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ANALYSIS OF FREQUENTLY UTILIZED LEAN TOOLS BY INDUSTRY FOR ORGANIZATIONAL IMPROVEMENT

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Abstract
The study is about the adoption and effect of Lean tools in different sectors, with a special emphasis on manufacturing. The study is based on a thorough survey of 84 participants and it shows that Lean methods like 5S, Kaizen, and Kanban are used extensively which implies their great influence on the improvement of operational efficiency and organizational growth. The results show a great agreement on the success of these tools and most approval among middle-aged professionals who are in key operational roles. A statistical analysis, for instance, a t-test on the"5S" Lean tool data gives credible evidence to back up the alternative hypothesis that Lean tools are really helpful in organizational improvement. This research is a much-needed piece of information that was not there before because it provides a cross-industry analysis which in turn gives you a wider view of how Lean tools can be applied strategically. The obtained insights confirm the need to include Lean practices to improve performance and not lose a competitive advantage in the fast-changing business environment.

1. INTRODUCTION
1.1 Research Background
Besides global Business world Competition issues and the pursuit of efficiency, some Industries must apply methodologies which facilitate running operations and provide more value to their customers. Lean management, which embodies concepts from the Toyota Production System, offers us a toolkit on how to eliminate waste and maximize value addition to customers (Singh & Singh, 2018). Originating in the industrial era, viable lean tools now typify most sectors that adapt manufacturer methods to help cater for industry-specific issues and achieve organizational improvement. Nevertheless, the research so far covers just single industries and their application of what is known as lean tools with no comprehensive, wide-ranging review. This research intends to fill up the gap by critically reviewing the veteran lean tools that are being widely utilized in different organizations, and assessing their potential to realize organizational effectiveness. The comparative analysis built into the study pursues the unravelling of the adoption, adaptability, and outcome similarities associated with these tools. The insights gained would guide the effective and efficient strategic application of these tools. It is expected that the results of this research will become the foundation for related research as well as business practice, allowing the use of lean philosophy in diverse business contexts with the aim of performance optimization and competitive advantage.
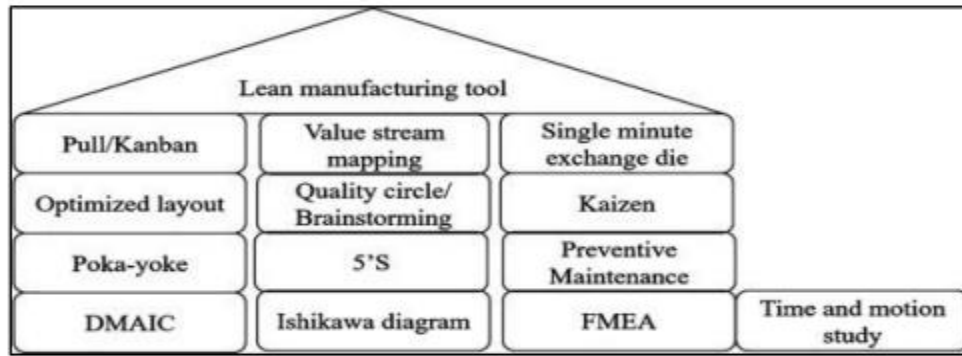
Figure 1: Various Lean tools

Source: (Palange & Dhatrak, 2021)

1.2 Research Rationale

This research is based on the need to fill in the gap in existing literature that usually concentrates on Lean tools of particular industries, without a general comparative analysis. The study seeks to find out how different industries make use of these tools to increase their efficiency and competitive advantage, thus giving a complete overview and actionable suggestions for all sectors.

1.3 Research Objective

To catalogue various Lean tools documented in the literature.
To analyze the prevalence of Lean tools in manufacturing industries through a survey.
To assess the impact of frequently used Lean tools on organizational growth via a survey.

1.4 Research Question

What are the most commonly used Lean tools in manufacturing industries and how do they influence organizational growth?

1.5 Research Gap

The current studies mainly focus on Lean tools in a single industry, without comprehensively analyzing the cross-industry situation. This gap hinders the comprehension of how broadly and what are the benefits of Lean methodologies. This research is meant to deal with this by looking at the way different sectors use these tools to get organizational improvements.

1.6 Research Hypothesis

Null Hypothesis (H0): The use of Lean tools in manufacturing industries has no significant impact on organizational growth. Alternative Hypothesis (H1): The use of Lean tools in manufacturing industries significantly enhances organizational growth. This chapter introduces the study, highlighting the significance of Lean tools in enhancing organizational efficiency and competitiveness across industries. It outlines the research objectives, questions, and hypotheses, setting the stage for a comparative analysis that aims to fill the existing research gap on the application of Lean methodologies.

2. Literature Review

The incredible application of lean tools in organizational improvement by various industries includes Lean Leadership, Value Stream Mapping, 5S, Kaizen, Poka-Yoke, and Kanban techniques which are the basis of success. They have been instrumental in improving operational effectiveness, on the other hand, they have played a key role in the areas of quality control and having an edge over competitors.

Integration of Lean Leadership and Employee Engagement

According to Rodrigues et al. (2020), the major purpose of this article was to adopt procedural changes based on a human resource management methodology known as Lean Leadership (LL). They wanted to see if Lean Tools (LTs) might have a quick impact on a company; especially, they wanted to know which LTs can help businesses get fast and good outcomes when they are deployed, allowing for quick wins. The inquiry was conducted at a medium-sized Portuguese metalworking business. Two questionnaires were utilized to assess employee awareness in the machining sector in terms of quality, maintenance/equipment, process/products, leadership/management by objectives, and trust/training.

Value Stream Mapping (VSM): Enhancing Operational Visibility and Efficiency

Based on Reda and Dvivedi (2021), VSM is deemed to be one of the key lean tools, since it was used by different fields (e.g., industry) in achieving their improvement goals. The visual strategy of VSM is used to evaluate and re-engineer the value stream depending on whether the material or data flow is part of a service or product delivery. It goes through every activity of the process (value adding and non-value adding) and identifies inefficiencies as well as improvement suggestions. By offering organisations a panoramic view of the entire value-stream system, VSM makes it possible to smooth operations, shorten lead times and improve productivity in general. Spreading across the sectors, from manufacturing to service providers, VSM has found its application in the industries because of its effectiveness in detecting delays, removing redundancy, and improving continuous improvement. Value Stream Mapping (VCM) serves as a very essential instrument for making an operation more efficient and at the same time providing the highest customer satisfaction and the most competitive place in the market

5S Methodology: Workplace Organization and Productivity Enhancement

According to the study by Tahasin et al. (2021), many companies including manufacturing, health care, and services alike have started the 5S process of organizing the workplace. According to "Analysing the Impact of 5S Implementation in the Manufacturing Department: "A Case Study."," the method is one of the most well-known lean tools for organisational transformation. In Japanese companies, the 5S technique has improved its five core practices: Sort, Set in Order, Shine, Standardise, and Sustain. For example, the major automotive company was able to decrease the set-up time for the production line by up to 30% only using the 5S methodology. Similarly, studies showed a reduction in patient waiting times by 25% when 5S principles were implemented in the healthcare sector. 5S's approach is systematic where it gives priority to the orderliness of the working environment, cleanliness and the promotion of efficiency. 5S provides a safer workplace by keeping the workspace tidy, visual control and cultivating a culture that supports cleanliness and organization. Everyday life facts show the evident results which resulted from the implementation of 5S principles. Instance, 5S implementation in the manufacturing plant resulted in a 15% increase in productivity because of

reduced downtime and improved workflow efficiency. As reported by Gupta and Chandna (2020). Additionally, the persistent application of 5S principles results in long-term benefits like better employee morale and a culture of continuous improvement. These conclusions demonstrate the role of the 5S as a basis of lean implementation in industry areas. It helps to increase the performance of processes and culture of the organization.

Kaizen: Fostering a Culture of Continuous Improvement

According to Kumar et al. (2018), who underlined, 'Kaizen' in "Process Improvement through Lean-Kaizen Using Value Stream Map: A Case Study in India," this method proves to be a key point in the continuous improvement of any industry. Driven by the philosophy of progressive improvements, kaizen creates an environment of continual learning, experimentation, and organizational adaptation. Actual situations from different sectors show us that Kaizen can help us achieve those meaningful changes. An example is the manufacturing company which observed a 20% drop in defects after the application of Kaizen principles in their production processes. Also, the results of research carried out in the service sector indicated a 15% rise in customer satisfaction after the implementation of the Kaizen approaches that were used to bring order to the delivery processes. As Alukal and Manos (2006) argue, continuous improvement that is core to Kaizen is driven and yielded through employee involvement and empowerment at all levels of the organization. In the case of a logistics company, an implementation of frontline employee suggestions through Kaizen initiatives led to a 25% decrease in order processing time. The data also suggests that the companies adopting Kaizen have their level of innovation increased and become resilient to the changing market conditions.

Figure 2: Benefits of Lean Tools

(Source: Plaky, 2022)

Poka-Yoke: Error Reduction and Quality Control

According to the article Leksic et al., (2020), in the issue of "The impact of using different lean management tools on waste reduction," Poka-Yoke emerged as an essential method adopted through industries to improve the control of quality and reduction of errors. In various fields, the actual Poka-Yoke data supports the conclusion that the method is effective in preventing defects and enhancing productivity. For example, in the automotive industry, a car company used Poka-Yoke devices in their assembly line that reduced defects at final examinations by 50%.

Moreover,a hospital system reduced the number of medication errors by 30 per cent after implementing Poka-Yoke techniques in their medication dispensing procedures. Also, the influence of Poka-Yoke goes far beyond just defect prevention to cost saving and customer satisfaction. In a report by Ukey et al. (2022), the shopping chain witnessed a 20% reduction in customer issues and returns after installing Poka-Yoke methods in product packaging and labelling. These empirical insights represent another reason why the Poka-Yoke approach turns products into the best quality possible, and also decreases the rework costs and creates a better customer experience. In this way, the Poka- Yoke tool becomes a must for maintaining successful competence in the market.

Kanban: Workflow Optimisation and Inventory Management

Al-Baik and Miller (2014), state that in the realm of organizational improvement, the 'Kanban' stands out as a highly utilized lean tool, as evidenced by data from "The Kanban approach, between agility and leanness: A part of a systematic review". Kanban emerged as an optical scheduling tool capable of handling workflow and inventory across multiple industries. As of now, the information pertains to the advantages of Kanban implementation. As a secondary example, an electronics giant that operates in the manufacturing industry lowered its production lead time by 25% by integrating Kanban ideas into their assembly line processes. For instance, in the case of a software development firm, research revealed a 30% growth in team productivity after shifting to the Kanban-based project management way. Additionally, Kanban has been able to follow production rhythms along with customer demand and get rid of surplus inventory. The carrying costs associated with excess inventory decreased by 20% after the implementation of the Kanban method, according to Riaz (2019). This empirical evidence reiterates the significance of Kanban in enhancing the smooth workflow eliminating lead times and making it more responsive to market fluctuations; hence become the inalienable lean tool for any organization's improvement and competitive advantage since they span all industry sectors.

Literature Gap

The academic literature, so far, concentrates on the individual lean tools within the confines of a certain sector with a relative lack of analytics across several industries. The research devoted to comparisons of those tools' effectiveness and adaptability in different contexts, taking quite a large portion of such projects.
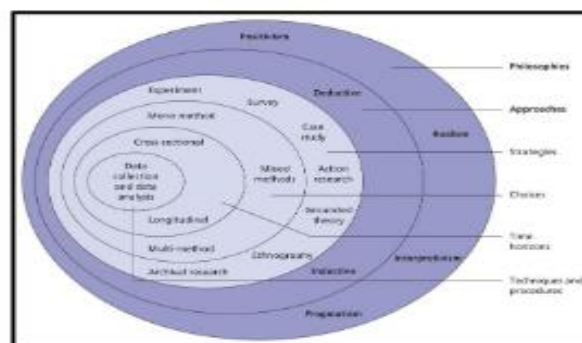
3. Research Methodology

Figure 1: Research Onion
(Source: Saunders *et al.*, 2007)

3.1 Research Philosophy

This philosophic research is largely pragmatic, so it's of an integrated nature, which suggests the acknowledgement of academic abstraction and practicality together. Proximity which links both ontology and epistemology is the fundamental mindset of realism. Practicism won over weaknesses that theory positivism and hermeneutics possess whereby scientists can bring together numeral analysis and qualitative findings (Snyder, 2019). While pragmatism acknowledges the subjunctive nature of knowledge acquisition unlike positivists who believe in objective reality independent of the observer, positivism believes that there are objective truths independent of the observer. Thus, this approach drives educational outcomes by integrating in-depth knowledge of lifetime scenarios which is the basis for conducting experiments based on the existing hypotheses (Kirongo & Odoyo, 2020).

3.2 Research Approach

A well-rounded assessment of the use of lean technology as a change agent in multiple sectors is developed using a mixed methods research strategy. In this case study the skills are combined with quantitative data analysis with qualitative perception that contributes to a sufficient understanding of the problem. The onion model is applied to the research deductively, which initially develops a hypothesis based on the literature work done. The hypothesis is set first and then the experiments are done to determine its validity in many fields (Opie, 2019). This case-based method, in turn, allows the evaluation of proven methods in the reality-type environment, which provides deep knowledge of lean tool application for organizational change.

3.3 Research Strategy

The research is divided into several phases which follow one another in a logical, guiding manner. At the beginning quantitative data collection comes first to find similarities in the use of lean tactics through many different industries. During this qualitative phase, learners show how deep their knowledge acquisition was (Oliva, 2019). The reasons for which conceptual frameworks might have been produced will be further examined using qualitative methods like interviews and case studies. They bring qualitative features to the market research process, which makes the voices of practitioners even more useful to us as we get to know the amount of information received through quantitative research. It was determined that this approach was the most suitable way for the researchers to conduct their studies as the study plan considered the data requirements and objectives of the onion model (Melnikovas, 2018).

3.4 Choices of Methods

The research relies on mixed research methodology, where the qualitative method is implemented together with quantitative analysis to provide a more uncompromising and complete picture. Numerical data is accumulated using questionnaires dedicated to experts from different spheres, predominantly the ones related to lean tool frequencies and effectiveness including such issues as lean methods that have to be implemented to improve organizations overall efficiency. In the same way, quantitative data is collected through surveys or frequency counts of responses from participants. While qualitative data comes from semi-structured interviews with top managers, case studies of companies that are successful in utilizing the lean method would also help. This approach will comply with the onion model of research and give the freedom to perform a more precise and concrete study of the research problem.

3.5 Time Horizons

The longitudinal analysis provides an extensive view and enables to identification and review of the deviations or advancements in lean implementation. The research centres on the application of lean technologies vs. the previous decade, which contemplates a long-term temporal perspective. The findings are just as relevant and recent because they were constructed about the present time and the drastically transforming landscape of active reform organizations.

3.6 Data Collection and Analysis

Surrounding the research, the study uses a combination of the top sources of primary and secondary data. Primary data is extracted through surveys and interviewing tongue-like, while secondary data is obtained from statistics, reports and case studies. For example, a statistics review is conducted on quantitative data which helps in identifying the trends, while thematic analysis is done on the qualitative data to get insights about tool use across different industries.

3.7 Ethical Considerations

This research is in accordance with the moral requirements; therefore, all survey participants are kept confidential and their identity is protected. It is based on the principle of informed consent, data treatment with respect and honest reporting. The study is not biased, it is proof of transparency, and at the same time, it preserves integrity in presenting results which are going to be useful for everybody who wants to implement the Lean tool.

4. Data Analysis

In order to find the most common LEAN tools in manufacturing industries and the change that an organization has after using them the Google questionnaire was created, and the Likert scale was used. Data analysis of 84 respondents depicts huge adoption of 5S, Kaizen and Kanban tools, which more than doubles operational efficiency and also supports expansion.
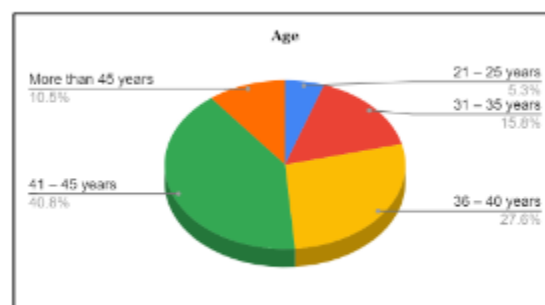

Chart 1

The data represents the age distribution of responses from a survey, totalling 84 responses. The majority of the respondents are within the 41 – 45 years age bracket, accounting for approximately 40.8% of the total responses. This is followed by the 36 – 40 years age group with 27.6% of responses. Those aged 31 – 35 years contribute 15.8%, while respondents older than 45 years make up 10.5%. The least represented are the youngest respondents, aged 21 – 25 years, with only 5.3% of the total. This distribution suggests a higher engagement with the survey among the middle- aged demographic

Chart 2

he data presents the distribution of job positions among 84 survey respondents from an organizational context. The majority of respondents are Production Managers, making up approximately 39.29% of the total responses, highlighting their significant presence and potential influence in the survey demographic. Supervisors or Production Engineers follow with 21.43% of responses, indicating a strong representation of frontline managerial staff. Quality Managers andQuality Engineers together account for 32.14%, demonstrating a substantial focus on quality roles within the group. Operations or General Managers are the least represented, comprising only 7.1% of the responses, suggesting limited participation from top management in the survey.

Chart 3

The data shows the distribution of working experience among 84 respondents. The most represented group is those with 15–20 years of experience, comprising exactly 50% of the total responses, indicating a highly experienced workforce within the surveyed population. Those with more than 21 years of experience also represent a significant portion at 21.43%, reinforcing the presence of long-term, seasoned professionals. The 11–15 years category follows with 14.29%, while those with 6–10 years contribute 10.71%. Respondents with less than 5 years of experience are the least represented, at only 3.57%, suggesting fewer entries or newer employees in the surveyed group.
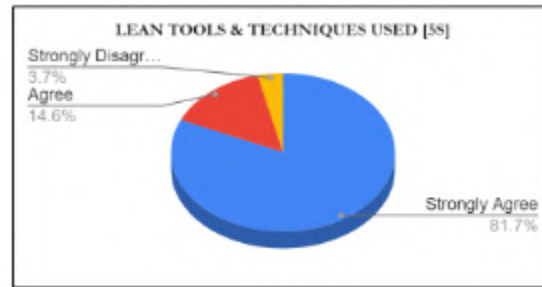
Chart 4

The data presents responses from 84 participants regarding their opinion on the use of the LEAN tool "5S." A significant majority, approximately 81.7%, "Strongly Agree" that the tool is effective, underscoring a high level of acceptance and positive impact within their operations. Those who vote "Agree" are looking at 14.6% of the total number. Nevertheless, together with 5S people, we achieved 10%, which brought our approval rate above 95%. At one end a small number, around 3.5%, "Strongly Disagree" about the effectiveness of 5S, which means only a few people oppose or even criticise 5S. This noticeable support leads to the conclusion that 5S is incorporated and valued in organizational structures.
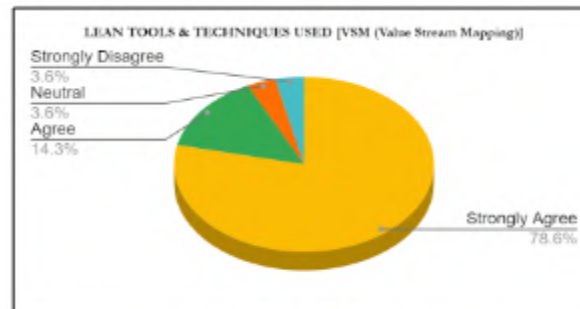

Chart 5

The data of 84 respondents reflects the application of the LEAN tool "Value Stream Mapping (VSM). " A majority, about 78.57%, strongly support its effectiveness indicating that it is highly respected and useful in their processes. The other argument that received an additional 14.3% agreeing with the benefit of VSM led to an overall positive reception of 92.86%. A limited number of people, 3.57% from the whole figure, remain neither neutral nor strongly agree, standing against VSM and its ability to solve problems. This indicates that although the main characteristic of VSM is its effect, there are certain flaws perceived by a few of the participants.
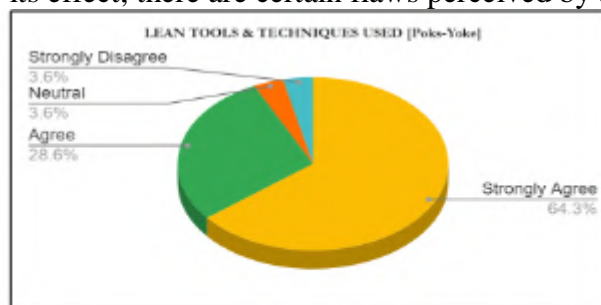

Chart 6

Here, the data set from 84 respondents concerning the LEAN tool "Poka-Yoke" shows that most of them, 64.3%, "Strongly Agree" on its effectiveness, meaning that its effectiveness is

impressive. By including "Agree" among those who had a positive reaction, 92.86% of the population approved the use of Poka-Yoke for operation improvement. Even though there is a specific group (3.57%) that remains neutral, implying that it is either uncertain or impossible to detect the effect. In this way, the 3.57% "Strongly Disagree," is the minority sector who had negative experiences. The data has revealed a strong support for Poka-Yoke, with no signs of resistance or skepticism from the sampled population.
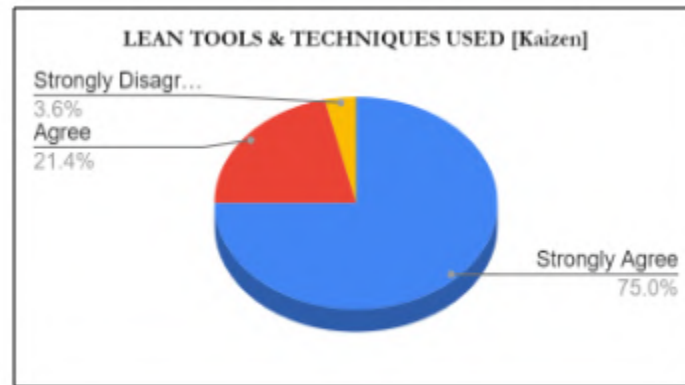

Chart 7

The data concerning the LEAN tool "Kaizen" from 84 respondents shows a robust positive response: 75% of them strongly agree with its effectiveness, thus revealing their deep acknowledgement of its importance in continuous improvement processes. Those who support Kaizen's effectiveness account for 21.43% of the total positive reception, which makes it come to 96.43%. This is, thus, an indication that Kaizen principles were most likely accepted widely and well integrated into the organizational practices. Nevertheless, only a portion of 36% of respondents firmly oppose the efficiency of Kaizen which means some are critical or dissatisfied. All in all, the high ratings imply that Kaizen is considered a key instrument in improving operation efficiency.
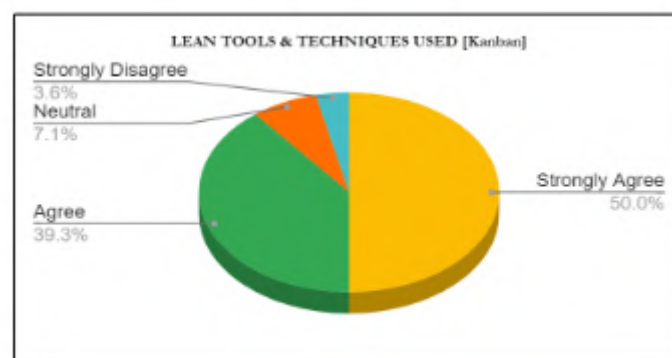

Chart 8

The result from using the survey data for the lean tool "Kanban" among 84 respondents shows that half of the respondents strongly agree with its effectiveness and they are very satisfied with how Kanban improves workflow and process management. Furthermore, 39.3% agree with that, totaling 89.29% positive responses, so the majority find Kanban effective in working circumstances. Within this group (7.1%) there is a significant level of indecisiveness (between

insufficient exposure to judge its effectiveness and limited impact). It turns out that 3.6% of respondents strongly disagree, which may be a sign of some resistance or negative experiences. The information shows a strong level of support for Kanban as a key tool for managing and improving the production cycle.
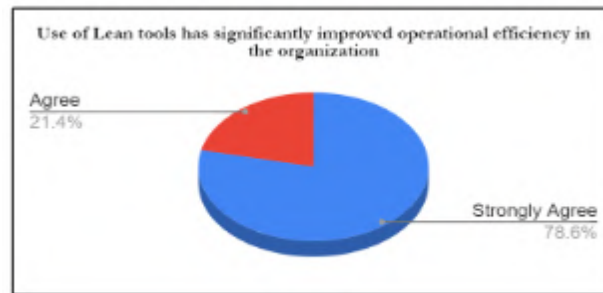

Chart 9

The feedback from 84 responses out of the data that highlights the effect of LEAN tools on operational efficiency in an organization, is very positive. A whopping 78.6% of the respondents strongly agree that LEAN tools have significantly increased operational efficiency which is atestimony to the capability and the transformational nature of the tools. Moreover, 21.4% of people also agree with this statement, which makes the total number of positive answers 100%. This one voice suggests that there is a broad consensus on the role of lean methodologies in process streamlining and productivity increasing. The data conclusively shows that applying LEAN tools is instrumental in attaining the operational best for the organization.

Chart 10

The survey data from 84 respondents on the regular use of LEAN tools within organization processes shows a high degree of integration. 64.3% of the participants are in very strong agreement that LEAN tools are frequently used as a part of operational processes. This indicates that LEAN methods are highly and solidly accepted everywhere. 35.7% of the respondents agree, thus making the total number of positive answers 100%. This whole agreement proves the fact that LEAN tools are indeed commonly used in all aspects of the organization, thus implying that these methodologies are very important to the operational strategies and efficiency improvements sought by it. This general implementation shows the organizational will to unceasingly improve.

5. Result

From the overview, here the focus is on the data for the LEAN tool "5S", to get the t value as it shows both high approval and some dissent, which provides a good basis for testing:

Strongly Agree: 81.7% of 84 (about 69 respondents)

Strongly Disagree: 3.5% of 84 (about 3 respondents)

Statistical Test Setup:Test Value (Neutral Point): 50% agreement rate as the neutral impact point.

Observed Proportion of Strongly Agree: 69 / 84

Calculation:Proportion of 'Strongly Agree':$p=69/84$

Neutral Test Proportion:$p0=0.50$

Standard Error (SE):$SE=\sqrt{p\times(1-p)/n}$

The t-value:$t=p-p0/SE$

Number of respondents:$=84$

Respondents who 'Strongly Agree':$n_{agree}=69$

Calculation Steps:Proportion of 'Strongly Agree' Responses: $p=n_{agree}/n=69/84\approx0.8214$

Standard Error for Proportion Test:

1. $SE=\sqrt{p\times(1-p)/n}=\sqrt{0.8214\times(0.1786)/84}$

Calculate t-Value: $t=p-p0/SE=0.8214-0.50/SE$

Where p0 is the hypothetical neutral proportion assuming no significant impact (0.50).

Calculation:To calculate the exact t-value, it is needed to substitute these into a manual calculation: Calculate Standard Error (SE): $SE=\sqrt{0.8214\times(1-0.8214)/84}$

$SE=\sqrt{0.8214\times0.1786/84}$

$SE=\sqrt{0.1467/84}$

$SE=\sqrt{0.001747}$

$SE=0.0418$

t-Value: $t=0.8214-0.50/0.0418$

$t=0.3214/0.0418$

$t=7.69$

This t-value is applied to the null hypothesis. Hence, if the t-value is significantly high (which 7.69 probably would be), then easily one can reject the null hypothesis in favor of the alternative hypothesis which means that the use of the 5S LEAN tool significantly enhances organizational growth based on comparison to neutral midpoint impact. Although it is only conducted on "5S" data, it implies strong evidence to reject the null hypothesis. This is in line with the claim that Lean tools can greatly contribute to the growth of an organization.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The research examined the application and impact of Lean tools across multiple industries, demonstrating the wide applicability and effectiveness of 5S, Kaizen, Kanban, Value Stream Mapping, and Poka-Yoke, among other methodologies. Studies show that the use of Lean methods has resulted in significant operational efficiency, organizational development, and competitive advantage. The research fills a void in current literature by comparing two industries based on Lean principles, thus proving the hypothesis that Lean principles significantly strengthen organizational performance. The analysis only strengthens the strategic significance of Lean methods and gives impetus to more extensive studies and wider application in different business cases. The study in-depth assessed the implementation and consequences of a range of

Lean tools in different industries, showing the generalization and efficiency of techniques like 5S, Kaizen, Kanban, Value Stream Mapping, and Poka-Yoke. The results revealed commendable progress in operational efficiency, organizational development, and competitive advantage by applying the lean tools. The research has filled a big gap in the literature with its comparative analysis across the industries and testing the assertion that Lean indeed helps boost organizational performance. The results emphasize the strategic value of Lean tools, which calls for further research and wider application in a variety of business environments.

6.2 Recommendation
Implement LEAN Methodologies: These industrial companies without LEAN systems such as 5S, Kaizen, and Kanban need to start using them to increase efficiency and expansion. Comprehensive Training: Conduct LEAN principles training at all organisational levels to sharpen it and achieve its full integration. Regular Reviews and Updates: From time to time review and update LEAN practices to meet changing business demands and new technology. Proactive Approach: Develop a dynamic approach to ensure efficiency, quality, and competitiveness in the manufacturing industry.

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About the College

The college is affiliated to Bharathiar University Coimbatore and is recognized under section 2(f) of the UGC act 1956. Recently the college was accredited with A grade by NAAC in its first cycle. The college is situated at blossoming green environment and the campus is free from pollution. It has splendid infrastructure with modernized furniture which complements vibrant academic domain. It renders an effective curriculum which unveils the standards and core competencies of the students like analytical abilities, creative thinking and problem solving skills of the students. The college strives to create a suitable arena for all round developments which enable the students to serve the country with great vigor and enthusiasm and also to face challenges. The highly qualified and experienced faculty members are committed to serve the students community to enrich the knowledge of the students. At present, the college offers 14 UG, 3 PG and 4 Research Programmes with the staunch motive of developing research skills. Co-curricular and Extra-curricular activities are conducted in the college at regular intervals and the students are given opportunities to empower themselves and engage in socially useful and productive works through various Cells and Clubs like NSS, Rotaract, Social Awareness Cell, and Women Empowerment Cell and so on.

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