The idea of crowdsourcing manufacturing and a proposed framework with a review of the literature to improve industries' manufacturing aspects – A Review

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Abstract: It is challenging manufacturing organizations to create high-quality goods within their allotted budgets and timeframes due to a lack of workers and other resources. Manufacturers will have the chance to enhance their products by utilizing the knowledge of a diverse group of individuals, including prospective clients, as crowdsourcing expands. With this new option, product design might take place in two different places: crowdsourcing and traditional design environments (in-house design). In traditional design environments, as opposed to crowdsourcing-based design environments in industrial sectors, control, hierarchy, and methodology are elements that affect the quality of product design in terms of the design process, team management, and information management. The existing literature addressed topics such as the product life cycle, quality control, product design, and post-production manufacturing operations. It describes issues with quality control of product design on crowdsourcing platforms and examines possible solutions. By developing a model suitable for product design and quality assurance in a crowdsourcing manufacturing environment, it identifies problems with product design quality control on crowdsourcing platforms and examines possible solutions to provide an exploratory analysis of Indian manufacturing industries.

Keywords: Crowdsourcing, manufacturing, product life cycle, product design quality, quality control.

I. INTRODUCTION

The term "crowd-sourcing" is a combination of the terms "crowd" and "outsourcing," which refer to the practice of outsourcing to the crowd. The crowd is one of the essential components of a crowdsourcing procedure. It functions more like a virtual team than a traditional design team. The team leader in traditional design workplaces is well aware of the demands of their staff. Consequently, the team leader can delegate tasks to the right individuals. In a crowdsourcing setting, the reliability and correctness of the data provided by the masses are usually questioned. This information must be verified in order to assign the task to the right person. [17]. The technique of gathering information or feedback for a study from a large number of individuals, typically online, is known as crowdsourcing. Crowdsourcing gives job seekers access to a large workforce with a wide range of skills and competences at a lower cost and with greater efficiency than recruiting experts or professional workers. [7]. The technique of crowdsourcing, which divides labor for laborious tasks, is quickly growing. Numerous duties, including funding, reviewing, idea generating, and a general quest for answers, can benefit from its successful application. In general, crowdsourcing is a way to obtain necessary concepts, content, or goods. Through an online community, it solicits feedback from a wider range of people than traditional employees and suppliers. The crowdsourcing technique is widely used to divide laborious tasks by pooling the efforts of multiple self-identified volunteers or part-time employees, where each participant contributes to the larger result. The ability to conceptualize and develop concepts to produce new products that meet the ever-changing needs and expectations of consumers makes product design an essential activity in today's society. Excellent products will not only satisfy the needs of manufacturing companies and countless consumers over the course of the product life cycle, but they will also provide our society with the best user experience and additional social and environmental benefits. So helping companies maintain their competitiveness in

the fiercely competitive global market [1]. In order to increase efficiency and preserve their position as global competitors, small and medium-sized enterprises (SMEs) in the manufacturing sector have traditionally placed a high value on having skilled, technical, and professional employees. Through crowdsourcing, SMEs can connect with online communities that might offer services like coming up with design concepts or solving problems. However, a number of challenges prevent them from using crowdsourcing into their product design and development (PDD) methodology [9].

Employees can utilize crowdsourcing as a collaborative activity to generate ideas and solve problems with the assistance of large teams of co-workers and teams. The potential to extract previously untapped tacit information in a less formal virtual setting is therefore made possible [8].There are other possible uses that could be created in the future because crowdsourcing is still a relatively new idea. The utilization of crowdsourcing by SMEs is quite rare. Some contemporary examples include managing customer service, developing new products, and soliciting funds [14]. Research effort scope:

The aforementioned proposed study offers the following (not all-inclusive) scope and utility. The little budgetary problems that SMEs have are insignificant and are caused by a shortage of human resources to provide high-quality products on time. The new potential, product design, can be carried out in two different environments: traditionally (in-house design) and through crowdsourcing.By leveraging the expertise of a vast group of crowd sources, including their future clients, the rise of crowdsourcing allows businesses to enhance their products.This study focuses on the stages of product design to identify the critical elements that influence the quality of product design and how it may be controlled and guaranteed.

Prior to determining its characteristics and sub-characteristics, we establish the quality of product design. Among the key factors, influencing the quality of product design in both traditional design settings and crowdsourcing-based design environments are quality control techniques, principles, and quality assurance guidelines.With a focus on the several elements that affect the caliber of product design activity, the challenges associated with product design quality are then compared between traditional and crowdsourcing-based design environments. The design of new products, their quality assurance methods, and quality are also covered in the study. The study also covers new product design, quality assurance guidelines, quality control problems, and associated solutions in a crowdsourcing-based design environment.

II LITERATURE REVIEW

The quality enhancement techniques developed by Danula Hettiachchi et al. [7] are crucial for obtaining high-quality crowdsourced data for academic and business uses. Task assignment, which dynamically adjusts the process settings for crowds, is a popular and commonly used technique. This study looks at task distribution techniques that address the issues of spreading questions, disseminating plurality, and distributing diverse work in crowdsourcing. Researchers highlight possible implementation problems, compare, and contrast the ways in which different approaches assess employee performance. In her conclusion, the researcher outlines possible avenues for further research on work assignments and how crowdsourcing platforms and other interested parties could benefit from them. Throughout the crowdsourcing life cycle, a variety of methods is employed to improve the quality of the data. In this work, the researcher provides a comprehensive overview of online task assignment strategies utilized in crowdsourcing for task deployment. After giving a brief overview of methods for enhancing data quality in crowdsourcing, the researcher deconstructs online approaches into difficulties such as plurality assignment, question assignment, and diversified job assignment. The researcher discusses the limitations and challenges of the currently employed task assignment techniques, focusing on their cost, complexity, efficiency, and applicability. Researchers anticipate that practitioners and researchers will be better equipped to meet their objectives if they comprehend and apply particular assignment strategies. Finally, outline a list of possible future research subjects in crowdsourcing job assignments, highlighting the ways in which studies might further demonstrate that task assignment strategies are broadly applicable, beneficial to workers, and able to lessen data biases. Only business performance and ISO

certification are taken into account in the findings of Chetankumar M. Sedani et al. [4], which are based on a small sample of 129 manufacturing facilities. The outcomes may have been different for companies that had previously implemented TQM programs in addition to certification. The lesson for managers is that, as suggested by Juran (1981), the development of a quality culture in any company will be facilitated by the commitment and support of senior management, as well as by effective planning and human resource management. Regardless of the managerial typology used, this is accurate. Crowdsourcing is a decreasing commercial strategy that entails asking a large number of people (the "Crowd") to contribute in order to obtain the necessary services, ideas, materials, or even funds. Research on this subject by QIN Shengfeng et al. is accessible at [19]. Few studies have examined the advantages and disadvantages of using crowdsourcing for manufacturing SMEs' new product development (NPD), despite the well-established potential benefits of doing so for product design. The Smart project, supported by Innovate UK, carries out a Proof of Market research on crowdsourcing-based product design to address the aforementioned queries. The purpose of this study is to determine the requirements, difficulties, and prospects for future growth associated with using crowdsourcing techniques for NPD. The study's research findings, which are published here, can direct the creation of collaborative design tools and methods that rely on crowdsourcing in the future. They also offer some useful references for the industry to incorporate this creative and rapidly evolving collaborative design approach into their operations.

A. Product design Quality Hierarchy

Product design is typically carried out by internal design teams made up of people with a range of backgrounds and specialties. Design collaboration works well for big businesses. For small and medium-sized businesses (SMEs) without the resources and expertise to support their product design processes, it is less effective. Crowdsourcing offers more advantages than only cost savings and worldwide involvement. According to Conor Muldoon et al. [6], the reason small and medium-sized businesses are interested in using crowdsourcing-based platforms for product design or enhancement is because of the staffing difficulty. A growing number of small and medium-sized businesses are considering outsourcing a portion of their product creation processes to crowd funding platforms as an alternative to more conventional methods. This enables them to benefit from the speed and affordability of the services they produce, as well as the substantial crowd engagement of potential clients depending on their products. Overall, crowdsourcing has demonstrated a great deal of promise for producing better product design value. Crowdsourcing solutions that properly support product design activities are still quite rare. SMEs therefore limit their use of these platforms to certain product design tasks, such as ideation and selection. Finding ways to support crowdsourced product design processes has been the focus of numerous researchers up to this point. Because product design research on crowdsourcing-based platforms is still in its early stages, there are not many studies on how to control the quality of product design on these platforms [23].

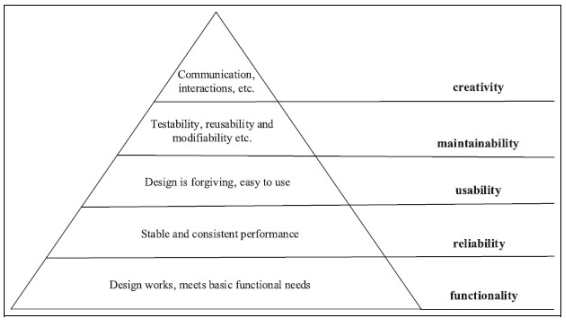

Fig.1. Product design quality hierarchy Niu XJ et al. [17]

B. Product Design Quality

A product's intrinsic design features are determined by its specific design standards, business requirements, and design quality requirements. Important components of a high-quality hierarchy design are originality, usability, functionality, and maintainability. This approach considers the needs of other stakeholders, including workers in the manufacturing, maintenance, and recycling divisions, in addition to the target market's (end users') needs. Every worker engaged in the product life cycle is seen from the standpoint of the product's full life cycle. Figure No. 1 makes it very evident that originality is the most crucial element. The suggestion by Sedani C. M. et al. [20] called for a comprehensive evaluation of Indian SMEs in central India to identify the necessary components for ISO 9000 certification. Additionally,

the study concludes that obtaining ISO 9000 certification is an essential step toward Total Management (TQM). According to research by Philips et al. [18], ensuring that customers are happy and satisfied may yield more financial and emotional benefits. Much research has been done on controlling one or two combinations of these five quality attributes in ascending order.

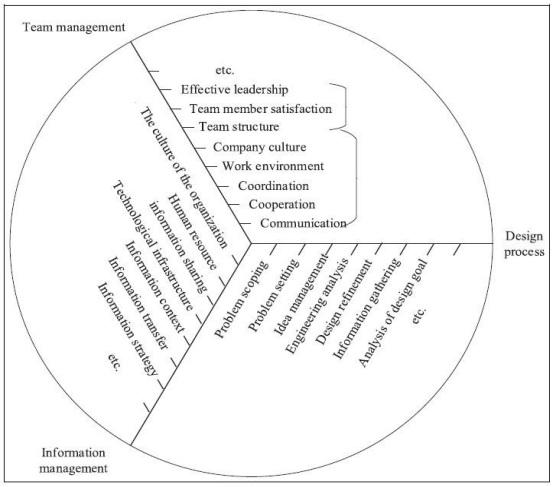

Fig.2 Factors affecting product design quality in relation with design process, information management, and team management in traditional manufacturing environment Niu XJ [17]

Furthermore, the ultimate goal of product design is to guarantee product excellence in these five domains. The current study views these five design quality levels and their hierarchical sequence as the essential components of successful design. Every design quality attribute has several sub-attributes. Figure 2 shows the elements influencing team management, information management, and the quality of product design in a traditional manufacturing scenario. For a theoretically grounded view of crowdsourcing information systems, see David Geiger et al. [8]. Existing crowdsourcing system classifications lack a theoretical basis because they are mostly based on empirical examination of actual crowdsourcing situations. Researchers were able to create theory-informed dimensions that differentiate four basic types of crowdsourcing systems by utilizing systems theory in the context of crowdsourcing systems. By looking at each archetypal system's unique characteristics, we were able to determine the specific services that each system might provide to crowd source businesses. We talked about the effects of certain design flaws based on the unique features of these systems. There are two significant implications of our findings. This article first demonstrates how crowdsourcing systems may be studied using systems theory. Future studies should build on this theoretical foundation to understand crowdsourcing tactics better. Second, a basis for additional research into specific system attributes is provided by the four categories of crowdsourcing systems that have been identified and their diverse roles. Given the consequences and requirements for system design that have been examined, this could also help practitioners choose the best crowdsourcing system for a particular objective or the ramifications of particular design issues. The focus of this review study was on the critical factors influencing the quality of product design in both traditional and crowdsourcing contexts. Furthermore, this study found issues with product design quality control on crowdsourcing platforms and proposed solutions based on the investigation's findings. To gain a better understanding of the key factors influencing product design quality, this study first defined the term and its sub-characteristics. Information management, information interchange, quality control techniques, and quality assurance regulations are the four areas of research that are the focus of the conventional design environment. According to analysis, there are more factors influencing the calibre of product design when the design environment is expanded in the context of crowdsourcing than there are in the conventional design environment. It compared these two-design environments, assessed quality assurance and control processes, and looked at the key factors influencing product design quality in the context of crowdsourcing. The study identified four problems with product design quality control using a crowdsourcing platform and offered solutions for each problem. SMEs will gain a great deal from the effective resolution of these problems since they will have access to a large pool of individuals with diverse backgrounds and skills, which will enable them to compensate for their lack of qualified employees and related resources. The pressure will be successfully released. Because of the research, a crowdsourcing platform to support PDD initiatives will soon be created. This work may provide some guidelines for platform development. Building occupations and their combinations are given extra attention because

functionality is so crucial to dependability, usefulness, maintainability, and originality. The needs identified in the early stages of product design are met by these functions rather than the other four design quality factors. To provide high-quality product design, the design process has always been closely monitored. However, what factors affect design quality, and which characteristics ought to be maintained across different product design quality levels? In order to gather research from the body of literature on quality control of product design during the product design phases, the following approach was employed. This is within the standard context of crowdsourcing and design [10].

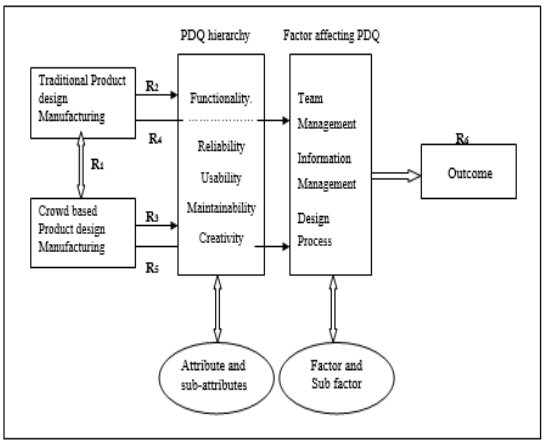

Fig. 3. Frame Work

We construct hypotheses H1 through H6 and identify research questions R1 through R6 in the Framework. The significant correlation between crowd-based design manufacturing and traditional design manufacturing is denoted by R1. R2: Various elements of the product design quality hierarchy are appropriate for the product design quality. Crowd-based design manufacturing, or R3, makes a substantial contribution to the hierarchy of product design quality. R4 represents the significance link between the elements influencing product design quality through traditional production and the hierarchy of product design quality. Using crowds-based design, R5 shows a strong correlation between the hierarchy of product design quality and the elements influencing it. R6 is the use of crowds-based design manufacturing to increase the quality of product design through static outcomes.

III. RESEARCH METHODOLOGY

For this research methodology work, it is proposed to carry out the work in the following flow chart

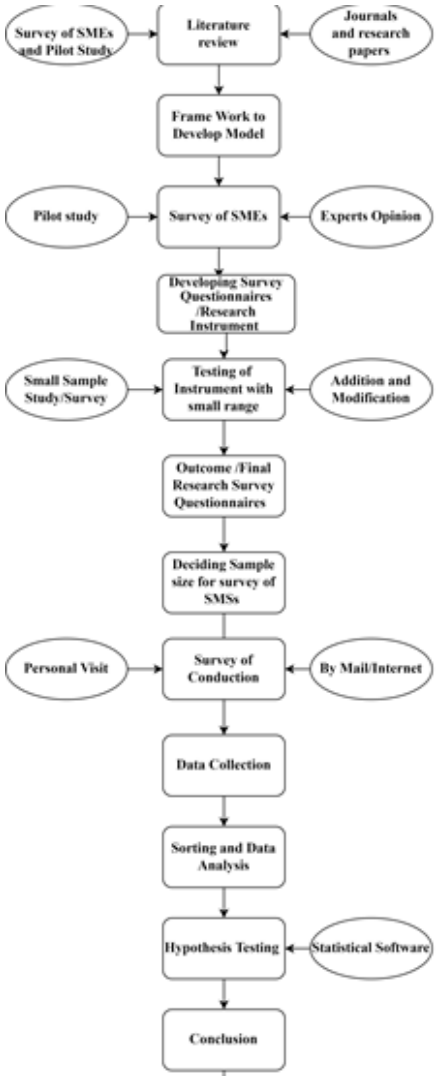

Fig 4 Flow chart of Research Methodology

Defining product design quality, surveying, and comparing the major aspects influencing it in traditional and crowdsourcing-based design settings are the ultimate goals of this study. In order to develop a model suitable for product design and quality assurance, it uses a crowdsourcing manufacturing environment to provide exploratory analysis in Indian SMEs. It identifies product design quality control challenges on crowdsourcing platforms and examines potential solutions to address these challenges.

Table 01. Research question and hypothesis

Research question	Hypothesis
R1: Significance relationship between traditional design manufacturing and crowd-based design manufacturing	H 1
R2: The product design quality is appropriate to various attribute of the product design quality hierarchy	H 2
R3: Crowd based design manufacturing provide significance contribution to product design quality hierarchy	H 3
R4: Significance relationship between to product design quality hierarchy and factor affecting product design quality by using traditional manufacturing	H 4
R5: Significance relationship between to product design quality hierarchy and factor affecting product design quality by using crowds-based design manufacturing.	H 5
R6: improvement in product design quality through statically outcome by using crowds-based design manufacturing.	H 6

Traditional manufacturing may face challenges, and one of the proposed model's techniques is crowd source manufacturing. According to a customer satisfaction survey based on a review of the literature, there is stillroom to improve productivity and the outcome of the hierarchy and factors affecting the quality of product design. Additionally, using crowds-based design manufacturing can improve the quality of product design through statistical results. Traditional manufacturing may face challenges, and one of the proposed model's techniques is crowd source manufacturing.

According to a customer satisfaction survey based on a review of the literature, there is stillroom to improve productivity and the outcome of the hierarchy and factors affecting the quality of product design. Additionally, using crowds-based design manufacturing can improve the quality of product design through statistical results.

Table 02. Hypothesis and findings

Hypothesis	To test /Findings
H 1	Traditional manufacturing is superior over crowd-based design manufacturing
H 2	Traditional manufacturing provides significance contribution to product design quality hierarchy (Five attribute)
H 3	Crowds based design manufacturing provide significance contribution to product design quality hierarchy
H 4	Traditional manufacturing is significance associate with product design quality hierarchy and factor affecting product design quality by using crowds-based manufacturing
H 5	crowds based is significance associate with product design quality hierarchy and factor affecting product design quality by using Traditional manufacturing
H 6	significance difference in outcome of crowds-based design manufacturing environment over Traditional product design manufacturing

IV. CONCLUSION

The anticipated cumulative results of the suggested research project are as follows: Utilizing existing resources and incorporating a crowdsourcing-based manufacturing environment to enhance product design quality and boost sales and customer happiness in order to benefit SMEs There may be a stronger correlation between the quality of a product's design and its sub-attributes and quality control metrics when product design tasks are crowdsourced. For product design quality assurance and control, a special product design lifecycle information model may be created in an integrated design environment that combines in-house and crowdsourcing. The model has the potential to improve product design quality, quality control, and assurance in addition to facilitating ineffective design communication and information sharing in the closed-loop of the product lifecycle. It can also advance the theory of design information representation and communication. A system that enhances the collection and exchange of design data across the whole product design and development process may be developed with the help of the recently proposed platform. It could link the supply chain's stakeholders and final product networks. It might facilitate the co-development of quality assurance, product design quality, and the crowdsourcing models that go along with them. The recently created model could help address the issues and problems that manufacturing businesses confront, as well as enhance budget allocation and utilization, resource management and sustainability, and product design quality.

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