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An Analytical Study of Product Life Cycle (Traditional and Modified) and its Applications in Marketing

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Abstract
Product Lifecycle Management (PLM) has become a well-rounded approach for controlling the creation, use, and disposal of products. To provide effective monitoring of value chains and enlarged businesses, it strives to integrate people, processes, resources, and information. PLM promotes collaboration, well-informed choices, and sustainability across the product lifecycle. In addition, life cycle assessment (LCA) measures a product's environmental impact from conception to disposal, while difficulties with data standardisation and uncertainty still exist. The triple bottom line strategy combines social, environmental, and economic factors to promote long-term welfare. Overall, in the complex and dynamic world of product development, PLM and LCA play critical roles in achieving sustainability and enhancing project success.
Key Words: - Product Lifecycle Management, Sustainability, Life Cycle Assessment, Value Chains, Decision-making, Project Success

Introduction: -
Design, production, repair, and recycling of products have developed over time, becoming sophisticated and knowledge-intensive operations. Even though the conventional paradigm, like that of a local cobbler, effectively incorporated all these responsibilities, it lacked scalability. The one-person business was no longer adequate as the number, complexity, and range of items rose. As a result, there are now knowledge silos due to the dispersion of product and procedure expertise in the mass production paradigm. However, Product Lifecycle Management (PLM), which seeks for the reintegration of individuals, procedures, resources, and information, has emerged in response to the requirement for efficient oversight of value chains and expanded companies. In order to create a profitable and environmentally friendly environment, PLM is a comprehensive strategy that facilitates cooperation and informed decision-making across the product lifecycle(Terzi et al., 2010).In industrialised civilizations, product life cycles are shorter, which increases resource consumption and trash production. Regarding the production and processing of materials, environmental concerns have emerged. Recycling and product life extension are less frequently considered, despite the frequent discussion of material efficiency. A change towards end-of-life planning and product longevity, however, is indicated by current market patterns and disruptions in the supply of raw materials. The idea of a circular economy places a strong emphasis on the value of good design for longevity, end-of-life, and life cycle extension. Reliable data shows that several product categories have shorter lifespans, which are linked to planned obsolescence, technical development, regulatory reforms, and commercial pressures. The trend of ageing populations could be hampered by the present economic downturn. (Bakker et al., 2014).A full study of a product's or process's environmental impact over the course of its entire life cycle is possible using the comprehensive technique known as life cycle assessment (LCA). A thorough review is ensured by the four primary LCA stages, which are aim and scope definition, inventory analysis, life-cycle effect evaluation, and outcome interpretation. LCA enables businesses and organisations to make decisions that promote sustainable growth by locating and evaluating environmental hotspots and potential solutions. Its extensive use in a variety of industries, including as waste management, energy, transportation, and architectural design, highlights its adaptability and significance. Effective LCA implementation, however, continues to be hampered by issues including data accessibility, standardisation, and keeping up with changing approaches. Overcoming these hurdles is crucial to harnessing the full potential of LCA and maximizing its value as a tool for informed decision-making and environmental stewardship.

Literature Review:

The term "lifecycle" refers to a product's whole journey, from its genesis through eventual destruction. The beginning of life (BOL), the middle of life (MOL), and the end of life (EOL) are the three separate phases that make up this journey. Product Lifecycle Management (PLM) concentrates on efficiently managing product data across multiple phases to ensure maximum performance and sustainability throughout this lifecycle. To improve intra-organizational communication and data management, PLM makes use of a variety of techniques, methods, and information and communication technology (ICT) tools. PLM's main goal is to increase effectiveness, adaptability, and engagement while taking into account the effects on the individuals involved in the lifecycle process. By adopting a comprehensive approach, PLM aims to maximize the value and lifespan of products while minimizing environmental impact (Terzi et al., 2010).

Setting project success criteria is difficult. It is encouraged to consider factors like client happiness, output quality, and implementation efficiency. Time, money, quality, utility, stakeholder appeal, learning, inspiration, knowledge development, and reporting are all considered project outcomes. The process (time, money, quality), the accomplishment of tactical goals, and stakeholder satisfaction can all be used to measure success. Project success is influenced by factors like competencies, motivation, project environment, management support, resource allocation, and communication (Khang & Moe, 2008).

A well-known sustainability concept that combines social, economic, and environmental factors is the triple bottom line. The Life Cycle Sustainability Assessment (LCSA) under this paradigm combines environmental Life Cycle Assessment (LCA), social Life Cycle Assessment (SLCA), and economic Life Cycle Costing (LCC). Despite the fact that the subject of SLCA is still relatively new, current research tries to evaluate societal ramifications and incorporate indicators of people's health and well-being. This all-encompassing strategy guarantees that sustainability evaluations take into account a variety of variables, encouraging logical decision-making for the long-term welfare of society and the environment. (Kloepffer, 2008). Social Life Cycle Assessment (S-LCA) is a methodical procedure that records and presents social repercussions across the course of a product's entire lifespan, from extraction to disposal. It seeks to advance learning, assist in making decisions, and encourage changes in social circumstances. S-LCA takes into account impacts at the facility, process, and supply chain levels, in contrast to other social responsibility techniques that concentrate on enterprise-level consequences. In terms of modelling the product system and utilising a functional component for quantitative evaluation and comparison of consequences, it is comparable to Environmental Life Cycle Assessment (E-LCA). However, S-LCA may also include qualitative information on business traits or process qualities that are not stated in terms of functional units(Benoît et al., 2010).

Since the 1960s, life cycle assessment (LCA) has seen substantial progress and is now a useful technique for assessing a product's environmental impact over the course of its full existence. The significance of LCA was boosted in the 1990s by standardisation initiatives spearheaded by groups like the International Organisation for Standardisation (ISO) and the Society of Environmental Toxicology and Chemistry (SETAC). LCA's significance has grown throughout the twenty-first century as a result of its incorporation into environmental legislation and the increased emphasis on life cycle thinking. However, issues with methodological variance still exist. However, LCA is expanding to include more application fields, broader effect categories, and more intricate models. It is critical to address methodological concerns, take larger consequences into account, and incorporate macroscopic possibilities into LCA practises in order to promote sustainable decision-making. (Guinée et al., 2011).Due to a number of variables, LCA results are frequently ambiguous, although uncertainty evaluations are rarely applied. By regionalizing assessments and including spatial information, studies seek to reduce uncertainty. It is still difficult to match regionalized effects to emissions and resource movements. Rebound effects, worldwide consequences, and incorporating social and economic factors into LCA are more improvements. For thorough sustainability evaluations, overcoming difficulties and properly including variables are essential. (Hellweg & Mila i Canals, 2014).

Since its introduction in 1950, the idea of product lifespan has undergone substantial development to now include the full process from product creation to recycling. Decision-making and product

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improvement are aided by the various persons, tasks, and data collection that are involved in each stage of the lifecycle. Utilising digital twins is an innovative way to product design that has arisen to address the issues of the modern day. These digital representations of actual items have a plethora of data, allowing designers to engage in conceptual and detailed design, seamlessly integrate data, spot problems before they become major problems, encourage consumer involvement, do simulation testing, and precisely anticipate performance. Design effectiveness is increased by utilising the potential of digital twins, resulting in new and optimised products (Martin & Sunley, 2011).

Traditional models, such as the Bass model, have emphasised interpersonal communication (word-of-mouth) and external forces (such as advertising) to explain adoption. However, more recent studies have included social signals (signalling social status or group identification) and network externalities (where product usefulness increases with more users) to the understanding of diffusion. Alternative strategies also take customer diversity and persistence into account as adoption factors. Diffusion models have generally changed to reflect the complexity of the expansion of new products (Peres et al., 2010).For product identification during manufacture and transportation, a digitising solution is required. Users can choose the application model, the target workforce, and the precise procedure for product identification. Users can select the best solution from a range of digitising possibilities, including barcode, QR code, and RFID. Following selection, a thorough technological profile of digitalization is shown, giving thorough details about the selected solution (Siedler et al., 2019).

The importance of effective product lifecycle management (PLM) in the modern globalised and distributed industrial environment cannot be emphasised enough. The formation of virtual organisations made up of numerous factories and joint ventures makes it imperative to provide stakeholders with real-time data. In this setting, PLM is crucial because it helps companies manage the intricacies of mass customisation, where it's crucial to simultaneously pursue product innovation and operational efficiency. Organisations are adopting knowledge management (KM) systems more frequently as they become aware of the complexity of knowledge. These systems incorporate explicit knowledge and implicit competence, expanding the traditional boundaries of data and information. information management (KM) enables organisations to improve their performance, take use of insightful data, and produce lasting value by releasing the full potential of information. Organisations can establish a holistic approach to product lifecycle management that fosters sustainable growth and competitive advantage in today's dynamic marketplace through the seamless integration of PLM and KM (Vezzetti, 2012). The discussion leads to some of the critical factors in product lifecycle management. The same have been highlighted in the Figure 1.

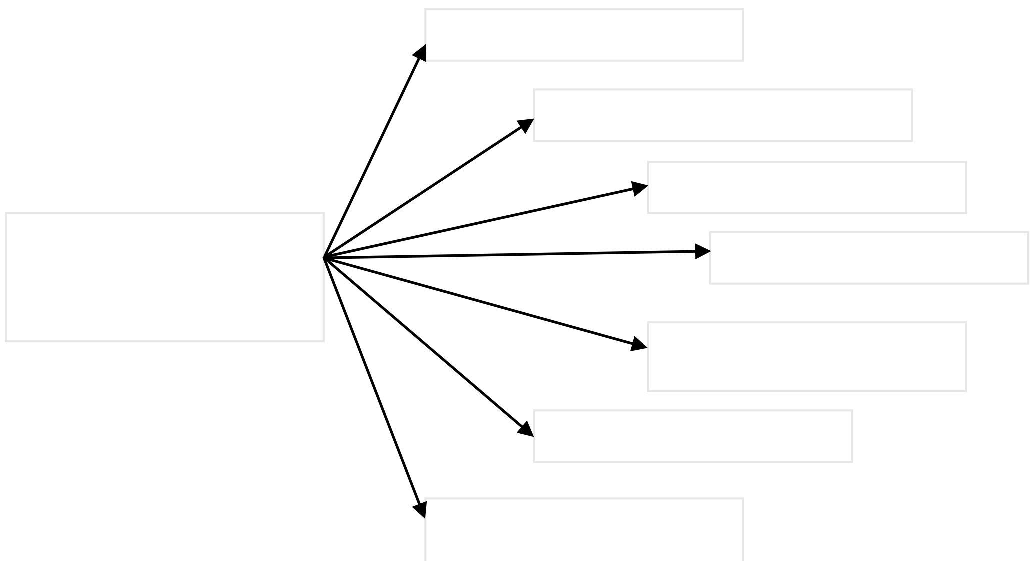

Figure 1 Factors to be Considered in Product Life Cycle Management

Conclusion:
Achieving thorough and sustainable evaluations requires the effective management of product lifecycles through Product Lifecycle Management (PLM) and the inclusion of sustainability factors such as Life Cycle Assessment (LCA). A key factor in guaranteeing successful outcomes is the evaluation of project success criteria, which includes customer happiness, output quality, and implementation efficiency. Evaluations of sustainability are further improved by the adoption of a triple bottom line strategy, which includes environmental, economic, and social considerations. Overall, these methods and frameworks encourage cooperation, well-informed choices, and the long-term health of people and the environment.

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