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Framework for implementing the principles of the circular economy in organizations – Guide

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 May 2017. It was prepared by Technical Committee SDS/1/10, *Sustainable resource management*. A list of organizations represented on this committee can be obtained on request to its secretary.

Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Although this British Standard is primarily intended to be used in the UK, it is expected that many of its provisions and guidance will be applicable in other jurisdictions.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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Section 1: General

0 Introduction

0.1 Overview of this British Standard

This British Standard is intended to help organizations and individuals consider and implement more circular and sustainable practices within their businesses, whether through improved ways of working, providing more circular products and services or redesigning their entire business model and value proposition.

This standard aims to provide a framework and guidance to a broad range of organizations, of differing sizes and with varying levels of knowledge and understanding of the circular economy. Starting with smaller, "quick-win" type initiatives can be a good way for organizations new to the circular economy to gain relevant experience and confidence.

The standard is divided into two areas:

1) What is the circular economy and why move to a more circular and sustainable mode of operation? Clause **3** aims to help organizations improve their understanding of the circular economy and how it might be relevant.

2) How to implement the principles of the circular economy within an organizational context? These sections form the majority of the standard and Figure 1 provides an overview of the key elements which are classified as "Guiding principles", "Flexible framework" and "Supporting guidance".

   - Guiding principles: Clause **4** outlines the principles of the circular economy which underpin the flexible framework and provides a strategic frame of reference for how closely decision making and activities align with the guidance provided.
   - Flexible framework: Clause **5** provides a flexible framework for organizations to use to determine the extent to which they intend to implement the principles of the circular economy and transition to a more circular and sustainable mode of operation.
   - Supporting guidance: Clause **6** and Clause **7** provide supporting guidance and are intended to be read alongside Clause **5**. These clauses provide guidance on enabling mechanisms and business models that can support the transition to a more circular and sustainable mode of operation, as well as key factors which it might be relevant to consider when using the framework.

Many elements of the framework and guidance have been developed by drawing on experiences and lessons learned from a range of organizations, both small and large, attempting to become more circular. Many aspects mirror what could be thought to be the basics of good sustainable business practice, but in this standard they are solely being examined from a circular economy perspective.

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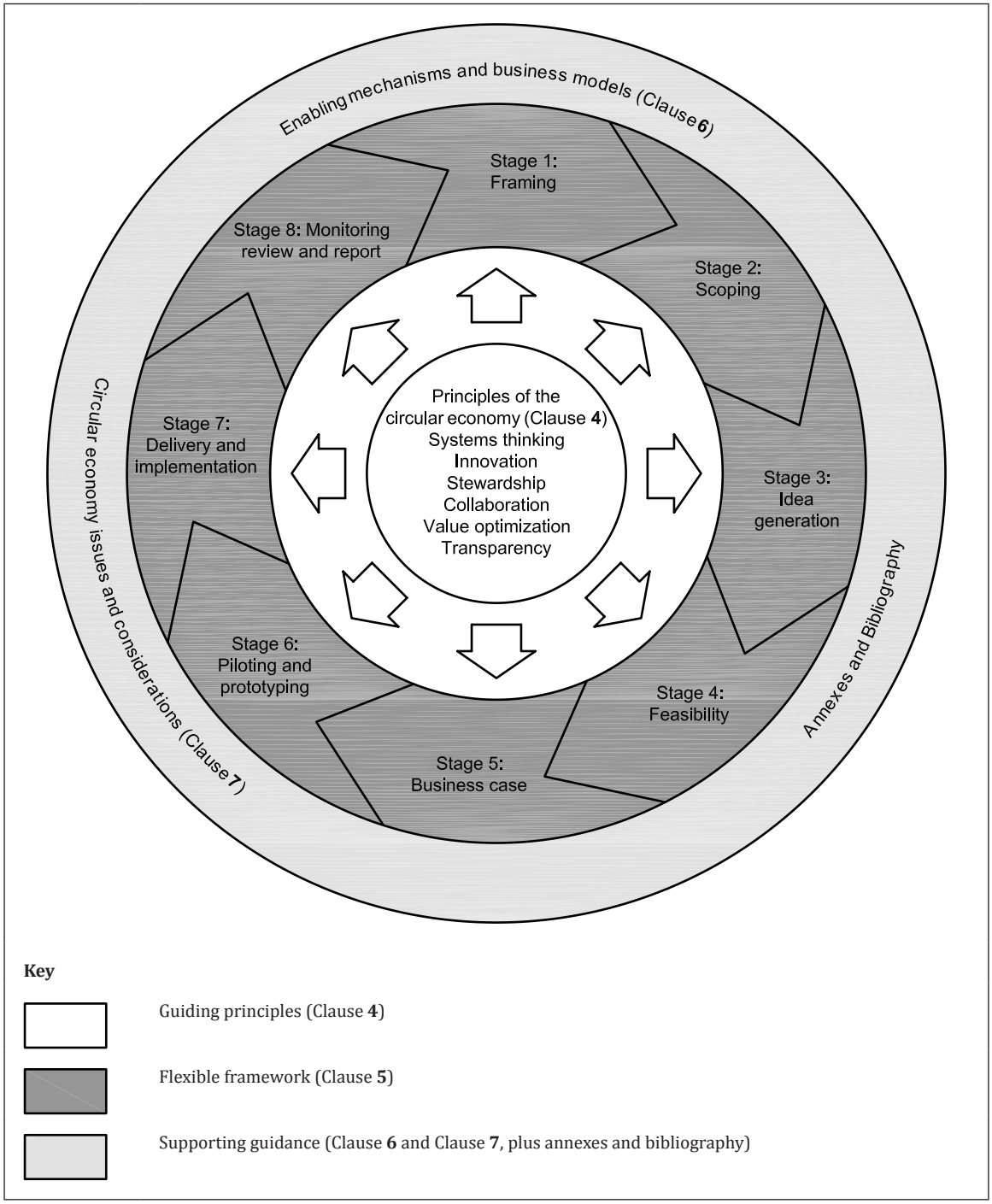
Figure 1 — *Overview of the framework for implementing the principles of the circular economy*



0.2 General

Natural resources, including materials, water, energy and fertile soil, are the basis for sustaining society. However, the activities of the large and growing human population is rapidly eroding many of the world's natural resources, while a large part of an increasingly urban global population is still struggling to meet basic needs.

Over the next 30 to 40 years unprecedented volatility and uncertainty seems likely. The global population is estimated to increase to around 8 billion by 2030, probably to over 9 billion by 2050, with increases in average wealth further raising the demand for products and services. As a result,

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competition for land, water and energy could intensify while the effects of climate change are likely to become increasingly apparent. Over this period, organizations are likely to face technological disruption, increasing trade barriers and intense competition for a wide range of material resources that become less easily available (which might also be due to geopolitical factors). Even today, some materials, such as rare earth elements and other critical raw materials, are already subject to supply pressure and price volatility.

To ensure the availability of resources in the future, current patterns and volumes of production and consumption need to change dramatically so that they are brought back. within planetary boundaries. To do this while continuing to thrive as a society, a complete re-think of how things are done is needed. Transitioning to a circular economy could offer a significant contribution to solving the emerging resource and climate problems and create opportunities for shared value.

In an organizational context, the circular economy refers to a systemic approach to the design of processes, products/services and business models, enabling sustainable economic growth by managing resources more effectively as a result of making the flow of materials more circular and reducing and ultimately eliminating waste. The energy required to fuel this needs to be extremely efficient and renewable by nature. As a term, the circular economy is increasingly gaining traction in business as more organizations recognize that the traditional, linear "take, make, use, dispose" (or "cradle to grave") economic model is potentially reaching its limits and the availability of cheap, easily accessible materials and energy can no longer be taken for granted. The economic benefits of improved circularity of resource use are also increasingly being recognized and acted upon by governments around the world (see, for example, the *EU action plan for the circular economy* [1]).

The circular economy is not a new concept. It blends the principles of multiple schools of thought, some of which date back to the 1960s. These include: industrial ecology and symbiosis, performance economy, biomimicry, cradle to cradle, blue economy, regenerative design and natural capitalism (see Figure 2). More recently, the Ellen MacArthur Foundation (EMF) has been widely credited as playing a pivotal role in engaging the business, policy and education community, focusing on the key pressure points and levers that can accelerate the transition to a circular economy.

NOTE See the following publications for further information on these schools of thought: Graedel and Allenby, 2002 [2] and Ayres and Ayres, 2002 [3] for industrial ecology; Chertow, 2007 [4] for industrial symbiosis; Stahel and Redray, 1976 [5] and Stahel, 2006 [6] for performance economy; Benyus, 1997 [7] for biomimicry; McDonough and Braungart, 2008 [8] and McDonough and Braungart, 2013 [9] for cradle to cradle; Pauli, 2010 [10] for blue economy; Lyle, 1996 [11] for regenerative design and Hawken, Lovins and Lovins, 2010 [12] for natural capitalism.

Because the idea of a circular economy proposes a real paradigm shift and a different way of thinking about the economy, it cannot easily be reduced to one simple definition. As a result, there are various interpretations of the idea across organizations, together with an abundance of terminology, often misused or used interchangeably. This adds to the complexity of the concept, which can in turn deter organizations seeking to improve how they manage resources.

This British Standard focuses on the circular economy as it is relevant for organizations. The central tenet is to take full advantage of the reusability of products, components and materials, the restorative and regenerative capacity of natural resources and to optimize value creation (both directly and indirectly). It is an approach which promotes optimal use of resources, reuse, repair, refurbishing, remanufacture and the recycling of materials and products (shown conceptually in Figure 3), as well as the preservation and regeneration of natural capital by returning biological nutrients into the biosphere. Process and product or service design and innovation (e.g. for repair, reuse, recyclability) can be complemented by business model design and innovation using approaches such as performance-based models to manage how products and materials circulate within the system.

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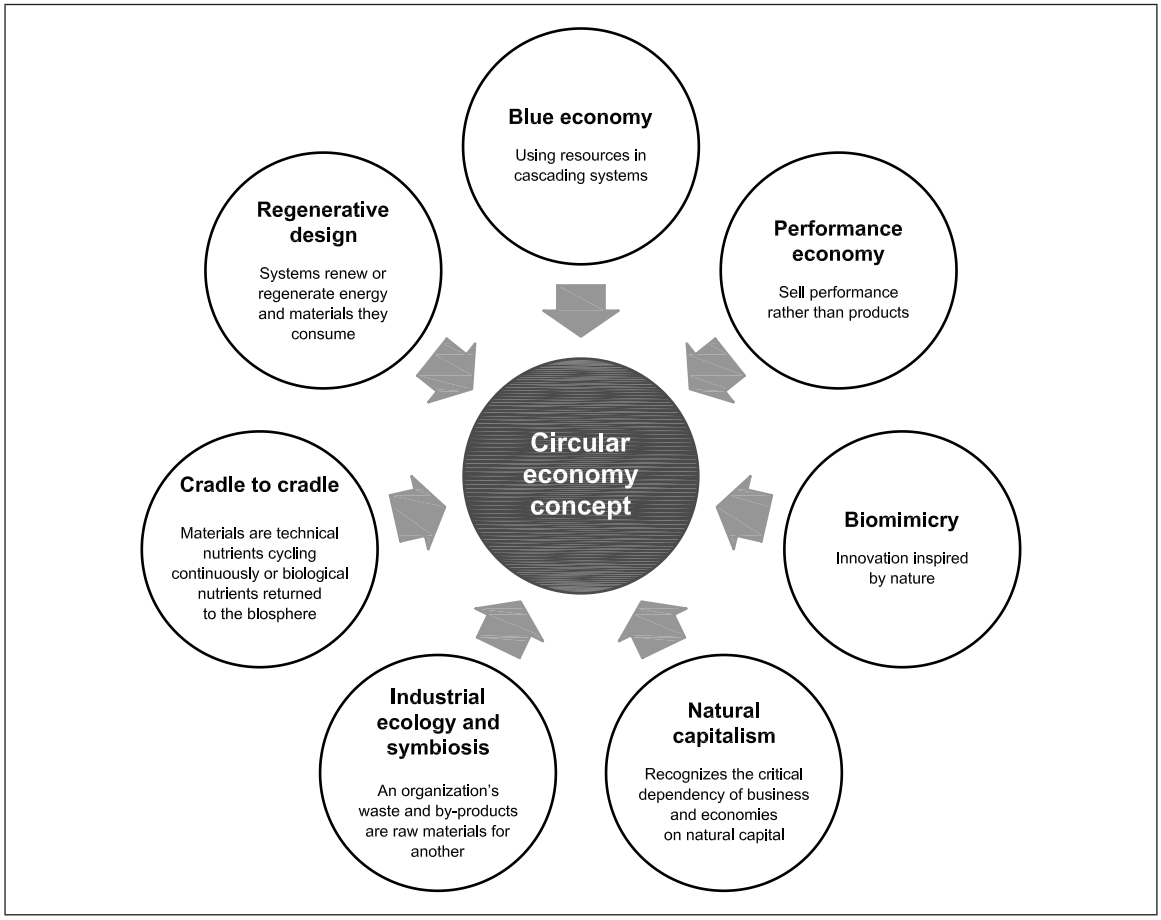
Figure 2 — *Circular economy schools of thought*



In theory, the smaller the loop (activity-wise and geographically) the more profitable and resource efficient it is likely to be. For example, it might be that the nearer to their original state products, components and materials can be kept the more value can be captured through the avoidance of processing, transport and other costs. However, in practice, which loop is best for an organization depends on the specific circumstances and a wide range of business risks or consequential impacts need to be considered (e.g. sourcing and geopolitical risks, energy usage and costs, environmental and social impacts, complexity, geographic scope, organizational capability, economic viability/return on investment).

In the circular economy, materials should not be discarded as wastes, but treated as raw materials with inherent value. The prevailing policy and legislative landscape, changing economics and emerging technologies can ultimately play a major part in deciding how far the transition to full reuse and recovery of material can be achieved. Ultimately, the circular economy is about organizations "turning things on their head" and completely re-thinking how resources are managed in order to enhance financial, environmental and social benefits, both in the short and long term.

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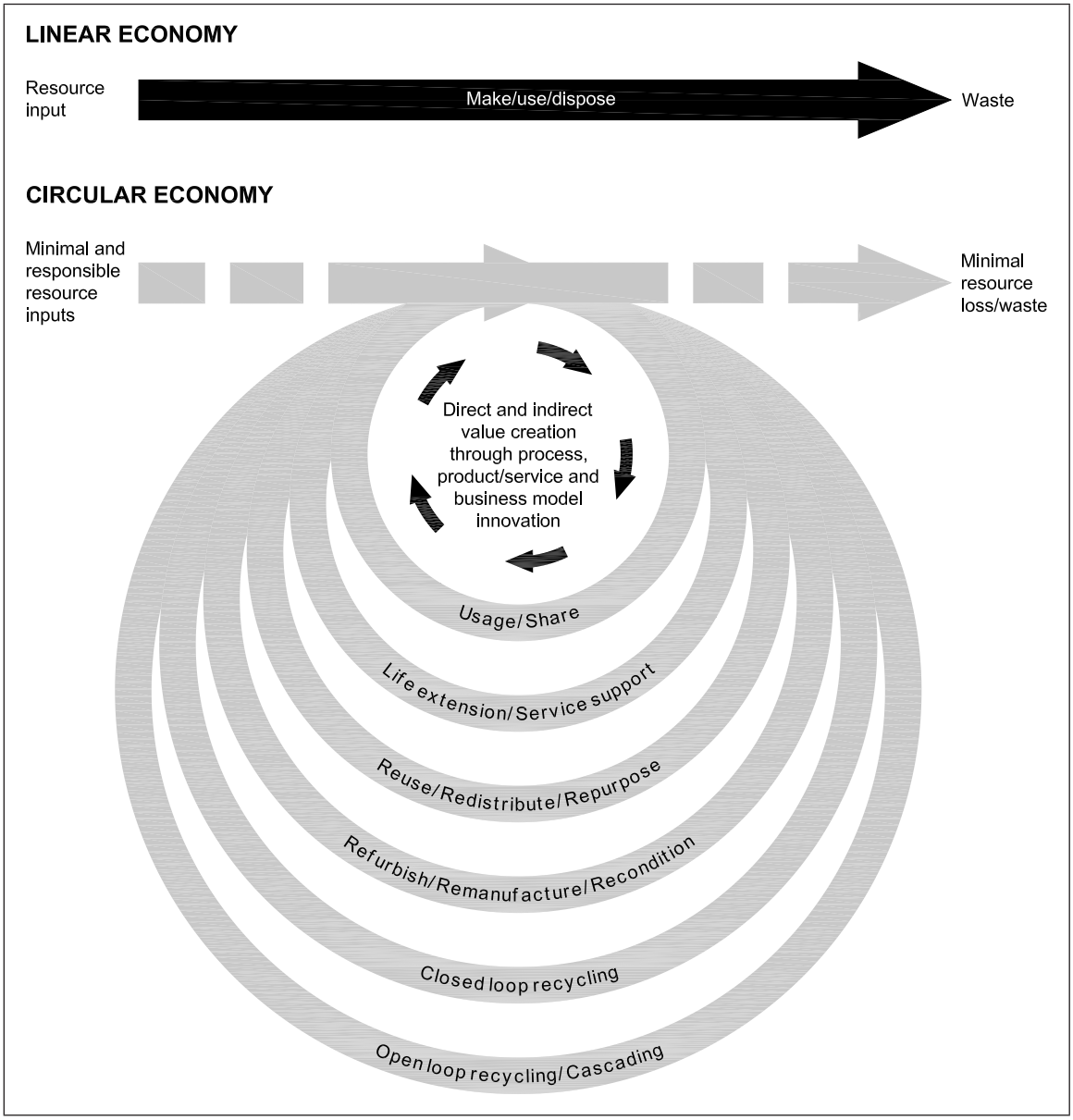
Figure 3 — *The circular economy at a glance – optimizing value creation through circularity*



0.3 Relationship with resource efficiency

Resource efficiency needs to be embodied within a circular economy approach. Whilst resource efficiency and the circular economy are sometimes referred to interchangeably, there are some distinct differences. Resource efficiency does not necessarily challenge the linear model of consumption and production.

Resource efficiency is a broad umbrella term used to describe efforts to reduce the total environmental impact of the consumption and production of products and services, from raw material extraction to final use and disposal. In a materials context, it is concerned with the efficient use of materials, waste prevention and reduction, and causing minimal damage to the environment and depletion of natural resources. It means doing more with less and delivering greater value with less input.

Organizations might become more resource efficient through relatively simple, incremental actions. A circular economy takes a whole systems perspective, where resources are systematically restored or regenerated. It means being more effective and optimizing how resources are managed

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across their life cycle in order to have a positive impact on the natural environment and society. Implementing its principles in an organization might require a paradigm shift in how an organization operates.

0.4 Relationship with zero waste

Over the last few decades, zero waste has become an aspirational goal for transitioning from a "throw-away" society. Several high profile businesses around the world have set zero waste targets, orientated predominately around sending nothing to landfill. A number of cities around the world have also adopted zero waste goals as part of their waste management strategies.

Zero waste is a philosophy that encourages the re-design of resource life cycles so that all materials and products are reused or recycled. It discourages the use of waste to energy, incineration or landfill, and ultimately seeks to eliminate the concept of waste altogether. In practice however, the concept can be perceived as waste focused and has been applied loosely and inconsistently. For example, zero waste claims have been made solely on the basis of 100% landfill diversion made possible by relying disproportionately on waste to energy or by not reporting wastes generated throughout the supply chain.

NOTE For further information on zero waste, see <http://zwia.org> [last viewed 9 May 2017].

Whilst zero waste does not necessarily lead to more circular solutions, if applied with the right mind-set the concepts are complementary and it is possible to progressively step towards a circular economy.

0.5 Relationship with the bioeconomy

The bioeconomy or bio-based economy refers to parts of the economy that use renewable resources which are biological in nature from land and sea (such as crops, forests, fish, animals and microorganisms) to produce food, materials and energy.

The bioeconomy is defined by the origin of the resources, not their management or use. Biological resources can be used or reused to make new products, components or material (e.g. paper or card) or returned to the biosphere in a way that rebuilds natural capital (through composting or anaerobic digestion, for instance).

The circular economy covers all renewable and non-renewable resources. There is a perception that the bioeconomy is inherently circular because biological resources are renewable. In practice, it can be quite linear because it is possible for resources to be used faster than they are replenished and might not be returned safely and appropriately to the biosphere to rebuild natural capital. However, a circular bioeconomy has a major role to play in helping the transition away from using fossil and other finite resources through the provision of bio-based products which can managed via the biological or technical cycles.

0.6 Relationship with lean thinking

Lean thinking describes a holistic continual improvement approach to creating more value for customers with fewer resources. Lean organizations aim to use fewer human resources, less material to create products, less time to develop them and less energy and space to produce them. Lean is focused on customer demand and developing high quality products and services in the most effective and economic way. Although lean thinking is most commonly associated with manufacturing and production, it can be applied to all aspects of an organization including internal functions, supply chains and the organization's wider value chains.

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Lean thinking has enabled many organizations to deliver high-quality products and services at lower cost. However, this does not necessarily mean that circular opportunities will be identified and acted upon and lead to positive systemic change.

Whilst the circular economy and lean thinking both aim to eliminate waste, they approach it from different perspectives. Lean focuses on removing anything that does not add value to the customer, whereas the circular economy is about re-thinking and optimizing how resources are managed to create value in its broadest sense. However, as with many initiatives, what's achieved very much depends on the organization's level of ambition. If approached with the right mindset, the circular economy could be a natural extension of lean thinking. It would involve thinking systemically about how resources are or could be managed. Many of the tools and techniques advocated by lean thinking (e.g. value stream analysis and future state mapping) have the potential to be adapted in this regard. It is also likely that implementing the principles of the circular economy would enhance lean outcomes.

0.7 Outcomes

This British Standard aims to give guidance to organizations of all types and sizes, wherever they are in the world, on the steps they can take to transition to a more circular and sustainable mode of operation. Specifically, it aims to provide organizations with an understanding of:

a) what the circular economy is and how it might be relevant both now and in the future; and

b) how to implement the principles of the circular economy in order to create direct and indirect value as a result of process, product or service or business model innovation.

Implementing the principles of the circular economy offers organizations an opportunity to re-think how they do business, potentially enabling them to be more circular, sustainable and competitive. For example, business opportunities could arise from understanding resource use and adopting new ways of working, both internally and across the value chain.

Progress can be achieved through:

1) the identification and effective management of current and future business impacts, risks and opportunities to improve resilience, avoid environmental harm and drive societal benefits;

2) making the most of resources while minimizing the production of waste (e.g. ensuring unused and/or unwanted items are returned to productive use);

3) strengthening relationships through effective collaboration with the value chain;

4) developing trust and confidence through greater accountability and transparency; and

5) using the principles of the circular economy as a framework for improving or completely changing the value proposition as a result of stimulating learning and innovation, thereby enabling the organization to begin to transition to a more circular and sustainable mode of operation if it makes sense to do so. An example of this is illustrated in Annex A.

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1 Scope

This British Standard provides a framework for and guidance on implementing the principles of the circular economy within organizations. This guidance is intended to apply to any organization, regardless of location, size, sector and type.

2 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

2.1 accession

legal principle whereby the ownership of a product carries with it the right to ownership of any new components or materials that are added to the product

2.2 anaerobic digestion

process of controlled decomposition of biodegradable materials under managed conditions where free oxygen is absent, at temperatures suitable for naturally occurring mesophilic or thermophilic anaerobic and facultative bacteria species that convert the inputs to biogas and whole digestate

NOTE 1 Digestate can provide nutritional benefits to plants grown in soils that have had digestate (whole or separated) applied and can reduce the use of artificial fertilizers significantly dependent on the soil type.

NOTE 2 Digestate that meets approved quality standards can be viewed as a form of open loop recycling.

[SOURCE: PAS 110:2014, **3.2**, modified]

2.3 assemble

bring components together and fit them into a specified configuration

[SOURCE: BS 8887-2:2009, **3.2**]

2.4 backcasting

working backwards from a desired future state of a process, product, service or organization (or aspects thereof) to determine both its feasibility and what actions need to be taken to reach that state

2.5 bill of materials

record of the component parts and materials used to make the product

NOTE 1 Bill of materials or BOM come in different formats (e.g. electronic or hand-written).

NOTE 2 A BOM would generally include some or all of the following details:

- *product description;*
- *unique parts and components including quantity;*
- *materials and substances (including substance names, weight and concentrations thereof) for each unique part and component;*
- *weight of each unique part and component; and*
- *total weight of product.*

NOTE 3 Where they exist, safety data sheets (though useful) are unlikely to provide complete materials information.

2.6 biodegradable

capable of undergoing biologically-mediated decomposition

NOTE 1 Biodegradation can be aerobic, if oxygen is present, or anaerobic, if oxygen is not present.

NOTE 2 Not all biodegradable products, materials or components are compostable.

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NOTE 3 Some materials (e.g. plastics) contain an additive which is intended to make them (bio)degrade over a period of time (which could be several years). These materials (known as [oxo-, oxy- or oxobio-] degradable) are not suitable inputs into composting systems. They are also generally not compatible with recycling with other materials, and wider environmental impacts are uncertain.

[SOURCE: PAS 110:2014, **3.7**, modified]

2.7 biosphere

part of the earth and its atmosphere in which living organisms exist or that is capable of supporting life

2.8 business model

organization's chosen system of interconnected and interdependent decisions and activities that determines how it creates, delivers and captures value over the short, medium and long term

NOTE 1 A business model is more than the organization's processes and products or the services it provides.

NOTE 2 A business model can be deemed to be "disruptive" if it disrupts an existing market and value network, displacing established market leading firms, products and services and alliances.

2.9 by-product

substance or object resulting from a production process, the primary aim of which is not the production of that item

NOTE A by-product is an output that is generally not a waste if further use is lawful and certain without any further processing (other than normal industrial practice).

2.10 cascade/cascading

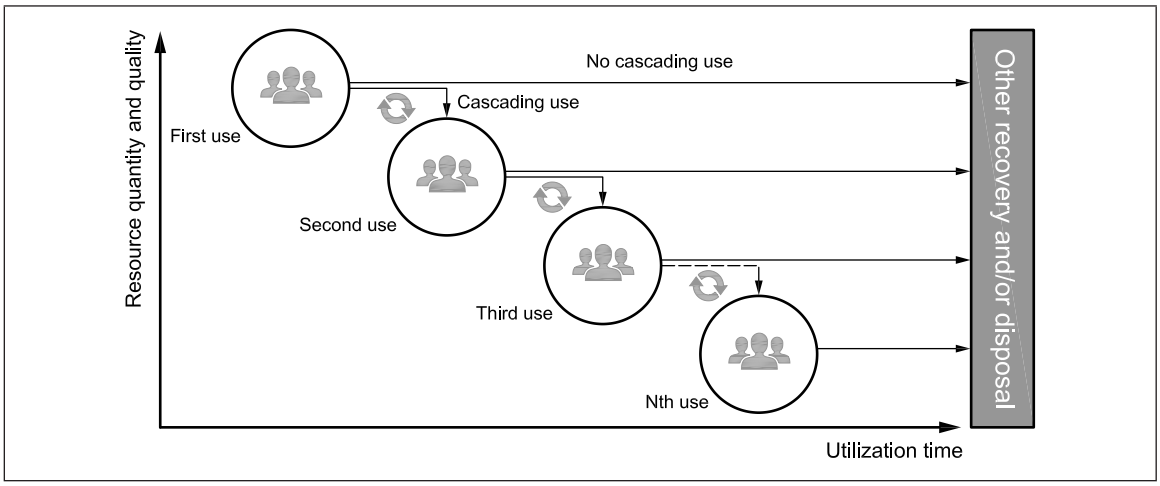
repeated use of a resource usually at decreasing quantity and quality at each subsequent stage/cycle

NOTE 1 See Figure 4 for a conceptual example of a cascade system.

NOTE 2 Cascading takes into account the inherent loss of quantity and quality over time. It took its origin in the field of biomass utilization and is widely used for bio-based materials such as wood. However, the concept is relevant to other materials as most result in a loss of quantity and quality when used over and over again.

NOTE 3 The challenge is to design the optimal cascade to minimize resource and energy consumption as well as other impacts. Energy recovery or disposal terminates the cascade as further material use is not possible.

Figure 4 — *Conceptual example of a cascade system*



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2.11 circular economy

economy that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles

[SOURCE: Ellen MacArthur Foundation]

NOTE 1 Implementing the principles of the circular economy in organizations means taking a systemic approach to the design of processes, products/services and business models to create value by enabling the sustainable management of resources.

NOTE 2 A circular economy is called restorative because valuable outputs, such as products, components or materials get "restored" for use (e.g. reclaimed for reuse, remanufacture or recycling and fed back into the system) rather than extracting further resources.

NOTE 3 A circular economy is called regenerative because living systems are enabled to "regenerate" (i.e. heal and renew) the resources that are consumed (e.g. by feeding back basic nutrients and creating favourable biological conditions).

2.12 change management

approach taken to prepare, equip and support individuals, teams and organizations to successfully adopt change and drive organizational success and outcomes

2.13 chemical ingredient

distinct substance or compound present within a product, material or component

2.14 component

part of an assembled product

[SOURCE: BS 8905:2011, **2.1**]

2.15 compostable

products, components or materials capable of being progressed in composting systems via the end user

NOTE 1 A material is classed as "compostable" if it biodegrades within an aerobic atmosphere to create a relatively homogenous and stable humus-like substance without leaving any non-desirable residues. Packaging is classed as "compostable" if it conforms to BS EN 13432 or equivalent standard.

NOTE 2 Compostable products, components or materials can be industrially compostable and/or home compostable. Appropriate facilities might not be widely available to enable items to actually be composted unless specific arrangements have been put in place to enable this.

NOTE 3 This applies in both a business-to-business (B2B) and a business-to-consumer (B2C) context.

2.16 composting

process of controlled biological decomposition of biodegradable materials under managed conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat

[SOURCE: PAS 100: 2011, **3.19** modified]

NOTE 1 It is recognized that there are other forms of composting that are unlikely to achieve and sustain thermophilic temperatures. Home composting is such an example. Vermicomposting is maintained within a very restricted, low temperature range suitable for the existence of appropriate selected species of worms.

NOTE 2 Composting that meets approved quality standards can be viewed as a form of open loop recycling.

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2.17 consumption

action of using a resource

NOTE An example of consumption is extracting and harvesting resources from ecosystems and mines, together with their subsequent utilization.

2.18 cycle

NOTE The biological and technical cycles represent feedback loops into the complex system of material flows in the economy.

2.18.1 biological cycle

cycle through which biological nutrients are restored into the biosphere in a way that rebuilds natural capital and enables the regeneration of renewable resources

NOTE 1 Such cycles can involve, at various stages, cascading, composting, anaerobic digestion or the extraction of bio-chemicals.

NOTE 2 See Figure 5 for a conceptual overview of the biological cycle. A material is defined as belonging to either the technical or the biological cycle depending on which of these it feeds back to, not necessarily which one it originates from.

2.18.2 technical cycle

cycle through which products, components and materials are restored to the economy as parts of new products, components and materials or used more intensively

NOTE1 Such cycles involve strategies and processes including sharing, maintenance, reuse, repair, remanufacturing or recycling.

NOTE 2 See Figure 5 for a conceptual overview of the technical cycle. A material is defined as belonging to either the technical or the biological cycle depending on which of these it feeds back to, not necessarily which one it originates from.

2.19 dematerialization

delivery of a function with no or reduced requirement for materials, often by a move from a physical to a digital alternative

2.20 disassembly

non-destructive taking apart of an assembled product into constituent materials and/or components

[SOURCE: BS 8887-2:2009, **3.11**]

NOTE The ideal is that individual materials and/or components are easily separable (e.g. with common hand tools).

2.21 disposal

any operation which is not recovery

2.22 downcycle/downcycling

process of converting secondary raw materials/by-products into new materials, components or products, typically of lesser quality, reduced functionality and/or lower value compared to their original intended purpose

2.23 durability

maximum potential lifetime of a product, component or material to perform a required function under intended conditions of use and maintenance for a long period of time before it becomes obsolete because it can no longer be repaired and/or upgraded

NOTE Durability is dependent on the intended use of the product and its service conditions and is distinguished from those items intended for immediate consumption.

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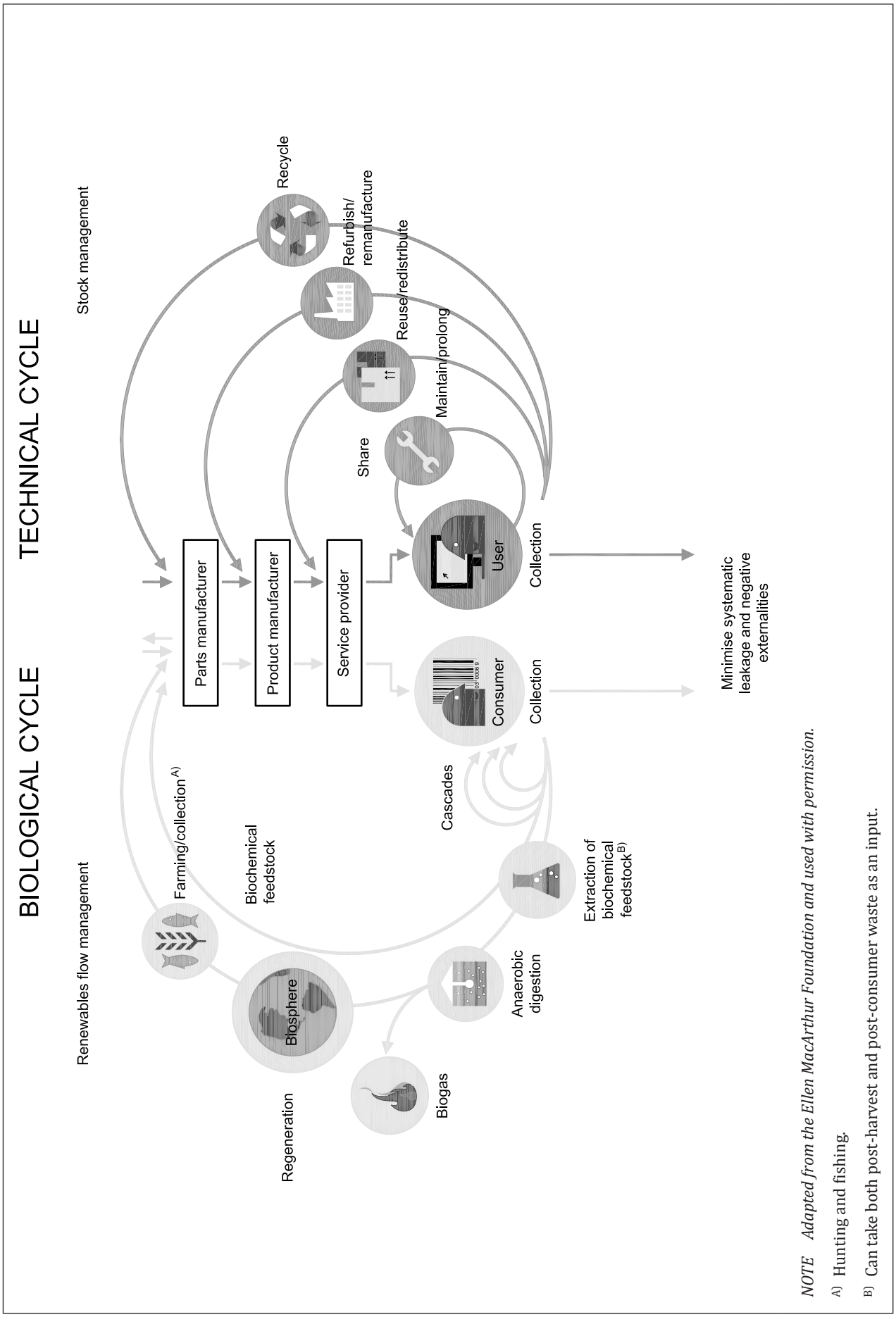
Figure 5 — *Conceptual overview of biological and technical cycles*



NOTE Adapted from the Ellen MacArthur Foundation and used with permission.

A) Hunting and fishing.

B) Can take both post-harvest and post-consumer waste as an input.

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2.24 ecodesign

integration of environmental aspects into product design and development, with the aim of reducing adverse environmental impacts throughout a product's life cycle

NOTE Other terminology used worldwide includes environmentally conscious design (ECD), design for environment (DFE), green design and environmentally sustainable design.

[SOURCE: BS EN ISO 14006:2011, **3.2**]

2.25 end user

person or organization that decides they have no further need of using a product, component or material at all or in its intended purpose

2.26 enabling mechanism

approach or technique that assists an organization in delivering and capturing value over the short, medium and long term

NOTE 1 One or more enabling mechanism(s) can represent a business model, where an organization's entire value proposition is based on them.

NOTE 2 Where underpinned by circular economy principles, an enabling mechanism(s) can assist an organization to deliver and capture value, alongside more sustainable management of resources.

2.27 guarantee

formal assurance (typically in writing) that certain conditions are to be fulfilled, especially that a product is to be repaired or replaced if not of a specified quality

2.28 innovation

anything new or changed that realizes or redistributes value

NOTE 1 Activities resulting in innovation are generally managed.

NOTE 2 Innovation is generally significant in its effect.

2.29 lease/leasing

contract between a lessor and a lessee for the hire of a specific asset, where the lessor retains ownership but conveys the right to the asset's use to the lessee for an agreed period of time in return for the payment of specified rentals

[SOURCE: SSAP 21 [13], modified]

NOTE There are two different types of lease: finance leases and operating leases. The distinction between the two is usually evident from the terms of the contract between the lessor and the lessee.

- *Finance leases (also known as capital leases) transfers substantially all the risks and rewards of ownership of an asset to the lessee. Ownership is usually fully transferred (e.g. rowing machine leased over 12 months where payments typically include purchase price, profit and interest) to the lessee at the end of the leasing contract.*
- *Operating leases are leases other than a finance or capital lease and the lessor retains ownership of the asset. Items can be hired for a matter of hours or longer.*

2.30 life cycle

consecutive and interlinked stages of a product or service system, from design, acquisition of raw materials, production, distribution, use and end-of-life management

[SOURCE: BS EN ISO 14040:2006, **3.1**, modified]

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2.31 life cycle assessment

compilation and evaluation of the inputs, outputs and the potential environmental and/or social impacts of a product or service system throughout its life cycle

[SOURCE: BS EN ISO 14040:2006, **3.2**, modified]

2.32 loop

NOTE This British Standard does not advocate a particular loop. For example, a closed loop system could in fact be significantly more resource intensive than an open loop system for a particular product, component or material. It could also be the case that there is more potential for "upcycling" to take place within an open loop context. Attention is drawn to the need for organizations to be able to support any claims made if marketing items as "closed loop".

2.32.1 closed loop system

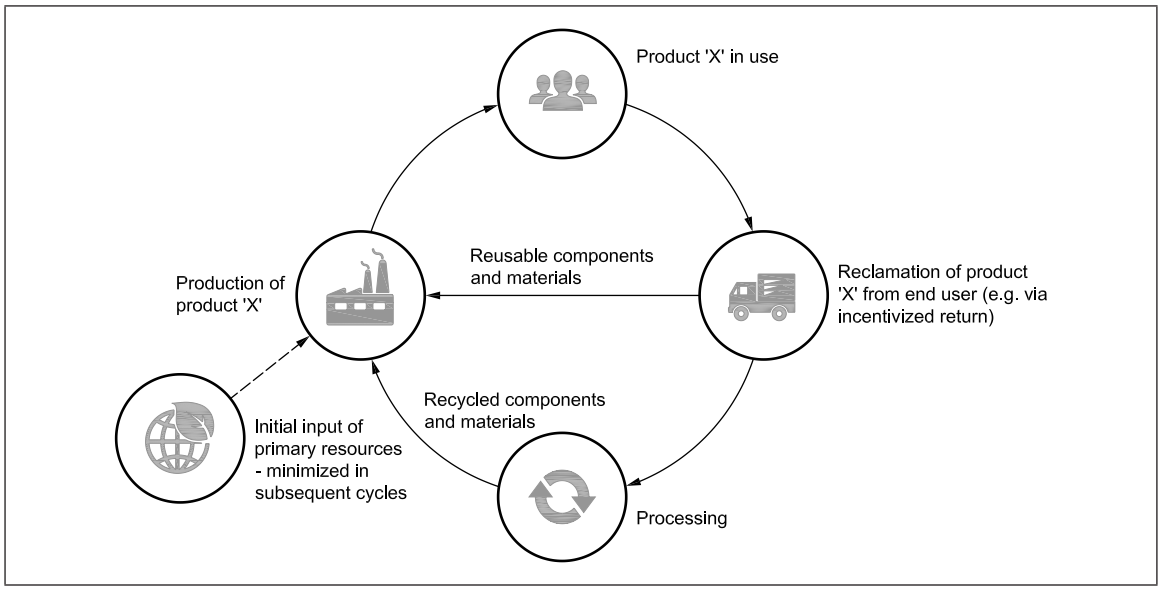
system in which products, components or materials are reused or recycled by an organization or a co-operating group of organizations into the same or similar products, components or materials with minimal loss of quantity, quality or function

NOTE 1 An example of a closed loop system is the return and reuse of glass milk bottles.

NOTE 2 See Figure 6 for a conceptual simplified example of a closed loop system.

NOTE 3 Attention is drawn to the need to avoid the accumulation of chemical ingredients which can represent a significant risk to human health and/or the environment.

Figure 6 — *Conceptual simplified example of a closed loop system*



2.32.2 open loop system

system in which products, components or materials are reused or recycled (which can be cascaded) generally amongst unspecified organizations into alternative products, components or materials

NOTE 1 An example of an open loop system is the collection of glass and it being sent for recycling into aggregate.

NOTE 2 See Figure 7 for a conceptual simplified example of an open loop system.

NOTE 3 Reuse or recycling on an open loop cycle system results in producing a different product, component or material, which might be of reduced quality, function and/or lower grade and purity than the original product, component or material.

NOTE 4 Open loop postpones disposal as each cascade or cycle reduces the utility of most products, components or materials. A small proportion of the original resource may continue to be reused or recycled.

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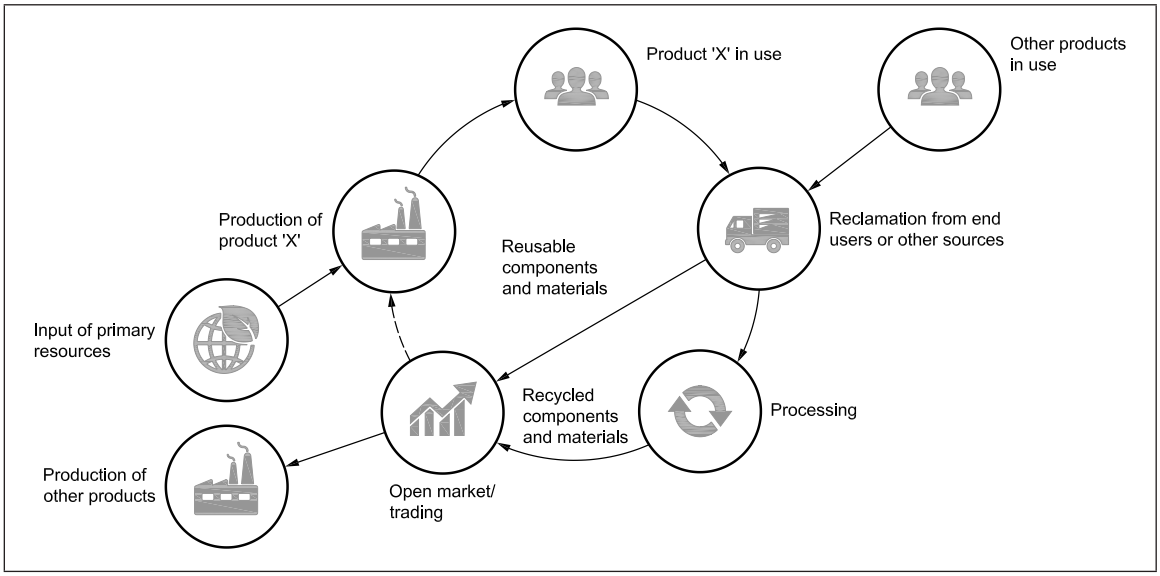
NOTE 5 Composting and digestate produced by anaerobic digestion which meets approved quality standards can be viewed as a form of open loop recycling.

Figure 7 — *Conceptual simplified example of an open loop system*



2.33 management system

set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives

NOTE 1 A management system can address a single discipline or several disciplines, e.g. quality management, financial management or environmental management. For the purposes of this British Standard, the term is used in connection with supporting an organization to achieve its circular economy strategy and objectives.

NOTE 2 The management system's elements establish the organization's structure, roles and responsibilities, planning, operation, policies, practices, rules, beliefs, objectives and processes to achieve those objectives.

NOTE 3 The scope of a management system can include the whole of the organization, specific and identified functions/sections of the organization, or one or more functions across a group of organizations.

[SOURCE: BS EN ISO 9000:2015, **3.5.3**, modified]

2.34 materiality assessment

process of identifying, refining and assessing the organization's significant impacts or dependencies on resources

NOTE 1 Materiality can be determined at different levels (e.g. process, product/service or organizational level).

NOTE 2 Assessments of materiality might consider the organization's vision and strategy, the views of its internal and external stakeholders and its value chain. The assessment can be qualitative or quantitative including financial.

2.35 natural capital

stock of renewable and non-renewable natural resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people

[SOURCE: *Natural Capital Protocol* [14], modified]

2.36 objective

result to be achieved

NOTE Objectives can apply at different levels, such as strategic, organization-wide, project, product and process.

[SOURCE: BS ISO 20121:2012, **3.6** modified]

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2.37 optimize/optimization
making the best or most effective use of a situation or resources to enable products, components or materials to be kept at their highest value and utility

2.38 organization
person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives

NOTE 1 The concept of organization includes, but is not limited to, sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private.

NOTE 2 For organizations with more than one operating unit, a single operating unit may be defined as an organization.

[SOURCE: BS ISO 20121:2012, **3.1**]

2.39 organizational resilience
ability of an organization to anticipate, prepare for, and respond and adapt to incremental change and sudden disruptions to both survive and prosper

[SOURCE: BS 65000:2014, **2.3**]

2.40 plan (noun)
description of how the organization intends to deliver its strategy or achieve all or aspects of its objective(s)

2.41 planned obsolescence
all techniques by which an organization seeks to deliberately limit product lifetime in order to increase replacement rate

2.42 principle
fundamental basis for decision making or behaviour

[SOURCE: BS ISO 26000:2010, **2.14**]

2.43 process (verb)
transform a product, material, component or assembly from one configuration or state to another

[SOURCE: BS 8887-2:2009, **3.28**, modified]

NOTE Transformation of material or component, or materials or components in combination, from one physical or chemical configuration or state to another.

2.44 process (noun)
set of interrelated or interacting activities which transforms inputs into outputs

NOTE A process can be documented or not.

2.45 product
article or substance that is offered for sale or is part of a service delivered by an organization

[SOURCE: BS ISO 26000:2010, **2.15**]

2.46 production
action of using resources to make products, materials or components

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2.47 product–service systems

business model combining both products and services and using results as a basis for innovation

NOTE There are different types of product–service systems, including:

- *selling additional services with the product during use such as maintenance and upgrade options or technical support and consultancy;*
- *providing result-orientated services such as outsourcing, pay for use and performance-based contracts where organizations commit to delivering a specific result;*
- *making products or services available for a short period of time on an exclusive or shared basis (e.g. rental or pooling); and*
- *allowing exclusive use of a product for a longer period of time (i.e. leasing).*

2.48 raw materials

2.48.1 raw material

basic material from which a product or component is made

2.48.2 primary raw material

material which has never before been subjected to use or processed into any form of end-use product (or part thereof) other than that required for its manufacture

2.48.3 secondary raw material

material which has been used and/or processed before and can be reused or processed again into any form of end-use product (or part thereof)

2.49 reclamation/reclaiming

collection of products, components or materials with the intention of avoiding waste and with the purpose of reuse or recycling

2.50 recondition

return of a used product to a satisfactory working condition by rebuilding or repairing major components that are close to failure, even where there are no reported or apparent faults in those components

NOTE With respect to reconditioning:

- *manufacturing effort involves the replacement of worn or broken parts, generally less extensive than required to remanufacture, but more than necessary for repair;*
- *performance after reconditioning is expected to perform its intended role but the overall performance is likely to be inferior to that of the original model; and*
- *any subsequent warranty is generally less than new or a remanufactured product but the warranty is likely to cover the whole product (unlike repair); reconditioned products do not require a warranty equivalent to that of a newly manufactured equivalent.*

[SOURCE: BS 8887-2:2009, **3.30**]

2.51 recovery

activity where the principal objective is to ensure that the used products, components or materials serve a useful purpose by replacing other new products, components or materials which would have had to be used for that purpose, or being prepared to fulfil that purpose, in the plant or in the wider economy

NOTE Recovery can be divided into three sub-categories: preparing for reuse (e.g. items need to be checked, cleaned or repaired before they can be reused), recycling and other recovery. Other recovery is mainly associated

with energy recovery, waste being used as a fuel and backfilling (i.e. where suitable recovered material is applied in a process of landscape engineering).

2.52 recycle/recycling

action of processing a discarded or used product, component or material for use in a future product, component or material

NOTE 1 Recycling involves actions which might change the physico-chemical state of an item. It includes the processing of organic material (e.g. composting) but excludes items used for energy recovery, as fuels, or for backfilling purposes (e.g. where suitable secondary material is appropriate to be applied in a process of landscape engineering).

NOTE 2 Recycling can occur on an open loop or closed loop basis.

2.53 recyclable

product, component or material which can be reclaimed for recycling via the end user

NOTE 1 Whilst many products, components and materials are technically recyclable, in practice recycling facilities might not be readily available and/or economically feasible to use.

NOTE 2 This applies in both a business-to-business (B2B) and business-to-consumer (B2C) context.

2.54 refurbish

aesthetic improvement of a product, component or material, which might involve making it look like new, with no or limited functionality improvements

[SOURCE: *Remanufacturing: towards a resource efficient economy* [15], modified]

2.55 remanufacture

return a used product to at least its original performance with a warranty that is equivalent to or better than that of the newly manufactured product

NOTE 1 From a customer viewpoint, the remanufactured product can be considered the same as a new product.

NOTE 2 With respect to remanufacture:

- *manufacturing effort involves dismantling the product, the restoration and replacement of components and testing of the individual parts and whole product to ensure that it is within its original design specifications;*
- *performance after remanufacture is expected to be at least comparable with the original performance specification; and*
- *any subsequent warranty is generally at least equal to that of new product.*

NOTE 3 This assumes that remanufacture applies to like-for-like products.

[SOURCE: BS 8887-2:2009, **3.34**]

2.56 repair

returning a faulty or broken product, component or material back to a usable state

NOTE 1 A repair may use remanufactured or reconditioned parts.

NOTE 2 With respect to repair:

- *the effort is the minimum required to address the specified fault;*
- *after repair, the product is expected to be in a useable state, but assurances of performance are generally limited to the repaired part; and*
- *any subsequent warranty is generally less than that of newly manufactured, remanufactured or reconditioned equivalents and might apply only to the component that has been replaced or repaired.*

[SOURCE: BS 8887-2:2009, **3.36**, modified]

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2.57 repurpose

using a product, its components or materials in a role that they were not originally designed to perform

NOTE 1 This action deals with instances where products, components or materials can be used again for a different purpose for which they were conceived without the need for any reprocessing or treatment, which falls under recycling.

NOTE 2 Augmentation of the product might be required to fulfil its new role.

[SOURCE: BS 8887-2:2009, **3.37**, modified]

2.58 resources

2.58.1 resources

assets (air, water, land, habitats) from which products and services are sourced, produced and supplied

NOTE 1 Resources can be either renewable or non-renewable.

NOTE 2 Whilst the term resources can apply to materials, water and energy, for the purposes of this British Standard, it is generally used to refer to physical materials that are made or composed of renewable and/or non-renewable resources.

NOTE 3 Resources can be natural or synthetic as well as primary or secondary in origin.

2.58.2 non-renewable resources

resources that are not able to be renewed or replenished in short time periods, such as minerals, metals, or oil, gas or coal

2.58.3 renewable resources

resources that are able to be renewed or replenished by ecological cycles or agricultural processes at a rate equal to or greater than consumption so that the products and services provided by these resources are not endangered and remain available for future use

2.59 reuse/reused

operation by which a product, component or material can be used again without requiring any reprocessing or treatment

NOTE 1 This action deals with instances where products, components or materials can be used again for the same purpose for which they were conceived without the need for any modifications, reprocessing or treatment.

NOTE Items might need to be "prepared for reuse", which involves checking, cleaning or repairing recovery activities so that they can be reused without any other processing.

2.60 reverse logistics

process of reclaiming products and materials from the end user with the objective of capturing value

2.61 safety data sheet

standardized format for communicating information about the properties of a chemical substance or mixture, its hazards, and instructions for handling, disposal and transport and also first-aid, fire-fighting and exposure control measures

NOTE Might also be known as a materials safety data sheet (MSDS). It is usually available in different languages and is not more than 3 years old.

2.62 service

action of an organization to meet a demand or need

[SOURCE: BS ISO 26000:2010, **2.16**]

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2.63 sharing economy

deployment of accessibility-based models for markets in order to enable access to products and services

NOTE 1 With respect to the sharing economy:

- *access is offered over ownership and might take several forms (e.g. pooled, loaned or shared);*
- *access is facilitated to consumer and/or business-owned assets and/or services through the use of technology and/or community engagement;*
- *emphasis is on enabling greater use of unused or under-used assets; and*
- *social value is often prioritized over profit maximization.*

NOTE 2 Sharing economy can also be referred to as collaborative consumption.

2.64 stakeholder

individual or group that has an interest in any decision or activity of an organization

[SOURCE: BS ISO 26000:2010, **2.20**]

2.65 stewardship

responsibility for sustainable development shared by all those whose actions affect environmental performance, economic activity and social progress, reflected as both a value and a practice by individuals, organizations, communities and competent authorities

[SOURCE: BS ISO 20121:2012, **3.20**]

2.66 strategy

high-level approach adopted to achieve a long-term or overall vision or objective

NOTE 1 A strategy does not generally set out how the organization intends to achieve its long-term or overall objective or vision in detail. It can exist at different levels of an organization – it could be organization wide, be specific to a department or team, operationally focused or specific to a theme or topic.

NOTE 2 A strategy may be documented or not.

2.67 supply chain

sequence of activities or parties that provides products or services to the organization

[SOURCE: BS ISO 26000:2010, **2.22** modified]

2.68 sustainability

goal of sustainable development

NOTE For the purposes of this British Standard, sustainability is the degree of sustainable development in the context of the organization.

2.69 sustainable development

development that meets the needs of the present without compromising the ability of future generations to meet their own needs

NOTE Sustainable development is about integrating the goals of a high quality of life, health and prosperity with social justice and maintaining the earth's capacity to support life in all its diversity. These social, economic and environmental goals are interdependent and mutually reinforcing. Sustainable development can be treated as a way of expressing the broader expectations of society as a whole.

[SOURCE: BS ISO 26000:2010, **2.23**]

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2.70 system
combination of the people, structures, processes and environment that interact to create an outcome

2.71 systemic
affecting an entire system(s)

2.72 systems thinking
holistic approach to understanding how different parts of a system can influence one another and the relationship of the system to the parts over time

NOTE 1 Process or method for thinking about complex, non-linear and interconnected systems.

NOTE 2 For the purposes of this British Standard, systems thinking refers to an organization's role in understanding and influencing the system (e.g. value chain and how value can be created in, for example, a value network) to affect the way the market performs and operates in order to deliver its circular economy objectives.

2.73 take-back
used or unwanted items returned to the point of departure, or other designated point, by the end user, to ensure that such items are reused, recycled or recovered

2.74 transparency
openness about decisions and activities that affect society, the economy and the environment, and willingness to communicate these in a clear, accurate, timely, honest and complete manner

[SOURCE: BS ISO 26000:2010, **2.24**]

NOTE Transparency also includes openness about the outcomes of decisions and activities.

2.75 upcycle/upcycling
process of converting secondary raw materials/by-products into new materials, components or products of better quality, improved functionality and/or a higher value

2.76 upgradable
characteristic of a product that allows its physical or virtual components or parts to be separately enhanced or replaced without having to replace the entire product

2.77 use
using or interacting with a product/service in its intended purpose

2.78 value
financial and/or non-financial gain

NOTE Value can be tangible or intangible and can be gained in the organization, within its value chain(s) or wider society.

[SOURCE: BS ISO 37500:2014, **3.25**, modified]

2.79 value chain
entire sequence of activities or parties that provide or receive value to or from the organization in the form of products or services

NOTE 1 Parties that provide value include the supply chain.

NOTE 2 Parties that receive value include customers, consumers and other users.

[SOURCE: BS ISO 26000:2010, **2.25**, modified]

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2.80 value network

network of relationships, which create value through a complex dynamic exchange between two or more individuals, groups and organizations

NOTE This is a systems thinking approach to strategic value assessment.

2.81 vision

aspiration of what an organization would like to become or achieve as expressed by top-level management

[SOURCE: BS EN ISO 9000:2015, **3.5.10**, modified]

2.82 warranty

written guarantee, issued to the buyer of an article or product by its manufacturer, promising to repair or replace it if necessary within a specified period of time

3 The circular economy and its relevance to organizations

3.1 General

In the future, it is predicted that global demand for products and services will increase as the world's population grows and development increases income levels, leading to more middle income consumers. These trends would increase demand for already constrained natural resources. The UN Sustainable Development Goals recognize this trend and provide a context to enable a global response via Goal 12 (Responsible consumption and production), which aims to challenge the way products and resources are consumed and produced.

NOTE For further information on the UN Sustainable Development Goals, see <http://sdgcompass.org> [last viewed 9 May 2017].

A circular economy aims for a global economic system that can thrive in the long term. It has the potential to give rise to much more resilient economies with abundant resources and a healthy environment, and to help combat climate change and its impacts.

By applying the principles of a circular economy to their processes, organizations can drive the transition and capture value as well – these are the micro-level benefits. More effective management of resources enables cost savings; new business models can unlock new sources of revenues and improved customer relationships; a more systemic approach can make organizations more resilient to external shocks and disruption.

There are emerging policy and legislative drivers too. In general, current initiatives of relevance to the circular economy tend to focus on waste management (i.e. downstream policy options rather than on prevention or reuse). However, the economic benefits of improved circularity of resource use are increasingly being recognized and acted upon by governments around the world.

It is worth noting that costs can often be incurred. Capturing such benefits often requires initial investments; cost savings might be partially offset by additional costs and capturing new revenue streams sometimes happens at the cost of some of the former ones. However, various analyses and case studies have demonstrated that more circular models can help organizations achieve net positive effects.

In addition, estimations of the macro-level benefits of the circular economy should take into account potential rebound effects. Indeed, reduced costs for people and organizations can give rise to increased consumption, which can offset the overall benefits.

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3.2 Circular economy benefits for organizations

3.2.1 Macro-level benefits

3.2.1.1 Improved resilience of economic systems

The price volatility of a given commodity is a key risk for regions and businesses that rely significantly on imports for that commodity. By maintaining material flows in cycles, either through a local or geographically bound area, a circular economy model can reduce the dependence of economies on the input of new primary raw materials and therefore mitigate against this risk.

3.2.1.2 Economic growth and employment

In the current economic model, the availability of materials and energy can limit opportunities for economic growth. The circular economy in contrast seeks to decouple these two factors with the aim of enabling further growth, for example in emerging markets. European-based studies also suggest that more circular models would be likely to have a positive net employment impact, though the extent would differ across industries and regions.

3.2.1.3 Preserved natural capital and climate change mitigation

Core to the circular economy model is the creation of conditions favourable to the preservation and restoration of biological nutrients to rebuild natural capital. The model also seeks to reduce negative externalities and several studies suggest that circular economy scenarios would lead to reduced greenhouse gas emissions compared to business as usual.

3.2.2 Micro-level benefits

3.2.2.1 General

The micro-level benefits differ depending on the type of organization, but can be summarized into two general archetypes.

a) **Organizations with material outputs**: These include all organizations, or parts of organizations, that generate revenues through significant material outputs, regardless of whether they produce these themselves (e.g. retailers, manufacturers, infrastructure, waste and resource management). Such organizations can apply the principles of the circular economy at the input level (e.g. procuring secondary raw materials or remanufactured components), at the output level (e.g. recovering products and materials after use), as well as in their own operations. The practicalities of applying the principles of the circular economy are different depending on their position in the value chain. For example, manufacturers have the opportunity to thoroughly re-think the design of their products and services while retailers instead need to engage with their suppliers.

b) **Organizations without material outputs**: These include the organizations, or parts of organizations, that obtain their revenues largely through service-based outputs (e.g. pure service providers, design agencies, architects, consultants, research/academia, governments). The main resource use of these organizations therefore comes from their equipment and operations, and there are likely to be more circular opportunities at this level. Some might also be able to leverage the principles of the circular economy to create new revenue streams thanks to new types of activities, for example by playing an intermediary role to enable performance models, or by providing complementary services such as repair.

3.2.2.2 Cost savings

A significant economic benefit resulting from circular economy models is the opportunity to reduce the net costs of producing, obtaining and using a product or service.

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Models such as reuse or remanufacturing can reduce the embodied impacts of materials, energy or labour of a product while giving rise to a new cycle of use. For all organizations, cost savings can be captured at the input stage (procuring less expensive products, components and materials) and businesses with material outputs can also save costs in their own production (providing products at lower cost).

Analyses have demonstrated that such savings can be greater than the added operational costs (e.g. product disassembly and repurposing) and offer attractive returns on the initial capital investment (e.g. the reverse cycle treatment infrastructure).

3.2.2.3 New sources of innovation and revenue

Implementing the principles of circular economy can bring a new pool of ideas for innovation and design. Organizations can capture new sources of revenue, for example by offering new types of services (e.g. repair, leasing), by capturing the value of their by-products (e.g. from food waste once it is separated from other streams), or, for the businesses with material outputs, by reaching new markets with pre-used or remanufactured products (e.g. emerging markets, insurance providers).

As is the case for cost savings, capturing these new revenues might involve new costs, whether operational or capital. These should be taken into account when estimating the net overall benefits.

The risks of market cannibalization should also be addressed. For example, a remanufactured product might be purchased in place of a new product. Detailed analysis should be carried out to assess the respective business benefits of the different types of products; in many cases, a remanufactured product can provide a greater profit margin than a new product in the same price range. Following this analysis, a communication and marketing strategy can help target products to specific markets and therefore optimize the overall benefits.

3.2.2.4 Improved customer relationships

With take-back schemes and the move to more service-based models, organizations have an opportunity to create more interaction touch points with their customers and therefore increase customer retention, brand loyalty and store footfall or webpage visits.

More circular models can improve customer relationships and brand perception. Products designed with a circular economy in mind can indeed be more durable and of higher quality, while service models can offer increased convenience (e.g. routine maintenance and emergency breakdown are managed by a third party).

However, there are challenges which also need to be addressed for a wide adoption of more circular products and services. Some of these might require customers to change their habits (e.g. sorting of certain products for return via incentivized return schemes) and others might initially have perception challenges (e.g. leasing schemes might be perceived as reducing freedom or being more expensive in the long term). To overcome these challenges, a proper assessment of the market is needed to enable adequate communication and marketing campaigns, as well as good user experience (e.g. to minimize the perceived complexity of a new service model).

3.2.2.5 Improved resilience for organizations

Organizations can improve their resilience by reducing their reliance on inputs of new primary commodities and their associated challenges, such as supply pressure and price or wider geopolitical, social and environmental risks.

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3.3 Implementation challenges for different types of organizations

The reference to organizations in this British Standard is deliberately inclusive, as it intends to provide the basis to enable organizations of all types to take action to implement the principles of the circular economy within their business.

Different types of organizations encounter different drivers, barriers, threats and opportunities when exploring circularity. Clause **4** and Clause **5** provide a flexible framework to allow different types of organizations to respond to the challenge of integrating the principles of the circular economy into their business practices. Beyond this, a range of broad business issues, which can influence how an organization progresses, are set out in Clause **6** and Clause **7**.

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Section 2: Guiding principles

4 Principles of the circular economy

4.1 General

This clause introduces and provides guidance on the six principles of the circular economy (see Figure 8).

When implementing the principles of the circular economy, the overarching goal for an organization is to create long-term business value by design through the sustainable management of resources in its products and services. Although there is no exhaustive list of the principles of the circular economy, all organizations should, as a minimum, refer to the guiding principles detailed in **4.2**. Organizations should evaluate whether additional principles are applicable to them and if so, expand and apply them as necessary.

The six principles of the circular economy can be used by organizations as a frame of reference for their decision making and behaviour. Organizations can also continually reflect on the extent to which their culture and activities are aligned with these principles. Annex A contains some useful guidance to help organizations evaluate the extent to which these principles are being realized through their decisions and activities.

*NOTE Supporting commentary under each principle is illustrative and is not intended to be exhaustive. Additional guidance pertinent to the realization of these principles is outlined in Clause **5** to Clause **7** and Annex A.*

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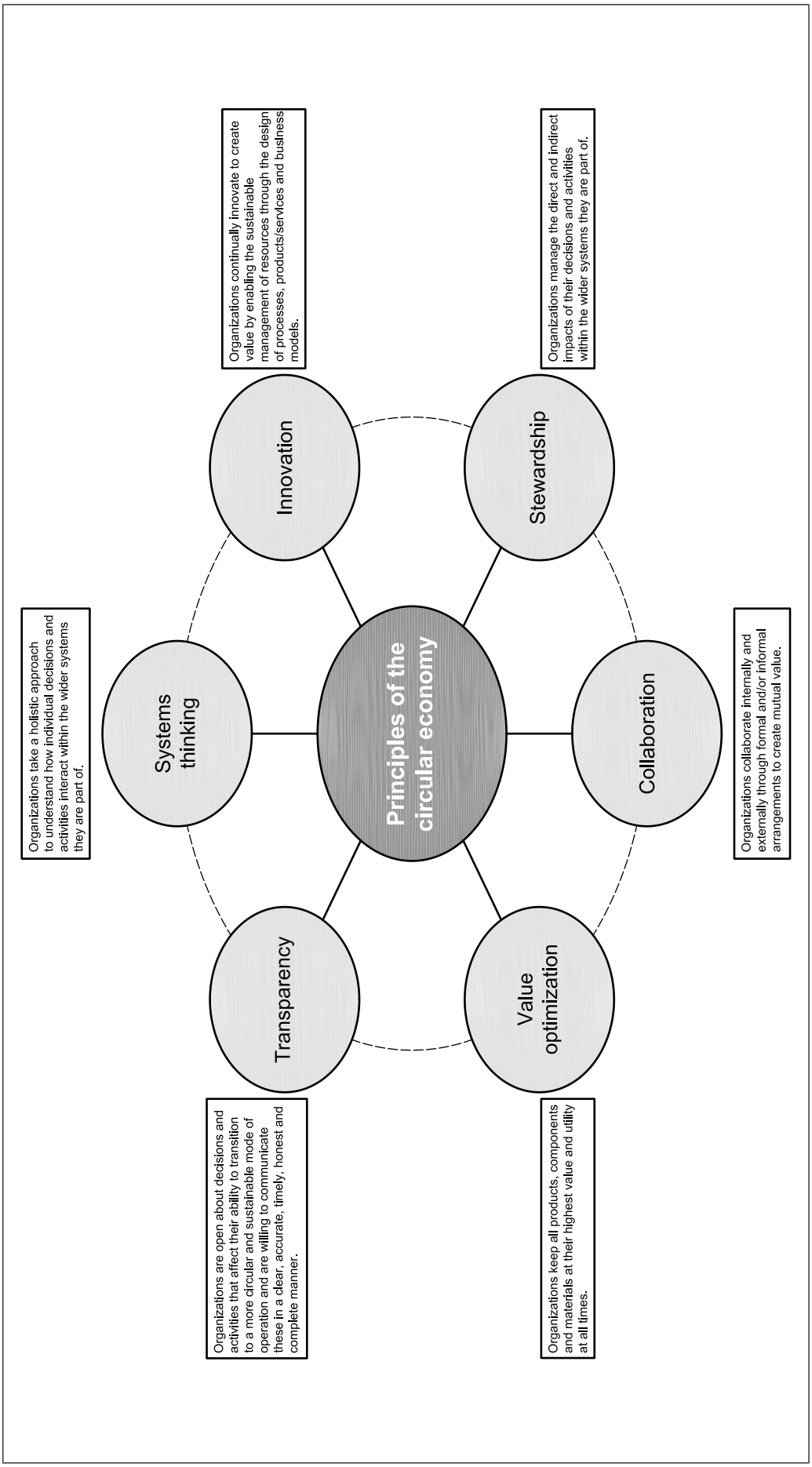


Figure 8 — *Principles of the circular economy*

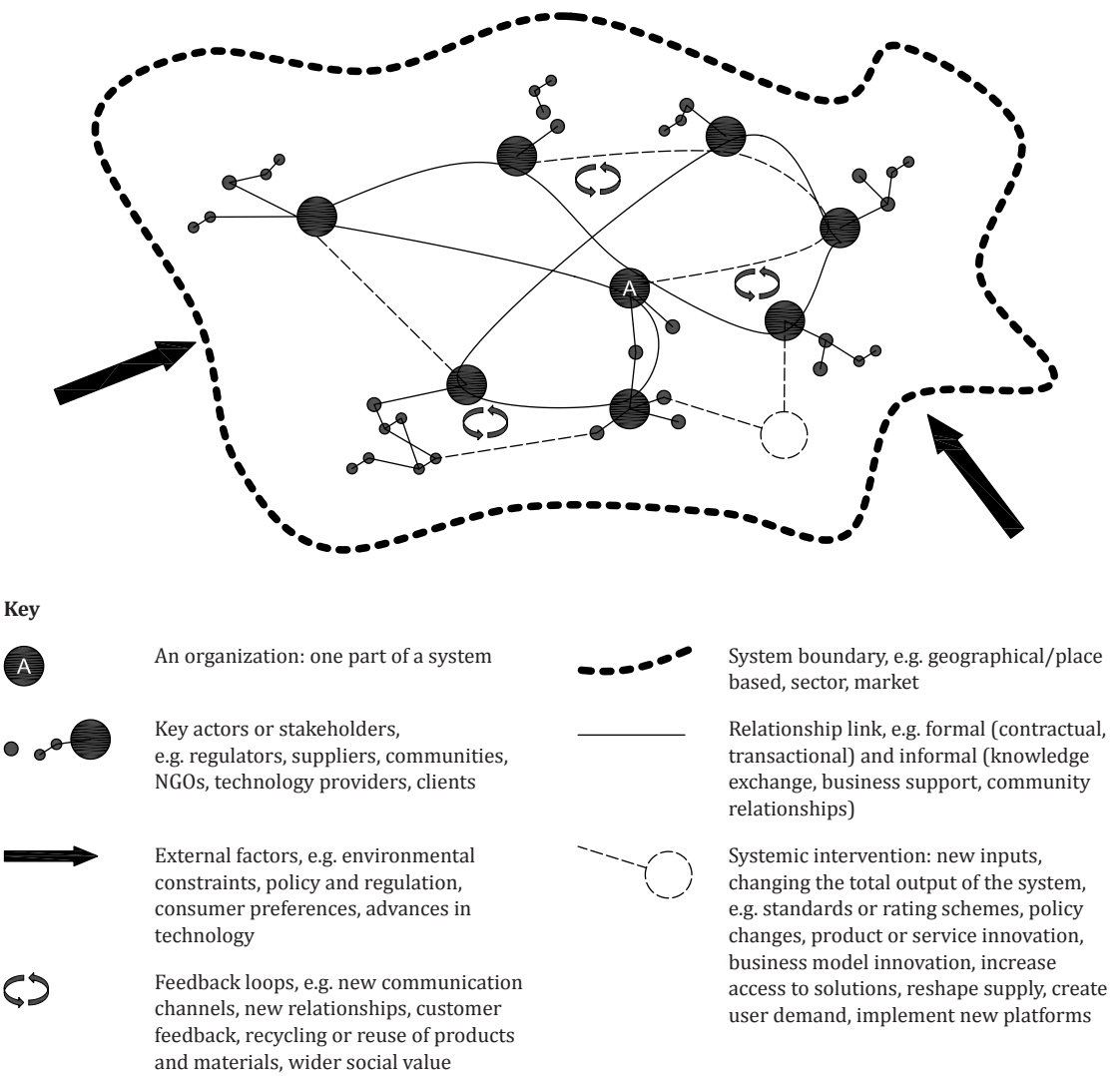
4.2 Principles

4.2.1 Systems thinking

Principle: organizations take a holistic approach to understand how individual decisions and activities interact within the wider systems they are part of.

In the context of this British Standard, systems thinking is about understanding the complex, non-linear and interconnected nature of any system in which an organization sits. Thinking about these relationships is crucial to understand how an organization creates value and how it might be able to intervene in the "system" to influence the sustainable management of resources in its portfolio of products and services (see Figure 9). For example, in the case of a product this might include identifying all the component parts and material inputs involved in bringing it to market, as well as the ways in which natural systems are impacted over its entire lifespan.

Figure 9 — *General concept of an organizational system with intervention highlighted*



Systems can be living (natural systems) and non-living and include markets and supply chains. They do not always behave as expected and the timescale over which behaviour manifests itself can vary. Systems thinking can help an organization manage change and complexity more effectively, and identify potential long-term consequences (intended or otherwise) of decisions and activities.

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4.2.2 Innovation

Principle: organizations continually innovate to create value by enabling the sustainable management of resources through the design of processes, products/services and business models.

Innovation is anything that results in something that is new or changed (e.g. product, service or process) which realizes or redistributes value. It is about taking this fresh thinking forwards, not the thinking itself. It takes many forms and can be process or outcomes based. Some innovation has come about through research and development (R&D), or as a result of smart design or progressive collaborations. Innovation can create entirely new goods and services or optimize what already exists (e.g. processes).

Innovation is critical to facilitating the transition to a more circular and sustainable mode of operation. Circularity requires a completely new perspective on consumption and production, which continually challenges current business practices and methods. For example, through their decisions and activities, organizations can extract value from what otherwise might be waste.

4.2.3 Stewardship

Principle: organizations manage the direct and indirect impacts of their decisions and activities within the wider systems they are part of.

Stewardship means an organization is responsible for the management of all facets of its decisions and activities, from inception through to fulfilment and end-of-life. These facets could include what is happening in its supply chain and customer base and should take account of economic, environmental and social issues both now and those projected into the future.

For example, in the case of product development, organizations should take into account environmental and social impacts from upstream processing and acquisition of materials, through to downstream issues associated with the use and end-of-life phases. This might include understanding the origin of raw materials; minimizing the depletion of natural capital; taking appropriate steps to respect human rights; not specifying the use of chemical ingredients which represent a significant risk to human health and/or the environment; creating employment and skills opportunities; improving the quality of life of people and communities; and having strategies and plans in place for the management of products and materials during use and at end-of-life.

Stewardship is about accountability that might be shared or wholly owned by an individual, organization or community. It has increasing importance for implementing the principles of the circular economy across the value chain.

4.2.4 Collaboration

Principle: organizations collaborate internally and externally through formal and/or informal arrangements to create mutual value.

It is unlikely that any one organization can achieve substantial progress in transitioning to a more circular and sustainable mode of operation without collaboration. Progressive collaborations between businesses (e.g. in supply chains and cross-sector), governments, academia, civil society and consumers are essential to making this happen.

An organization should evaluate how its ability to meet its objectives might be enhanced through collaborative working or require external collaboration in order to be successfully met. This might include, for example, using its technical expertise to change the mind-set of suppliers about the perceived quality issues for recycled materials usage.

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Working with different organizations, each with varying motivations, cultures and requirements, can prove challenging. The success of any collaborative programme is built on the ability of two or more organizations to develop a joint approach and mutual trust. Each organization should accept collective responsibility for managing an integrated process, with mutually agreed objectives.

The organization's internal culture and structures should support and embrace collaboration. Internal silos, lack of transparency or unwillingness to share information, and competition between different business units and departments can all happen and be very real and frustrating barriers.

The success of any collaborative programme is built on developing mutual trust, effective communication and a shared vision and purpose – this applies both internally and externally. Knowing when to take the lead in a collaborative relationship versus playing a more supporting role is also critical.

4.2.5 Value optimization

Principle: organizations keep all products, components and materials at their highest value and utility at all times.

The circular economy is about creating and optimizing value by reconsidering what might be seen as waste or system losses and identifying opportunities to realize new potential from them. This value can be a cost saving (by giving access to cheaper material inputs and reducing waste management costs), or new revenue streams (by supplying additional products, components and materials), or less quantitative value (such as improved customer relationship or resilience).

Three main approaches can be outlined:

a) First, material streams that are seen as waste (whether in production or post-consumption) can become valuable inputs in other applications. Making the most out of these streams can require some tweaks in production processes and designs (e.g. reducing the number of grades or types of materials used to create economies of scale). Where the material stream is deemed to be waste (i.e. unrecoverable and without value or even harmful) all efforts should be made to reduce it as much as possible.

b) Second, the value captured from resources can be increased by using products longer or in multiple-use cycles. This often requires collaborative efforts across value chains to enable changes in the design of products (e.g. using longer-lasting or compostable materials, designed to be upgradable or repairable) and the development of reverse logistics and better treatment processes (e.g. repair centres, anaerobic digestion plants). Adoption of business models, such as leasing, can enable both producers and customers to capture a share of value created and reduce the upfront costs for the user.

c) Finally, spare capacity, whether in space or equipment, can also be leveraged as a new value stream. This can be done within one organization or across different organizations (B2B) and individuals (B2C and C2C) through sharing schemes. There are sometimes opportunities for third-party players to facilitate this process.

In parallel with these approaches, continuously reducing demand for energy and improving energy efficiency of processes and products, while not specifically a circular economy idea, can further help maximize value creation at both production and use levels.

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4.2.6 Transparency

Principle: organizations are open about decisions and activities that affect their ability to transition to a more circular and sustainable mode of operation and are willing to communicate these in a clear, accurate, timely, honest and complete manner.

In general, transparency should be favoured, so that information is made accessible proactively or on request. For example, where appropriate, an organization should be prepared to disclose information and data relevant to its implementation of the principles of the circular economy. This might include the provenance and composition of materials and chemical ingredients in products, anticipated lifespan of the product, repair manuals, end-of-life measures such as how customers should reuse or recycle.

The principle of transparency does not necessarily mean that proprietary information is to be made public, nor does it involve providing information that is privileged or that would breach legal, commercial, security or personal privacy obligations. However, as with collaboration, building trust, both internally and/or externally, is key.

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Section 3: Flexible framework

5 Framework for implementing the principles of the circular economy

5.1 General

In implementing the principles of the circular economy, organizations are likely to face the triple challenges of:

a) adapting their activities to operate in an economically, environmentally and socially sustainable manner;

b) meeting new and emerging market needs and expectations – now and into the future; and

c) delivering a) and b), whilst operating within or across a range of different consumer cultures, legislative environments and economic frameworks.

It is important to recognize that addressing demand-side solutions can stimulate more sustainable consumption patterns (e.g. influencing consumer behaviour to increase uptake of leasing or sharing business models), which might be equally or more important than supply-side interventions (e.g. materials selection, product design and manufacture).

5.2 Establishing an organization's level of circular economy maturity

Organizations are likely to have differing levels of circular economy familiarity: from those starting out to those advanced in their thinking, but nevertheless wanting to review or sense check their approach.

In recognition that a business model is much more than an organization's processes and products or services, this clause allows for different levels of maturity (i.e. improving and optimizing) to be considered within an organization (see Figure 10). However, it is important to note that any one organization might be operating at different maturity levels concurrently across different divisions, product or service categories, regions and so on.

As set out in Figure 10, it is anticipated that as an organization develops from Level 0 to Level 4 (and beyond), it would transition towards a more circular and sustainable mode of operation. For example, a manufacturing company might evolve from basic regulatory compliance (Level 0) to zero waste to landfill, through to achieving higher levels of recycling and ultimately might adopt remanufacture as part of their business model (Level 4).

Annex A provides a tool to help organizations identify and evaluate their existing maturity against the levels identified here, by reviewing the extent to which the principles of the circular economy are being implemented through their current decisions and activities.

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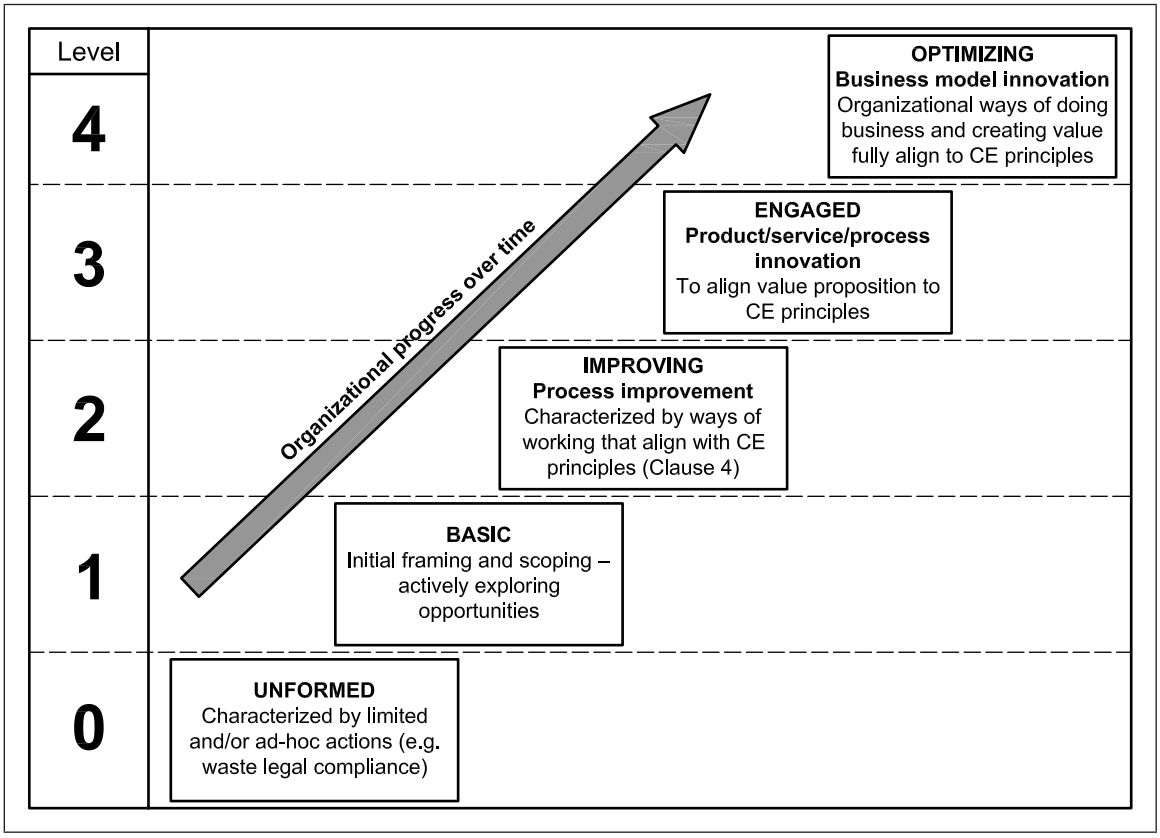
Figure 10 — *Level of organizational circularity maturity*



5.3 The eight-stage flexible framework

The remainder of this clause provides a flexible eight-stage framework to help organizations practically implement the principles of the circular economy (see Clause **4**).

Working through the eight-stage framework set out in **5.4** to **5.11** can assist organizations to develop a road map for continual and transformational improvement. The framework also involves an element of iteration. For example, although the eight stages have been presented in a sequential manner, this is for presentational purposes only. It is likely that organizations would move back and forth between the stages as their level of circularity maturity develops.

Organizations are encouraged to implement this framework by keeping in mind the nature of their own business. Additional guidance is provided on enabling mechanisms and business models that can support the circular economy (Clause **6**) and other key factors to consider when using this framework (Clause **7**).

In applying the flexible eight-stage framework, many organizations would choose to start at Stage 1. However, an organization could enter the framework at any of its eight stages, due to the varying levels of circular economy maturity and activity that currently exists. The flow diagram in Figure 11 can assist organizations to identify their specific entry point when applying the eight-stage framework. This British Standard does not advocate or endorse any proprietary tools or resources that might be available and used to support this framework.

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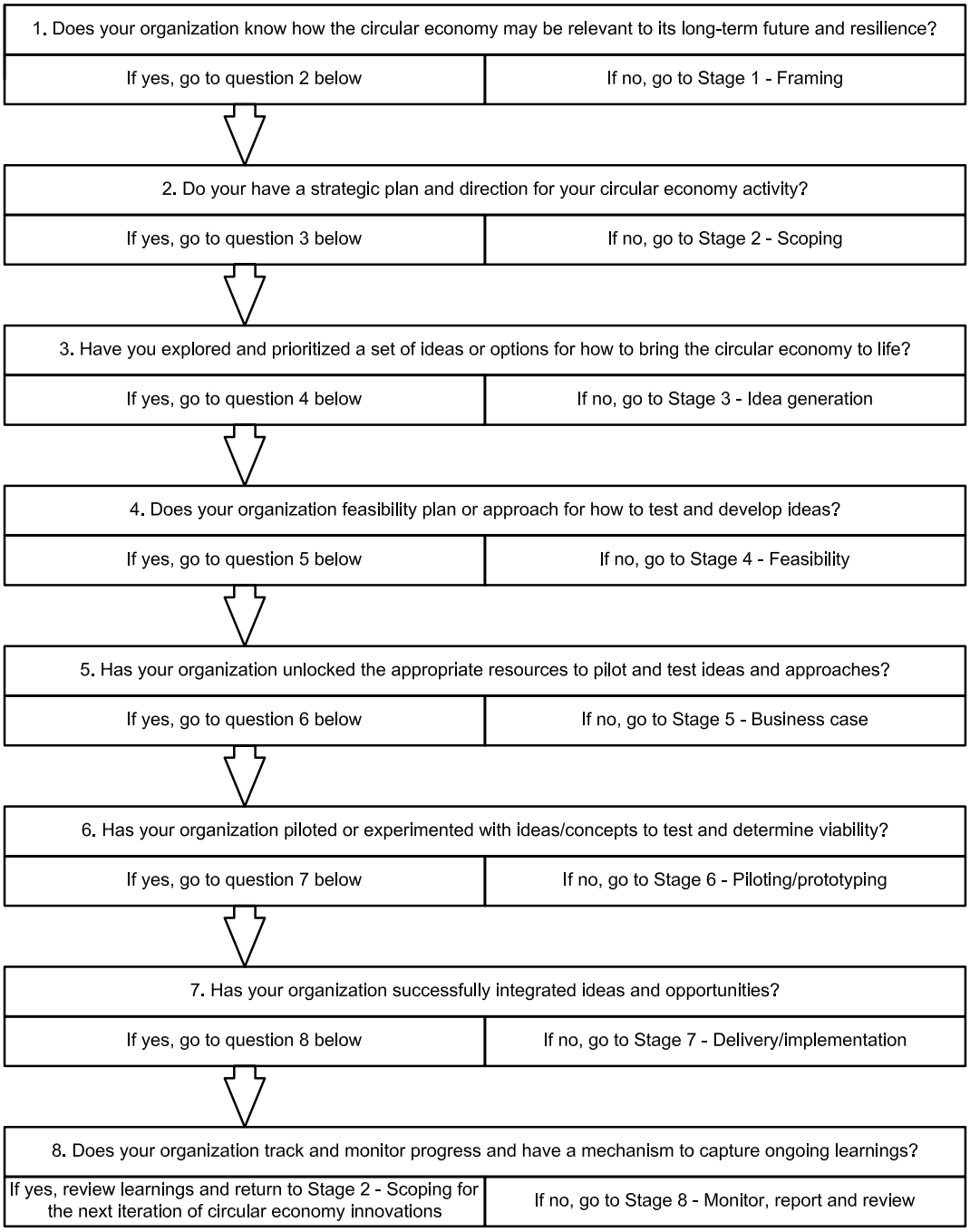
Figure 11 — *Navigation tool to help organizations identify where to start in using the eight-stage flexible framework*



NOTE A business case might be required to enable organizations to unlock resources, pilot new ideas/options and then implement, scale-up or roll-out subsequent outcomes. Business case requirements vary from organization to organization. As such, an outline case might also be required for an organization to proceed with any or all of the stages outlined.

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5.4 Stage 1: Framing

Organizations should determine the relevance of the circular economy to their business and identify where to begin. To do this, the following actions should be carried out.

a) Assess current state of play and relevance of the circular economy.

- Identify how resources are used and/or managed across the organization, key dependencies and associated risks and opportunities.
- Determine which resources are of most importance to the long-term success and resilience of the organization. This might, for example, take the form of a materiality assessment – an exercise designed to gather information from the business and its stakeholders to identify if a particular issue is sufficiently important to warrant attention.
- Review any existing initiatives of relevance to the circular economy within the organization, its supply/value chain and wider industry or sector.
- Develop an initial understanding of how the circular economy might be relevant to the organization.

b) Stakeholder mapping.

- Define and identify internal and external stakeholders of relevance to the circular economy (including mapping and defining customer requirements). This should be done by first identifying the different stakeholders and secondly clarifying their interest and relationship with the organization, including partnerships and collaborations.
- Acknowledge those who might need to be brought together within the organization (e.g. those already doing relevant work and early advocates who might champion the agenda).
- Discuss and identify the key internal and external stakeholders who might inform a materiality assessment or help in assessing the organization's current state of play.

  NOTE Given the overlap, this activity is likely to be conducted simultaneously with the above on current state of play and relevance.

c) Generate internal awareness and enthusiasm.

- Communicate and engage with internal stakeholders on the relevance of the circular economy and its benefits.
- Engage and excite internal stakeholders about what the circular economy could mean for the organization and what their role might be – including benefits and opportunities.

Stage 1: Gate review

Review Stage 1 outcomes against the principles of the circular economy (Clause **4**).

Is the circular economy determined to be important to the organization's long-term success and resilience and does it provide a helpful framing to move forwards?

If yes – continue to the next stage.

If no – do not continue further at this point, but schedule a Stage 1 review after an identified period of time. Continue to monitor general societal and sector and competitor trends which might prompt an earlier than scheduled Stage 1 review.

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5.5 Stage 2: Scoping

In considering a vision, strategic plan and direction for circular economy activity, organizations should look carefully at what is possible and/or required within the context of the circular economy. To do this, the following actions should be carried out.

a) Identify the system(s) to be explored and influenced.

- Define the system and establish its boundaries.
- Map the system using relevant systems thinking tools and techniques, such as:
  - system mapping for resource/material flows;
  - value networks for stakeholder and relationship mapping; and
  - existing life cycle assessment studies.
- Identify key stakeholders, particular those of relevance to current or potential collaborations.
- Identify risks and opportunities and the root causes of any problems or issues.
- Identify points of potential leverage within the system. This could include identifying those elements inside/outside of the organization's immediate control and influence which might be influenced through indirect intervention.
- Clarify the objectives of taking any action and how they relate to the circular economy.

b) Understand the organization's current vision and how the circular economy could support or undermine delivery of its long-term value proposition.

- Understand where the organization is now, where it wants to be and what it is planning to do to achieve this vision (e.g. through backcasting or future-state mapping).
- Reflect on the assumptions that underpin the organization's activities today and how they might change in the short, medium and long term.
- Determine whether there is a clear (business) case for action within the context of the circular economy, identifying those elements which are ready to change and where there might be resistance to change (and why).
- Understand the organizational barriers standing in the way of a long-term vision and strategy for implementing the principles of the circular economy.

  *NOTE Refer to Clause **7** and Table 2.*

c) Agree vision and high-level strategy.

- Define the organization's overarching vision and level of ambition for the circular economy.
- Map the changes that need to happen to get there.
- Agree a high-level strategy, objectives and road map to achieve the ambition (see **7.13**).
- Where possible at this stage, assign ownership to each activity identified on the road map.
- Establish a team/working group to take the road map forwards and track progress.

  NOTE Although the vision and road map exercise is intended to provide a sense of direction and ambition, in many cases it might be an iterative process that could need to be reviewed and refreshed on a regular basis as knowledge and understanding evolves.

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Stage 2: Gate review

Review Stage 2 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Determine to what extent approval from top-level management is required before progressing to Stage 3.

5.6 Stage 3: Idea generation

Organizations should develop a list of ideas/options to tackle problems and/or opportunities identified in Stage 2 and prioritize these accordingly within the context of their circular economy vision, strategic plan and objectives. To do this, the following actions should be carried out.

a) Define goals and clear briefs/topics for exploration.

- Define goals and clear briefs and topics for exploration in line with problems and/or opportunities identified during Stage 2. This should include reflecting on the organization's value proposition and how it could be changed with respect to transitioning to a more circular and sustainable mode of operation.
- Confirm key internal/external stakeholders and invite them to working sessions/discussions as appropriate. Customers can also be engaged through activities such as market research and focus groups.

b) Identify list of ideas/options and prioritize accordingly.

- Identify a list of ideas/options to progressively move towards a more circular and sustainable mode of operation through process, product/service and/or business model innovation.
- Identify key associated risks and assumptions (e.g. market context, emerging trends, existing value proposition, strategic fit, stakeholder interests, timelines, ability to reduce resource intensity, etc.). This could be achieved through:
  - internal workshops;
  - working sessions with key external stakeholders, e.g. customers, suppliers, regulators; and
  - review of existing innovation pipeline.
- Understand the opportunities that could be realized and barriers standing in the way of identified ideas and concepts (see guidance in Clause **7**).
- Prioritize ideas/options in line with the organization's circular economy vision, objectives and strategy.

NOTE More detailed analysis might be required to better understand key issues associated with identified ideas/options (e.g. material flow analysis or extended value stream analysis).

Stage 3: Gate review

Review Stage 3 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Determine to what extent approval from top-level management is required before progressing:

- small interventions identified – consider progressing straight to Stage 6;
- larger/more complex interventions – progress to Stage 4.

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5.7 Stage 4: Feasibility

Organizations should assess the practicality of progressing their prioritized ideas/options identified in Stage 3. To do this, the following actions should be carried out.

a) Define and undertake feasibility assessment.

- Define the type of feasibility required for the prioritized ideas/options. This could range from detailed feasibility studies to a high-level assessment depending on the circumstances.

  NOTE 1 Organizations might wish to consider adopting agile methodologies to speed up the process of identifying viable ideas/options and discounting those which are unlikely to be feasible as quickly and cheaply as possible (i.e. be willing to "fail fast").

- Once defined, the feasibility assessment might include:
  - assessing the strategic, customer and market and wider value creation potential of prioritized ideas/options and could include: value proposition; activities, processes, resources, capabilities, collaborations; revenue models; customers or customer interface; and viability of supply.
  - mini-piloting involving "light touch" testing and some prototyping (e.g. low technology/low cost mock-ups) of products and services in a live environment with actual customers;
  - the undertaking of more detailed technical analyses such as options appraisal techniques or other supporting qualitative and quantitative assessment tools (e.g. environmental life cycle assessment and/or social life cycle assessment).

    NOTE 2 For further information on social life cycle assessment, see <http://www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/social-lca/> [last viewed 9 May 2017].

  NOTE 3 There are a number of proprietary tools and resources available which can help organizations assess the feasibility of different ideas/options, for example Business Model Canvas (see Osterwalder and Pigneur, 2010 [16] and Value Proposition Canvas (see Osterwalder et al, 2014 [17]). Attention is drawn to the fact that many of these tools are designed and could be used for the "business as usual" linear economy unless they are approached with a particular mindset (i.e. circular economy).

b) Review and/or confirm ideas/options.

- Review and confirm which ideas/options are felt to be most feasible and aligned with circular economy vision, strategy and objectives.
- Evaluate capability and readiness of the organization and make key internal and external stakeholders aware of proposals.
- Confirm what is required to progress to the next stage (e.g. business case, top-level management approval).

Stage 4: Gate review

Review Stage 4 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Determine to what extent approval from top-level management is required before progressing to Stage 5.

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5.8 Stage 5: Business case

Organizations should develop a business case to secure the necessary resources to pilot new ideas/options and then implement, scale-up and roll-out. To do this, the following actions should be carried out.

a) Develop detailed business case.

- Assess the business case requirements to progress the ideas/options identified and secure the necessary top-level commitment and buy-in.
- Translate the ideas and options into a business case covering appropriate areas such as:
  - market analysis;
  - customer journey;
  - operations;
  - IT;
  - logistics and supply chain;
  - financial information;
  - metrics, including direct and indirect value creation;
  - regulatory requirements and licence to operate; and
  - hurdle rates (required or target internal rate of return) and other business specific financial expectations.
- Examine issues of relevance (e.g. resourcing and timescales) to subsequent stages (e.g. piloting and delivery).
- Identify and agree performance metrics/outcomes. These should correspond with the metrics used to monitor and review the pilots and any scaling-up of successful outcomes. See Stage 8 and guidance provided in Clause **7**, specifically **7.7** and **7.13**.
- Identify frequency of business case review and update.
- Review and adjust business case in light of feedback from key internal or external stakeholders (e.g. how proposals interact with other projects underway within the organization).

  NOTE Organizational requirements for business cases vary.

Stage 5: Gate review

Review Stage 5 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Determine to what extent approval from top-level management is required before progressing to Stage 6.

NOTE The business case is likely to require revisiting and revising over time.

5.9 Stage 6: Piloting and prototyping

Organizations should experiment with ideas/options on a small scale to determine practical viability. To do this, the following actions should be carried out.

a) Establish ownership and governance.

- Determine who needs to be involved and when. Ensure those parts of the organization that are key to any future scaled implementation or roll-out are fully engaged.

- Design the governance for the testing process as appropriate, including the needs and expectations of all key stakeholders.

b) Develop a plan for piloting, prototyping or development.

- Confirm the objectives and performance metrics or measures of success for the pilot. This includes what questions, hypothesis, assumptions, etc., are being tested.
- Establish the scale of the pilot or prototype.
- Explore different ways of testing (e.g. engaging stakeholders, value chain, customers and end users) and identify and confirm the most appropriate approach.
- Establish an appropriate system to monitor and capture information and data throughout the process, including key performance indicators and options for changing or updating approach.
- Define the circumstances in which the pilot might be suspended or ceased altogether.

c) Conduct and review pilot/prototype.

- Continually capture lessons learned, including the views of the market/customer, through the period of the pilot.
- Confirm approach to information management and disseminate learning to relevant stakeholders internally or externally. This should include insights on process as well as results.
- Review outcomes of the piloting process and consider what changes are required before it can be taken to scale. This might include the need to revise the existing business case.

Stage 6: Gate review

Review Stage 6 outcomes against the principles of the circular economy (Clause **4**).

Determine if further testing is required (repeating Stage 6), or ability to proceed to partial or full-scale roll-out/implementation (Stage 7), and evaluate if any of the preceding stages need to be revisited.

Determine to what extent approval from top-level management is required before progressing to Stage 7.

5.10 Stage 7: Delivery and implementation

Organizations should scale/roll-out the adoption and integration of proven approaches to transition to a more circular and sustainable mode of operation. To do this, the following actions should be carried out.

a) Develop and execute delivery plan and its implementation.

- Develop and execute plan for full roll-out and implementation of proven approaches to transition organization to a more circular and sustainable mode of operation. This should include confirming strategic short-, medium- and long-term objectives and indicators/targets, as well as outcomes-based metrics for direct and indirect value creation.

  NOTE 1 With regards to key performance indicators, reference can be made to those already defined by the organization itself for other purposes, or by standards or other organizations.

- Evaluate existing ways of working, including management systems or other processes, which might be in place. This should include:
  - agreeing roles and responsibilities;
  - confirming the required types and levels of resources (e.g. financial, human or material/product/service/process);

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- establishing and addressing learning and development needs to ensure key individuals within (and potentially outside) the organization are equipped with the necessary tools and capabilities to deliver in line with the circular economy vision, strategy and objectives;
- agreeing, prioritizing and establishing management and governance arrangements in line with the organization's circular economy vision, strategy and objectives; and
- ensuring that identified actions, impacts and outcomes are managed and appropriate internal controls are in place. This should include supply chain management and partnership/collaboration approaches.

NOTE 2 Some organizations already use recognized management systems, for example in the areas of quality, accountancy, environmental management, energy management, human resources, and health and safety.

- Agree and implement a change management system (see **7.4**) to enable the organization to implement and sustain the planned change and ensure the prevailing culture is supportive of a move towards a more circular and sustainable mode of operation.

b) Mechanisms to measure progress over time.

- Establish processes to review progress against objectives and indicators/targets as well as outcomes-based metrics.
- Ensure mechanisms are in place to capture key data and other insights (e.g. from users/customers/employees) on an ongoing basis to enable strategic and operational performance evaluation to take place.

Stage 7: Gate review

Review Stage 7 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Determine to what extent approval from top-level management is required before progressing scaled roll-out/implementation at the end of Stage 7.

5.11 Stage 8: Monitor, review and report

Organizations should track performance to ensure ongoing success and continual and transformational improvement. To do this, the following actions should be carried out.

a) Monitoring and measurement.

- Monitor progress against stated circular economy vision, strategies, objectives and targets (see **7.13**).
- Foster a positive learning culture by identifying and capturing lessons learned. Build ability to adapt to changing conditions as they emerge while maintaining focus on vision and strategy (see **7.4**). This could include consideration of:
  - successes;
  - experience;
  - near misses;
  - failures;
  - exercises; and
  - learning.

b) Reporting progress.

- Agree scope, audience, format and levels of disclosure for reporting progress towards transitioning to a more circular and sustainable mode of operation through a range of communications channels.
- Establish or reinforce mechanisms for handling and responding to stakeholder feedback on the organization's circular economy vision, strategy, objectives and targets.

c) Continual and transformational improvement.

- Take action when necessary to address any positive or adverse trends or outcomes identified. This includes opportunities for innovation and performance improvements.
- Evaluate the performance and effectiveness of approaches taken to transition the organization to a more circular and sustainable mode of operation.
- Plan and implement improvements and changes to approaches where evidence indicates that these are necessary and/or desirable.
- Ensure successes are celebrated and communicated to relevant stakeholders.

Stage 8: Gate review

Review Stage 8 outcomes against the principles of the circular economy (Clause **4**).

Ensure relevant aspects of Clause **6** and Clause **7** have been taken into account.

Ensure top-level management reviews the organization's approach to implementing the principles of the circular economy at planned intervals to ensure its continuing suitability, adequacy and effectiveness. This includes determining whether the organization's circular economy vision, strategy and objectives are suitable, adequate and effective.

NOTE Annex A contains some useful guidance to help organizations evaluate their level of maturity and the extent to which the principles of the circular economy are being realized through their decisions and activities.

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Section 4: Supporting guidance

6 Guidance on enabling mechanisms and business models

6.1 General

A business model comprises an organization's chosen system of interconnected and interdependent decisions and activities that determines how it creates, delivers and captures value over the short, medium and long term. However, business model innovation for the circular economy goes beyond advances in processes and/or products or services. Innovation in these areas might well create better processes, as well as products and services, without necessarily addressing sustainable resource management within an organization's underlying value structure or proposition.

Some existing business models deliver clear environmental and societal benefits, although these might be secondary to the organization's main value proposition. Whilst the term "circular business model" is increasingly being used, this is also misleading because it suggests something that might not be the case. Implementing any one business model does not necessarily equate to a shift to a more circular and sustainable mode of operation. More correctly, there are business models which have the potential to "fit" within a circular economic system. Unless the wider systemic context is considered at the same time then they are simply new or reimagined business models operating within the prevailing linear economy. From the perspective of this British Standard, this is best delivered through a systems approach, where the selected business model and its value proposition are both underpinned by the principles of the circular economy (see Clause **4**) and implemented through a flexible framework (see Clause **5**).

An established organization is unlikely to alter a (commercially) successful business model(s) unless it sufficiently understands the long-term threats/opportunities associated with moving to a more circular and sustainable mode of operation. Where a strong business case exists, established organizations (e.g. a car component manufacturer operating for many years) are more likely to re-engineer existing business models to deliver their main value proposition alongside chosen circular economy objectives. Internally and across their supply/value chain, this requires an effective process of change management (see **7.4**), with a supportive culture across all business functions and top-level management buy-in.

To disrupt or be disrupted appears to be an increasingly held business mantra, for example several new disruptive business models have emerged in the digital space (e.g. Freemium). For new disruptive start-up companies, where the value proposition is underpinned by the principles of the circular economy (see Clause **4** and Clause **5**), business model selection is likely to lead to a more circular and sustainable mode of operation from the outset.

This clause aims to give a comprehensive overview of:

a) the key considerations for an organization when selecting a business model; and

b) key business model types which, when adopted as part of a systematic approach, can deliver a more circular and sustainable mode of operation. Content is organized into manageable groups and supported by generic examples and supporting information.

The emergence of national and academic approaches is already reflecting diverse terminology, with the result that similar business models might be defined in different ways.

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6.2 Enabling mechanisms

This British Standard distinguishes between business models and enabling mechanisms. Where underpinned by the principles of the circular economy, an enabling mechanism(s) can assist an organization to deliver and capture value, alongside the more sustainable management of resources. For example, financing mechanisms (e.g. crowd-funding) can aid value proposition delivery. However, there are exceptions where one (or more) enabling mechanism(s) delivers and captures an organization's entire value proposition. For example, offering additive manufacture via 3D-printing, repair services or reverse logistics. (where that is all it does). Generic business model elements are introduced in **6.3.2**.

Enabling mechanism(s) selection should also form part of a systematic approach to identifying the principles of the circular economy (see Clause **4**) and their implementation through the flexible eight-stage framework (see Clause **5**). Otherwise, they could potentially run contrary to a more circular and sustainable mode of operation (e.g. if 3D-printing resulted in mass production of disposable products for convenience, rather than to produce replacement parts extending product-life).

6.3 Business model design

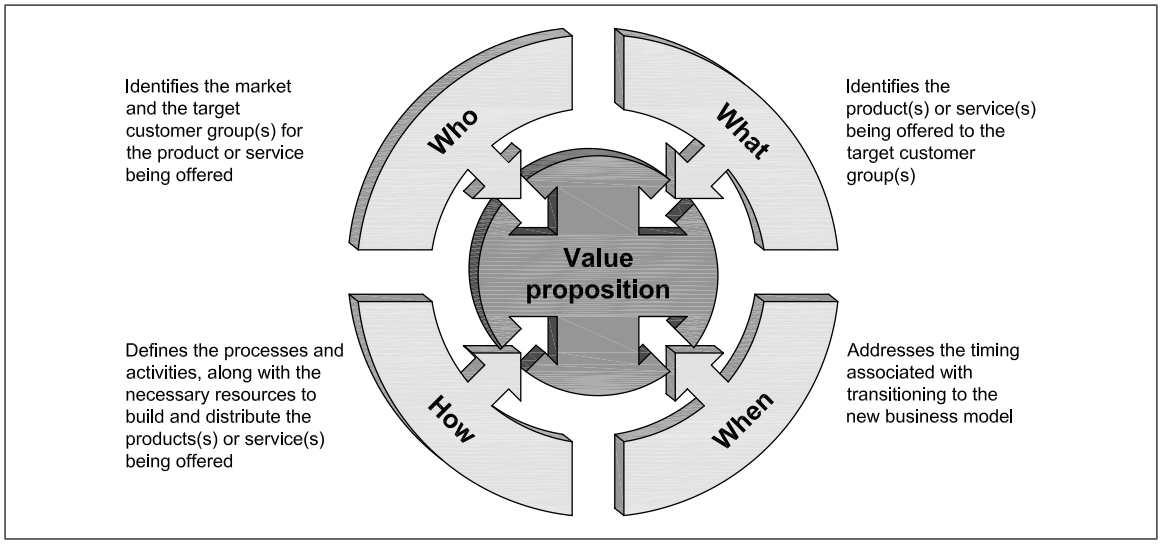
6.3.1 General

The value proposition is central to any business model, as it defines the products and services that create value for the organization's existing and/or new customer base. It also relates to the viability of the business model; more traditionally this identified how the organization proposed to make money (e.g. revenue mechanism employed). However, for organizations transitioning to a more circular and sustainable mode of operation, the value proposition might not be solely financial in nature and instead reflect delivery of wider social (e.g. see sharing economy in **6.4.3**) and environmental benefits.

6.3.2 Key elements

Business model methodologies typically comprise of four interconnected elements: Who, What, How and When. These elements support the development of the organization's value proposition (see Figure 12).

Figure 12 — *Overview of business model development*



In effect, a business model defines the organization's market and customers, its products and services, its activities, processes and infrastructure and the value it creates and captures which

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includes its financial viability. In a non-commercial context, organizations might not have the same motivations as for-profit organizations, but fundamentally they still create, deliver and return value. For example, they create public benefits, programmes and services rather than products and services in the classic for-profit sense.

6.4 Business model types and selection

6.4.1 General

Increasingly, a test for all organizations is whether their current business models can deliver intended circular economy objectives (see Clause **4**). Key decision makers should be aware of both business models design and the approach utilized in their respective organization.

Identifying business risks and opportunities associated with sustainable resource management is a prerequisite to determining which business model would be best suited to deliver the organization's circular economy objectives, alongside its wider value proposition.

An organization's ability to continuously innovate is likely to be increasingly central to its long-term economic competitiveness.

6.4.2 Preference

This British Standard is not prescriptive on business model selection, due to both the difficulties in determining a clear rationale and the organization-specific nature of the underlying decision-making. Systematic approaches to the design of business models, as outlined in **6.1**, should promote sustainable resource management by, for example, optimizing how resources are managed, including the reuse, repair, refurbishing, remanufacture and recycling of materials/products.

The way in which the principles of the circular economy are implemented via business models is heavily dependent on a range of factors including leadership, organizational maturity, culture and type of products/services/markets. For example, adopting a new business model which has the potential to be disruptive might be preferable for a start-up organization. However, for an established business, with many years' trading experience, innovation around the existing business model might be preferable to adapt (e.g. re-engineer) from more linear towards more circular operational functionality. For example, an organization profits from the extension in the lifetime of ink cartridge components by offering a refill service.

There is no one-size-fits-all approach for an organization to deliver its defined circular economy objectives. This is due to both the highly organization-specific nature of business model development and their different operating levels (e.g. divisional/unit and/or individual product or service). Larger, more established organizations (e.g. those providing a range of products/ services) are perhaps most likely to commence their circular economy journey in a more limited way (e.g. single service level), where new concepts can be tested (e.g. prototypes) in one business unit and/or individual product-level to learn lessons (e.g. scalability). Where the business case is made and the required system changes have been identified and implemented, the organization can then evaluate a more macro-level (e.g. range of products/services) roll-out.

6.4.3 Business model groupings

In Table 1, six business model groupings are introduced:

1) on-demand;
2) dematerialization;
3) product life cycle extension/reuse;
4) recovery of secondary raw materials/by-products;

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5) product as a service/product–service system (PSS); and

6) sharing economy and collaborative consumption.

These six groupings have the potential to be compatible with a circular economic system (see also **6.1**); however, these are not mutually exclusive. For example, to realize its value proposition an organization might need to adopt a business model which includes: digitization, product-life extension and product-as-a-service. In reality, larger, more complex organizations might concurrently have different business models operating across their divisions/units and for different product/markets.

Any perceived focus on products as opposed to services is unintended. A brief description of each is provided, together with benefits/advantages (specific to each business model, but generic points on sustainable resource management are not repeated) and practical examples.

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Table 1 — *Overview of business models (1 of 4)*

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
ON DEMAND			
Produce on demand (made to order)	Producing a product or providing a service only when consumer demand has been quantified and confirmed.	Aeroplanes, often furniture and designer clothes/footwear are only manufactured once ordered. Other items are produced based on user/customer votes (e.g. most popular t-shirt designs are made available for sale), where a mechanism is required to guarantee an informed response.	Minimizes raw material demand and avoids over-stocking. Can enhance "personalization" via delivery of a better fit to customers' requirements, leading to less product redundancy.
DEMATERIALIZATION			
Digitization	Replacing physical infrastructure and assets with digital/virtual services.	Move from physical video/DVD stores to online film and music services, etc., digital as opposed to camera film or vinyl records.	Offers dematerialization advantages over tangible products, but without reducing the perceived value to the customer.
PRODUCT LIFE CYCLE EXTENSION/REUSE			
Product life-extension	New products are designed to be durable for a long lifetime (durability). Design improvements might be needed to also facilitate easier repair, particularly by third parties.	Leading high-grade washing machines. An infrastructure and buildings specification with an extended design-life (e.g. 120 instead of 100 years).	Increased product life.
Facilitated reuse	Reuse with or without repair/upgrade and supplied either free of charge (FOC) or resold.	FOC: furniture reuse networks. Resold: online auction and for-sale websites.	Reduces the demand for new products.
Product modular design	Products designed to be modular so that parts can be replaced to update/upgrade a product, but not replace the whole item.	Modular construction (e.g. mobile phones).	Replacement at part(s) rather than product level (e.g. new screen as opposed to new mobile phone). Can also encourage cost-effective product repairs and reduce need for replacement of integrated components, thereby reducing resource consumption.

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Table 1 — *Overview of business models (2 of 4)*

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
Refurbish, repair, remanufacture and recondition	Product gets a next life (e.g. after remanufacture – the process of restoring the product or part functionality to "as-new" quality; facilitated by design for disassembly). Enables the producer to put the product back into the market to earn a second or subsequent income, from a second or subsequent user.	Remanufactured products, parts and components provided with "as-new" performance and reliability at a reduced cost compared with new. Major car manufacturer offering genuine exchange parts remanufactured from returned used parts which are inspected and rebuilt to meet the same quality standards and performance as new, and carry the same warranty.	Reduces demand for new products/raw materials.
RECOVERY OF SECONDARY RAW MATERIALS/BY-PRODUCTS			
Recovery of secondary materials/by-products (including recycling)	Value optimization by creating products from secondary raw materials/by-products and recycling (e.g. polyethylene depolymerization, steel, bio-based materials), whether open or closed loop.	Closed loop: • glass/plastics bottles back into glass/plastics bottles; • aluminium car body components back into auto-industry; • recycled asphalt planings in new roads. Open loop: • plastic bottles recycled into fleece jackets and fibres for shoe lining; • nylon fishing nets used in carpet and skateboard manufacture; • reclaimed timber to make garden furniture; • car tyres into shoe sole outers; • marine plastic to manufacture training shoes; • clean wood-fibre to beer bottles; • bio-based materials/packaging to quality compost or digestate; • recycled aggregate to offset primary aggregate (e.g. block manufacture).	Reduces natural capital demand and minimizes waste.

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Table 1 — *Overview of business models (3 of 4)*

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
Incentivized return/extended producer responsibility	Incentivizes customers to return used/unwanted items back to the producer via a convenient system. Producer then either recycles materials or repairs/refurbishes/ remanufactures the product. Incentive usually in the form of a discount offered on a new product for surrendering the old one.	Scope to implement at scale via national take-back schemes for product categories, in particular, via extended producer responsibility (e.g. batteries, light bulbs, appliances) Financial or alternative incentive offered for the return of used or unwanted electrical items. Store credit (money-off) on new purchases when returning worn/unwanted clothes items. Jeans returned for repair/refurbishment.	Facilitates recovery of used/unwanted products (and embodied materials) through a controlled and auditable system.
PRODUCT AS A SERVICE/PRODUCT–SERVICE SYSTEMS (PSS)			
Lease agreement	Leasing access to and not selling ownership of a product or service. This can be on a B2B or B2C basis. In general, an "operating lease" model is likely to be best suited for PSS models in the context of a circular economy as ownership of the asset is retained by the lessor and can be combined with service or performance-based business models.	Lease agreements on: fleet and domestic cars, industrial solvents, power tools, TVs and DVD players, etc., over a 6-or 12-month contract. B2B: leasing of floor/wall coverings. B2C: clothes leasing (e.g. jeans). Subscription to TV sports channel.	The lessee's capital outlay is typically lower when compared to outright purchase when taking depreciation, maintenance and disposal/replacement costs into account. The lessor typically benefits from higher overall profitability during the lease period and retains ownership.
Performance based (Pay for success)	Company delivers product performance or defined results rather than the product or service itself. The customer purchases a defined level of performance, where the company's primary revenue stream comes from payments for performance delivered or demand-fulfilment. Ownership remains with the operating company.	Leasing a washing machine for 1 000 washing cycles or providing a pick-up and delivery laundry service. Other examples include: lighting (pay per lux); printing (pay per print); aero-engines (power by the hour).	Customer purchases a solution delivering the desired level of performance.

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Table 1 — *Overview of business models (4 of 4)*

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
SHARING ECONOMY / PLATFORMS AND COLLABORATIVE CONSUMPTION			
Sharing economy	C2C or B2B, but where no direct financial transaction occurs, or income is secured. More socially driven, rather than commercial, where access might strengthen community relationships. For B2B lending, business benefits might include reduced costs over directly sourcing the products/services concerned.	More traditionally dependent on the participation and generosity of community members (C2C) to share goods/ services. Can be more formalized via tool libraries (e.g. electric drill, lawnmower). Increasing interest in community-based lending of skills/know-how. Facilitates the sharing of over-capacity or underutilization (e.g. cars or apartments).	Strengthens local/community engagement. Reduces need for ownership and storage of goods. Sharing of skills/know-how.
Sharing platforms/resources (collaborative consumption)	Peer to peer (P2P) lending or "collaborative consumption" amongst users, either individuals or organizations, but where some form of transactional arrangement (which could be financial) is provided.	Renting out private parking spaces; shared ownership of products (e.g. pressure washer purchased between several neighbours). Space and logistics sharing (e.g. shared containers, storage, shipping and logistics). Bike sharing systems in cities (e.g. self-service cycle hire schemes in London and Paris etc.); users need to take out a subscription. This system can also be viewed as a form of "lease agreement", given that the user has to take out a subscription. The main difference is that the per cycle hire retention period is typically very short (e.g. same day) and payment is not re-occurring.	Enables increased utilization rate of products and services by making possible shared use/ownership among consumers. Enables customers to access a product, rather than owning it outright, and use it only as needed.

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7 Guidance on circular economy issues and considerations

7.1 General

Transitioning an organization towards a more circular and sustainable mode of operation, be it in a focused pilot or on a much wider scale, can be complex, especially within the existing, predominantly linear, economy. Clause **4** and Clause **5** set out the principles and core framework of activities that can enable an organization to advance this transition. Clause **6** provides guidance on enabling mechanisms and business models. However, there are many factors which can enable or impede an organization in delivering their circular economy objectives.

This clause provides an outline of several additional factors which organizations might wish to consider. It is not possible to pre-empt all possible issues or considerations that could be relevant, so this section is not exhaustive. However, a core group of additional issues and considerations that organizations might experience have been identified.

The following broad thematic areas might help organizations to identify areas of both risks and opportunities that could affect delivery of their circular economy objectives.

a) **Economic**: Existing economic systems are not always well designed to enable more circular approaches to doing business, from the way insurance and taxation operates, through to business accounting approaches, the pricing of environmental harm, criteria for return on investment, to the way organizations recognize and report profits.

b) **Technical**: Circularity initiatives can often involve the re-design of products and services, the application/adoption of new technologies, the use of alternative/reuse of existing materials and the consequential impacts these changes have on wider systems. Significant uncertainty can exist, but circular initiatives need to be able to consistently meet the required quality and deliver the expected functionality if they are to become established in an organization's operations and thinking. Use of secondary raw material inputs might require updates to standards and specifications.

c) **Policy and regulatory**: Existing regulation has, in general, been developed and deployed within the context of a linear economy. As such, rules (e.g. how discarded items are managed, how organizations collaborate or how business is financed) are not always supportive of the circular economy. In addition, modern approaches to regulation are often risk based, which might not align with the uncertainty that can relate to innovative circular economy initiatives. Further work is needed to understand how future policy and regulatory frameworks can be made sufficiently flexible to support the move to a circular economy.

d) **Behavioural**: Culture change is hard within an organization, let alone in its wider value chain, sector or society at large. The prevailing organizational culture might not be particularly favourable to adopting a more circular approach to business.

e) **Organizational**: The management and governance arrangements which exist within and between organizations can also either enable or impede the transition to a more circular and sustainable mode of operation. For example, an organization's approach to circularity could demand certain information, resources, processes and relationships which do not exist within its present systems.

The matrix in Table 2 outlines common relationships between these broad thematic areas and the issues and considerations set out in the remainder of this clause. Organizations might wish to refer to or adapt this matrix when following the guidance in Clause **5**.

Table 2 — *Example matrix to help organizations to identify potential issues and considerations relating to progressing their circular economy vision, strategy or objectives*

Issues and consideration	Economic	Technical	Policy and regulatory	Behavioural	Organizational
Accounting and finance (**7.2**)	✓		✓		✓
Anti-trust and competition law (**7.3**)	✓		✓	✓	✓
Change management (**7.4**)				✓	✓
Chemicals (**7.5**)	✓	✓	✓		
Energy and fuels (**7.6**)	✓	✓	✓	✓	
Information management (**7.7**)	✓	✓	✓	✓	✓
Liability and insurance (**7.8**)	✓		✓		✓
Logistics and reverse logistics (**7.9**)	✓	✓	✓		✓
Marketing (**7.10**)	✓	✓	✓	✓	✓
Materials markets (**7.11**)	✓	✓	✓	✓	
Materials selection (**7.12**)	✓	✓	✓		✓
Monitoring and measurement (**7.13**)	✓	✓	✓		✓
Procurement and contract management (**7.14**)	✓	✓	✓	✓	✓
Product design and development (**7.15**)	✓	✓	✓	✓	✓
Waste regulation (**7.16**)	✓	✓	✓	✓	✓

Beyond the issues and considerations set out in this clause, the best way an organization can prepare for any intended or unintended consequences of implementing the principles of the circular economy is to explore how related decision making or activities interact with all aspects of its business and value proposition/chain.

7.2 Accounting and finance

Organizations should establish the financial implications (positive or negative) of implementing the principles of the circular economy. Existing legal and financial systems that support traditional forms of business might not necessarily be helpful or clear.

Organizations should determine how they intend to finance and financially account for the delivery of their circular economy objectives. This should include having appropriate plans in place to manage associated risks and opportunities. The main financial challenges are likely to be balance sheet extension, increased need for working capital, and potentially increased credit risk. Existing approaches to determining internal rates of return might not be appropriate because the organization might need to invest over a longer term than previously. Key finance personnel should be involved at the earliest stages of the decision-making process, when circular economy requirements are being defined.

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Many of the emerging business models which have the potential to "fit" within a circular economic system are still at pilot scale and it can be difficult to secure traditional forms of finance, particularly if profitability or track record is yet to be demonstrated. The introduction of asset tracking or reverse logistics might lead to increased costs, particularly with respect to transportation and handling. A shift to offering product–service systems generally means that organizations need to think about how they would manage their cash flow. For example, income might change from a traditional "boxed" point of sale transaction to multiple payments (e.g. monthly over several years), as well as increased risks associated with consumer creditworthiness and bankruptcy.

In the traditional sense, the value of what might ordinarily be deemed waste is not generally considered. For example, such items are often written off even if they do have a residual value. Organizations should determine how to account for the value of any collateral (underlying assets, contracts or both) associated with the delivery of circular economy objectives. This is particularly important where they seek to retain control of assets (e.g. as a result of manufacturing or remanufacturing with secondary raw materials or offering product-service systems). Residual value of materials can increase by designing products to last longer and for easy disassembly to enable lower costs of reclamation and allow most of the resources to be retrieved. Organizations should aim to have a good understanding of the materials contained in their respective assets, together with the associated recovery costs and material market prices (see also **7.11**). Organizations should also take into account how to ensure the contract price is appropriate for the service provided both now and in the future.

Organizations should periodically evaluate relevant assets and contracts to ensure the level of security is appropriate. In particular, thought should be given to managing the risks associated with the ownership of assets. Risks can include loss of ownership (e.g. through accession) and in turn loss of security if the user of the asset is declared bankrupt (see also **7.8**).

At the present time, prices paid for goods and services typically do not take into account the economic value of environmental damage caused or avoided. Progress towards a circular economy is likely to be accelerated if this were to be the case in the future (e.g. as a result of changes in policy or market forces). Assessment of risks and opportunities associated with environmental externalities (positive or negative) might be an additional factor for organizations to consider.

7.3 Anti-trust and competition law

Collaboration is fast becoming a business priority. Collaborative approaches have been shown to deliver a wide range of benefits, which can enhance competitiveness and performance. Benefits include better cost management, improved timeliness, improved resource and risk management, and delivering business value and innovation.

It is unlikely that any one organization acting in isolation could achieve substantial progress when implementing the principles of the circular economy. As a result, collaboration is one of six principles of the circular economy (see Clause **4**).

Competition (or anti-trust) laws aim to regulate anti-competitive conduct by businesses (such as the operation of cartels and price-fixing). Many countries around the world have competition or anti-trust laws, which differ from jurisdiction to jurisdiction. As a general rule, any conduct involving collaboration or co-ordination between competitors (e.g. on the setting of prices, allocation of market shares, where to sell or to whom to sell) is likely to breach competition law. Other types of collaboration between competitors might be lawful, but organizations engaging in any sort of collaboration with their competitors need to be careful not to do anything that might distort competition in their markets. This is particularly relevant where interventions in the value chain are necessary to achieve circular economy objectives.

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Organizations should therefore take appropriate precautions to minimize the risk of engaging in anti-competitive behaviour. Such precautions might include the following.

a) Seeking appropriate advice and guidance from internal or external legal counsel. It is also possible in some jurisdictions to seek guidance from the relevant competition authority (e.g. the European Commission in the case of the European Union).

b) Adopting an open and transparent approach (see also Clause **4**) to collaboration. This might prove to be a useful way to mitigate competition concerns, particularly amongst competition authorities.

c) Developing and implementing compliance programmes to ensure there is awareness in the organization of the risks of infringing competition law and an understanding of how they are to be managed at an organizational level.

d) Setting meeting agenda in advance and limiting discussion to the topics on the agenda. If inappropriate issues are raised then meetings should be stopped and the person(s) raising the issues should be requested to cease discussing them or leave the meeting. If the discussion of the inappropriate topic continues then the meeting should be terminated. Minutes should accurately record the concerns and reasons for any stoppage or departure.

e) Keeping and circulating accurate notes and records of all discussions which take place. All materials, communications and documents received or exchanged should be retained.

NOTE BS ISO 44001 and BS 11000-2 provide further guidance on establishing and improving collaborative relationships in organizations of all sizes.

7.4 Change management

Implementing the principles of the circular economy represents major change. In most organizations, major change requires fundamental shifts in culture. Change often fails to get off the ground, stalls soon after commencement, or eventually collapses because the prevailing culture (beliefs, thinking and behaviour) of an organization is incompatible with what the organization is trying to achieve.

Change management is distinct but complementary to other management approaches (e.g. project management). For example, project management focuses on aspects to deliver planned change within the required scope, time, budget and quality. Whereas change management is first and foremost about people, those aspects should be focused on which are required to "implement and sustain" the planned change, such as influencing individual behaviour and organizational culture, introducing new ways of working and capturing lessons learned for future change programmes.

Organizations should evaluate their readiness, ability and capacity to undergo a transition from their current state to their desired future state by implementing the principles of the circular economy. This should include an assessment of the change and impact the change is anticipated to have on the organization and its value chain. Specific actions might include:

a) defining the change and why it needs to happen;

b) determining the key stakeholders involved and who is likely to be affected by the change;

c) developing and communicating a clear vision of the organization's desired future state to all key stakeholders;

d) assessing the organization's culture, readiness, ability and capacity for change;

e) determining whether key individuals understand and are committed to the change programme;

f) identifying potential issues which could impede progress and what success would look like;

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g) establishing realistic expectations at all levels of the organization; and

h) developing specific change management strategies and plans.

There are four key aspects in particular that organizations should give careful consideration to.

1) Design of organizational governance – "business as usual" governance tends to be quite hierarchical where day-to-day business activities, generally disconnected from each other, are overseen and directed from the top. This might not be entirely suitable to progress and sustain major change within the context of the circular economy. More successful organizations are likely to be those that engage and empower individuals at all levels of the organization to take a degree of responsibility to drive change.

2) Leadership – strong leadership is needed to implement the principles of the circular economy. For example, effective leadership can keep the organization focused on what it needs to achieve, whilst managing often competing demands. Good leadership should ideally be present at all levels of an organization.

3) Communication – change programmes typically fail due to insufficient or unclear communication. Good communication can have a positive effect on organizational culture and makes a significant contribution to the overall effectiveness of the change programme.

4) Expect the unexpected – there is a degree of uncertainty when implementing the principles of the circular economy so it is reasonable to assume that unforeseen issues could be encountered along the way. Organizations should decide how these situations are to be dealt with, particularly where responsibility to drive change has been devolved.

7.5 Chemicals

Chemicals are necessary for the manufacture of many items an organization buys, uses, interacts with and/or sells. Whilst chemicals offer certain benefits and qualities (such as prolonging the life of a material), a growing number of chemical ingredients are identified as being of concern for human health and/or the environment. Although there is a wide range of national legislation and safety standards that prohibit or restrict the use of certain chemicals or govern how they are used, not all are regulated.

A chemical ingredient seen as not posing an unacceptable risk today could be identified as such in the future, as knowledge of its environmental effect increases over time. Chemical ingredients which are now deemed to be of concern might also be found in items sold before any prohibitions or restrictions came into effect. If these reused or recycled materials become incorporated into (or marketed as) new products, any subsequent regulatory controls might now apply, for example the EU Registration, Evaluation, Authorisation and restriction of CHemicals (REACH) Regulation [18] (see also **7.8** and **7.12**). Whilst this might be a straightforward process for organizations using materials whose provenance is known, generally recycling facilities (for instance) would not be able to identify all feedstock sources that they receive.

Organizations should not wait for regulation or pressure from civil society before understanding how chemicals might be relevant or taking action on chemicals of concern. The specification of less harmful chemical ingredients and better tracking of chemicals of concern in products, components and materials can facilitate reuse and recycling in subsequent material cycles. Organizations should take into account the extent to which chemicals are relevant to their circular economy objectives. This might include the following actions.

a) Taking appropriate steps to identify all materials and chemical ingredients that are present within products, components or materials, or used as part of the organizations processes.

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This should include those that are prohibited, restricted or required to be phased out under legislation, as well as chemicals that are not currently subject to regulatory requirements. Chemical analysis might be necessary in cases of uncertainty, particularly reused or recycled material and ingredients of uncharacterized provenance.

b) Requiring suppliers, as far as it is practicable, to fully disclose chemicals present in products, components or materials supplied. This would typically be in the form of a safety data sheet, bill of materials (BOM) or similar.

c) Establishing processes to prohibit, restrict or phase out those chemical ingredients that represent a significant cause for concern and/or specify alternatives which are determined to represent a lower risk to human health and the environment. It should not be assumed that chemical substitutions are any safer than the chemicals they are intended to replace.

d) Reviewing "in use" and "end of use" challenges associated with the presence of chemical ingredients in products, components or materials supplied. This should include instances where conflicting priorities or unintended consequences could manifest. For example, chemicals used to prolong the life of materials might make it harder for the material to reused or recycled in the future. Conversely the exclusion of a specific chemical might mean that the material has a shorter lifespan. It could also be legitimate to permanently remove an item from the material cycle where it contains a particularly harmful substance. In the case of materials intended for the biological cycle they should not contain chemicals which have the potential to give rise to harmful effects on human health and/or the environment, or can do so in combination with other chemical ingredients.

e) Providing appropriate information in a language and form understandable to users on the provenance and composition of materials and chemical ingredients and how this might be relevant to the use of products, components or materials or their subsequent reuse or recycling (see also **7.7**).

The interaction of legislation on waste, products and chemicals in the context of the circular economy is complicated. This is an area where organizations might feel that they need the support of external skills and expertise.

7.6 Energy and fuels

In the linear economy, disposal of products, components or materials means much of the residual (embodied) energy is being lost. The use of energy resources in a linear business model is also typically more intensive in the upstream parts of the supply chain. Systems that rely less on using new materials as inputs might lead to significant energy savings.

At its core, a circular economy aims to completely "design-out" waste through process, product or service and business model innovation, where global de-carbonized energy demand is extremely efficient and met through renewable sources. Few organizations are likely to be in this latter situation and reducing the demand for energy and improving energy efficiency should be key areas of focus.

In developing their circular economy objectives, organizations should evaluate how they can reduce the energy intensity of their value proposition and contribute towards decarbonization across their value chain. Systems that rely less on using new materials as inputs might lead to significant energy savings. For instance, this might result in product "light weighting" or the development of new material specifications based on secondary rather than primary inputs, taking advantage of both closed and/or open loop systems (see also **7.12**). Manufacturing innovation for a material or compound could significantly reduce energy consumption. For example, research can help determine the extent to which secondary raw material substitution during manufacture can be made, whilst

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retaining the required material/product functionality. Ultimately, in a fully circular economy, secondary (not primary) raw materials would become the dominant input.

The prevailing policy and legislative landscape (see **7.16**) and changing economics and emerging technologies ultimately decide how far organizations are able to go in designing out waste. Organizations are likely to have some residual fraction (i.e. material that is leftover and cannot be usefully reused or recycled), either due to market conditions, material deterioration as they cascade through alternate usage cycles, or due to any (current) social barriers (e.g. recycled content viewed as being of inferior quality). Where it is carbon-based, this residual non-hazardous waste stream can potentially be utilized to generate fuels and energy. Importantly, however, once combusted the material cycle is broken and lost.

The most common methods available to extract energy from the residual waste stream are shown in Table 3.

Table 3 — *Common methods for extracting energy from non-hazardous residual waste*

Technology	Type of non-hazardous residual waste
Biogas plants (e.g. anaerobic digestion)	Organic matter is converted to biogas. A further by-product of the process is digestate; whilst this might be rich in nutrients such as nitrogen, phosphorus and other elements, any land-based applications are likely be much more restricted and regulated than for biogas plants operating in a source-segregated feedstock.
Co-incineration in cement and lime production and/or combustion plants to replace fossil fuels	Fuels produced to a regulatory and/or user specification; typically setting thresholds for calorific value, moisture, inerts and chlorine, etc.
Waste-to-Energy (WtE) plant	Residual waste from recycling processes and contaminated materials that can no longer be recycled (e.g. due to quality deterioration through cascading) and recover metals (that are difficult to recycle from composite laminated packaging) from the bottom ash.

There is often a tension – perceived or actual – between the immediate economic benefit of energy generation and investments needed for long-term material value recovery from waste streams. In transitioning to a more circular and sustainable mode of operation, organizations should ensure that energy from waste never competes with and/or compromises prevention, reuse and recycling opportunities, now and in the future. As reuse and recycling becomes more economic and practical for a wider range of waste types, together with changes in consumption patterns associated with lifestyle choices, the composition of what remains is likely to change over time. Future-proofing any waste management system against changes in tonnage and composition is therefore both complex and an inexact science.

When considering the relative environmental benefits of extracting energy from non-hazardous residual waste, one of the key factors is climate change. The balance between the many factors that affect this is complex; whilst much work has been done to understand this – often underpinned by life cycle thinking – it is beyond the scope of this British Standard.

It is against this backdrop that organizations should continually review whether energy from waste is the best solution for residual waste. Other actions should include:

a) identifying where the greatest energy savings can be achieved, either through reductions in raw material usage or through the reuse and recycling of secondary raw materials;

b) identifying where renewable energy sources can displace those from fossils fuels and not wait for legislation to drive change; and

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c) identifying the most efficient way to extract energy from residual waste that can no longer be reused or recycled.

Where materials are treated in biogas plants, opportunities might exist in addition to electricity generation to refine and use the gas produced, e.g. supply to the natural gas distribution network or use as a vehicle fuel. Where materials are diverted to WtE plants, care should be taken to ensure this is restricted to non-hazardous residual waste and is sent to facilities that are:

1) classified as recovery operations, using waste principally as a fuel to generate energy;

2) good quality "combined heat and power" (CHP) systems integrating the production of usable heat and power;

3) using good practice ash treatment systems capable of extracting and reusing metals and producing quality secondary raw materials from bottom ash that can be used in construction (e.g. as a substitute aggregate); and

4) consistently meeting emissions standards established by the relevant jurisdictional authorities and demonstrated through regulatory monitoring and reporting requirements.

Other considerations can include innovations which extract and recover more secondary raw materials. Examples of such innovations could include:

i) recovering waste carbon dioxide from flue gases as a precursor for polyurethane foam production; and

ii) introducing tri-generation or "combined, cooling, heat and power" (CCHP) systems where some of the heat is used to generate chilled water for air conditioning or refrigeration.

7.7 Information management

Information management is crucial to any organization and its value chain. It helps to make processes more efficient, enables collaboration and can also be key to keeping up to date with good practice(s).

Information management is especially important in circular economy activities and the following might require particular attention by organizations.

a) Chemical composition of materials: knowing this is important to assess aspects such as their recyclability, their toxicity or the scarcity of their base materials. This can help with decisions concerning, for example, end of use and subsequent usage cycles.

b) Mechanical specifications: component information can provide guidance concerning disassembly, reuse, repair or remanufacturing of a product.

c) Product tracking: in the context of a service-based business model, for example, information about the location and status of products should be managed to enable their effective servicing and recovery.

d) User data: a crucial factor to the adoption of a service-based business model is its convenience. Many sharing models today owe their success to advanced software using machine-learning, telemetry and other advanced algorithms to extract information from user data and make the service as valuable as possible.

Organizations looking to implement the principles of the circular economy should therefore take into account the following.

1) Exploring opportunities to develop or use mechanisms such as product passports, which could contain information about the chemical and mechanical specifications of the product to enable their reclamation into new use cycles.

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2) Assessing which information would be useful to share widely to enable more effective management of products and materials, taking into account potential intellectual property issues.

3) Exploring opportunities to leverage fast-developing data analysis techniques such as big data analytics and machine learning. For instance, this might be helpful for understanding material and value flows or to support complex decision making such as materials selection, and so on.

7.8 Liability and insurance

Central to any effective framework for managing liabilities and insurance is the need to strike a balance between a high level of consumer protection and business competitiveness. In a traditional buyer-seller model the commercial relationship can be relatively short and the seller's liability might only cover the initial guarantee period. In pursuing circular economy objectives, however, organizations could find these relationships become much longer and involve additional and extended obligations on both sides. As a result, organizations should take into account the potential liabilities and insurance implications associated with delivering their objectives. Liabilities can be financial, legal/regulatory and/or risk reputational in nature. Given that specific legislation is in its infancy for transactions in this area, legal advice should be sought at the earliest stages of the decision-making process when circular economy requirements are being defined.

Organizations should make themselves aware of the implications of delivering their circular economy objectives in the context of placing products and services (including digital content) on the market(s). Most jurisdictions have legislation in place to help ensure products are sufficiently well designed and built so that they are "fit for the purpose" for which they are sold, and that reasonable precautions are taken to protect the user against injury while the product is being used. In the evolving circular economy, many products and services placed on the market are not new in the traditional sense, but might instead involve a commercial relationship that extends to the reuse, refurbishment and remanufacture of those products and services. In general terms, consumer protection and product standards laws apply to previously used or second-hand products in the same way that they do to those products at the time they were first placed on the market. In some jurisdictions there might also be legislation in place for specific items that have been previously used.

In the case of reuse, items might be repurposed, but are also likely to have undergone only minor alterations, retaining the same or similar form. However, products might not meet the necessary minimum standards before they can be placed on the market again because standards have changed during the intervening period. Even if they do meet those standards, there might still be a perception that reused or remanufactured products have a lower "utility value" (whether functional and/or aesthetic) than products manufactured entirely from primary resources.

Organizations should establish if there are any insurance implications of placing reused or repurposed products on the market. For example, insurance costs might be higher even if the products have been confirmed to meet the relevant standards. Organizations can help to mitigate this by involving their insurers early on in the process to educate them about the nature of any risks and how they intend to manage them.

Where an organization remains the owner of a product throughout the product's period of use, it bears the financial costs of both failure and repair, in contrast to a linear model where many of these risks are transferred to the user. It is also the case that users are generally more careful with products that they own than with products that they lease. Organizations should take into account the legal and insurance implications of product leasing where they do retain ownership. Product-service system (PSS) models, in particular, assume an extended and prolonged relationship with customers. For instance, in the case of leasing, the asset should be maintained periodically and taken back from the customer at the end of the lease.

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Where the organization does retain ownership, there could be issues with the principle of accession. This principle varies from jurisdiction to jurisdiction, but generally it implies that parts or components that are added to a larger product might automatically become part of the larger product and hence belong to the owner of the larger product rather than their original owner. This means that assets might not be legally secure (see also **7.2**).

Organizations should guarantee the functioning of a product throughout the duration of the contract, which might involve the repair, maintenance and/or replacement of the product if it ceases to function. In return, the customer is expected to use the product with an appropriate standard of care, follow the operational requirements of the manufacturer and respect the maintenance requirements.

Organizations might be able to structure leases of products in such a way as to transfer all or some risks of incidental ownership to the user (e.g. in the case of a finance or capital lease). Even short-term leases (e.g. where items are hired for only a matter of hours or days) can involve a higher diversity of obligations than a regular sale and might increase the overall operational risk of the organization.

Issues might arise where long-term guarantees or extended warranties are offered to help fulfill circular economy objectives (e.g. to influence the durability or reparability of products). For example, does the pricing of a product reflect the period of the guarantee or warranty offered? To what extent does the guarantee or warranty need to be backed up by insurance? If so, does this (and the guarantee or warranty itself) extend to used components or use of third-party components? If commercial warranties are going to be used, how does their duration compare with that of any legal guarantees?

Other relevant considerations include for how long spare parts are available beyond the manufacturer's guarantee period or whether repair information, spare parts or diagnostic tools are made available to independent third parties for the purposes of product life extension or reuse. Organizations should also establish whether additional resource is required for fulfilling their obligations under product leases. This might include setting capital aside to bear the costs of failure and repair of products. Appropriate skills competencies might also need to be recruited and maintained within the organization or its value chain.

Where reputational risks are concerned, organizations should ensure through their market research activities that they understand their customers' concerns and aspirations associated with products and services delivered in the circular economy space. This can provide the necessary framework to determine how best to raise awareness and build consumer confidence (e.g. through support and education), so as not to act as a barrier to market entry.

7.9 Logistics and reverse logistics

Efficient logistics is vital to trade through the transport of products, materials and information from beginning to end, and forms the backbone of many industries. For some organizations considering how to manage the return, recovery and remarketing of products, components or materials is particularly relevant to their circular economy objectives.

Reverse logistics is no longer just about optimizing vehicle utilization and minimizing operational costs. Instead, it is a part of a wider system for the collection and redeployment of used or surplus items, including testing, sorting, refurbishing, recycling and redistribution. It is an important enabler and can help to improve the more circular flow of products, components or materials. It can also improve the transparency of returned items and related secondary raw materials markets demand.

Organizations should take into account the design of reverse chains as early as possible to ensure take-back, buy-back or any other incentivized return mechanisms are effective. This could include establishing the need for asset tracking, optimizing product and material flows and determining if regulatory controls exist (e.g. used items might be deemed to be waste – see **7.16**).

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The focus should be on retaining the value of items for as long as possible, particularly as products are not generally designed for reverse logistics. It might also be necessary to review if the right collaborations are in place (e.g. seeking advice from and establishing relationships with recycling processors on secondary raw materials markets or increasing and improving collaborations between collection and logistics operators with regards to reuse).

7.10 Marketing

Implementing the principles of the circular economy gives rise to new types of products and services. Ensuring these successfully enter the market requires identifying how to make them appealing to customers and part of the overall value proposition (see also Clause **6**).

The marketing considerations of making a business model more circular are especially relevant at three key customer decision stages:

a) acquisition of a product (i.e. whole or in parts, pre-used) – for example, second-hand, remanufactured, refurbished, repurposed or recycled;

b) adoption of a service model – for example, a pay-per-use service, a leasing scheme or a repair scheme; and

c) choice of end of use collection scheme – for example, use of household residual or recycling bins via kerbside collections, collection at local refuse sites, or take-back or re-sell programmes.

At each of these stages, the success of implementing the principles of the circular economy depends on the ability to trigger a different behaviour in customers. Organizations should therefore take into account the extent to which communication and marketing can be relevant to their circular economy objectives at an early stage.

When devising their approach, organizations should pay particular attention to the following considerations.

1) Perceived economic value (i.e. how to ensure the product or service is perceived as good value for money): Economic value remains an important driver for user's choice of a given product or service. However, public perception is not always automatically aligned with actual costs. For example, when it comes to a pre-used product, the communication approach needs to reassure the customers of its quality compared to a new product (if indeed this even needs to be communicated). Trust and brand perception can be important factors in combination with actual warranties (e.g. providing the same warranty for a remanufactured product as for a new one). The cost effectiveness of a service scheme might also need targeted communication and marketing efforts from the provider. Leasing schemes, for example, can be perceived as costly even when calculations prove they are lower than the total costs of ownership.

2) Convenience (i.e. how to ensure the product or service and its management are easily fitting customers' routines and lifestyles): This is especially important when developing a collection scheme. However efficient the process, if it is too complicated it is unlikely to be adopted at scale. In many cases, a trade-off exists between convenience and economic value: people are willing to put more efforts into an activity that leads to direct money savings or gains.

3) Value-driven factors (i.e. how to ensure the product or service reinforces customers' identity drivers): Trends, fashion and other social factors can play a role in the perception of the product or service. Companies often attempt to leverage people's environmental concerns when marketing products with better environmental impact. However, there is little evidence that such approaches work when it comes to large-scale adoption of new business models. As a result, the business-led credentials associated with promoting products or services with circular economy benefits should be transparent.

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4) Claims and declarations (i.e. how to ensure that products and services are communicated and marketed responsibly): All claims and declarations need to be legal, fair, honest, transparent and sensitive to the views and needs of stakeholders. All claims and declarations should be verifiable and help build brand trust and preference. For example, if products are marketed as closed loop, then an organization should be able to support such claims. Another example is ensuring that products marketed as recyclable are actually able to be reclaimed for recycling via end users, rather than the claim being based on a technicality.

Finally, attention should be directed towards the sale processes as well. In many cases, the incentives and training of sales people might need to be adapted to enable circular products and services to be prioritized.

7.11 Materials markets

We live in an increasingly globalized society. Most products are manufactured using materials which have been globally or locally traded. Population growth and increasing consumption is putting pressure on many of the earth's natural resources. Considerable debate exists over the factors that contribute to commodity market volatility, which is beyond the scope of this British Standard. Despite the considerable uncertainty about future trends in commodity prices, there is a view that volatility is here to stay. This might be due to supply disruptions as a result of geopolitical uncertainties in particular commodity producing regions, energy supply and availability, and increasing environmental impacts associated with producing commodities and extreme weather events affecting harvests, which might be increased due to climate change. These factors can have impacts even without an upward trend in prices. For energy intensive primary raw material production such as oil, metal, plastics, paper and glass, prices are intrinsically linked to local energy costs. Organizations should determine to what extent this is all likely to be relevant to their circular economy objectives at a very early stage.

Reducing the need for primary resources and reusing and recycling materials should be a key consideration for organizations (see also **7.12**). Whilst a global industry for secondary raw materials has developed over the last few decades for many recycled materials (e.g. paper, plastics and metals), regulated trading exchanges or markets are yet to fully emerge (in the same way as those currently operational for primary raw materials) and are also subject to volatility. Prices for secondary raw materials tend to follow expansions and contractions in overall demand for manufactured products alongside the cost of primary raw materials on the global market. At present, increasing supply of secondary raw materials, due to higher recycling, tends to be relatively unresponsive to demand. As a result, processors are likely to be selective as to the quality of secondary raw materials they buy. This is compounded by the lack of common standards for secondary raw materials and quality variance across the reprocessing sector. For instance, some secondary raw materials are regulated as waste (see also **7.5**, **7.7**, **7.8** and **7.16**) and add time and costs to their effective recovery, where these are not borne by primary raw materials. Organizations might help to mitigate this by involving regulators early in the process, to educate them about the nature of any risks and how they intend to manage them. There could also be value in developing relationships with waste management companies and processors directly to inform decisions and plans around the reclamation and processing of secondary raw materials.

At present, reusable assets are typically written down to zero or have a small scrap value over their economic life in a financial business case. The value might even be negative due to costs of disposal. Residual value is driven by demand, and as a result, it can be difficult to put a price on used assets (see also **7.2**), particularly as currently very few sectors value end-of-life products. Organizations might wish to look for second-hand markets which can serve as a proxy and improve the robustness of any business case it prepares around the circular economy. For example, in such markets, assets might have a higher residual value and the resale value can be incorporated if the assets are able to be

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sold on easily. It is also important to note that design for disassembly can increase the residual value. Organizations might need to collaborate with other organizations including civil society to develop reuse and recycling markets in order to sustain or drive further demand and increase residual values (see also **7.8**).

7.12 Materials selection

The attributes and functionality of materials are continually evolving as a result of materials innovation and new and more effective material applications. Sustainable resource management requires the assessment of social, environmental and economic aspects of a material. These three aspects of sustainability should be deemed to be interdependent because a change in one aspect can impact on another. Organizations should take into account the social, economic and environmental aspects throughout the material's life cycle, covering:

a) sourcing of materials;

b) conversion of materials into products;

c) use and performance of the product over its functional lifetime;

d) end-of-life of the product and either its reuse, recycling or final management; and

e) end-of-life of a material and either its reuse, recycling or final management.

Organizations should take into account the lifetime/durability of materials used in products or components, whether they can be easily reclaimed (e.g. for reuse and/or recycling) and where they are to end up after use (e.g. managed within the technical or biological cycles). Thought should also be given to how intensely a product is likely to be used (with or without repair/maintenance) and whether this is likely to affect how readily materials can be reused or recycled. These factors should ideally be determined at the design and development phase (see also **7.15**); for example, blended or composite materials are generally difficult to recycle.

This British Standard does not advocate a particular loop system for recycling. Organizations should give careful consideration as to whether they adopt closed or open loop systems. In general, organizations should avoid accessing primary raw materials and energy, and yet sustain the utility value and functional performance of a product or material application. It is important for organizations to understand the potential value of the end-of-use benefits compared with alternative sourcing of primary raw materials. This is particularly the case where recycling produces a secondary raw material not necessarily of the same or required function as the primary raw material.

In the case of the biological cycle, biological nutrients can be returned to the biosphere as a common pool of resources (e.g. through composting and then spreading the compost on a field) where regeneration takes place, with additional inputs of both energy (from the sun in most cases) and other resources (such as water and other nutrients). Biological cycles, whether natural or controlled, are therefore open loops by nature. Such processes can be highly effective when they are adapted to the system's conditions.

In technical cycles, on the other hand, both closed and open loop options are possible. As they enable a greater number of cycles, closed loop systems might be preferable to open loop ones. For instance, if product or material "A" is turned into product or material "A", with the same specifications, then the process ought to be repeatable. As a result, organizations might find there is greater incentive to invest, for example in design changes and/or reverse logistics, if the product can be returned to the same supply chain in the same function and can therefore provide further value to the same organization. For example, in general most metals can be reclaimed, sorted, re-smelted and processed into an appropriate new shape, thereby avoiding the need to take and process primary ores into the same or similar products.

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In contrast, when product or material "A" is turned into a different product or material "B", the next cycle requires a different process and depends on the characteristics of product "B". For example, recycling might result in a downgrading of material quantity and quality which limits its usability going forward (i.e. it is downcycled). However, improvements in quality (e.g. purifying metal to a higher grade) and functionality are also possible. This can be deemed to be upcycling.

Ultimately, when a holistic view is taken of the impacts of recycling at end-of-life, it might be found that some materials are quite problematic to recycle (see also **7.6**).

Organizations should determine how information is to be managed and preserved to allow reuse, recycling or other recovery to take place in the future (see also **7.7**).

NOTE BS 8905 provides a useful framework for the assessment of the social, economic and environmental issues associated with the use of materials.

7.13 Monitoring and measurement

Organizations should determine what success would look like for them and how this is to be measured over time. Measurement is a fundamental aspect of an organization's management and governance arrangements and serves many purposes. For example, it is needed to track progress against targets or milestones, provide data to evaluate the effectiveness of policies or operational processes/controls, and support internal decision making or informing investments. Organizations should also take into account how to measure progress against their circular economy vision, strategy and objectives to monitor the transition to a more circular and sustainable mode of operation. This might require some form of benchmarking, particularly in the case of organizations with multiple sites.

There is no universally accepted approach to measuring organizational effectiveness in its transition to a more circular and sustainable mode of operation. Several potential methods and metrics might be helpful to give an indication of product circularity; these range from material flow analyses (which aim to track the flow of materials within a given system on the basis of weight) to life cycle assessments and aggregation of several data sources (e.g. proportion of recycled content, product use and lifespan, recyclability). No one method or metric is likely to fully capture how circular an organization (or aspects of it) really is, or to enable a definitive ranking to be established, due to inevitable competing issues that can arise when considering environmental, social and economic factors (e.g. prioritizing potential savings in greenhouse gas emissions from sourcing vegetables more locally, compared with imports providing Fairtrade premiums for the benefit of people and communities in another parts of the world). Caution should therefore be exercised in adopting any proprietary system/software that makes explicit claims here.

An organization should ensure that the performance and suitability of its circular economy vision, strategy and supporting programmes are assessed and evaluated at agreed frequencies, and agreed upon by top-level management, according to its risks, opportunities, needs and vision.

This British Standard is not prescriptive; however, as a starting point the organization should use appropriate measurements to undertake a baseline review to determine existing levels of circularity. This can be used to support an assessment of whether existing levels are acceptable.

Compiling a bill of materials (which provides a list of the component parts and materials) for products used within the organization represents an ideal starting point to identify material flows. Product or service life and intensity of use can also play an important role in circularity performance. Attention is drawn to the *Circularity indicators – methodology* [19] which could be a useful starting point for organizations to consider in this regard. However, determining an indicative level of circularity should not be examined in isolation to other factors such as energy usage and costs, greenhouse gas emissions, and toxicity of chemical ingredients because it might not provide the right answer. For

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example, reducing product packaging might save on materials usage and waste but lead to an increase in carbon and air quality impacts if it ends up making the whole distribution process inefficient.

In terms of specific actions, the organization should identify:

a) what needs to be monitored and measured;

b) the methods for monitoring, measurement, analysis and evaluation, as applicable, to ensure valid results;

c) how to provide a continuous assessment of circularity;

d) the thresholds at which the output from measurements are to be considered acceptable;

e) how measurement and monitoring arrangements can work alongside, support or be integrated into existing monitoring processes; and

f) how the results from monitoring and measurement are to be validated and verified.

NOTE Monitoring involves collecting information over time. Measurements can be either quantitative or qualitative.

Organizations should seek to understand what evidence is needed to support their assessment of circularity and ensure there is an evaluation process developed to support this.

A basic maturity model, such as the example in Annex A, can assist organizations in determining their level of circularity maturity.

7.14 Procurement and contract management

Interventions in the supply chain are likely to be needed to achieve circular economy objectives. This might mean that relevant criteria need to be built into the process of acquiring products and services from suppliers, or it could involve taking a more engaged and collaborative approach to supply chain management. In the case of the latter, this approach involves relationship building with the supplier and uses influence, information and education with the aim of ensuring that both the supplier and the organization are working towards similar goals.

Most procurement processes and practices are based on the purchase of products and services that support the traditional, linear consumption and production model. End of use considerations and reuse or recycling opportunities are rarely evaluated at the procurement stage unless the purchased item has an obvious residual value. Adopting the principles of the circular economy is likely to require both process and behavioural change within teams responsible for sourcing or buying/procuring products or services. It might also require changes to supply contracts, as well as the approach to contract management itself. Organizations should take into account the whole cycle from identification of needs through to the end of a services contract, or an asset's end of use, including its management.

There is often too much focus by organizations on what is wanted instead of what is required to meet the need. Organizations should start by understanding the business needs and desired outcomes required rather than starting from the point of a detailed purchasing specification. This means that teams responsible for sourcing or buying/procurement should be involved at the earliest stages of the decision-making process when circular economy requirements are being defined.

Any proposed specifications or criteria should ideally be market tested with suppliers and constructive dialogue started before moving to the tender stage, to ensure that the requirements are challenging, but still deliverable (and likely to generate competition).

Once organizations have established the relevance of their circular economy objectives to individual suppliers, sufficient information should be included in tender or other documentation to enable

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suppliers to demonstrate their capability to support the objectives. Information provided by the organization can include:

a) requirements of suppliers and subcontractors that support the organization's circular economy objectives;

b) timelines and delivery milestones; and

c) scope and level of detail required (e.g. suppliers' strategy for meeting circular economy objectives).

Organizations should assess responses on the basis of the suppliers' capability to meet their objectives. Proposed approaches, solutions and relevant performance criteria should be reflected in the suppliers' conditions of contract. Sufficient detail should be included to be able to determine instances of non-compliance and to inform subsequent performance reviews.

Contract management should not be underestimated and should be taken into account alongside the development of any specific procurement strategy. Roles and responsibilities for supplier oversight should be clearly stated and individuals involved should have the necessary competencies. For example, teams responsible for sourcing or buying/procurement might not have the necessary contract management skills and expertise and this should be accounted for. Where organizations do not go through a formal tender process, it is still helpful for them to consider their circular economy objectives when choosing and managing suppliers.

NOTE BS ISO 20400 provides general guidance on the consideration and implementation of more sustainable procurement practices.

7.15 Product design and development

Most solutions on the market are product–service combinations and in practice organizations create, produce and/or deliver product(s), service(s) and/or product–service system (PSS) combinations. Some organizations create, design and manufacture their own products or services, whereas others act as system integrators, sourcing components and sub-assemblies procured via suppliers, and then assembling and delivering them as a final solution to customers.

In a circular economy context, decisions made early in product design and development can significantly influence what the product or service is, what the business model is that supports it, what it is made from, where it is made and what is likely happen to it once it is no longer wanted (and indeed subsequent cycles). Indeed, it is widely believed that at least 80% of a product's environmental impact is likely to be determined at the design stage, not just in designing and developing the physical product or end service, but when identifying and understanding problems and how to go about solving them (see Figure 13).

The organization should ensure its objectives for the circular economy, design and development and value proposition are aligned. For example, an organization makes a commitment to providing products which are designed and built to last, but in practice continues to design products to have a specific lifespan (i.e. planned obsolescence). It could also be the case that design and development solves a particular problem which does not necessarily meet the needs, desires or expectations of its customers. For example, one of the key reasons why a well-known global photography company's business model failed was because it focused too much on improving its physical film-based products, instead of on the value customers got from that product; as a result, it did not make the transition to digital quickly enough. These are important factors to recognize in both new product design and development and the re-design of existing products and/or services in order to achieve improved circularity.

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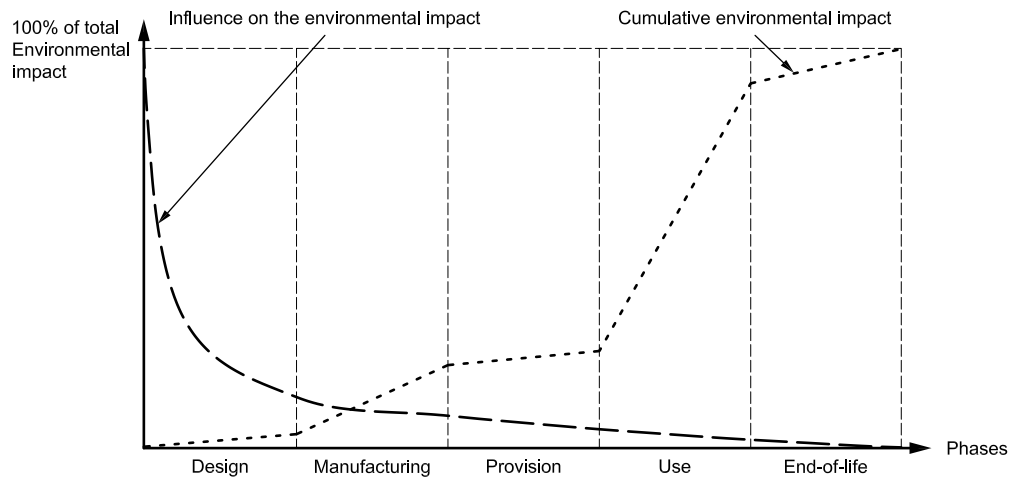
Figure 13 — *Illustrative influence on environmental impact during design and the cumulative impact during product life cycle stages*



NOTE This figure was developed by Mattias Lindahl, Tomohiko Sakao and Erik Sundin, Linköping University, Sweden. Used with permission.

Organizations should therefore ensure that circular economy considerations are integrated into product design and development in early stage design activities, problem exploration and brief development, with the aim of improving circularity and reducing impacts throughout the life cycle of the product or service. This can be done as part of adopting ecodesign practices which consider factors relevant to the circular economy, such as use of resources at each stage of the life cycle, from extraction through to end-of-life (e.g. materials, water, chemicals and energy). Circularity should be balanced against market, technical, cost and other considerations. It is important to take account of the organization's overall circular economy objectives (e.g. reuse, recycling, remanufacturing, reconditioning) at the design and development phase in order to balance the overall goals with the life extension of products, components and materials.

The precise circularity considerations are dependent on the type of product, e.g. active (energy using products or services) and non-active (non-energy using products or services), the place in the value chain and markets addressed. Considerations relevant to the organization's circular economy objectives should be incorporated into each phase of the design and development process from product planning, idea generation, concept development, design, production and launch.

Ensuring that circular economy considerations are integrated into product design and development requires a team approach and a range of internal business functions and external stakeholders should be engaged and involved in the process.

Traditionally, product designers (design engineers, packaging designers, chemists) are thought to be key players in product design and development; however, procurement and contract management are also important (see also **7.14**). In the design/development of products and services, or product/service combinations, other business functions might be involved in the service design such as marketing, customer services, and legal. It is also important to recognize that some organizations contract out product design and development to suppliers, consultancies and, in some instances, to contract manufacturers. Therefore, whether product design and development is undertaken in-house or by third parties, organizations should ensure that issues relevant to the circular economy

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are recognized and addressed between different life cycle stages. Other actions might include determining the:

a) range of different organizations and stakeholders involved at different stages of the product's life cycle;

b) relationship to existing general, environmental or quality management systems; and

c) relationship to operational design decisions.

At an operational design level, a range of design strategies are available to improve circularity at different life cycle stages. An illustrative checklist of potential circular design strategies for key design focus areas is provided in Annex B.

NOTE The following standards relate to various social, economic and environmental aspects of product design and development:

- *BS 8905 provides a useful framework for the assessment of the social, economic and environmental issues associated with the use of materials;*
- *BS EN ISO 14001:2015, **8.1** highlights the importance of taking a life cycle perspective during the development of products (and processes) within an environmental management system;*
- *BS EN ISO 14006:2011 provides guidance on incorporating ecodesign into environmental management system;*
- *PD ISO/TR 14062 describes concepts and current practices relating to the integration of environmental aspects into product design and development; and*
- *BS EN 62430 provides guidance on environmental conscious design (ECD) for electrical and electronic product.*

7.16 Waste regulation

Most jurisdictions have a waste policy framework and legislation in place which aims to protect the environment and human health (e.g. the EU Waste Framework Directive [20]). How waste is defined and the controls put in place (and their interpretation) can vary between different jurisdictions. Whilst various frameworks have brought greater policy prominence to more sustainable consumption and production, much of the underlying emphasis is often still on strengthening waste legislation to deliver resource objectives. For example, if left solely to prevailing market forces, increasing EU end-of-life recycling targets exert little influence on the upstream supply chain. Governments are increasingly recognizing the need to move away from a command and control approach to work with business to remove regulatory barriers to improved efficiency and circularity of resources.

The prevailing regulatory framework is usually fit for purpose for waste management, but it is currently unlikely to be favourable for secondary raw materials management. There are valid reasons for treating discarded items as waste. However, the reuse and recycling of items that could remain in the economic chain of utility without increased risk of harm to human health and/or the environment has sometimes been hindered. For example, used electrical items provided by third parties to an organization to be repaired or refurbished and then sold to the public might be viewed as waste by regulatory authorities. Regulations also exist to restrict and manage the shipping of waste for reuse, recycling and disposal to other countries.

The existence of different interpretations especially on how waste is classified can make it problematic for organizations to use their resources in the most optimal way. Whether something is deemed to be waste and how this is to be managed needs to be decided on a case-by-basis and is beyond the scope of this British Standard.

Organizations should take into account the extent to which waste regulations might affect their circular economy objectives at an early stage (for example, storage of and/or activities involving the handling of used items). Organizations can help to mitigate issues by consulting regulators early in the process.

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Organizations should also be aware that opportunities exist to follow rigorous methods to classify certain secondary raw materials and refurbished equipment as fully recovered and therefore no longer regulated as waste (see also **7.8**). Such decisions often require agreement on standards for the recovered materials and or equipment, such that they can be traded. Decisions on such standards have implications for free trade agreements and are likely to require extensive consultation before parties to those agreements accept them. For global markets, consultation with the World Trade Organization might be required to ensure such standards are not a technical barrier to trade.

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Annex A
Evaluating implementation of the principles of the circular economy

Organizations should ensure that the performance and suitability of their current approach to implementing the principles of the circular economy is assessed and evaluated at agreed frequencies, and agreed upon by top-level management, according to its risks, opportunities, needs and aspirations (see also **7.13**).

A basic maturity model, such as the example in Table A.1, is a strategic tool which can assist in determining an organization's level of organizational circularity. The elements and levels shown are intended for guidance and illustration only, are not exhaustive or fixed and as such can be adapted as necessary. Finer detail should be entered where this assists understanding and communication. Organizations are also free to adopt a different approach to evaluating their level of organizational circularity.

When an organization is developing its maturity model, it is useful to involve a number of stakeholders with differing roles and responsibilities, seeking consensus on the most appropriate and meaningful practices and levels. Each level described in a cell of the maturity model should, as far as possible, be unambiguous, objective and show clearly measureable achievements.

The maturity model links the principles (in Clause **4**) with the practice (in Clause **5**) and back to the drivers and desired outcomes set out in the introduction (in **0.7**) and Clause **3**.

The questions that might be asked to help determine how an organization's approach to implementing the principles of the circular economy measures up against the maturity model (Table A.1) are set out in Table A.2.

An organization should appraise its current position in respect of each level, noting any which need particular attention to restore balanced progression. Specific objectives should be identified and actions plans devised to secure both balance and broad general advance.

A periodic review should be conducted of the organization's progress towards transitioning to a more circular and sustainable model of operation. Adjustments to the model might be required to reflect changing circumstances.

The information in the maturity model can be analyzed using many tools, for example by display as a radar or spider chart to highlight the principles that need most attention.

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Table A.1 — *Example maturity model for organizational circularity (1 of 2)*

Principle	Level of maturity				
	Unformed (>2/3 of responses = not considered)	**Basic** (≥1/3 to 1/2 of responses = Partly considered)	**Improving** (>1/2 of responses = Partly considered)	**Engaged** (≥1/2 to 2/3 of responses = Fully considered)	**Optimizing** (>2/3 of responses = Fully considered)
Systems thinking	No systems thinking evident within the organization.	Organization has begun to apply systems thinking techniques in relation to resource management.	Organizational vision for circular economy activity is at least part developed, with top-level management buy-in and thought given to how resource management relates to the value chain or wider system.	Systems thinking recognized as being key to exploring different perspectives, causality linkages and feedback related to progressing circular economy vision, strategy and objectives.	Organization can demonstrate it routinely applies systems thinking to circular economy decision making and activities and is investing in this area for the longer-term (e.g. staff training, clear outcomes-based measures).
Innovation	Innovation within the organization is limited and sporadic with little interaction beyond the organization itself.	The organization has begun to recognize the innovation opportunity of the circular economy and created some linkages to customer needs and future business strategy.	Top-level management is committed to innovation and the organization has begun to recognize the need to integrate stakeholder needs and feedback in developing circular economy activities.	Circular economy innovation is established in the organization and structures exist to ensure that value chain input is fed into the system with active governance in place related to innovation (e.g. IP/legal implications, sharing ideas).	Organization can demonstrate it has fostered a culture of innovation to create business value through the sustainable management of resources in products and services and has at least begun to innovate its business model.
Stewardship	Organization focuses on addressing public relations/marketing issues and/or regulatory requirements, but no real genuine focus on circular economy (e.g. complying with rules for managing on-site waste and ensuring contracts are in place for recycling and disposal).	Improved knowledge and understanding of the organization's direct and indirect environmental and social impacts related to resource management.	Some environmental and social risks and opportunities related to resource management beginning to be considered in decisions and activities. Little active management of issues beyond the organization's direct control.	Environmental and social risks and opportunities related to resource management across the value chain are known and understood by the organization. Key issues are factored in decisions and activities of relevance to the circular economy. Some programmes in place to tackle indirect issues.	Organization can demonstrate it is actively managing the direct and indirect impacts of its decisions and activities across the value chain. This might include actively engaging in industry or multi-stakeholder advocacy and/or collaborations to tackle systemic issues.

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Table A.1 — *Example maturity model for organizational circularity (2 of 2)*

Principle	Level of maturity				
	Unformed (>2/3 of responses = not considered)	**Basic** (≥1/3 to 1/2 of responses = Partly considered)	**Improving** (>1/2 of responses = Partly considered)	**Engaged** (≥1/2 to 2/3 of responses = Fully considered)	**Optimizing** (>2/3 of responses = Fully considered)
Collaboration	Limited experience of collaboration in the organization, with the majority of current resource-related interactions focused on suppliers and based on information on the type of materials used to deliver products/services.	Some consideration has been given, across the organization, to how the firm collaborates with other parties in relation to its exploration of the circular economy; this is likely to be limited to suppliers, customers, others in the sector.	The organization has all the key elements of a functional collaborative approach to support its circularity initiatives, but its application is partial both across internal stakeholders and with other parties in its value chain.	Circular economy related collaboration is operationalized and active collaborations can be identified and are known across the business.	Organization can demonstrate it has fostered a culture of collaboration internally and externally to progress its circular economy vision, strategy and objectives. There is an active process in place to identify partners, govern ongoing relationships, and evaluate their performance.
Value optimization	Organizational value generation/ optimization is focused solely on financial benefits, with little to no consideration to optimizing resource management over the longer term.	Management of resources used within the organization's products and services are given some consideration, with focus on value related to end of use (recyclability) and reducing wastage.	Value optimization is recognized by numerous parties across the organization, with activity in most phases (design, production, use and end-of-life).	Organization has an active approach to optimizing value. Consideration has included value generated to other parties through resource management at a systemic level.	Organization can demonstrate that products, components and materials are kept at their highest value and utility at all times.
Transparency	Organization's knowledge and understanding of its resource management issues is limited and where known is not widely disseminated, either internally or externally.	Information on key resource management issues related to aspects of their value chain understood and basic information provided on recyclability of some materials supplied to customers.	Transparency related to the organization's circularity journey is recognized, including by top-level management. However, activity tends to remain passive or reactive rather than proactive.	Visibility of information is actively planned across organization's material resource management and circular economy activities, with top-level management oversight. Customer information has a focus on accessibility of resource information to different users.	Organization can demonstrate it is fully open and transparent both in terms of gathering and specifying information from upstream partners and promoting advice to downstream parties on best approaches to retaining resource value at the end of use.

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Table A.2 — *Questions to help organizations consider how the principles of the circular economy are being realized through their decisions and activities (non-exhaustive) (1 of 4)*

Principles	Questions
Systems thinking	• Has a vision of the future for a more circular and sustainable mode of operation been determined? • What existing system(s) and parts of the system(s) relate to your circular economy vision and objectives? • What are the relationships among system components? How do they affect one another? • Where does circular causality/feedback emerge? Is one feedback loop more influential than another? If so, how? • How does the vision you are attempting to achieve reveal issues in the system? • How are you a part of the system(s)? How do your decisions and activities affect the system and how does the system affect your decisions and activities? • How do you want to influence the system(s) and parts of the system(s)? What are the assumptions you are making? • What experience, skills, relationships and resources are necessary for this to happen? • Could there be unintended consequences of any proposed action? Are there possible short and long-term consequences? • Over what time frame are changes expected to yield results? How will you know if the change has been successful?
Innovation	• How does top-level management demonstrate leadership and commitment to innovation? Is a culture of innovation fostered at all levels? • Are customers' needs, desires, expectations and current levels of satisfaction understood? • Has the circular economy been considered as part of innovation? Have clear circular economy objectives been determined? To what extent is the circular economy a part of your existing business strategy/business model? • How do you manage different types of innovation within your organization (e.g. process, product or service, business model)? • Will innovation be individual or collaborative, open or closed? • Have you determined/considered the need to protect intellectual property or are you happy to open source? Have you considered the legal implications? • How do you determine and select opportunities for improvement and implement any necessary changes to meet these requirements? • How will decisions and activities associated with your circular economy objectives meet current customer requirements as well as address their future needs and expectations? • Do you understand how your decisions and activities might be new or transformative or are improvements to existing arrangements? • Have you identified which organizations within your value chain are key to achieving your circular economy objectives? • Have you considered the timescales for implementation? • What processes have been put in place to ensure change management is successful? • How do you monitor and review value creation and continual innovation? • How are lessons learned captured and acted upon? Does the organization embrace a culture of learning from failure?

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Table A.2 — *Questions to help organizations consider how the principles of the circular economy are being realized through their decisions and activities (non-exhaustive) (2 of 4)*

Principles	Questions
Stewardship	• Does top-level management sufficiently demonstrate leadership and commitment with respect to taking responsibility for its decisions and activities? • How are resources relevant to your organization? Which resources are your current business model most reliant on? • Have current and future economic, environmental and social risks and opportunities associated with the use of resources across your value chain been determined/assessed? How do these affect your ability to create, deliver and capture long-term business value? • Are issues associated with chemical ingredients which represent a significant risk to human health and/or the environment known and understood and eliminated or mitigated where possible? • Will decisions and activities associated with your circular economy objectives change current and future resource risks and opportunities? • Have steps been take to mitigate resource risks and opportunities during sourcing, manufacturing, distribution, usage or end-of-life management? • How will responsibility be taken for addressing upstream and downstream impacts? • How do your initiatives improve your customers' needs and expectations be met in a way that improves the quality of life of people and communities? • Will training be required to ensure the product or service is used efficiently? • What strategies and plans are in place for the management of products and materials at end of use/life? What is your role in delivering these strategies and plans?
Collaboration	*Awareness* • How will collaboration help you transition to a more circular and sustainable mode of operation? • What role will collaboration play in innovation? • Do you have the support and commitment of top-level management for collaborative working? *Knowledge* • Have you considered collaborations outside of your usual peer group? (For example, collaborations with academic bodies, civil society, competitors, research councils, stakeholders, trade associations, professional bodies, standards bodies.) • Would collaboration change the management of resource risks and opportunities? • What is the policy on sharing of relevant information and data with partners? • Have potential collaborative organizations been identified against your circular economy objectives? • Have all significant current relationships been identified? *Internal assessment* • Is the organizational structure suitable and able to provide the flexibility required for collaborative working? • How will collaborative programmes be implemented including education, training and recruitment?

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Table A.2 — *Questions to help organizations consider how the principles of the circular economy are being realized through their decisions and activities (non-exhaustive) (3 of 4)*

Principles	Questions
Collaboration *(continued)*	*Partner selection* • Do you have a process for partner selection? • Has the value of each relationship been evaluated in the context of your circular economy objectives? • Have all partners been selected according to clear criteria? *Working together* • How does governance support collaborative working? *Value creation* • Do you understand how value is created through collaboration? • Have you identified issues and areas of improvement? *Staying together* • Do you understand how relationships are managed? • Do you know what success looks like? *Exit strategy* • Do you have an agreed joint exit strategy for each of your collaborative relationships?
Value optimization	*General/design* • How are any products, components and materials designed to be kept at their highest value and utility at all times? • How is the value of reuse or recycling considered at material level, both pre- and post-product use and at product level? • Does design of any products allow for dismantling and separation of components and materials at end-of-life? • Have products/services been designed to maximize product or service life extension? • Have you estimated the economic benefits for the circular economy? *Production and distribution phase* • How are value optimization requirements communicated to the supply chain and factored into sourcing/procurement and post-contract monitoring arrangements? • How is waste avoided during manufacturing and distribution activities? *Use phase* • What strategies have been adopted to prolong life of the products, components and materials (e.g. extended warranties, planning for standardization and compatibility, designed to be upgradable, parts and components can be separated and assembled easily)? • How easy will it be to get the product repaired if all or part of it stops working?

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Table A.2 — *Questions to help organizations consider how the principles of the circular economy are being realized through their decisions and activities (non-exhaustive) (4 of 4)*

Principles	Questions
Value optimization *(continued)*	*End of use phase* • Have you thought about what happens to your products at end of use phase? • Does another party get value from your product at the end of use phase? • Has there been a presumption against use of energy recovery and disposal at end of use phase? • Are components and materials able to be separated into manageable and uncontaminated streams to facilitate reuse and recycling? • Are relevant information and data accessible to ensure products, components and materials can be appropriately managed at end-of-life?
Transparency	• Has resource use been mapped within your value chain, including sourcing and production locations? • Have you determined the full composition of materials and chemical ingredients in your products, materials and components and the manufacturing process(s) used to create them? • How is information relevant to the sustainable management of resources in products and services made accessible? • What transparency obligations have you placed on your suppliers or other organizations in your wider value chain? • How are reasonable views or requests for further information considered and responded to in a timely manner? • How do you engage with stakeholders who speak different languages? • How can new technologies be used effectively to increase transparency? • How transparent are you about the materials and chemicals used and contained with your products? • Are instructions for proper use provided in a language and form understandable to users? • Is written or visual information provided with and on all packaging or products about known issues (e.g. environmental or human health related hazards) associated with the product? • Are instructions about end-of-life management provided in a language and form understandable to users? • Are any claims made about your product accurate, clear, and defensible? Would they stand up to independent scrutiny?

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Annex B
Potential circular design strategies and checklist

This annex provides guidance on potential circular design strategies associated with a particular design focus area and a suggested checklist of options for design improvement.

Table B.1 — *Design focus areas and potential design strategies*

Design focus area	Potential design strategies
New concept, solution, value proposition, business model development	When considering more circular product design aspects during the early stages, care should be taken in identifying, understanding and defining the problem to be addressed and the system that it operates in. This might include stepping back from the usual solution or current way of doing things to explore alternative approaches, solutions and business models. Here the overarching values, mission, vision, brand of the organization can also be considered for alignment and ambition.
Product–service systems	For circular design, designing with a holistic view of the role of the product, related services and the system it is part of is important. Design strategies to consider and ensure are designed in are: products built to last, shared, rented, repaired, remanufactured, refurbished, etc. When designing a product, various life cycle scenarios can be considered and what the end-of-life, first life strategy is. The role of the consumer here is also key and consideration of related behaviours, interactions with the product or service that might be required for the business model to succeed.
Product and part/component level (including packaging)	Here many traditional ecodesign strategies can be used relating to material reduction, light weighting (where applicable) energy is use reduction through energy efficient choices. The choice of materials plays a large role here and should be considered from a life cycle perspective. There is not one right answer, it is dependent on a case by case basis when looking at the product and system it is part of. For example, if designing a durable product then a higher-grade material might be best or a particular fixing method could mean the product is not necessarily the easiest to disassemble or recycle.
Supply chain including manufacturing and distribution	When designing the product, service, the manufacturing methods, locations and supply chain also play a role and can be considered for minimizing or eliminating all types of waste in production and distribution (energy, water, material use). Alongside this supply chain and material considerations should also be given in terms of social and ethical responsibility as well as associated supply chain risks related to materials.

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Table B.2 — *Non-exhaustive checklist of options for design improvement matched to design focus areas*

Design focus area	Non-exhaustive options for design improvement	Y/N
New concept, solution, value proposition, business model development	Alternative value proposition/business model development	
	Identify alternative design solutions to solve the problem, root cause, system and life cycle perspective	
	Consider the product, service opportunity in context of the organization's brand, vision, mission, values	
Product–service systems	Optimize ease of reuse, disassembly and recycling	
	Optimize product lifetime by designing for ease of maintenance, repair and upgradability	
	Optimize product lifetime by designing for durability and reliability	
	Consider modular product structure	
	Consider open design and greater transparency	
	Consider building stronger product-user attachment or classic design	
	Consider encouraging reduced need for ownership and consumption, e.g. through shared use of the product	
	Reduce impact during use: energy and water consumption, consumables	
	Consider end-of-life strategies, e.g. reuse of product, remanufacturing/refurbishing, recycling of materials, waste-to-energy	
	Reduce energy used in disassembly and recycling	
Product and part, component level (including packaging)	Optimize product size, weight, volume	
	Avoid design aspects detrimental to reuse and recycling, e.g. composites/mixtures of materials	
	Select lower impact materials – cleaner/sustainable/renewable/lower energy/recycled content/recyclable	
	Eliminate substances which are or could be potentially hazardous to human health or the environment that can or might be released during use	
	Restrict or eliminate substances which are or could be potentially hazardous to human health or the environment which remain present in the product or part	
	Reduce the use of materials with resource security risks	
	Reduce number of parts	
	Increase incorporation of used components	
	Include similar considerations for packaging and consider role within distribution	
Supply chain including manufacturing and distribution	Optimize resource efficiency in production techniques	
	Reduce energy consumption	
	Reduce water consumption	
	Reduce process waste	
	Use internally reclaimed or recycled materials from process waste	
	Reduce emissions to air, water and soil during manufacture	
	Optimize shape and volume for efficient packing density	
	Optimize transport/distribution in relation to fuel use and emissions	

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