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A Systematic Literature Review of the Concept of Circular Economic Readiness and a Proposed Circular Economy Readiness Scale

Carl Waring ^{a[1]} and Kapila Liyanage ^a

^a College of Science and Engineering, Markeaton Street, University of Derby DE22 3AW, UK

> Abstract. The response to climate change for example, considering the concept of sustainability, is lagging. Meaning, current Regulation is only limited to slowing the impact of climate change down with an aim of not making the current situation any worse. The circular economy (CE) is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste and pollution and regeneration. The application of CE practices relies upon the deployment of systems thinking, However the effective deployment of systems thinking across the circular economy is only limited to simple ad-hoc interventions. This paper conducts a systematic literature review (SLR) of readiness frameworks that assess the effectiveness of the deployment of circular economic interventions in relation to corporate goals. That includes the effective deployment of systems thinking across the discipline of Asset Management. This SLR differentiates itself from others because it identifies a number of research gaps and proposes a simple concept of a readiness scale that can be used to measure and determine an organisation's or network of organisation's circular economic readiness, being the organisational capacity to carry out planned business activities to fulfil business strategy and planned objectives. This includes incorporating emergent values created from the deployment of complex systems thinking practices. As this research is still a work in progress, this paper does not aim to present a full readiness framework; rather, it presents a progressive step towards the development of a simple readiness scale which will serve as the basis for a holistic CE readiness framework.

Keywords. Circular Economy, System thinking, Readiness, Asset Management

1. Introduction

The response to climate change for example, considering the concept of sustainability, is lagging. Meaning, current Regulation is only limited to slowing the impact of climate change down with an aim of not making the current situation any worse. The term sustainability itself can obscure real issues [10] and the emerging baseline for sustainable

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¹ Corresponding Author. C.Waring@derby.ac.uk

investment for Environment and Social Governance (ESG) is becoming marred by political corruption [8].

Unless incentivised otherwise, organisations in general would only seek to adopt the minimal amount of change to meet compliance rather than have a desire to exceed it. Therefore, there is a need for a way in which organisations can express their circular economic value differentiators as the outcome of their business strategy, thus informing circular economic competition [18].

1.1 The Circular Economy

The circular economy (CE) is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste and pollution and regeneration. The application of CE practices relies upon the deployment of systems thinking. CE can be considered as a strategy within the scope of sustainability Ruggieri et al [15] However, its effective deployment has been limited, possibly because of its emerging identity, maturity and perceived value over time [19] but can now be considered as 'an economic system that replaces the 'end-of-life' concept' [11].

1.2 Asset Management

Asset Management [9] is the management of the whole life of assets. The Standard "enables an organisation to realise value from assets in the achievement of its organisational objectives" [16]. However, if the business goals did not value a particular theme e.g. the adoption of CE then the asset management system would not be obliged to consider them [6]. Ness and Xing [13] however recognises the focus on CE adoption for the built environment incorporating asset management and wider stakeholder/actor engagement. This is a missed opportunity.

1.3 Systems Thinking

Systems thinking relies upon multi methodological concepts and approaches and is a way of thinking that uses the concept of 'system' to make meaning of different phenomenon, to understand problem situations and deal with various issues.

The main benefit of deploying systems thinking is to create 'emergence'. That is, emergence is an outcome that is greater than the sum of its parts, for example the emergence from a railway system grows the economy, connects interdependent societies, enables people to be educated, employed and travel sustainably compared with other means of transport.

However, there is limited deployment of systems thinking across the circular economy. For example, there is limited research available as to what represents an organisation's 'circular economic management system'. This could be defined as 'the strategy, plan and combined designed circular economic effort *and value created by actors for the benefit of stakeholders to enable regeneration*'.

The identity and scope of what this means should be defined by each actor (or organisation or network of organisations) in relation to the value and identity they create with stakeholders in relation to the economy, the environment and wider society. Typically, the systems thinking concepts that could be deployed could include Soft Systems Methodology (SSM) [5], Viable Systems Modelling (VSM) [2], Ashbys Law

of Requisite Variety [1] Strategic Options Development and Analysis (SODA) and Systems of Systems Modelling (SOSM) to name only a few. Importantly Ness and Xing [13] touch on the deployment of Soft Systems Methodology one of several systems theories to use as performance principles for strategic asset management.

1.4 Readiness

Readiness is the organisational capacity to carry out planned business activities to fulfil business strategy and planned objectives. Business strategy and planning is bounded in the future and should be continuously adapted in the short, medium and longer term. In this case the term readiness is the organisation's capability to adapt to those emerging business strategies.

On the basis that if you adopt circular economic strategy then the more sustainable you will become, then it follows that there is a need to determine an organisation's status of circular economic readiness at a point in time.

The way this is done with other themes is to bound the theme as a management system with identity and value, develop a strategy that creates the organisation's CE vision and develop a strategic plan that enables that value for example the value from circular economic activities delivered through a strategic circular economic management system.

The discipline of asset management already accommodates the discharge of corporate goals through its asset management strategy and plan and there is potential for it to accommodate the adoption of CE strategy, planning and practice. This represents an opportunity. Within a systems thinking context, the concept of a 'circular economic management system' is novel [18]. If such systems were designed and specified as a requirement as part of the corporate goals, then the readiness of an organisation's circular economic management system would represent how the organisation creates regenerative value.

2. Research Methodology

A number of potential gaps have been identified that translates to the concept of understanding an organisation's or network of organisation's state of circular economic readiness within the context of the organisation developing its circular economic strategy as part of its identity and value proposition. This includes how that organisation exploits the effective deployment of systems thinking in relation to an organisation's 'circular economic management system', and how that system is enabled through the discipline of asset management as an overarching enabler for CE.

This research looks to analyse the published literature using a systematic literature review which will contribute towards filling this gap. A systematic literature review is a specific methodology that locates existing studies, selects and evaluates contributions, analysis and synthesises data, and reports the evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known [4]

2.1 Research Questions

As part of the SLR process it is important to structure the line of enquiry around specific research questions. This SLR has used the following questions:

RQ1. What readiness frameworks are available that assess an organisation's overall circular economic engagement, commitment and value as part of its business strategy?

RQ2. From those frameworks, which of those exploit the value of applied systems thinking such that emergent properties and value of circular economic effort and interventions can be interpreted on an emergent scale.

2.2 Research Criteria and Sources

An SLR requires a declared search criteria that which bounds the line of enquiry in relation to the research questions. Articles and papers were reviewed from a broad range of sources and prominent sources of CE and Asset Management guidance.

The specific search items included: "Circular Economy + Readiness + Framework", "Circular Economy + SSM", "Circular Economy + VSM", "Circular Economy + SODA", "Circular Economy + SOSM", where the use of SSM, VSM, SODA and SOSM would be used as more advanced/complex deployment of systems thinking. The search criteria also included "Circular Economy + ISO 55001" where ISO 55001 is the Asset Management Standard. The research period started from 2000 which includes for example some of the earlier terms used for similar circular activities such as 'Cradle to Cradle' [3]

The initial search returned 26 results. A large proportion of these were about ad-hoc circular economic interventions around a specific material or specific parts of the asset lifecycle. For example, areas that would impact only part of the organisation's business model.

2.3 Results/Findings

Of particular relevance to the line of enquiry was Pigosso [14] research around a circular economic self assessment tool, implying a degree of readiness relative to the number of circular characteristics an organisation may adopt. As the paper points out the limitation of the framework is that it is not qualitative. For example, it would not be able to determine the value of adopting such practices.

A similar framework 'Circularytics' is provided by The Ellen MacArthur Foundation [7] which is a measuring tool around characteristics of circular economic activity. Both frameworks have similar constraints. Interestingly Circulytics refers to Asset Management but does not make the link that the discipline of asset management could be an enabler for circular economic deployment. In some respects both frameworks take a deconstructionist view that if the detail of a system are understood then those components can be replicated. This view is not always relevant, particularly in relation to developing business strategy.

It does not necessarily follow that the more circular economic characteristics an organisation has, makes that organisation more circular economically effective. The scope of CE characteristics should align with business strategy and goals. In addition, this paper describes the term readiness as meaning something different to that as

described by Pigosso [13] For example this paper is focused on value and outcomes relative to the organisation's goals in perpetually becoming more circular economic and also considers readiness to include the organisation's ability to adapt as part of Complex Adaptive Systems (CAS).

Organisations cannot become 'circular economy compliant', they can however apply circular economic concepts better than others to become more sustainable and offer or produce more regenerative outcomes. Therefore, it's the output or impact of the circular economic system that matters at a point in time that is an effective measure and what that planned system's impact is in the future. This is where the value of emergence can be designed, planned and described.

The research also found an alternative interpretation of readiness [17] which looks at organizational aspects that would encourage or prevent organizations considering the circular economy or parts of it as a business strategy. This is relevant to the field, however the approach may be more aligned to determine as to whether an organization is 'receptive to adopting circular economic practices' as opposed to be ready for it.

Given the definition of readiness as described in this paper, the results and findings associated with circular economic frameworks can be summarized into the following high level groups:

- Group 1: General descriptions of types of circular economic interventions and characteristics that an organization may accommodate. Some of these are called readiness frameworks but not as defined in this paper. Some papers described these characteristics as CE best practice. However, from a systems thinking perspective 'best practice' is relative. A more appropriate term would be 'good practice'.
- Group 2: Operating models and characteristics thereof of hypothetical or existing organization circular economic behaviour.
- Group 3: Specific circular economic interventions around a limited part of the asset lifecycle for 'non-circular economic' organisations. For example applied as an afterthought to a linear economy organisation.

There was limited evidence in the deployment of systems thinking and application of multimethodological approaches with exception to Malvina Roci [12]. This paper applies relevant systems thinking to the circular economy within the context of Complex and Adaptive Systems (CAS) which looks at actors and stakeholder relationships. This is particularly relevant as it describes the dynamics of complex relationships between actors and stakeholders.

There is limited research activity around the subject of the circular economy and asset management. However, it is recognized that there are opportunities to exploit asset management strategy as an enabler for the circular economy [13]. It would help if corporate goals incorporated the drive to adopt circular economic strategies and practices. Evidence of this is emerging.

3. Proposed Circular Economy Readiness Scale

This paper has been specific in describing what the term readiness means. Within a strategic context, circular economic readiness is the organisational capacity to carry out planned business activities to fulfill business strategy and planned objectives. The assumption must be that the organisation by design must be seeking to become more circular economic as part of its identity and value offering. The alternative is to carry out

ad-hoc circular economic interventions on linear based organisations. The paper suggests also that there is the need to deploy more complex systems thinking approaches in order to generate greater circular economic value.

Systems thinking approaches already exist but have yet to be deployed effectively across the circular economy with great effect. What's more, it is more about the outcome or emergence of the impact of the circular economic management system rather than concerning what the system comprises.

There is a risk that the circular economy becomes a tick box activity. To avoid this, perhaps there is the need then for organisations to interpret the value or outcome of creating emergent circular economic interventions at a point in time through the application of a scale. This scale can be used to plan, validate and assure current and future circular economic interventions and reflect on an organisation's circular economic value proposition and effort in engaging with circular economic activity. This scale could apply to any sector.

Building on the definition of readiness defined here, value of circular economic interventions can be thought of through three dimensions which need to be worked on simultaneously:

- Circular economic interventions with the here and now, dealing with what you already have.
- Circular economic interventions that need to happen prior to the asset existing, for example with the benefit of future circular economic hindsight.
- Circular economic enabling changes, existing things that need to be adapted, new things that need to be developed whether they are temporary as part of a transition as the organisation designs its circular economic future or new permanent things that are needed as part of that future to exist and that future that the organisation wants to be part of. In economic terms, how you extend and link the value of your products and services with externalities.

If organisations were serious about adopting circular economic practices they would consider and work across all three dimensions, all of the time and never stop.

3.1 Circular Economy Readiness Scale Concept

The circular economic readiness scale (CERS) is dependent upon several foundational principles described below. The scale also requires both internal and external top-down and bottom up drivers and enablers. For example, a high level external and internal driver could be that the organisation wants to be seen as being 'more circular economic' than its competitor.

The scale is intended to work at multiple levels of complexity meaning it would work for a single actor or stakeholder or multiple actors and stakeholders, thus forming for example a 'circular economic syndicate' at a point in time. There are two main principles:

1. The organisation's identity is formally engaged with and adopts the concept of the circular economy and is therefore committed to developing its circular economic policy, strategy and strategic circular economic plan and implementing the plan through its circular economic management system or similar. This is an ongoing commitment. Further context is provided in the tables below in relation to the Rail Sector and the deployment of Asset Management.

- 1.1) Within the context of the Rail Sector, the rail sector identifies itself as the most sustainable form of transport compared with alternative means and is promoted as such at the highest level from government/local government sponsorship and in so doing promotes the sector and its supply chain to engage with circular economic practices under a coordinated and integrated approach, promoting circular economic good practice.
- 1.2) Within the context of Asset Management, the drive for circular economic value will be defined through the organisation's Rail Sector related business goals and enabled through its asset management strategy and strategic asset management plan.
 - 2. In so doing, the organisation will continually move away from a 'take-makewaste' operating model towards sustainable/regenerative modes of operation.
- 2.1) Within the context of the Rail Sector the sector will promote viable operating models and commercial frameworks, circular economic syndicates (networks of actors and stakeholders that provide circular economic solutions as opposed to those that don't).
- 2.2) Within the context of Asset Management, asset management will be deployed at advanced levels of practice that uphold the strategic circular economic plan, the design, integrity and configuration of the asset and asset systems through its multiple lifecycles, upholding asset service delivery in a drive for example for closed loop circular economic management systems involving a strategic network of actors and stakeholders that are part for example of that circular economic syndicate.

The CERS scale is shown in Figure 1 and is split into three horizontal levels. The top range represents the emergent and interdependent characteristics and organisational capability of advanced CE activities managed under CE policy and CE management systems or equivalent resulting in regenerative outcomes. The middle range represents the transition from linear to non-linear CE organisational capability. The bottom range represents circular economic interventions applied to linear based businesses i.e. the outcome of these interventions will never be regenerative. A good example of that would be only considering the circular economy value within the context of recycling where recycling is considered as a circular economic failure.

The scale comprises a dimension along the vertical axis on the left-hand side that represents a range of circular economic levels. These dimensions are progressive and interconnected, for example moving up the scale would involve adopting higher levels of interdependent circular economic activity enabling additional CE benefits as well as relying upon the deployment of more complex systems thinking concepts and more advanced asset management capability. This scale ranges from -5 (simple/basic deployment of CE capability) to +5 (complex/advanced deployment of CE capability) Where +5 for example represents asset systems as services that are closed loop CE systems linked to supporting local industries and communities and taken advantage of by stakeholders, is fully sustainable, enables balanced external societal benefits and biodiversity and provides more regenerative outputs compared with alternatives.

The CERS can be used to locate the current level of CE readiness of the organisation (or syndicate) at a point in time and continually develop a strategy and strategic CE plan that enables the organisation to move from one level of readiness to the next.



Figure 1. Circular Economic Readiness Scale

Explaining it in this way provides insight into the value of exploitation of applied systems thinking and emergence where CE value is created and how that value increases exponentially. In context an example of both ends of the readiness spectrum are shown in Table 1. Further incremental and emergent values could be defined and improved across the spectrum.

Scale	What does this mean for CE Readiness in a generic context?	What does this mean for CE Readiness in a Rail context?	What would asset management be enabling to achieve this level of CE Readiness in Rail?
+5	CE syndicates are formed operating under a competitive CE environment, external beneficiaries established, CE is enabling growing regenerative capability.	e.g. Outside demand and regenerative capability is accelerating for railway systems, offsetting less sustainable means of transport. Stakeholders and communities are generating pull. CE competition well established.	e.g. Closed loop asset systems are established, Asset Systems as services are prevalent, modular and multiple asset lifecycles have been established, dependent upon multiple whole life cost optimisation and real time asset performance monitoring.
0	Initial recognition of CE value or equivalent and at a starting point to initiate CE management system/s	Identification of the need to link up the value of what rail brings to wider social, environmental economic sustainability,	Evidence of work involved to consider enhancing asset management systems to accommodate more advanced deployment of asset management to accommodate future CE demand.
-5	No recognition of CE	No recognition of CE value or regenerative capability, generally responding to regulatory compliance.	General maintenance within the context of the design life of the asset.

Table 1. CE Readiness Scale Spectrum (Rail/Asset Management)

This research has defined the term readiness within a business and strategic context, then looked at research related to circular economy readiness frameworks. The majority of the frameworks are not readiness frameworks within a strategic business context but more about a list of circular economic characteristics as an aid to learn and interpret and promote circular economic activity.

4. Conclusion

This research is still a work in progress, this paper does not aim to present a full readiness framework; rather, it presents a progressive step towards the development of a simple readiness scale which will serve as the basis for a holistic CE readiness framework.

There is potential that the concept of readiness in relation to the circular economy may become a tick-box exercise. This needs to be avoided as it will prevent circular economic value being realized. This research has determined that the deployment of systems thinking is limited across circular economy. This presents the greatest opportunity as the circular economy is not an end in itself but also a way of thinking and working with the way the economy works and you use systems thinking to develop new ways and means in which actors and stakeholders engage with that economy.

This paper changes the thinking about how to think about the value of circular economic interventions and ties this back to business strategy. This is in the form of readiness within the strategic context as you are either ready to go to the next stage of your circular economic journey or you are not.

Organisations can choose whether they are circular economic are not. By definition if you are not circular economic your business is not sustainable. This research around readiness frameworks and a readiness scale helps to open up and sharpen the debate.

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