

**Taichi Arioka (PhD) Faculty of Business, Economics & Law**

---

Over the past decade, the manufacturing industry has been propelled by the Fourth Industrial Revolution (I4.0). This new paradigm has driven companies to convert their factories into intelligent ones by seamlessly integrating digital and physical spaces. To achieve this transformation, various I4.0 technologies, such as the Internet of Things (IoT), Big Data Analytics (BDA), Artificial Intelligence (AI), Additive Manufacturing (AM), and Cloud Computing (CC), have been employed. Simultaneously, global interest in sustainability has surged, leading to the advancement of the Circular Economy (CE) as a means to achieve carbon neutrality and resource optimisation at the corporate level. Previous studies have acknowledged the crucial role of I4.0 technologies in realising CE but predominantly focused on some of its specific strategic areas. Notably, extensive attention has been given to "reducing" resource consumption and "recycling" resources, while the area of "rethinking" encompassing product and service design has been understudied despite its profound impacts on the management of resources and processes throughout the subsequent operations. To address this research gap, this study explores how manufacturing companies from New Zealand (NZ) and Japan leverage I4.0 technologies to enhance their dynamic capability in the design phase of CE practices. Drawing on the perspective that product and service design represents a dynamic capability, a qualitative case study approach is designed. By conducting cross-country comparisons between NZ and Japan, this research identifies best practices in leveraging I4.0 technologies during the design phase of CE implementation. The best practices are expected to include supplier involvement in the design phase through IoT, data-driven design through BDA, and precise design specifications through AM. By focusing on the critical aspect, this study will contribute to a more comprehensive understanding of the application of I4.0 technologies in CE implementation. The findings will also offer valuable insights for companies seeking to effectively embrace CE.

**Keywords**

Industry 4.0; digital technologies; circular economy; sustainability; product design; manufacturing; dynamic capabilities