

Transforming the Seafood Industry: The Rise of Automation and its Future Impact

A. M. Parmar*, S.B. Sakhiya, R.B. Vala and N. D. Patel

*Department of Fish Processing Technology, College of Fisheries Science,
Kamdhenu University, Navsari*

Corresponding Author

A. M. Parmar

Email: aniruddhsinh123@gmail.com



OPEN ACCESS

Keywords

Seafood industry, Automation, Recent advances

How to cite this article:

Parmar, A. M., Sakhiya, S. B., Vala, R. B., and Patel, N. D. 2025. Transforming the Seafood Industry: The Rise of Automation and its Future Impact. *Vigyan Varta* 6 (10): 151-154.

ABSTRACT

The seafood industry, essential to the global food economy, faces rising demand, labour shortages, high costs, and food safety concerns. Automation offers a powerful solution by boosting efficiency, sustainability, and product quality. Innovations in robotics, artificial intelligence (AI) and the Internet of Things (IoT) are transforming processing stages such as sorting, grading, filleting, and packaging, driving significant growth in the seafood processing equipment market. While automation enhances efficiency, product quality, food safety, and traceability, it also presents challenges, like high upfront costs, specialized training needs, and potential workforce displacement. As automation advances, the industry will adopt more robotics, AI, and IoT, ushering in new business models, sustainability improvements, and higher product quality. Addressing these challenges is crucial for a smooth transition toward a more efficient seafood processing industry.

INTRODUCTION

The seafood industry plays a crucial role in the global food economy, providing millions of people with employment and serving as a vital source of nutrition (Anderson & Wessells, 1992). As demand for seafood continues to rise, so too does the need

for more efficient, sustainable, and safe processing methods. Traditional seafood processing, often reliant on manual labor, faces numerous challenges such as labor shortages, high operating costs, and concerns about food safety (Anderson *et al.*, 1994).



Automation in seafood processing emerges as a promising solution to these challenges, revolutionizing the industry and setting the stage for its future growth.

Recent advances in seafood processing automation

1. **Robotic Automation:** Robotic systems are now capable of performing delicate tasks such as fish filleting with precision and speed, significantly reducing waste and improving product yield (Buckingham *et al.*, 2001). For example, robots equipped with advanced vision systems can identify and sort different species, sizes, and quality of fish, ensuring uniformity and reducing human error (Garcia *et al.*, 2019).
2. **AI and Machine Learning:** AI-powered systems are increasingly being used for quality control in seafood processing. These systems can detect defects, contaminants, and spoilage with greater accuracy than human inspectors (Guo *et al.*, 2016), ensuring that only the highest quality products reach consumers. Machine learning algorithms are also being used to optimize processing operations by predicting maintenance needs, reducing downtime, and enhancing overall efficiency (Subash *et al.*, 2024).
3. **Automated Packaging:** Automated packaging solutions have also gained traction in the seafood industry, offering benefits such as reduced labor costs, faster processing times, and improved hygiene. These systems are designed to handle delicate seafood products carefully, minimizing damage and extending shelf life (Feng & Sun, 2012).
4. **Blockchain and IoT Integration:** The integration of blockchain technology and the Internet of Things (IoT) in seafood processing is another significant

development. These technologies enable real-time tracking of seafood products from catch to consumer, ensuring transparency, traceability, and compliance with food safety regulations (Rowan, 2022).

Recent data and market trends

The global seafood processing equipment market is projected to grow significantly in the coming years. According to a report by Markets and Markets (2020), the seafood processing equipment market size was valued at USD 1.95 billion in 2020 and is expected to reach USD 2.79 billion by 2025, at a CAGR of 7.4%. This growth is driven by the increasing demand for processed seafood products, rising concerns over food safety, and the need for efficient processing solutions (Subash *et al.*, 2024).

Moreover, the adoption of automation in seafood processing is accelerating, with companies investing in advanced technologies to improve productivity and reduce costs. A recent survey by the International Seafood Sustainability Foundation (ISSF) highlighted that over 60% of seafood processors have already implemented some form of automation, with many planning to increase their investment in the coming years (Rowan, 2022).

Benefits of automation

- **Improved Efficiency:** Automation increases processing speed and reduces labor costs (Markets and Markets, 2020).
- **Enhanced Product Quality:** Advanced technology ensures precision and uniformity in filleting, sorting, and packaging (Garcia *et al.*, 2019).
- **Increased Food Safety:** Automation minimizes contamination risks by reducing human contact (Feng & Sun, 2012).

- **Reduced Labor Costs:** Automation reduces dependency on human labor for repetitive tasks (Buckingham *et al.*, 2001).
- **Improved Traceability:** IoT and blockchain enable transparency and supply chain tracking (Rowan, 2022).

Challenges and opportunities

- **High Upfront Costs:** Automation requires significant investment (Markets and Markets, 2020).
- **Training & Maintenance:** Operation requires skilled personnel (Guo *et al.*, 2016).
- **Integration with Existing Systems:** Compatibility issues arise (Subash *et al.*, 2024).
- **Workforce Displacement:** Automation may reduce certain jobs (Anderson *et al.*, 1994).
- **New Business Models:** Industry 4.0 innovations open new opportunities (Subash *et al.*, 2024).

Future trends

- **Increased Adoption of Robotics:** Robotics will handle complex tasks such as filleting, gutting, and sorting (Buckingham *et al.*, 2001).
- **AI Integration:** AI improves predictive maintenance and quality control (Guo *et al.*, 2016).
- **IoT Connectivity:** IoT sensors will be central for real-time monitoring (Rowan, 2022).
- **Advanced Analytics:** Big data will strengthen operational strategies (Subash *et al.*, 2024).

- **Sustainability Practices:** Automation reduces waste and energy consumption (Feng & Sun, 2012).

Case studies

1. Vakash Seafoods Pvt. Ltd. (India): Used AI-powered grading systems with improved accuracy (Garcia *et al.*, 2019).
2. Aqua Star Pvt. Ltd. (India): Implemented robotic gutting systems, improving efficiency (Buckingham *et al.*, 2001).
3. Suryabala Exports Pvt. Ltd. (India): Applied automated portioning machines ensuring precision (Markets and Markets, 2020).
4. Blue Earth (UK): Adopted automated grading systems to reduce waste (Rowan, 2022).
5. Sealpac UK: Provides cutting-edge seafood automation packaging solutions (Subash *et al.*, 2024).

Recommendations

- Invest in Automation to improve efficiency and competitiveness (Markets and Markets, 2020).
- Develop Training Programs to equip workers with technical expertise (Guo *et al.*, 2016).
- Focus on Sustainability when implementing technology (Feng & Sun, 2012).
- Encourage Innovation and support next-gen business models (Subash *et al.*, 2024).

CONCLUSION

Automation is poised to transform the seafood processing industry, addressing many of the challenges it currently faces (Rowan, 2022),

while opening up new opportunities for growth and innovation. By embracing robotics, AI, and IoT, the industry can achieve efficiency, sustainability, and product quality (Subash *et al.*, 2024). As these technologies evolve, seafood processing will become more productive, sustainable, and consumer-driven, ensuring long-term global viability.

REFERENCES

- Anderson, J. G., & Wessells, C. R. (1992). Consumer ability to discern seafood quality: Results of experimental studies. In *Proceedings of the Sixth Conference of the International Institute of Fisheries Economics and Trade* (pp. xx–xx). Corvallis, OR: Oregon State University, International Institute of Fisheries Economics and Trade.
- Anderson, J. G., Wessells, C. R., Kline, J., Morrissey, M. T., & Reilly, T. (1994). *Seafood consumption and perceptions of seafood quality and safety: Results of a survey of Rhode Island consumers* (URI/OSU Research Paper Series, RI-94-103). Kingston: University of Rhode Island.
- Buckingham, R., Graham, A., Arnarson, H., Snaeland, P., & Davey, P. (2001). Robotics for de-heading fish: A case study. *Industrial Robot*, 28(4), 302–309. <https://doi.org/10.1108/01439910110397216>
- Feng, Y.-Z., & Sun, D.-W. (2012). Application of hyperspectral imaging in food safety inspection and control: A review. *Critical Reviews in Food Science and Nutrition*, 52(11), 1039–1058. <https://doi.org/10.1080/10408398.2011.651542>
- Gao, X., Li, J., Fan, L., Zhou, Q., Yin, K., Wang, J., & Wang, Z. (2018). Review of wheeled mobile robots' navigation problems and application prospects in agriculture. *IEEE Access*, 6, 49248–49268. <https://doi.org/10.1109/ACCESS.2018.2866788>
- Garcia, R., Prados, R., Quintana, J., Tempelaar, A., Gracias, N., Rosen, S., & Løvall, K. (2019). Automatic segmentation of fish using deep learning with application to fish size measurement. *ICES Journal of Marine Science*, 77(4), 1354–1366. <https://doi.org/10.1093/icesjms/fsz186>
- Guo, Y., Liu, Y., Oerlemans, A., Lao, S., Wu, S., & Lew, M. S. (2016). Deep learning for visual understanding: A review. *Neurocomputing*, 187, 27–48. <https://doi.org/10.1016/j.neucom.2015.09.116>
- Markets and Markets. (2020). *Seafood processing equipment market by product type, application, and region - Global forecast to 2025*. Markets and Markets Research.
- Rowan, N. J. (2022). The role of digital technologies in supporting and improving fishery and aquaculture across the supply chain – Quo Vadis? *Aquaculture and Fisheries*, 8(4), 365–374. <https://doi.org/10.1016/j.aaf.2021.09.002>
- Subash, A., Ramanathan, H. N., & Šostar, M. (2024). From catch to consumer: Enhancing seafood processing management with Industry 4.0 innovations. *Discover Food*, 4(1), 1–12. <https://doi.org/10.1007/s44187-024-00087-2>