

Advancing Sustainability through the Internet of Things (IoT) in Food Supply Chain Management: A Reflexive Thematic Analysis Approach

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Abstract: This study investigates how the Internet of Things (IoT) can advance sustainability within food supply chain management (SCM). The global food system faces pressing sustainability challenges including waste, inefficiency, and emissions. IoT technologies offer new opportunities to address these issues through enhanced visibility, resource optimisation, and data-driven decision-making. This research explores the role of IoT as a socio-technical enabler of sustainability, identifies adoption barriers, and interprets its integration within established sustainability frameworks. A qualitative research design grounded in Reflexive Thematic Analysis (RTA) was employed to analyse secondary data from academic studies, industry reports, and case examples. A hybrid deductive-inductive coding process was used, combining the *Triple Bottom Line* and *Circular Economy* frameworks with emerging patterns from the data. The study aligns its findings with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2, SDG 9, SDG 12, and SDG 13. Four key themes emerged from the analysis: (1) IoT-driven efficiency gains, (2) transparency and traceability, (3) barriers to sustainable IoT adoption, and (4) IoT as a catalyst for sustainable transformation. IoT enhances operational efficiency, reduces resource waste, and promotes ethical sourcing through real-time data and automation. The study reveals IoT's transformative potential when integrated with technologies such as Artificial Intelligence (AI) and blockchain to support circular and resilient food systems. The findings highlight strategies for cost-effective IoT implementation, cross-sector collaboration, and policy frameworks that strengthen digital infrastructure and governance. These insights support managers, policymakers, and technology providers in leveraging IoT for sustainable and inclusive food supply chains. This study contributes to the theoretical understanding of IoT as a socio-technical sustainability enabler, extending digital transformation research within the food sector. By applying reflexive thematic analysis, it provides a nuanced and integrative perspective on how IoT supports environmental, economic, and social goals simultaneously, offering a pathway towards achieving the SDGs and accelerating the transition to sustainable food systems.

Keywords: Internet of Things (IoT), Food Supply Chain Management, Triple Bottom Line, Reflexive Thematic Analysis; SDGs; Digital Transformation