

# A Framework to develop and evaluate Circular Economy Readiness within the Rail Sector

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## Abstract

The circular economy (CE) has been a policy initiative for supply chain looping strategies to reuse, refurbish, recycle, minimise, eliminate, share, and optimise material and energy use while maintaining firm profitability. Nevertheless, it appears there is no unified reporting framework that defines how effective an organisation's circular economy activity is. Furthermore, such a framework requires systems-wide thinking and co-ordinated action across business, government and society. Also, it appears there are no previous studies that have examined how an organisation's CE effectiveness can be developed or measured specifically based upon Systems Theory. In particular, within the context of how an organisation designs itself, its products and services, such that it can continually adapt and remain viable and sustainable in the future.

If organisations were concerned enough about their own viability in relation to the products and services they sell and the impact that they have on the environment, then their business strategies and plans would include evidence to continuously improving circular economic activity.

If customers and Regulators understood how effective an organisation's products and services were in having a reduced or minimised impact, or better still, had a regenerative effect on the environment then this would create visibility of CE competition and CE value against incentives.

To create a CE competitive environment, the products and services that form part of that CE competition relies upon 'thinking in systems'. Systems Thinking is the ability to understand and/or design non-linear interdependencies of feedback relationships in context. For example, within a CE context, designing things for their next use, design for disassembly, maintaining the residual value of raw materials, designing products as an asset instead of a liability (to the environment) and designing products of service.

As this research is still a work in progress, this paper does not aim to present a conclusive approach or methodology; rather, it presents a progressive step towards the development of a CE readiness framework within the rail sector.

The longer-term aim for the outcome of the research in future will be to form the basis to enable a common platform to determine levels of CE value/competition not only within the Rail sector but wider industry.

## Keywords

Circular Economy, System thinking, Ethics in Engineering, Environment Strategy, Sustainability, Viable Systems Methodology (VSM), Problem Solving Methodologies, Business Strategy, Innovation.

## Biographies

**Carl Waring** is a Principal Consultant at Frazer-Nash Consulting Ltd, a Lecturer in Ethics in Engineering and Innovation and Risk Management and a PhD Researcher at the College of Engineering and Technology University of Derby, UK. Carl is a Chartered Engineer and Chartered IT Professional and has in excess of 25 years in consulting in developing and improving the ways and means in which organisations manage and invest in infrastructure / Asset Management (ISO55000) as well as managing and investing in information technology. He earned his Masters in Information Management from Birmingham City University focusing his research in computer supported cooperative working based upon systems theory and problem solving methodologies. His current research interests and work include complexity in organisations, applied systems theory, strategy development, organisational readiness, how to determine organisational capability set against objectives, circular economy, data readiness within the context of being able to exploit Artificial Intelligence and Machine Learning and Asset Management across Rail, Highways and other infrastructure sectors. He has worked in rail engineering, railway regulation, worked overseas including Hong Kong, UAE, USA and Australia and presented at a number of conferences in particular around Systems Theory and Asset Management.

**Kapila Liyanage** is a Senior Lecturer in Engineering Management at the College of Engineering and Technology, University of Derby, UK. He earned B.Sc. (Hons) in Physics with Industrial Management from the University of Kelaniya (Sri Lanka) and PhD in Computer Simulation of Manufacturing Systems from the Sheffield Hallam University (UK). Throughout his academic career, he has received achievement awards for outstanding performance in teaching and doctoral supervision. His current research interests include sustainable operations and supply chain management, circular economy, systems modelling & simulation and Industry 4.0. He has PhD and MPhil completions and supervise on-going PhD research work in the area of sustainable operations and supply chain management. Dr Liyanage has over 40 publications in high impact factor journals and leading international conferences. Dr Liyanage is currently serving as a regular reviewer for leading international journals including the Journal of Cleaner Production and Sustainability MDPI. Furthermore, he has served as a technical committee member for several international conferences and been invited to give Keynote Speeches at several international conferences. He is also a fellow member of the Higher Education Academy (FHEA) and a member of the Institution of Engineering Technology (MIET).