdistan region by 0.459, which is a significant change that explains the effect of the independent variable (CE) on the dependent variable IPV by PRO in industrial firms in the Kurdistan region. This implies that during the process of redesigning or innovating new products through Concurrent Engineering, productivity is increased, and product value is improved while reducing costs. Concurrent engineering encourages collaboration among different teams, departments, and disciplines, leading to faster workflows, improved accuracy, and better communication. It also allows for early identification of potential issues, thus reducing mistakes and saving time during the design phase. The R2 value of 0.26 indicates that approximately 26% of the change in IPV by PRO can be attributed to the CE technique. In other words, the explanatory value of the independent variable (CE) in relation to the dependent variable (IPV by PRO) accounts for 26% of the observed variation. The remaining 74% is influenced by other variables.

In conclusion, the data from Table (4) support the acceptance of the main hypothesis (H1) that Concurrent Engineering (CE) has a significant impact on Improving Product Value (IPV) by Productivity (PRO) in the industrial firms in the Kurdistan region.

Fourth: There is statistically significant impact at the level of ($\alpha \leq 0.05$) of applying the concurrent engineering has an impact on Improve Value of Product by quality of product in industrial firms in the Kurdistan region?

Model	**Coefficients**			**Model Summary**		**ANOVA Table**	
	Unstandardized Coefficients	**T Test**	**Sig**	**R^2**	**Adj.(R^2)**	**F Test**	**Sig.**

	B	Std.Error						
Constant	1.745	0.240	7.264	0.000	0.302	0.299	90.142	.000
CE	.569	0.060	9.494	0.000				

Table (5) regression model results between CE and IPV by dimension QU. (Authors primary data).

H1: There is a significant impact of applying the CE on IPV by QU in the industrial firms in the Kurdistan region

The findings presented in Table (5) reveal a significant relationship between CE (Concurrent Engineering) and IPV (Improving Product Value) by QU (Product Quality) in industrial firms within the Kurdistan region. The results obtained from the simple linear regression model demonstrate the influence of the independent variable, CE, on the dependent variable, IPV by QU. The statistical significance of the regression model is evident from the F-test results, where the calculated p-value is 0.000, which is less than the significance level of 0.05. This indicates that the regression model effectively predicts the outcome variable. Moreover, it confirms that there is a substantial impact of the independent variable CE on the dependent variable IPV by QU in the industrial firms operating in the Kurdistan region.

Based on the f-test results for the regression model, it becomes evident that the application of CE significantly affects IPV by QU in the industrial firms within the Kurdistan region. These results highlight the importance of adopting concurrent engineering practices to improve product quality, ultimately leading to an enhancement in the overall value of products offered by these industrial firms.

The analysis of the regression model, as presented in Table (5), confirms a significant impact of the independent variable CE (Concurrent Engineering) on the dependent variable IPV by QU (Improving Product Value by Product Quality) in the industrial firms of the Kurdistan region. This indicates that the extent to which the researched industrial firms adopt concurrent engineering practices affects the improvement of product quality. The consistency result (B0) displayed in the regression model is positive and significant, with a coefficient of 1.745. This suggests that even when CE is equal to zero, there is still an inherent IPV by QU in the industrial firms, implying that the foundation of product quality in these firms is influenced by the application of concurrent engineering. The marginal slope coefficient (B1) is calculated to be 0.569 and is significant at the 0.05 level based on the t-test value. This means that a one-unit change in the CE technique results in a 0.569 change in IPV by QU in industrial firms in the Kurdistan region. This significant change highlights the role of concurrent engineering in enhancing product quality through various dimensions such as product design, process design, and supply chain design. It is an evolutionary tool with a wide range of applications, incorporating customer requirements to introduce new products of higher quality. The value of R2 is 0.30, indicating that approximately 30% of the change in IPV by QU can be attributed to the CE technique. This suggests that concurrent engineering plays a substantial role in improving product quality, but other variables also contribute to the remaining 70% of the observed changes.

In conclusion, the data from Table (5) support the acceptance of the main hypothesis (H1), which asserts that concurrent engineering (CE) significantly impacts the improvement of product value by product quality (IPV by QU) in the industrial firms of the Kurdistan region.

fifth: There is statistically significant impact at the level of ($\alpha \leq 0.05$) of applying the concurrent engineering has an impact on Improve Value of Product by competitive price at industrial firms in Kurdistan region?

Model	Coefficients				Model Summary		ANOVA Table	
	Unstandardized Coefficients		T Test	Sig	R^2	Adj.(R^2)	F Test	Sig.
	B	Std.Error						
Constant	2.068	0.241	8.569	0.000	0.229	0.225	61.831	.000
CE	.474	0.060	7.863	0.000				

Table (6) regression model results between CE and IPV by dimension CP. (Authors primary data).

H1: There is a significant impact of applying the CE on IPV by CP in the industrial firms in the Kurdistan region

The analysis of Table (6) reveals a significant relationship between CE (Concurrent Engineering) and IPV (Improving Product Value) by CP (Competitive Pricing) in the industrial firms of the Kurdistan region. The results from the simple linear regression model demonstrate that CE has a significant impact on IPV by CP.

The F-test results indicate the statistical significance of the regression model, with a p-value of 0.000, indicating that the model effectively predicts the outcome variable. Moreover, there is a significant impact of the independent variable CE on the dependent variable IPV by CP in the industrial firms in the Kurdistan region, as supported by the f-test result. Examining the analysis at the macro level, we find that the consistency result (B0) in the regression model is positive and significant, with a coefficient of 2.068. This means that even when CE is equal to zero, there is still an inherent IPV by CP in the industrial firms, suggesting that the foundation of competitive pricing is influenced by the application of concurrent engineering. The marginal slope coefficient (B1) is calculated to be 0.474 and is significant at the 0.05 level based on the t-test value. This implies that a one-unit change in the CE technique results in a 0.474 change in IPV by CP in industrial firms in the Kurdistan region. This significant change can be attributed to concurrent engineering's ability to improve product value by promoting competitive pricing. It achieves this by eliminating stages that increase product costs during the product development process through redesign and streamlining processes. Concurrent engineering also ensures that products meet customer requirements and are developed efficiently while reducing defects. The value of R2 is 0.22, indicating that approximately 22% of the change in IPV by CP can be attributed to the CE technique. This suggests that concurrent engineering plays a significant role in improving competitive pricing, but other variables contribute to the remaining 78% of the observed changes.

In conclusion, the data from Table (6) support the acceptance of the main hypothesis (H1), which states that concurrent engineering (CE) has a significant impact on improving product value by promoting competitive pricing (IPV by CP) in the industrial firms of the Kurdistan region.

4. Conclusion and recommendation

4.1. Conclusion

The results of this study have been undertaken to investigate the impact of concurrent engineering on improving product value in the Kurdistan region of Iraq. This study includes both theoretical and practical parts. Also, this study adopted both qualitative and quantitative method to achieve its objectives and indicating statistical analysis data. Simple liner regression model was used to analyzing data The results reached through this study are theoretical and practical.

The findings of the study are as follows:

1- Implementing CE techniques in industrial firms leads to cost reduction during product development and facilitates timely market entry for products.

2- Concurrent engineering practices contribute to product sustainability in the market by enabling effective correction of product mistakes and fostering innovation through product redesign to meet customer and market demands.

3- The study establishes a significant and positive correlation between concurrent engineering techniques and product value across various dimensions, including cost reduction (CR), customer satisfaction (CS), productivity (PRO), quality (QU), and competitive pricing (CP). This indicates that changes in concurrent engineering have a considerable impact on improving product value.

4- Data analyses reveal a positive and significant overall impact of concurrent engineering on product value across dimensions (CR, CS, PRO, QU, and CP). Applying concurrent engineering techniques leads to improvement in product quality, cost reduction, meeting customer demands, competitive pricing, and successful market penetration with high-quality products.

In conclusion, concurrent engineering proves to be a valuable approach for industrial firms in the Kurdistan region, significantly enhancing product value through various dimensions and leading to improved competitiveness and success in the market. The study's results have theoretical implications and practical significance for businesses seeking to improve their products and gain a competitive edge.

4.2 Recommendations

Based on the findings, this study presents several recommendations for further research and firms interested in the subject:

1- Industrial firms are encouraged to adopt concurrent engineering techniques to enhance product value. Implementing these practices can lead to cost reduction, improved product quality, meeting customer demands, and achieving a competitive edge in the market.

2- Future studies could benefit from focusing and specifying a single product to investigate the specific impact of concurrent engineering techniques on enhancing product value. By narrowing down the scope, researchers can delve deeper into the effects of concurrent engineering on a particular product's development, quality, and market performance.

These recommendations aim to promote the adoption of concurrent engineering practices in the industry and encourage further research to explore its specific effects on different product types. By doing so, firms can enhance their product development processes and maintain a competitive position in the market.

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