

BENCHMARKING STUDY OF AUTOMATED CABIN MANUFACTURING PROCESS ACROSS AUTOMOTIVE INDUSTRIES

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Abstract

This study examined the literature on benchmarking automated cab manufacturing processes, cost and risk factors. The study can be used in the benchmarking assessment of automation in manufacturing industries in the future. Technology is used in automated and flexible production, and these processes should be compared with the leaders in the industry. A company's productivity and automation efficiency rise as a result of benchmarking. The study takes into account prior benchmarking studies, benchmarking methods, automation in cabin manufacturing, and automation advancements. Benchmarking also includes lean manufacturing, which is critical for increased performance and growth. Automobile Manufacturing companies face the challenge of implementing best practices in their business and manufacturing processes. The primary cost drivers in the production of automobiles are the overhead costs, which are largely impacted by the costs associated with running production facilities. Many businesses believe that it is vital to cut those expenditures in an environmentally beneficial way. Recently, efforts have been made to lower operating system and maintenance energy use.

Keywords: *Lean manufacturing, Benchmarking, Automation, productivity, Cost drivers, flexible manufacturing systems.*

Introduction

Cabin is the front end of a commercial automotive vehicle which houses the driver & co-driver. It primarily consists of sheet metal components which are pressed into panels, welded together, painted and finally assembled with needed sub elements like beading, windshield, dashboard to make it complete and right to fit at final vehicle assembly stage of a commercial automotive vehicle. The cabin manufacturing process comprises of multiple stages starting from de-stacking of sheet metal, pressing (multiple stages) to get the parts, cleaning, welding, coating / painting, sub assembly fitment. Due to the size and enormity of the cabin, the manufacturing process is quite complex and is highly capital intensive. Automation is necessary since vehicles are getting more and more complicated. Since there is more congestion and there are more automobiles, quick and precise sensing is needed to increase sensory perceptions of the humans driving it. These innovations still need to be combined to produce a fully smart cabin that

collaborates with the driver. These systems aid drivers in information processing, decision-making, and more productive vehicle operation (Heinz-H. Erbe, 2004). Therefore, a necessity to benchmark various processes used for cabin manufacturing and recommend better suited cost effective approach for cabin manufacturing is needed. A more organized and systematic application of the highest standards through quality efficiencies is made possible by benchmarking, which is essentially a quality management tool. It is founded on the idea of comparing an organization's performance to a criterion or standard. (Passos & Haddad 2013) Benchmarking involves a structured comparison between similar products, services or processes based on related characteristics of comparison and features. It is required to study in detail the processes, faculties, technology and management system installed at various manufacturing locations and arrive at the comparisons table highlighting the key features. These are then collated in a table form comprehensively and presented in order to conduct benchmark studies, it is imperative to gather data via study of literature and other published information globally.

Review of literature

Lean manufacturing:

According to Shaman Gupta and Sanjiv Kumar Jain “In a number of different industries around the world, lean manufacturing is now an ideology of production that is extensively explored and also used. Lean manufacturing's basic principle is to deliver a high-quality product while making sure the consumer doesn't have to pay too much for it. Today's majority of firms are going through a phase where they must adapt to the fast shifting client needs. Numerous businesses have begun implementing the lean manufacturing idea in order to maintain their position in the market adoption of lean manufacturing in steps. the system's wastes are identified. There are a lot of organisations that need to be aware that they have both hidden and obvious wastes in their systems. Wastes can come in a variety of forms within an organisation. The many waste types and their causes must be understood. Lean manufacturing advocates addressing the root causes of issues and finding long-term solutions. These sorts of waste can be reduced or eliminated using a variety of instruments and strategies” [3]. In the purview of Kiran Kumar G K “In the realm of competitiveness, lean manufacturing is an effective and rapidly expanding methodology. In lean manufacturing, a variety of processes and procedures are used; the techniques chosen rely on the task being performed. Lean's success is influenced by a variety of factors. Lean manufacturing has increased the versatility and viability of enterprises. Furthermore, lean manufacturing creates a framework that is incredibly supportive of waste reduction.” [4]. Lean manufacturing can be also looked in this perspective as seen by Sundar Et al “Lean manufacturing is a concept that was created to optimize utilisation while eliminating waste and in response to the dynamic and demanding commercial setting. Organizations are compelled to deal with hurdles and complexity as a result of industrial system's radical shift. The competence of any business, whether manufacturing- or service-focused, to consistently and methodically adapt to these changes in order to increase the value of its products may probably influence whether it will survive. In order to reach this perfection,

value-adding processes are therefore required; as a result, building a lean manufacturing system is now a key capability for any type of firm to sustain.”[5]

Cabin manufacturing

The commercial vehicle cabin market was mostly driven by the US and Canada. Due to the region's widespread use of heavy trucks, there is a significant need for vehicle cabins. Smart cabin is ecological observation employing detectors for temperature, dampness, gases, and pollution. It offers a wide range of changing functions, including operation of ventilation, air conditioners, illumination, and other connected household appliances that can be applicable to Cabin manufacturing in heavy vehicles.(Tiwari et al,2020) China, Japan, and Australia control the majority of the commercial truck cabin segment. Due to the increasing demand in countries like India, China, Thailand, and Indonesia, the market will expand rapidly throughout the time of forecast. Since there is an increasing need for protection and comfort and an increasing awareness for the need of automation in cabins of commercial vehicle.[6].Cabin and plant automation enables people to remotely or automatically control objects within the cabin and plant. mechanisation is employed to track and control multiple equipment or systems to boost product quality and to require less labour from humans. Automation technology reduces labour[7]Nastasija Markusheska says that “Aircraft manufacturers offer their clients a multitude of alternatives for customising their aircraft, including a huge selection existing extra equipment from which they can choose various components based on their needs. The wide range of possibilities includes different engine types, navigational setups, and cabin interior designs. The ability to differentiate their brands is provided by this freedom to the airlines. Additionally, a distinctive cabin interior design creates a lasting impact on their clients and establishes their expectations for the impending flight. On the other hand, a wide range of options leads to a wide range of requirements, protracted delivery times, and challenging installation processes that require interrupting the running assembly of the cabin, deconstructing existing cabin components, and putting together new cabin models. A customised aircraft will therefore cost more and take longer to produce”. [8]. It is possible to manufacture commercial vehicles' cabins similarly to how aircraft cabins are manufactured. Technology advances in recent years have led to the automation of all systems and processes. The article by Tiwari et al has suggested a model for an internet-based cabin and plant automation system that focuses on monitoring and controlling electronic devices both inside and outside the cabin and plant.Tiwari et al [7]2020.According to Acher et al the focuses on role played by acoustics and weight of the vehicle structures in cabin manufacturing.The study highlights that the factors that cause internal disturbance must receive special attention as part of the effort to lighten the vehicle structures. In fact, a reduction in the structure's weight frequently results in an increase in interior disturbance.Numerical simulation is the main method used in modern engineering to evaluate the vehicle's vibro-acoustic behaviour throughout the design stage. [9].According to Mohrbacher et al the lighter the better is an understatement for fuel efficient commercial vehicles .For higher performance and this has to be followed when working with high strength steel, improved manufacturing techniques is frequently required. This is because the deformation and hardenability of contemporary high-tensile steel have changed. Therefore, from the perspective of production, this is a relatively

conservative strategy. Creating synergy between cutting-edge manufacturing technology, design, and material is a considerably more effective strategy, allowing for further weight reduction and efficiency improvements. In this perspective, laser-based material processing, especially laser welding, offers a variety of potential. It presents fresh opportunities for modern commercial vehicle component manufacture.([10])

Benchmarking

Benchmarking's primary goal is to obtain assessment on the current predicament as well as additional details on aspects that contribute to productivity as well as challenges and barriers. The idea of benchmarking has recently come to be associated with organizational effectiveness.. In a setting often with similar business units using an internal BM strategy, the best operational approaches were recognized and put into practise with hardly any organisational pushback. It provides a step-by-step approach, where BM analysis is combined with common inventory management procedures.[11].Bench marking in Indian Industry is still evolving and incompetent while compared with industries globally is clearly stated in the article by Jain et al “The Indian auto industry has uniformly embraced benchmarking as a technique for improving efficiency and economy. Benchmarking is still viewed by Indian automakers as a technique for comparing product attributes, performance parameters, processes, and systems. Additionally, it has been thought to be less useful on a tactical level. The findings also demonstrate that benchmarking is still in its infancy in the Indian automotive sector and that executive administrative engagement is still very much needed for it to take off. Due to the concern over losing a competitive advantage and the issue of secrecy, competitor benchmarking is given less emphasis. The most significant reason for not adopting benchmarking, according to this report, is ineffective infrastructure, which is followed by budget restrictions and shortage of specific expertise.[12]

Benchmarking techniques

Benchmarking can be categorised based on how it is done and the context in which it is used. Depending on what is being compared. Benchmarking is classified into process, performance, and strategic categories. The three benchmarking kinds that the authors specify are as follows:

- (1) **Benchmarking of processes.** Different work processes and operating systems are addressed. By comparing processes or operations with those of measuring counterparts, activities or processes are enhanced.
- (2) **Benchmarking of performance.** In order to assess how well the company performs in contrast to its competitors, performance measures are evaluated. Through comparisons of the attributes of the products and services, it reveals the organization's competitive position.
- (3) **Strategic benchmarking:** It is a research that is conducted whenever there is a desire to alter the strategic direction of the business Therefore, strategic benchmarking requires evaluating strategic, as opposed to operational, issues.

Flexible Manufacturing System

Miguel et al.(2019), observes Flexible manufacturing system implementation using qualitative and quantitative methods for coil manufacturing used in engines at a Brazilian automotive

industry. Kumar (2018) has examined and reported that Flexible Manufacturing system is used to fulfil the task within the allotted time, the production environment of today needs manufacturing performance. Therefore, the need for flexible manufacturing systems has emerged as a critical interest regarding the flexible production systems. This production system combines a number of elements that includes Artificial Intelligence combined with technology. It can be identified by the replacement of the tough automation typically found in exchange lines with a digital control setup. KUMAR [13] 2018. It is also analysed that flexible manufacturing is being applied in the market all products in entirety. The emergence of new patterns of product competition, some of which have even come to dominate those markets like flexible manufacturing. These new patterns of competition seem to be a reflection of certain firms' significantly increased flexibility to respond to shifting technical and market opportunities by releasing more new items, providing broader product lines, and upgrading products more swiftly than ever before. Additionally, a lot of these more adaptable product developers are able to offer well-differentiated items to a wider customer base by precisely segmenting product markets. [14]

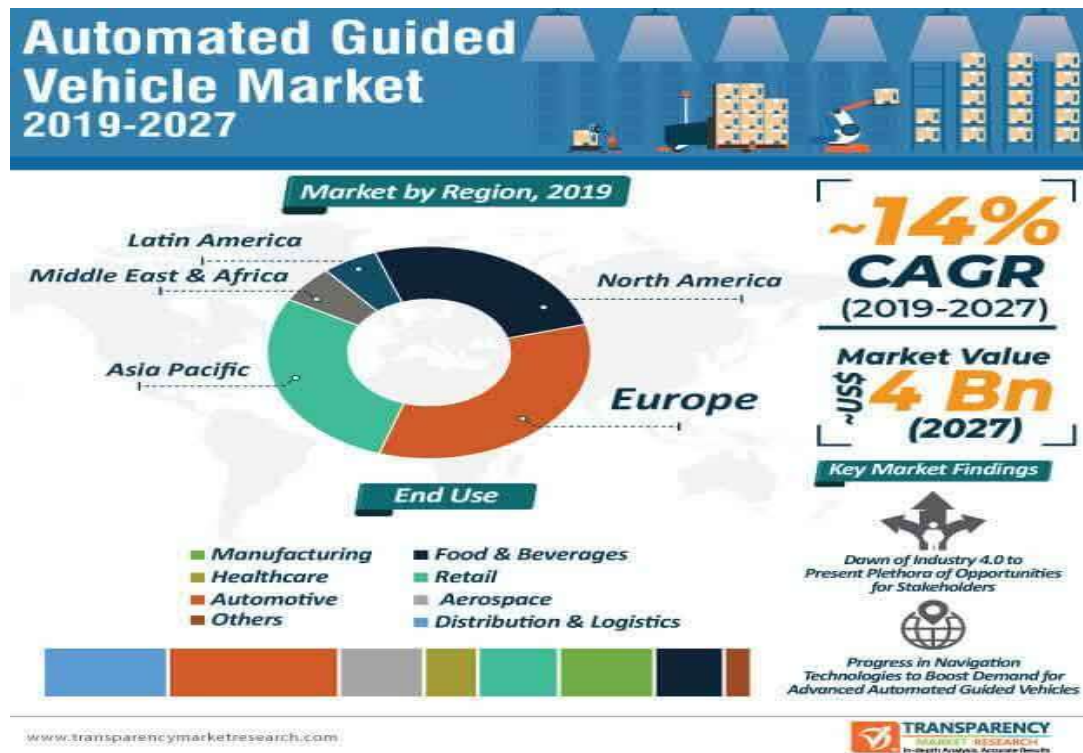


Image 1:[15] The above image explains the market for different end users and opportunity for enhancement and innovation in cabin manufacturing.

Based on the above literature reviews, the following gaps are observed:

- Discrete manufacturing processes like coil manufacturing and the techniques are explained however a holistic approach is not available
- Cabin manufacturing & automation is niche concept though emerging in the research stages, industries are yet to implement.

- Innovations for automated vehicles are progressively being employed in large trucks, moving past SUVs and passenger cars. Highly automated commercial vehicles (HACVs), which make use of a variety of technologies to enable automation, are a useful method for handling the rising need for commercial vehicles that keeps business and industry moving especially in the Indian sub-continent.

Towards addressing the above gaps, it is proposed to conduct a benchmarking study on the current industry practices under the cabin manufacturing

Benchmarking of different Cabin manufacturing systems

Comparing an organization's plans and performance to those of best-in-class businesses both within and beyond the industry is known as benchmarking. An organization's performance can be improved by embracing and applying best practises, which is the goal of bench marking. The requirement to find, maintain, and transfer best practises has replaced the previous focus on benchmarking as a way to increase organisation effectiveness through the identifying of quality standards. In order to determine which specific benchmarking regions will enhance which aspect of cabin manufacturing performance, this study is being undertaken [16] Together, Fortaco Group and Buisard Cabins formed the FortacoBuisard Cabins business under Fortaco Group. They are an established, market-leading vehicle cabin technology and manufacturing business through a strategic alliance to serve the off-highway equipment sector. They work together to expand the options for vehicle cabins available globally. Cabin operations are located in Pune, India, Kurikka, Finland, Sablé-sur-Sarthe, Slovakia, and Holic, Slovakia. Since 2019, Fortaco Group and Tata AutoComp have collaborated to design and produce car cabins in India. The combined cabin portfolio includes agriculture applications as well as fully assembled plug-and-play vehicle cabins and high-volume operator cabins. They are one of the most accomplished and trustworthy makers of operator cabins, with a track record spanning more than 80 years. When benchmarking strategies are used correctly, firms can achieve the intended results and successfully reach their objectives. The widespread use of benchmarking by many businesses today may be linked to greater results. According to studies, benchmarking techniques and the intended improvement in performance in manufacturing and business operations generally are positively correlated. Finally, different benchmarking procedures and their effects on the application of best practises strategies were also learned through the literature reviews

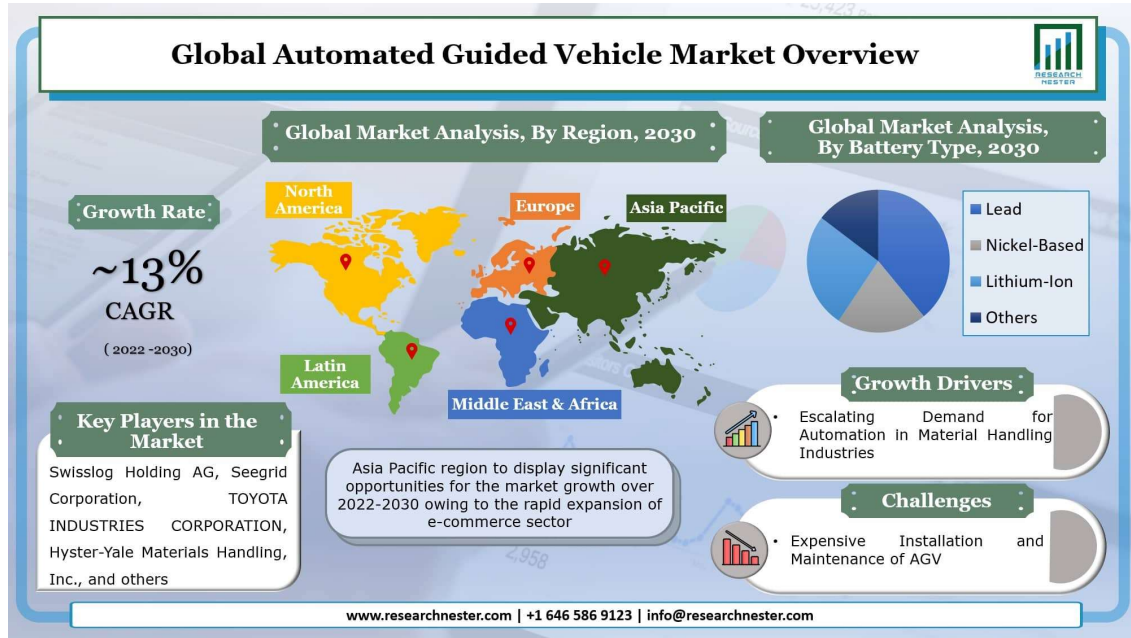


Image 2:[17]Detailed studies were conducted across the industry about various aspects.

The collated details are tabulated and presented under table :

Technological Aspects	Cost& Aspects	Risk	Maintenance Aspects	Policies Aspects
Innovation in sensor technologies and artificial intelligence	Impact on the total cost of ownership		Overall useful life	Fuel-saving and quantifiable environmental benefits
Fuelconsumption	Impacts on labor costs		Automated trucks on the road affect overall fuel use, and emissions	Disengagement from driving partially or fully
Maintenance	Risk profiles and insurance costs		Niche trucking applications	Risk of unemployment due to automation
Training the users	Adaptation challenges of using with automated vehicles		Role of the driver change	Greater adoption of sustainable driving
Human control needed	Safety and fuel savings		Quantifiable changes in safety benefit	

Benefits

The benefits of benchmarking study into cabin manufacturing process in automotive manufacturing helps in the following:

- Simplifies manufacturing processes
- Elemental facility requirement
- Lowers Cost
- Consolidates Data for Better Decision-Making
- Proactive Control & Quality
- Improved Profit Margin

Conclusion

In this study an exhaustive literature survey dealing with the cabin manufacturing and automation, flexible manufacturing system and its bench marking has been carried out .The technology that is used in aircraft can be applied for developing new concepts in cabin. manufacturing innovations, that will save time and money, and a priori analysis can spot potential flaws or faults. Any engineering project's digitalization process starts with gathering technical data regarding the componentry. Modern production processes can deal with the new obstacles in the competing industry. The advent of Flexible system has made it possible for the manufacturing sectors to achieve flexibility while also improving their performance. It makes it possible to combine high levels of productivity, flexibility, and little work-in-progress inventory. Also, the literatures dealing with the benchmarking in the automation industry and various issues concerned regarding it to give the reader a brief insight on the actuality of the benchmarking in cabin automation. In the current context, the firm demands products of utmost quality and reliability at prices that are reasonable. Industrial automation is used to boost service excellence, consistency, and volume of production while lowering manufacturing and design costs by introducing ingenious, creative, and innovative solutions and services in order to meet these challenges. In addition, with the aid of Artificial Intelligence and robotics technique, an effective control of automation of cabins can be achieved. This article has made a solemn attempt to highlight the facts of cabin automation and the leaders in various others industries starting from their planning to implementation. However, the exhaustive literature indicates that still this field has ample room for further research.

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