

Investigating the Preparedness of Car Manufacturing in Indian Automobile Industry to Integrate Intelligent Robotic Process Automation

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Abstract—The Indian automotive industry is reorganizing its business Production facilities with advance designs to solve the problems and increase adaptability and production speed. These changes will help achieving idle hardware adequacy in general, supply chain responsiveness and customer satisfaction. An association of factories breakthroughs and models with IT systems around the world are starting to happen and typically referred to as an associated facility. Manufacturing firms have now realized that robots and other AI technologies offer excellent ways for improving efficiency substantially. An exponential use of automation would change the way manufacturers evaluate their production and improvement plans. From precision machining and assembly to material handling, robots have done it all relief for manufacturers around the world. This paper offers that there are many more processes that are automated even though they require a human help that needs more automation.

Keywords: Automobile Manufacturing, Robots, Automation, Car, AI, IRPA(Intelligent Robotic Process Automation),OEM

I. Introduction

Automobile manufacturing Industrial enterprises undertakings round the world are retooling their manufacturing plants with progressed advances and styles to resolve these issues and boost fabricating adaptability and speed. These changes help them accomplish unused levels of by and enormous hardware adequacy, supply chain responsiveness, and client fulfilment. A joining of factory-based operational advances and models with worldwide IT systems is starting to happen, and typically alluded to because the associated plant. most aspects of human life are today impacted by technological advancement. Automotive sector, which is sort of a labour-intensive sector for India is not any exception. Different segments of the world have witnessed different sorts of technological upgradation.

The diffusion of new technologies in the automotive sector in different countries is quite uneven. To understand changes in professional duties and roles, we need to know the entire factory supply chain. The factory is divided into production areas: stamping shop, welding shop, paint shop, production line and final assembly/collection hall.

One production plant found that a large force was required to control the press accurately and safely. Therefore, instead of manual work, robots are installed in the presses. Previously, a

press operator placed a piece of metal on a table and pressed a lever to push his arm down so that when the arm retracted, the part would form as desired. To ensure safety during pressing, sensors have been installed to avoid danger. Another reason for automation in this business is the enormous demand for complex shapes and adjustments. This increases plant productivity. Various techniques in car manufacturing needs a highest amount of precision that robots can implement efficiently. Therefore, modern robots do the work and only skilled workers maintain the machines. In some factories, the workers in this workshop were transferred to the assembly line for production demands, while in smaller companies their labour force was replaced.

India is having growing market share, as of now China is main manufacturing hub. China has now increased the overall cost of manufacturing and is now facing geopolitical barriers. India with better demography and availability of the trained manpower who can offer co-host and quality arbitrage, is emerging as an automobile destination in global marketplace. Government of India is also seizing the opportunity in terms of offering PLI (Production Linked Incentive) scheme and promoting self-sufficiency in defence production.

India's automotive industry grew tremendously since 2020, making it to come in top 3 in the world. In 2019, it was the fifth largest commercial vehicle manufacturer.

Honorary Prime Minister Modi launched the Make in India programme in September 2014 as part of a larger national building initiative. The program's goal is to turn India into a global design and manufacturing powerhouse.

Historically it is observed that higher level of automation builds efficiencies and productivity, therefore this paper focus to re-examine the process and procedures involved in robotic process automation and its integration with manufacturing process.

II. Current Trends And Practices In Automobile Manufacturing

A. Literature Survey

Following study shows current manufacturing schemes under practice:

H. Chen, W. Eakins, J. Wang, G. Zhang, and T. Fuhlbrigge [1] proposed that in the automotive industry, wheel stacking is a method of connecting the wheels of a vehicle body when the power lines move at irregular speeds, and this errand is now done by workers who physically work shifts. Wheel Stacking revenues are about several million dollars each year. Therefore, the demand for mechanized wheel stacking handles is increasing. Therefore, mechanical robots are popular in the industry due to their adaptability and accuracy.

B. Sun, S.-L. Jämsä-Jounela, Y. Todorov, L. E. Olivier, and I. K. Craig [2] stated that the engine is the heart of the car in the automotive industry, and in the vehicle, the engine prepares for maximum efficiency, so with the increasing demand for precision, precision, higher productivity, and quality, the industry is turning to automated production. Has grown. One of the most important expectations.

Neelofar Kamal [3] states that the automotive industry is one of the core industries of India along with the auto parts industry. Auto is one of the largest companies in Global Showcase. Because it has robust forward and reverse links with several key sectors of the economy. The automotive segment occupies a prominent position in the fabric of the Indian economy.

Nikita Arya [4] aims at studying performance and growth of the Indian automotive industry, factors contributing to such growth and the current situation of foreign investment in the sector.

K P Naveen Reddy, Undavalli Harichandana, T Alekhya, Rajesh S M [5] stated that at least 5 out of 100 of the numerous tasks can be computerised. RPA employs computer programming packages and techniques, leveraging the most recent innovations such as fake insights, machine training and learning, speech and voice communication to require future levels of robotization. This makes it essential for any corporate organisation that wants to communicate deals directly during advanced transitions.

Geethanjali Jujjavarapu, Elonnai Hickok, Amber Sinha [6] is focusing on AI in India's manufacturing and service industries explained that manufacturing processes can be made smarter and greener to avoid breakdowns. Using AI in factories can improve productivity and quality while maintaining a robust safety framework.

Weizheng Wang [7] focuses on investigating how the effective application of industrial robots in intelligent automobile manufacturing production lines can meet the automotive industry's market demand. Process robots use advanced manufacturing technology and intelligent control functions to speed up the completion of various processes in automotive manufacturing.

Shubham Sen [8] states how these AI techniques are helping the various part of the automobile sector to grow.

Neelofar Kamal [9] has reviewed how these Make in India initiatives are helping in growth of the economic development as well as the overall speeding up the manufacturing of automobiles in India, it also states how use of automation using AI and RPA will help in faster development.

Amith A Kulkarni, Dhanush P, Chetan B S, Thamme Gowda C S, Prashant Kumar Shrivastava [10], states the use of automation in various areas of the automotive manufacturing firms, including robot wheel loading, process error tracking, automatic machine alignment and rebuilding, Automated decision systems, multi-arm operations, assembly, and, most importantly, security functions.

Davis Meike at al [11] advertised enhancement of control effectiveness by incorporation of a stand-by mode for most control utilization.

Dmitry Akimov et al [12] utilized fluffy run the show base for demonstrating a car robot appropriate for non-stationary environment.

Robert D. Atkinson [13] conducted Expansive exploration on the relinquishment and patterns of mechanical robots in different countries. South Korea has the most mechanical robots stationed, according to a 2017 check. These robots have a positive and practicable impact on living norms. Russia and India have the smallest number of robots, using about 3- 4 robots per few thousands workers.

Dr. S. Smys [14] presents an automotive industry-based pick-and-place robot that supports detection, control and production. Robot transmitter and receiver modules are specifically designed, programmed and developed for this purpose. This machine eliminates the leakage problem typically found in hydraulic systems - a key advantage over sliding elements which

cause friction. It is also relatively inexpensive to produce, making it easy to deploy on large scale projects.

Stefan Z. Jovanović, Jelena S. Đurić, Tatjana V. Šibalića [15] shows the study of RPA and how it is helping businesses to automate the things as well as speedup the overall processes. It also shows the comparative analysis of RPA vs the traditional automation.

Kanupriya, Sandeep Kumar [16] shows the trend of FDI inflows into the automotive industry from 2004 to 2014. The production trend in the automotive industry is picking up.

Neeraj Kumar and Dr. Kuldip Kaur [17] shows the ponder of changing structure of Indian car industry, how the remote speculators are appearing intrigued within the Indian automobile industry and consequently there's a require of speeding up advances within the fabricating.

Judith Wewerka, Manfred Reichert [18] focuses on major challenges to successfully implement Intelligent robotics process automation.

Michal Bartoš, Vladimír Bulej, Martin Bohušík, Ján Stanček, Vitalii Ivanov [19] bargains with an outline of mechanical robot utilization plausibility in car industry which these days is the foremost vital client of industrial robotic advertise particularly within the car industry, as well as patterns and points of view on the long run of car mechanical autonomy. It too displayed a show assignment from genuine mechanical home in shape of particular venture diagram almost robotized fixing of screws on the generation and appearing the change in in general execution.

As per the Industrial Revolution 4.0 and the Impact on Automotive Sector [20] report, Based on the Phase 1 results, simultaneous qualitative and quantitative studies of original equipment manufacturers (OEMs) and automotive component (Tier I and Tier II suppliers) manufacturing plants were conducted to identify industry stakeholders (factories (from managers to union members to government agencies)). The results of the second stage were qualitatively analysed and published here.

After this literature survey it can be concluded that not a single plant in India is fully automated and needs human intervention while the car manufacturing as none of the robots are intelligent enough to take independent decision and work in collaboration. The research done so far has focused on robotic and intelligent process automation, both domains aim at automating things, but there is still insufficient research on the integration between these domains. When software robots can use artificial intelligence (AI) to think about data and make decisions, it opens new possibilities to transform RPA and potentially open up entire industries. End-to-end automation is essential in providing the self-service options that many customers desire. This will result in increased productivity and usher in a new era of rewarding work.

B. Exploratory analysis

These studies and research about process automations are underplaying the connection between these domains, its customization and integration. Most of them are focusing on Intelligent process automation, robotic process automation, use of AI in manufacturing. Therefore, more comprehensive research is needed for Intelligent Robotic Process

automation and this exploratory study will be focusing to bridge this gap. Following survey is conducted between various OEMs, Tier 1 and Tier 2 manufacturers.

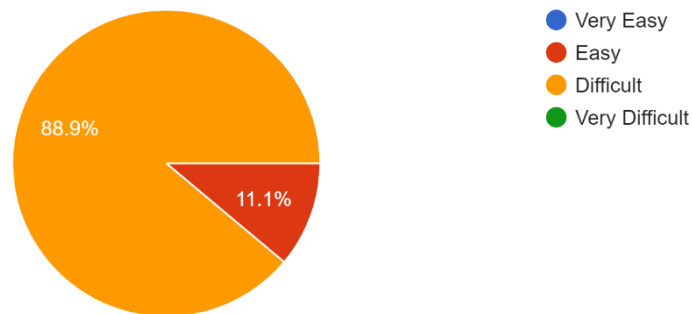


Figure 1: Survey to Integrate AI in Indian Automotive Industry

As seen in the figure 1, survey for the question How easy it will be to integrate AI based logics in existing environment? Approximately 90% of OEMs, Tier 1 and Tier 2 manufacturers claim it bit difficult to integrate AI in existing environment and hence it can be proven that all new infrastructure is needed to start using latest trends of AI. So a well-defined and well researched AI based system is necessary to be designed to build good amount of efficiencies.

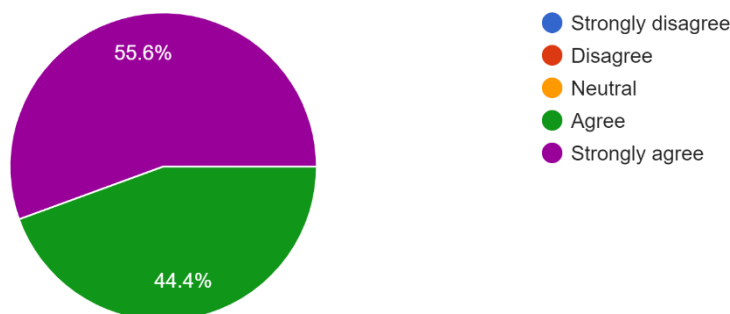


Figure 2: Survey to improve efficiency in Indian Automotive Industry using AI.

As seen in the Figure 2, survey for the question Will AI Based robotic process environment increase overall efficiency? Around all of the OEMs, Tier 1 and Tier 2 manufacturers claim that getting intelligence into robotic process automation will surely improve overall efficiency.

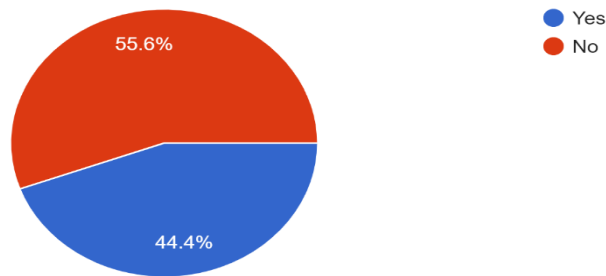


Figure 3: Survey to check use of AI Indian Automotive Industry floor shop.

As seen in the Figure 3, survey for the question Do the internal system of the automobile fuzzy logic enabled, AI enabled shop? More than 50% of the OEMs, Tier 1 and Tier 2 manufacturers are not having AI enabled robotic shop in assembly line.

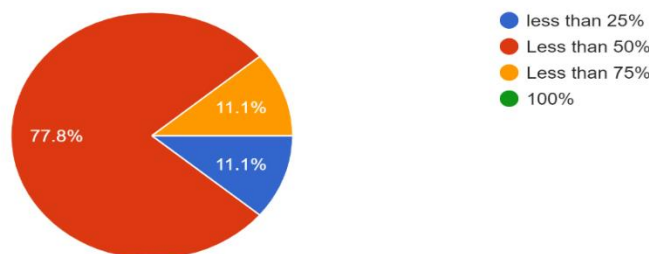


Figure 4: Survey to check degree of automation in Indian Automotive Industry

As seen in the figure 4, survey for the question What is the degree of automation in shop floor? Most of the OEMs, Tier 1 and Tier 2 manufacturers have around 50% of the automation in shop floor and hence has lot of scope to increase automation.

iii. Degree of integration for using robotic process automation automotive sector

From the overall survey it can be concluded that there are many places in which automation using AI can be increased and this section defines some of the areas of the car manufacturing where Integration of AI in robotic process automation is needed and how much degree of integration is expected.



Figure 5: Final quality checking of car after painting and baking

Credit: freeepik

As seen in the Figure 5, even though paint shop in India is fully robotically automated, when the car comes out from baking, still for overall quality control manual checking is needed, here there is possibility of going for IRPA. One can think of using optical image scanner and machine vision enabled as well as trained robots.



Figure 6: Semi-Automatic assembly line Credit: freeepik

Almost all the assembly lines of Indian car manufacturing are manual not even semi-automatic, so here there is huge scope of automating the overall process. As seen in figure 6 there are still lot many processes which need human intervention in the shop floor.



Figure 7: Ergonomic robots Credit: Ford Motor Co.

As seen in Figure 7, part lift assist robots also called as ergonomic robots are the dumb robots, and these are only doing a job of pick and place, they get the part, and the workers are manually assembling it. Around 4K parts are manually assembled, and hence going for intelligent robots which can also fix up the things will be ultimately speeding up the overall manufacturing process.



Figure 8: Mounting various components Credit: freepik

As seen in Figure 8, bumpers, door fittings, dashboard etc. are directly purchased from Tier 1 manufacturers and mounted manually, here there is a need of intelligent robots for mounting but still a human is involved in this even today. While fitting any part, the worker may tweak and try to fit the part. Here the need of Sense-Adopt-process robots are necessary, sensing the pressure points and fitting. If any of the existing robots fail, they need to be repaired manually, hence self-learning robots are needed for fail free operation.

Iv.Future Prediction Of Indian Automotive Industry In India

The adoption of robotics technology is growing rapidly in the India due to the increasing need for process automation, increased efficiency and productivity, and a decrease in human errors [32]. The Asia-Pacific region is the fastest-growing globally, with countries such as India, China, Taiwan, and South Korea emerging as leaders, attracting industries like automotive, electronics, and aviation to establish their factories there. This is fuelling demand for the automotive robotics market, making the Asia-Pacific a rapidly emerging region [32]. Parts manufactured in automated processes are extremely precise. Implementing mechanization in the industry makes a difference, reduces labour force, and saves on wage rates, and the framework acts as a source of cashback. Fine handling automation software is intended to allow forms to do more than monitor operation. One can consider following types of IRPA integration.

1. Non-Invasive Compatibility: IRPA is fully compatible with any framework humans use with computers.
2. Improved management: IRPA centralizes the management of bots, audits, and analytics within an organization to provide a platform to remotely model, monitor, control, plan, and execute deployments of RPA software robots.

V. Conclusion

More research is being conducted globally on Automated tasks and processes, Data-driven automation of decisions, and Intelligent automation of the ecosystem. The automotive industry has made significant advances in process automation, but there's still much work to be done when it comes to data automation. In addition, automobile companies have barely begun automating their ecosystems – a crucial area for future growth. The issue of optimizing production flow and evaluating productivity in a manufacturing line is being analysed. While human operators can operate machines, robots are favoured due to their ability to mitigate production disruptions caused by human error or equipment breakdowns. The challenge lies in determining the actual productivity difference between human operators and robots at the design stage. The automation industry is seeing growth due to companies' emphasis on cutting costs, saving time, producing top-quality goods, and boosting productivity with minimal errors. The point of automation isn't to decrease labor but increase efficiency. In times of COVID-19, when social separating is nearly a standard, automation it can permit for

inaccessible and independent operation and this Intelligence can yield good results from quality of the production to load sharing to fault tolerance. Information produced through plant network gives companies the capacity to keep real-time track of efficiency. Automotive robots are deployed in production facilities to ease the workload of employees and enhance efficiency through collaboration.

References

- [1] H. Chen, W. Eakins, J. Wang, G. Zhang, and T. Fuhlbrigge, "Robotic wheel loading process in automotive manufacturing automation," in 2009 IEEE/RSJ International Conference on Intelligent Robots and Systems, 2009, pp. 3814–3819.
- [2] B. Sun, S.-L. Jämsä-Jounela, Y. Todorov, L. E. Olivier, and I. K. Craig, "Perspective for equipment automation in process industries," IFAC-PapersOnLine, vol. 50, no. 2, pp. 65–70, 2017.
- [3] Neelofar Kamal, Impact of „Make in India“ on Automobile Sector International Journal of Business Administration and Management 2017
- [4] Nikita Arya, "A Review of Growing Automobile Industry in India", in 2019 International Journal of Research and Analytical Reviews VOLUME 6 I ISSUE 1 I JAN. – MARCH 2019
- [5] K P Naveen Reddy, Undavalli Harichandana, T Alekhya , Rajesh S M, "A Study of Robotic Process Automation Among Artificial Intelligence", International Journal of Scientific and Research Publications, Volume 9, Issue 2, February 2019
- [6] Geethanjali Jujjavarapu, Elonnai Hickok, Amber Sinha, "AI and the Manufacturing and Services Industry in India https://cisindia.org/internetgovernance/files/AIManufacturingandServices_Report_02.pdf
- [7] Weizheng Wang, "Applied Research of Industrial Robots in Automotive Intelligent Manufacturing Production Line", IWAACE 2020, Journal of Physics: Conference Series
- [8] Shubham Sen, "Artificial Intelligence in Automobiles: An Overview", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 7, Issue 5, May 2018
- [9] Neelofar Kamal, "Study on Impact of „Make in India“ on Automobile Sector", International Journal of Business Administration and Management. ISSN 2278-3660 Volume 7, Number 2017.
- [10] Amith A Kulkarni, Dhanush P, Chetan B S, Thamme Gowda C S, Prashant Kumar Shrivastava, "Recent Development of Automation in Vehicle Manufacturing Industries", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue-6S4, April 2019
- [11] Meike, Davis, and Leonids Ribickis. "Energy efficient use of robotics in the automobile industry." In 2011 15th international conference on advanced robotics (ICAR), pp. 507-511. IEEE, 2011.
- [12] Akimov, Dmitry, Petr Krug, Andrey Ostroukh, Ekaterina Matiukhina, and Valery Ivchenko. "Development of an automobile robot system model based on soft computing

in an unsteady environment." ARPN Journal of Engineering and Applied Sciences 12, no. 11 (2017): 3433-3439.

- [13] Atkinson, Robert D. "Which Nations Really Lead in Industrial Robot Adoption?." Information Technology & Innovation Foundation (2018).
- [14] Dr. S. Smys, Dr. G. Ranganathan," ROBOT ASSISTED SENSING, CONTROL AND MANUFACTURE IN AUTOMOBILE INDUSTRY", Journal of ISMAC (2019) Vol.01/ No. 03 Pages: 180-187 <http://irojournals.com/iroismac>
- [15] Stefan Z. Jovanović, Jelena S. Đurić , Tatjana V. Šibalija, "ROBOTIC PROCESS AUTOMATION: OVERVIEW AND OPPORTUNITIES", International Journal "Advanced Quality", Vol. 46, No. 3-4, 2018. year, Belgrade, Serbia
- [16] Kanupriya, Sandeep Kumar, " A STUDY ON AUTOMOBILE INDUSTRY IN INDIA", ABS International Journal of Management 2019.
- [17] Neeraj Kumar and Dr. Kuldip Kaur, "CHANGING STRUCTURE OF INDIAN AUTOMOBILE INDUSTRY", International Journal of Current Research Vol. 7, Issue, 07, pp.18009-18014, July, 2015
- [18] Judith Wewerka, Manfred Reichert, " Robotic Process Automation in the Automotive Industry - Lessons Learned from an Exploratory Case Study", Research Challenges in Information Science, May 2021.
- [19] Michal Bartoš, Vladimír Bulej, Martin Bohušík, Ján Stanček, Vitalii Ivanov, " An overview of robot applications in automotive industry", 14th International scientific conference on sustainable, modern and safe transport Elsevier 2021
- [20] Industrial Revolution 4.0 and the Impact on Automotive Sector, December 2021
- [21] <http://library.fes.de/pdf-files/bueros/indien/15840.pdf>
- [22] Frankfurt, "International federation of robotics," 2016. [Online]. Available: <https://ifr.org/ifr-press-releases/news/us-economy-auto-sector-buys-every-second-industrial-robot>.
- [23] N. Vanikar, "Need of Automation in Investment Casting Industry Due to Major Defects Caused by Manual Operations," 2015.
- [24] A. A. Kulkarni, C. B. S, T. Gowda and P. K. Shrivastava, "Recent Development of Automation in Vehicle Manufacturing Industries," 2019.
- [25] Serio, Guiseppe and Ben Stanley. "Accelerating security: Winning the race to vehicle integrity and data privacy." IBM Institute for Business Value. January 2017. <https://www-935.ibm.com/services/us/gbs/thoughtleadership/acceleratesecurity/>
- [26] Aoudni, Y., Donald, C., Farouk, A., Sahay, K. B., Babu, D. V., Tripathi, V., & Dhabliya, D. (2022). Cloud security based attack detection using transductive learning integrated with hidden markov model. Pattern Recognition Letters, 157, 16-26. doi:10.1016/j.patrec.2022.02.012
- [27] Dhabliya, D. (2021). Delay-tolerant sensor network (DTN) implementation in cloud computing. Paper presented at the Journal of Physics: Conference Series, , 1979(1) doi:10.1088/1742-6596/1979/1/012031 Retrieved from www.scopus.com

- [28] Dhabliya, D. (2019). Security analysis of password schemes using virtual environment. International Journal of Advanced Science and Technology, 28(20), 1334-1339. Retrieved from www.scopus.com
- [29] Hahn, Tim, Marcel Kisch, and James Murphy. "Internet of threats: Securing the Internet of Things for industrial and utility companies." IBM Institute for Business Value. March 2018. <https://www-935.ibm.com/services/us/gbs/thoughtleadership/iotthreats/>
- [30] "Intelligent Connections – Reinventing enterprises with intelligent IoT." Global C-suite Study 19th Edition. IBM Institute for Business Value. January 2018. <https://www.ibm.com/services/insights/csuite-study/iot>
- [31] Automotive Industrial Internet of Things IBM Institute for Business Value
- [32] Flexible manufacturing systems using IIoT in the automotive sector Con Cronin, Andrew Conway, Prof, Joseph Walsh 29th International Conference on Flexible Automation and Intelligent Manufacturing (FAIM2019), June 24-28, 2019, Limerick, Ireland.
- [33] The Role of Industrial Robots in the Development of Automotive Industry in China Isak Karabegović <https://www.igi-global.com/article/adoption-of-industrial-iiot-iiot-in-auto-component-manufacturing-smes-in-india/225017>
- [34] Karabegović I.; Husak E.; 2016. China as a leading country in the world in automation of automotive industry manufacturing processes, IV International Congress Motor Vehicles & Moto
- [35] <https://www.xenonstack.com/blog/intelligent-process-automation>
- [36] <https://www.uipath.com/blog/industry-solutions/rpa-in-the-automotive-industry>
- [37] DR. ANKUR KUMAR RASTOGI An Analysis of Indian Automobile Industry: Slowdown as an Opportunity for New Development INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT & MANAGEMENT 2015
- [38] <https://www.mordorintelligence.com/industry-reports/automotive-robotics-market>