

Three dimensions of circularity: A systematic approach to circular procurement

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In order to strive for a sustainable development, the traditional linear economy must shift into a Circular Economy. To catch the essence of circularity and allow to work practically with circular strategies in purchasing, we suggest thinking of product circularity in three dimensions: recirculation, utilisation and endurance.

The three dimensions of circularity can be used to guide a purchasing organisation to contribute to circularity in all aspects of its operations: acquisition, use, end of life and organisation and networks. This includes to support circularity through the three dimensions, not only in the criteria setting but also in all steps of the procurement process.

In the following document we present the three dimensions of circularity and relate it to circular procurement.

1. Introduction: Circular Economy and procurement

In the past five decades, it has become increasingly clear that explosive growth in the global economy threatens planetary environmental health. In the current linear business model, industry takes resources from the earth, makes and sells products, and those products become waste when they are no longer valuable. One systemic alternative is called Circular Economy. A Circular Economy attempts to eliminate the distinction between “resources” and “wastes” by considering how the material in use today can continue to be used for as long as possible into the future. This can be achieved, for example, by *reusing* existing products, *refurbishing* or *remanufacturing* products so that they can easily be used again, or *recycling* the material of old products into new products.

In the context of public procurement, the above is particularly relevant since it is a key economic activity in governments¹. In Sweden, the total value of purchase covered by public procurement regulations in 2017 has been estimated at SEK 706bn. This equates to 17.4% of GDP at fixed price². Therefore, it is of paramount importance that public sector entities are actively involved in the shift to a Circular Economy, since they are actors that procure goods and services from businesses, and have the opportunity to influence the decrease of use of virgin material resources while helping eliminate waste.

On a legislative note, the Swedish procurement legislative framework is based on EU law (Directive 2014/24/EU, consolidated text 1/1/2020). Specifically, Sweden has transposed the directive into its legal framework by developing a National Public Procurement Strategy. This contains seven objectives, of which one is on Green Public Procurement (GPP). Also, the EU Circular Economy Action Plan (CEAP, 2015) has identified Circular Public Procurement (CPP) as a significant driver for a transition to a Circular Economy and the new CEAP 2020 reinforces such a concept while urging member states to set a “comprehensive set of requirements to ensure that all products placed on the EU market become increasingly sustainable and stand the test of circularity” (COM(2020) 98 final 2020). In that regard “the Commission will propose minimum mandatory GPP criteria and targets in sectoral legislation and [...] phase in compulsory reporting to monitor the uptake of GPP without creating unjustified administrative burden for public buyers.” In parallel, it is worthwhile mentioning the international standard on sustainable procurement ISO 20400:2017 that provides guidance for any organisation that needs to deliver sustainable outcomes through its supply chains. In Sweden, the national Procurement Authority *Upphandlingsmyndigheten* highlights the critical role that public procurement plays in shifting society to a more Circular Economy.

In this, several questions arise: How can public authorities embrace and utilise a Circular Economy perspective in procurement, and what kinds of criteria can procurement bodies adopt to encourage circular production and consumption?

¹ Brammer & Walker (2011) Sustainable procurement in the public sector: An international comparative study. *International Journal of Operations & Production Management*.

² Konkurrensverket (2019). Statistics on public procurement 2019.

http://www.konkurrensverket.se/globalassets/publikationer/rapporter/rapport_2019-3_statistikrapport_2019-webb.pdf.

2. Framework: The Three Dimensions of Circularity: Recirculation, Utilisation, Endurance

The concept of a Circular Economy has generated a wide interest and many attempts at definitions³. To align with the essence of circularity while employing circular strategies in purchasing, we suggest thinking of product circularity in the following three dimensions⁴:

- 1) Material recirculation:** the degree to which products are composed of material recovered from some prior use (e.g. remanufactured or recycled) rather than composed of primary “virgin” material; and the extent to which materials are designed to be recovered / recycled after use;
- 2) Utilisation:** frequency at which products are used rather than sitting idly (e.g. in storage); and
- 3) Endurance;** the extent to which products retain value over time, rather than becoming physically degraded or socially irrelevant (e.g. physically or socially obsolete).

Based on these three dimensions (Figure 1), circular procurement can, in short, be described as procurement that aims to enable / encourage direct attention towards products that are made as much as possible of materials that have been used before, are used often, and retain their value over long periods of time. It may be challenging for all products to maximise all three dimensions, and there is a need to discuss the primary and possible goals for each product group.

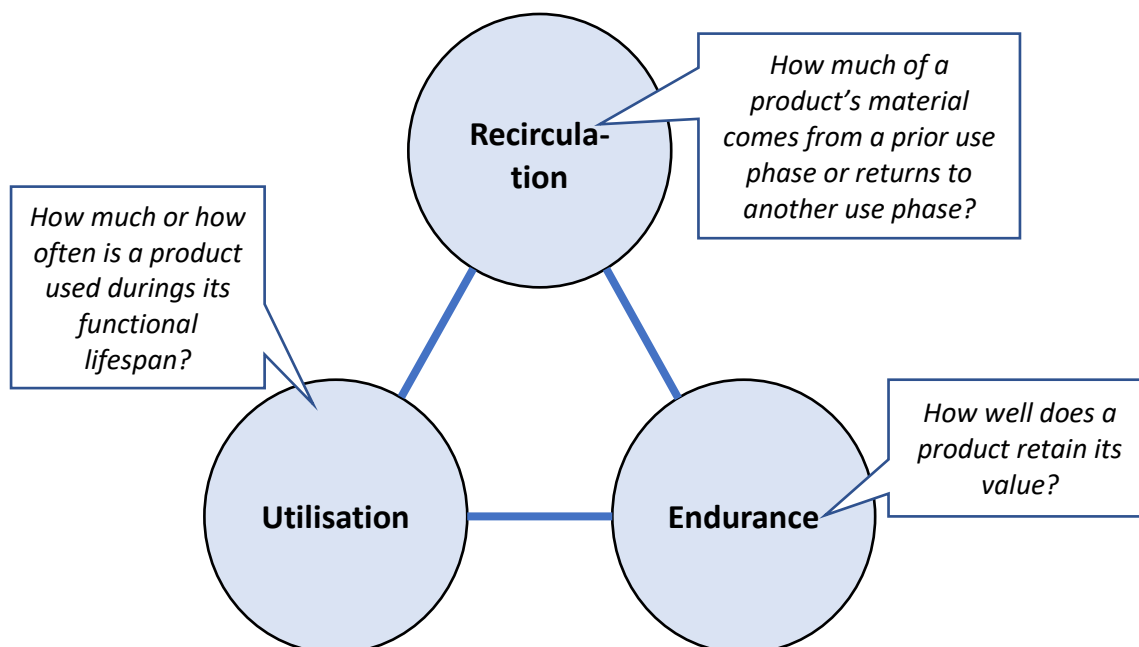


Figure 1. Three Dimensions of Circularity: Recirculation, Utilisation and Endurance

³ Kirchherr, Reike & Hekkert (2017) Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, conservation and recycling*, 127, 221-232.

⁴ Boyer, Mellquist, Willander, Linder, Hunka, Vanacore, Rex & Algurén (2020) Three-Dimensional Product Circularity: A Working Paper from RISE Sustainable Business, <https://doi.org/10.13140/RG.2.2.22460.80004>.

As often when concerning sustainability, there are many aspects to consider, and it is not always easy to fulfill all dimensions of circularity. However, the three dimensions provide valuable guidance on how to achieve the broad vision of a Circular Economy. It is our advice to systematically consider these three dimensions in any design and review of purchasing criteria as not to miss important aspects of circularity.

2.1 Additional aspects of sustainability and circularity

Sustainability is a broad concept. In addition to the dimensions of circularity cited above, several additional perspectives ought to be considered if one is contemplating a holistic approach to sustainability, for example toxicity, resource depletion, climate impact, etc. These aspects are important in themselves as well as in relation to circularity. However, there is growing evidence that relatively *circular* products have relatively lower impacts on climate change and abiotic depletion⁵, but it is also important to note that trade-offs between different sustainability goals can occur. To this end, we acknowledge that several sustainability indicators, such as Environmental Performance Indicators (EPIs) and Circular Performance Indicators (CPIs), can be used in a complementary way. Questions such as resource depletion and climate impact can be targeted by use of e.g. Life Cycle Assessments (LCA) and related tools such as Environmental Product Declarations (EPD). Many product groups also have different kinds of environmental labels that can be used as certificates of responsible sourcing, low environmental impact and even quality. Although the broad perspective on sustainability is important, in this document, **the focus is on enhancing circular product flows, represented by the three dimensions of Recirculation, Utilisation and Endurance.**

For help with chemical issues and chemical substitution, the [Swedish Centre for Chemical Substitution](#) provides several available tools. During 2020, the Centre also is having a specific focus on furniture and interior design and provides comprehensive material in order to help facilitate the identification and substitution of chemicals.

2.2 Circularity throughout the operations

One challenge for a large organisation is to adhere to principles of circularity as a part of its normal operations. It can be difficult to know how an organisation should manage its product ownership, purchase and settlement of products so that the products live a long life with a high degree of utilisation and that the value of the materials is preserved for as long as possible. As a help in working systematically on these issues, RISE has developed an approach called "User Cycle"⁶, see Figure 2 below. Taking furniture as an example, according to the User Cycle, the furniture flows of a procuring organisation can be divided into four dimensions, three of which are phases (steps in the management of furniture) and the fourth is a more general context: Acquisition, Holding, Settlement, and Organisation and Network (see the following section).

- *Acquisition* is about how an organisation procures new furniture, for example by buying or renting them.
- *Retention / ownership / use* is the management of furniture while it is being used, including ongoing maintenance.

⁵ Linder, Boyer, Dahllöf, Vanacore & Hunka (2020) Product-Level Inherent Circularity and Its Relationship to Environmental Impact'. *Journal of Cleaner Production*, 260. <https://doi.org/10.1016/j.jclepro.2020.121096>.

⁶ Rex, Thomtén & Norefjäll (2019) [Den cirkulära kunden](#), Vinnovafinansierad genomförbarhetsstudie (in Swedish).

- *Disposal* is about how the organisation disposes of the furniture that is no longer needed.
- *Organisation and networks* are about the structures that exist within the business for, for example, managing information and finances. This dimension also includes the internal organisational culture and the external network within which the organisation operates within furniture.

The User Cycle provides a generic picture of a large organisation's furniture-related activities divided into dimensions as above. The dimensions of the User Cycle affect each other and the activities that take place within the organisation can support or inhibit circular behaviour.

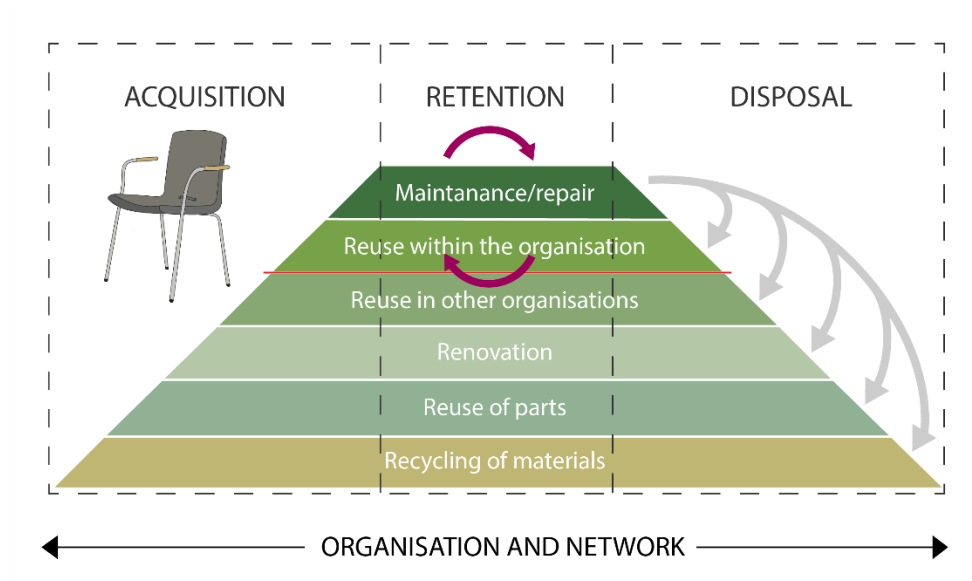


Figure 2. The User Cycle of Furniture

The base of the User Cycle is a so-called material value pyramid. The pyramid shows the order of priority on which the project is based, which is in line with the EU Commission's waste hierarchy. The aim is to achieve the highest benefit from a resource, climate and economic perspective. The goal is to act to keep materials / artifacts as high up in the pyramid as possible. Repair and maintenance keep the furniture at the top of the pyramid - in a long life within organisations - and is the top priority. Recycling of materials is the lowest priority. Energy recovery / landfill is considered outside the User Cycle as it is not included in a circular flow.

Interested in learning more about the use cycle?
Find the report "The circular customer" [here](#).

The large part of the organisation's role in the circular flow of products is covered in the acquisition of the product itself, but some parts of the circularity will be enabled by other procurements and actions

within the procuring organisation. An example related to furniture: One aspect of circularity is the use phase of the furniture. In the circular perspective, manufactured goods should be kept in “peak use” as long as possible before being re-used or recycled, etc. Procurement criteria following the stated principles of material recirculation, utilisation and endurance will ensure the products are designed for peak use. The peak use can be facilitated by criteria focused on the design of the product, to include and allow service, repairs, upgrades, etc. In the procurement it could include criteria for keeping spare parts in stock, care manuals or design that allows repair with common tools and / or common parts. But the use phase also includes activities and practices in using the furniture efficiently and for as long as possible. The peak use can also be supported by other activities in the organisation: having users or maintenance personnel service and repair at the right intervals, monitor and circulate and keeping the right balance of long-term and short-term flexibility in stock within the organisation. These activities to prolong the use phase can also be procured separately as services supporting the peak use in different ways. An optimal circular procurement also includes criteria enabling or facilitating other activities supporting the circular flow and peak use. Thus, the three dimensions can support not only criteria setting for the acquisition but also be used as a structure to regard other actions and possibly complementary purchasing subjects to ensure more circular flows in total.



Image developed by L. Quistgaard in Business model innovation for circular furniture flows

2.3 Traceability as facilitator of circularity

As a facilitator of circularity, procurement criteria could reflect the need for transparency and traceability aspects. With traceability information and documentation, circularity could be increased. For example, it can include the availability of spare parts, as well as help to identify the specific component and where to find / buy it. Traceability could include information about chemicals which would help to decide whether or not to (re)circulate a product. Other examples include instructions for assembly and disassembly, or information about possible health risks related to remanufacturing.

A [traceability tool](#) developed in the Vinnova funded project [Business model innovation for circular furniture flows](#) could be of help and inspiration.



2.4 Development as a circular customer⁷

Procurement of circular furniture is a step towards becoming a circular customer. However, comprehensive changes must be made for most procuring organisations to act more circularly and this will require both internal capacity building and increased interaction in the value system. RISE's experience in circular procurement suggest the circular customer could develop procurement capacity in four different ways.

- 1) To extend the perspective from products to the entire life cycle, to the value chain of the product, to the production system that the value chain is part of and to whole value system and circularity.
- 2) To switch to new business models, from circular products to more service-based solutions such as hiring, function-oriented, or performance-based procurement.
- 3) To develop the organisation from a buyer of products and services to being involved and co-creative in the development of new circular services and other business models.
- 4) To increase the degree of innovation, where the focus is likely to be on modifying existing products and materials first, and then switching to products with new designs and features and in a later step, to completely switch new materials and products.

The circular customer needs to build expertise to overcome the barriers that exist for each stage of development in these four areas.

By shifting towards a higher degree of circularity, many things will change in the context of procurement. Examining the needs of the procuring organisation with three dimensions of circularity could lead to a changing perspective on what to procure (see Figure 3). There could be a change in the scope of the procurement or the object of the procurement. It is wise to not start with a narrow perspective or a short timeline if the examination ends up in a change of what to procure.

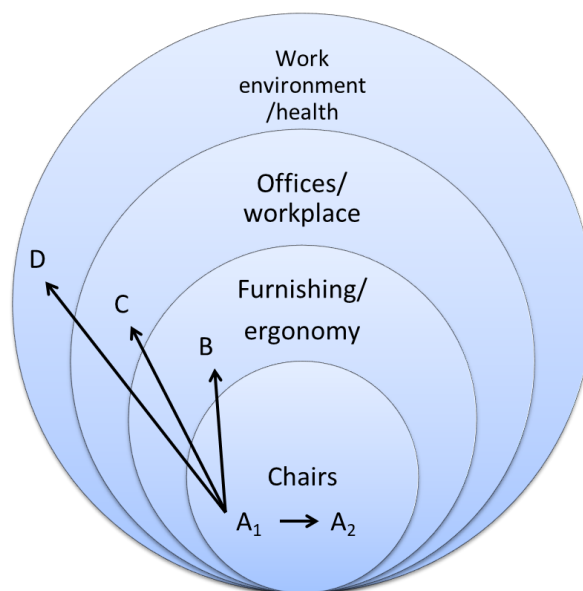


Figure 3. Different Scopes of Procurement of Furniture

⁷ The concept of the "circular customer" has evolved through several RISE led projects on circular procurement as: PROCEED <https://www.ri.se/sv/vad-vi-gor/projekt/public-procurement-circular-economy-edge>, Business model innovation for circular furniture flows, www.cirkularitet.se, Den offentliga kunden i ett cirkulärt affärs ekosystem https://www.ri.se/sites/default/files/2020-05/D%C3%A4ckprojekt_Slutrapport_final_200518_1.pdf, [Den cirkulära kunden](#), This is a Vinnova funded feasibility study (the document is available in Swedish).

Examining criteria for procurement of chairs could lead to chairs being part of a procurement of ergonomic furnishing. The chairs could be a subset of the procurement of functional workplace and include flexible sitting, standing and laying in sofas, hammocks and pillows, etc. The whole procurement could be about a circular and healthy work environment including home and away sitting on multiple “chairs” in offices, homes, cafés, parks, etc. The scope of the procurement will change quite significantly the criteria for use and circularity of the chair, or any product.

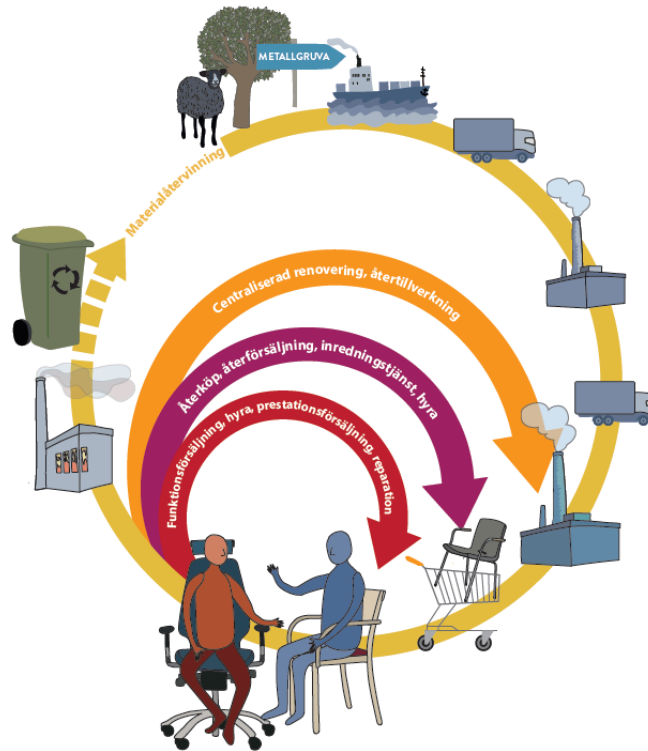


Image developed by L. Quistgaard in the project Business model innovation for circular furniture flows

3. The smörgåsbord of indicators for circularity

Recent years have witnessed an explosion of indicators, metrics, assessment tools, and checklists that help identify products and practices that support a Circular Economy. There are now dozens of ways to verify the extent to which international organisations, nations, cities, businesses, and individual products are “more or less circular.”

A recent study identified 55 different circular economy indicators used around the world, including 20 developed to measure the circularity of individual products⁸. Some indicators are designed for particular industries while others can apply in multiple contexts. Applying some metrics requires very specific data inputs (yielding relatively precise outputs) while others need only a rough judgement call (yielding rather imprecise outputs).

On one hand, organisations interested in Circular Economy ought to have access to assessment tools that fit their particular challenges and their particular capacities. An architect assessing the circularity of a building, for example, might benefit from a circularity metric designed specifically for building materials⁹, but should not bother using a tool designed for the Chinese iron and steel industry¹⁰. A start-up company just discovering the Circular Economy might not have the resources to correctly apply a multidimensional metric with complex data inputs¹¹, but might find an exploratory metric useful and practical¹². A firm interested in stimulating reuse and repair through a service-based business model is not best served by applying a metric focused exclusively on material recirculation¹³. On the other hand, it is important that metrics for a Circular Economy share a conceptual backbone so that their application can encourage changes in society that contribute to similar goals, or at least avoid major contradictions.

3.1 Measuring the Three Dimensions of Circularity

It may be tempting to collapse all three dimensions into a single composite circularity score, but since there is no natural relationship between material recirculation, utilisation, and endurance we recommend that these three dimensions are assessed and reported separately, as a dashboard of circularity indicators.

We outline several options for assessing these dimensions below and discuss their applicability with furniture as an example area.

3.1.1 Measuring Material Recirculation

Material recirculation is the most often measured dimension of circularity. There are multiple ways to measure it. Metrics can focus on one or multiple recirculation pathways like repair, reuse, remanufacturing, or recycling. Metrics can also focus on either recirculated inputs (e.g. how much of my product is made of reused, refabricated, or recycled *stuff*), recirculated outputs (how much of my

⁸ Saidani, Yannou, Leroy, Cluzel & Kendall (2019) A Taxonomy of Circular Economy Indicators. *Journal of Cleaner Production*, 207, p. 542–59. <https://doi.org/10.1016/j.jclepro.2018.10.014>.

⁹ Verberne (2016) Building Circularity Indicators: An Approach for Measuring the Circularity of a Building. Presented at the Eindcolloquium, Eindhoven, Netherlands, 18 February 2016. <https://prezi.com/dtlihekyiwf/building-circularity-indicators/>.

¹⁰ E.g. Zhou, Chen & Xiao (2013) On Evaluation Model of Circular Economy for Iron and Steel Enterprise Based on Support Vector Machines with Heuristic Algorithm for Tuning Hyper-Parameters. *Applied Mathematics & Information Sciences* 7, no. 6, p. 2215–23. <https://doi.org/10.12785/amis/070611>.

¹¹ E.g. Ellen MacArthur Foundation, and Granta Design. ‘Circularity Indicators: An Approach to Measuring Circularity. Methodology.’ Ellen MacArthur Foundation, 2015.

https://www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Methodology_May2015.pdf.

¹² E.g. Evans & Bocken (2013) Circular Economy Toolkit’. Combridge Institute for Manufacturing. circulareconomytoolkit.org.

¹³ E.g. Linder, Sarasini & van Loon (2017) A Metric for Quantifying Product-Level Circularity’. *Journal of Industrial Ecology* 21, no. 3, p. 545–58. <https://doi.org/10.1111/jiec.12552>.

product or my manufacturing waste ends up being recirculated at the end of its functional life), or both. The amount of recirculated stuff also must be quantified somehow, for example, in percentage recirculated mass or in percentage recirculated economic value.

Sustainable Business researchers at RISE Research Institutes of Sweden have developed and tested a metric that focuses specifically on material recirculation. The metric, called “C”, is defined as the proportion of a product’s economic value that comes from recirculated material. Simply expressed, C is equal to the economic value of a product’s recirculated material divided by its total economic value. The outcome is a single value, between 0 and 1, where a score of 1 represents a product whose value comes entirely from recirculated material.

$$C = \frac{\text{economic value of recirculated components}}{\text{economic value of all components}}$$

A particular advantage of the C-metric is that it is not designed for any particular industry and can thus be applied in a variety of contexts. RISE researchers have worked with the furniture industry, local-government procurement officers, and the automobile industry to apply the metric. Furthermore, a small-scale test using products from a variety of industries presents a clear correlation between high C-scores and low environmental impact, such as climate impact (Linder et al. 2020), so this metric appears to correspond with how many would hope circularity would behave.

How would material recirculation apply to procurement of furniture?

No matter the specific indicator, measuring material recirculation would involve verifying the *source* of materials used in furniture production and / or the *destination* of materials when furniture is discarded. Indicators should reward products or firms that source relatively more of their materials from prior uses through reuse, re-fabrication, and recycling instead of from virgin material sources. Additionally, firms and products would be rewarded if discarded furniture and material returned ultimately to some other use—whether or not in the furniture sector—instead of being sent to an incinerator or a landfill.

3.1.2 Measuring Utilisation

Measuring utilisation is comparably less common. The utilisation dimension inquires how often a product gets used. An intensely used product can be thought of as *earning* the embodied energy invested into it. A car driven many miles in a short period of time—for example, a car used in a carsharing service or a taxicab— demands fewer resources *per kilometre driven* than a car that spends 90-99 percent of any day parked. Such an intensely used vehicle is also less likely to break down due to decay, or age into obsolescence.

Measuring utilisation is also much easier for products that are actively used. For example, it is relatively easy to measure how much or how often cars, computers, washing machines, power drills, lighting fixtures, and clothing get used. However, it is more challenging to identify how often or how much passive objects like a window, a poster, a street sign, or a houseplant get used because their use is effectively constant. Measuring utilisation may require that certain products be considered components of larger assemblies of products, and this may require communication across sectors or new business models to understand segregated products as part of a product package.

RISE Sustainable Business researchers are considering metrics for utilisation based on changes in economic value. The “U” metric — still under development — is defined by the proportion of a product’s change in economic value due to being used, rather than changes due to physical decay or exogenous shifts in the marketplace.

For example, a washing machine that has been run very intensely because it is serving multiple households will have lost relatively more of its market value due to being used rather than decaying or being edged out of market relevance by a more efficient alternative. This metric works particularly well for products with measurable use and requires comparisons across a sample of other products. More passive products or assemblages of products like interior spaces could be measured as users per unit of space per unit of time (persons per square meter, per hour). These are both still experimental applications.

How would utilisation apply to procurement of furniture?

Measuring utilisation in the context of furniture would involve understanding how often an article is in active use, relative to the amount of time it is in storage or under repair. This might be more easily achieved as part of a service-based business model in which the owner / distributor of furniture keeps track of the amount of days a product is leased by a customer as a proportion of the total age of the product. An article of furniture could even be decomposed into interchangeable components with each their own utilisation score. Measuring utilisation would also benefit from enhanced sensor technology that could detect how many hours of a day, on average, an article of furniture was being used (e.g. sat upon, illuminated, walk upon). This becomes more challenging, however, with furniture that is used passively, for example a window, a wall, or a bookshelf.

3.1.3 Measuring Endurance

Physical durability is an important part of endurance, although it also contains other aspects. Certainly, a product that breaks on its first use is a good example of *low* endurance. However, endurance is also a measure of a product’s *social* and *technical* relevance. A very durable VCR machine purchased in the late 1990s is worth very little, even if it was designed for high durability. A high-endurance product is designed to respond to changes in society that are unpredictable today. This can involve *future adaptive design* that uses techniques like modularity, interchangeable parts, and design for multiple customer segments to anticipate future changes in users and uses of the product itself.

RISE Sustainable Business researchers have begun to develop a **Market Entropy (ME) metric** that is determined by estimating the cost of restoring a product to its original market value. It is expressed as one minus a ratio of:

- a) the total cost of the utility of a product (i.e. the cost of maintaining, repairing, refurbishing a product and delivering a product's utility) in some random period of time; to
- b) the total value of the utility of a product, measured in sales revenue.

In short, a product that is low-cost to maintain at its market value is rewarded with a higher, better score. Such a metric encourages long-lasting, high-quality products that are inexpensive to repair. It also encourages future-adaptive design of products, so that products can in fact improve with time. Designers can enhance a product's endurance through future adaptive design, which would allow for relatively inexpensive repair, upgrades, and modification that keeps a product relevant.

How would endurance apply to procurement of furniture?

Measuring endurance in the context of furniture would involve determining the cost of keeping a product at its original market value. This requires data about the cost of maintenance and the value of a piece of furniture in the marketplace. A company can enhance endurance through repair and maintenance programmes, using interchangeable parts, upgradeable surfaces, and close communication with product users.

3.2 A note on measuring costs

Purchasing decisions typically result from a combination of different parameters and measures, including costs. For circular product flows, it is important to understand the scope of the costs.

A life cycle approach assesses the impact that a product can have from a sustainability viewpoint during its entire lifespan, i.e. from cradle-to-grave or perhaps from cradle-to-cradle (for circular products). An **LCC analysis** is a methodology that **identifies all the costs associated to a product or a service throughout their lifetime** (see Figure 4). As such, this approach makes sound economic sense and should foster circularity.

An LCC Analysis comprises of two components:

1. Total Cost of Ownership (TCO) including:
 1. Buying price and all associated costs (e.g. delivery, installation, insurance, labour costs);
 2. Operating costs (e.g. maintenance for a product that might be purchased as a service, spare parts, energy, fuel, water use);
 3. End-of-Life costs (e.g. disposal, decommissioning).
2. Monetisable positive or negative externalities including:
 - At the **organisational level**: the evaluation of costs related to benefits of risks and / or mitigation and benefit realisation.

- At the **societal level**: the cost of both environmental and societal externalities (e.g. greenhouse gases; job creation)

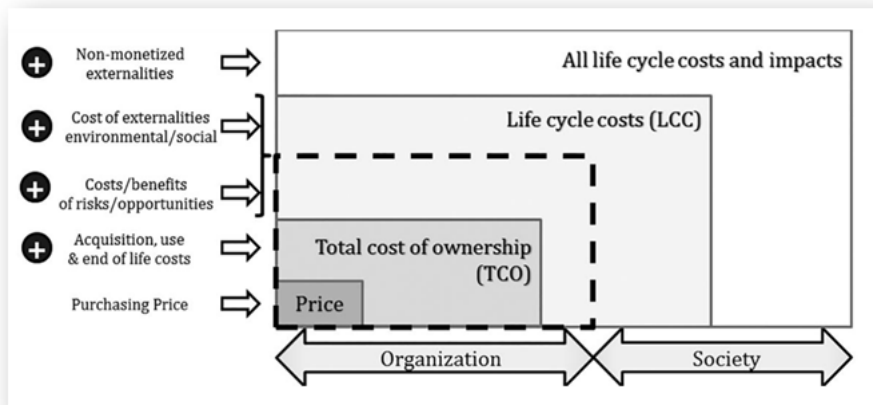


Figure 4. Overview of LCC Approach (Source: ISO 20400:2017)

3.3 Providing realistic, objective and verifiable measures

It is important to remember that product specifications / criteria have to be **realistic** (= achievable vision, market and budget), **objective** (= the specified behaviour does not vary depending on the agent that performs it) and **verifiable** (= measurable through indicators). Also, when designing tender specifications, one must consider technical aspects and / or functional aspects. A more comprehensive approach combining the aforementioned two approaches would include the following aspects specifications¹⁴:

- Product design
- Production process
- Operational phase
- End-of-life management.

Overall, in order to meet sustainable procurement criteria, it is advisable to implement a dedicated performance measuring system as a means to continuously improve performance, engage with and communicate to decision makers, internal and external stakeholders.

¹⁴ See PROCEED project Circular Public Procurement Toolbox (Vanacore et al., 2020, pp. 18-19): https://www.ri.se/sites/default/files/2020-06/PROCEED_Mgmt%20TOOLBOX-FINAL_EN.pdf

4. The three dimensions of circularity, in regard to six questions identified by *Upphandlingsmyndigheten*

Public procurement can contribute to increased sustainability in many respects. Our answers below focus on how to contribute through increased circularity, as one strategy for sustainability, and with potentially large impacts on for instance, climate impact and resource use. The answers are based on a review of the sustainability criteria for furniture by *Upphandlingsmyndigheten* 2020.



Image developed by L. Quistgaard in Business model innovation for circular furniture flows

Question 1

How can public procurement further contribute to increased sustainability in the areas of furniture and furnishings?

In order to take a comprehensive approach to circularity, public procurement bodies are encouraged to:

1) Review, request and encourage circulation in *three* dimensions:

- **Recirculation:** the recirculation of products and materials already in use;
- **Utilisation:** the intense use of existing products and materials;
- **Endurance:** long-lasting products designed to adapt to unforeseeable changes in style, technology, and customer segments.

2) Regard their contribution to circularity in all aspects of its operations (acquisition, use, end of life and organisation and networks). This includes to support circularity through the three dimensions, not only in the criteria setting but in *all* steps of the procurement process. For example, in the identification of procurement subject, in the market dialogue, in the follow up, etc. See the box below for examples of guidance documents to use in this process.

Examples of documents and materials with the aim of assisting procurement bodies and large customer organisations in fostering circularity through a holistic view of procurement:

- [Norefjäll, Rex, Nilsson & Möller \(2020\). Upphandling och cirkulär ekonomi. RISE Report 2020:18.](#) This document (in Swedish) provides a description of how circularity can be included in each part of the purchasing process, with questions to ease discussion and first steps.
- [Rex, Nilsson & Quistgaard \(Eds\). \(2020\) Var en del av den cirkulära omställningen! Inblickar och diskussionsfrågor om hur du kan bidra till cirkulära flöden av möbler.](#) Educational material (in Swedish) which facilitates learning and discussions around a range of themes and examples related to circularity and furniture.
- [Vanacore, Boyer & Williander \(2020\) The Circular Public Procurement Toolbox.](#) A toolbox including an innovative roadmap for public procurers to guide them in their circular public procurement activities by focusing and leveraging on measuring circularity with specific product circularity indicators elaborated by RISE Research Institutes of Sweden.
- [ISO 20400:2017 - Sustainable procurement.](#) Guidance document for sustainable procurement, including reference to the importance of circular procurement.
- Rex, Thomtén & Norefjäll (2019) [Den cirkulära kunden.](#) The document (in Swedish) describes the User Cycle and provides help for organisations that wants to change their practice into a more circular one.

Other aspects such as social sustainability, toxic content, etc. need also to be considered for a comprehensive sustainability assessment (although they are not the focus of this document). Regarding chemical substitution, the Swedish Centre for Chemical Substitution provides several tools. For 2020, the Centre has also set a specific focus on furniture and interior design and provides comprehensive material in order to help facilitate the identification and substitution of chemicals.

Question 2

What are your experiences with or perspectives on current sustainability criteria?

A review of the current sustainability criteria for furniture at *Upphandlingsmyndigheten* has been conducted using the three dimensions of circularity. It shows that the current criteria have only a few supporting circularity. Therefore, it is recommended that the criteria are systematically reviewed and complemented using the three dimensions of circularity.

Note! Criteria suggestions below are given for inspiration and point of discussion. We acknowledge that these suggestions need further development in terms of effectiveness, definitions, formulation and means of verification to be fully operative.

An initial review of existing criteria shows that:

RECIRCULATION

Current status:

- No criteria found that encourage recirculation.
- The criterion “routines for guarantee of origin” (in Swedish, *säkerställande av ursprung*) includes upstream traceability and focus on “virgin material / origin” – This criterion could be complemented with information regarding reused material (Recirculation).

Examples of criteria supporting this dimension of circularity:

- Degree (weight, volume, economic) of the product that is made of reused, refabricated, or recycled materials¹⁵. In this case the C-metric can be applied.
- Degree of product (or manufacturing waste) that is possible to recirculate at the end of its functional life span.
- Availability of plans / instructions / incentives for recirculation of the product (or parts of product) / waste material at the end of its functional lifespan.
- Product design that incorporates future reuse and / or disassembly of the product (or parts of product), e.g. the possibility to disassemble it into pure material streams without specific tools (or within a certain time frame) and by non-professionals.
- Product design that enables the product (or parts of the product) to recirculate in a similar product (closed loop recycling or upcycling).
- Product design that enables the product (or parts of the product) to recirculate in an alternate product (downcycling).
- Product documentation that informs about how to recycle the product.
- Product documentation that informs about options for repairing / remanufacturing, etc.
- Product documentation that includes information about content of all materials and chemical substances (enabling, for instance, the assessment of best options for future recycling and / or assessment of fulfilment of current and future legislation e.g. regarding chemicals).
- Availability of supplier take-back system of the product.
- Availability of traceability documentation / system including information that enables multiple circulation loops (e.g. material and substance content, instructions for assembly and disassembly, availability of spare parts (both identification and logistics)).
- Documentation on the process and information regarding remanufacturing, to ensure product quality (this could potentially be verified through a system of “individual certification” (in Swedish, *personcertifiering*) (see box below)).

UTILISATION

Current status:

- No criteria found that encourage increased utilisation.

Examples of additional criteria supporting this dimension of circularity:

- Availability of information regarding furniture localisation (e.g. in offices or storages), for example by means of labels, sensors or similar.
- Availability of enhanced sensor technology that could detect for example how many hours of a day an article of furniture is used (e.g. sat upon, illuminated).
- Availability of support (advice / consultation) from the supplier regarding how to increase utilisation of existing and / or purchased products.
- Availability of support in inventory and utilisation strategy for existing furniture stock.

¹⁵ Here, the economic value can be used, for example, as input for calculating the C-metric.

- Availability of diverse business model offers, such as service-based business models, in which the owner / distributor of furniture for example keeps track of the amount of days a product is used and where the customer pays for those days, or furniture leased by a customer as a proportion of the total age of the product.
- Hard and software additions to the furniture that keeps track of existing stock, localisation and / or the amount of days a product is used or leased by a customer as a proportion of the total age of the product.
- Availability of traceability documentation / system (e.g. on material content, prior uses, guarantee, etc.).
- Information about prior use of the product (e.g. type of customer, length of prior leasing contract).

ENDURANCE

Current status:

- The current criterion “Spare parts should be available during at least five years since date of production” is likely to enhance the product endurance.

Examples of additional criteria supporting this dimension of circularity:

- Availability of traceability information that provides data about:
 - the product (including e.g. manufacturer, date of production, date of remanufacturing, data about how (and degree of) the original product has been modified (added / removed parts and / or substances), guarantee time, expected wear and tear), and
 - information that facilitates reuse, repair, remanufacture, etc. (e.g. identification and availability of spare parts, information about chemicals (which in turn could help to decide whether or not to (re)circulate a product), instructions for assembly and disassembly, information about possible health risks related to remanufacturing).
- Availability of traceability system to facilitate circularity (such as QR-codes or other labels, data systems).
- Availability to purchase add on services such as maintenance, repair or renovation.
- Product design that incorporates circularity principles and product adaptivity, such as modular product design.
- Long-term availability of spare parts or interchangeable parts (e.g. 20 years).
- Product design that facilitates easy renovation, within a maximum cost and time frame, in house, by a non-professional (given the right spare parts, etc.).
- Product design that facilitates the possibility of product upgrades, at a maximum cost and time frame, e.g. surfaces.
- Availability of support (advice / consultation) from the supplier regarding how to increase enhance lifetime of the product.

Process related criteria

In addition to the more technical requests of the three dimensions above, criteria may also be included that aim to encourage circular strategies and development processes. Such criteria may regard the following:

- The supplier describes its own goals, ambitions and strategy to contribute to more circular furniture flows.
- The supplier provides advice / is willing to discuss how future collaboration can lead to more circular flows.
- The supplier provides information as to how it supports the customers circularity goals.

Question 3

What are the most important sustainability requirements to place upon new furniture?

Below, the answers based on the three dimensions of circularity perspective, and the current circular practices.

- Product design that incorporates circularity principles, such as:
 - Degree of reused material in the product development, measured, e.g. through a C-metric (Recirculation).
 - Product design that enables long product life, e.g. has available spare parts, is possible to renovate easily, is designed for remanufacturing and / or adaptive design (Endurance).
 - Availability of traceability information / systems that provides data on, e.g. all materials and substances included, instructions for assembly / disassembly (Endurance).
- Availability of alternative business models that enables, e.g. leasing.
- Availability of add on services for repair, etc.

Note! The categorisation of “new” and “used” furniture might shift in the future, as more and more circulated materials / components are utilised in the “new” category.

Question 4

What are the most important sustainability requirements to place upon used furniture?

Below the answers based on the three dimensions of circularity perspective.

- Availability of traceability information and / or system that provides:
 - Data about the furniture (including for instance, manufacturer, date of production, date of remanufacturing, data about how the original product has been modified, guarantee time, expected wear and tear), and
 - Information that facilitates reuse, repair, remanufacture, etc. (e.g. identification and availability of spare parts, information about chemicals, instructions for assembly and disassembly, or information about possible health risks related to remanufacturing) (Endurance).
- Product design that incorporates circularity principles and product adaptivity, such as modular product design and product adaptivity, the availability of spare parts (Endurance).
- Availability of supplier take-back system of the product (Recirculation).
- Availability of support (advice / consultation) from the supplier regarding how to increase utilisation of existing and / or purchased products (Utilisation).
- Availability of support (advice / consultation) from the supplier regarding how to increase enhance lifetime of the product.
- Documentation on the process and information regarding remanufacturing, to ensure product quality (this could potentially be verified through a system of “individual certification (in Swedish, *personcertifiering*) (see box below) (Recirculation).

New products can be certified using existing tests and label schemes. However, for remanufactured products this has not been developed yet. In the project Business model innovation for circular furniture flows, “individual certification (in Swedish, *personcertifiering*) was identified as a possible certification. Read more in these documents (in Swedish):

[Höjvall \(2019\) PERSONCERTIFIERING - Ett möjligt system för märkning av återbrukade möbler](#)

[Snabbfakta \(2019\) Personcertifiering – metod för verifiering av cirkulära möbler](#)

Question 5

What support is needed to facilitate follow-up in the field?

For any follow-up it is important to know what the goals are. With clear goals, and relevant tools, it is possible to generate the information needed to reach those goals. Also, with such information, it is possible to build a solid base also for follow-up intentions.

Following the discussions earlier in this paper, there might be different goals at different levels, hence requiring different types of support:

- *Goals of more circular product flows in society:* here measures suggested on the three dimensions of circularity (section 3) might be relevant on following up on progress towards the three dimensions covering the essence of circularity per se.
- *Strategic goals of the purchasing organisation:* why is circular procurement important? Is it to contribute to less resource depletion, less climate impact, encourage circular business ecosystems, or a more competitive regional industry? If one of the aims of increased circularity is reduced contribution to resource depletion, then it might be important to get in place the C-metric, LCA / EPD on biotic and abiotic use of resources, and / or refined measures and statistics on the amount of waste generated. Also, how to steer and measure towards those goals and how to handle trade-offs with for instance short-term economic goals.

There is sometimes a lack in organisations to discuss the overall organisational goal. *Upphandlingsmyndigheten* could assist in the above processes by:

- Emphasising the importance of formulating strategic goals;
- Providing forum for discussion on how to formulate goals at different levels (nation, purchasing organisation, specific procurement);
- Present examples of goals and follow up at different levels, and test and evaluate different tools, measures and approaches.

Upphandlingsmyndigheten could also assist in developing and presenting tools for measuring and follow up (like the LCC tool) and / or support development of tools and infrastructure that ease relevant information sharing between suppliers and customers. One such infrastructure of great importance for circularity is traceability.

Traceability

Circularity entails new questions in relation to follow up of criteria. For example, enhanced use of repair requires spare parts, which in turn means that the customer / user need to be able to identify the component and easily find / have access to spare parts. Another example is remanufacturing, which is

facilitated for example, by the availability of instructions for assembly and disassembly. With traceability information and documentation, circularity is facilitated, and follow-up is also aided by such documentation.

A [traceability tool](#) developed in the Vinnova funded project [Business model innovation for circular furniture flows](#) could be of help and inspiration.

Traceability is also something that has been highlighted in national and international legislation, for example, a digital product passport has been discussed in the new EU strategy “The Green Deal”¹⁶. In parallel, in Sweden the investigation of a product pass has been planned for 2021¹⁷.

Question 6

Other input to the work?

Based on the presented review, *Upphandlingsmyndigheten* is encouraged to:

- Design a process for all upcoming review of criteria based on the three dimensions of circularity presented in this report. This to complement existing criteria library with incentives for more circular product and material flows.
- Consider providing assistance in new procurement subjects, to ease and enable circular business eco-systems, e.g. repair services, inventory services, software, storage, take-back offers, broker services, architects, designers, process leaders, etc.
- Consider evaluating and suggesting ways to measure circularity. As seen in section 3, many attempts are under development and need to be tested and refined to be operational and support suppliers and customers in both validation and “impact evaluation”.

Leading a shift to a Circular Economy via circular public procurement is a demanding task and therefore it is essential that public authorities are simultaneously determined in *what* they want to achieve (higher degree of product circularity) and flexible in *how* to achieve the desired higher-level of circularity without deviating from the guiding circular principles. In this it is important to progressively involve all the interested parties such as OEMs and *Upphandlingsmyndigheten* in the process.

Moreover, since various hindrances may arise in a circular procurement process, it is necessary to associate one or more of the three circularity dimensions to the selected product(s) and to have sufficient actors in the supply chain that are interested in circular business opportunities. One way to find those possible pathways for circular public procurement could be to run various forms of very early RFIs (Request for Information) rounds with suppliers in different product categories. Such an early dialogue should increase the probability to find and open up for promising pathways to circular procurements.

¹⁶ European Commission (2019) [The European Green Deal](#), COM(2019) 640 final.

¹⁷ Januariavtalet. Sakpolitisk överenskommelse mellan Socialdemokraterna, Centerpartiet, Liberalerna och Miljöpartiet de gröna (in Swedish).