how to design with

aging & wear

in mind

- designing public seating furniture

for a circular economy

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Aim of the guide

Each year, a vast amount of furniture in the public sector in Sweden is disposed of, ending up in landfills. The furniture is often discarded for aesthetic reasons rather than functional, meaning that fully functional furniture with remaining value is simply thrown away. Furniture has become consumer goods that are replaced as trends and fashions change. To change this, designers and manufacturers need to start thinking about what happens to the product after sales and how to preserve its value over time; for example by allowing for it to be recirculated. Simple measures such as facilitating refurbishment and maintenance can help save a great deal of resources, both environmentally and financially¹.

This short guideline aims at assisting designers in creating public seating furniture that is more suited for a circular economy. The point of departure has been the aging and wear of furniture; aspects that are especially important in the case of closed loop systems where furniture has to withstand longer use and being recirculated over and over again. The information and recommendations presented in this guide are based on both theoretical as well as empirical research. Interviews with experts and professionals in furniture design and in the furniture trade in Sweden have been conducted to collect information, as well as a study examining how end users and experts perceive and tolerate aged and worn public seating furniture. The project was funded by Vinnova and coordinated by IDC West.

i.

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interviewees and participants!

and all volunteering





If you have previous experience of designing for circularity and furniture design, the introductory chapters can be skipped. General design recommendations start at page 7, and component specific information and recommendations can be read on pages 13 and forward.



Table of Contents



FURNITURE1
ITURE2
OWS3
LING IN A CIRCULAR ECONOMY4
ENVIRONMENTS5
7
N9
20
iv

The Product: Seating furniture

Page 17 Page 15 Page 13 Page 13

In addition to some general information concerning material choice, construction and aesthetics, each of the chair's different components are going to be addressed separately with more part-specific information and recommendations. With 'upholstered seating furniture for public environments', all kinds of conference chairs, breakroom chairs and reception chairs in places that either are open for the public or are tax funded are being considered. Office chairs are however exempt as their more technical nature call for higher requirements to be met. Yet, many of the recommendations presented here are universal and can be applied on a number of products.

To be able to design something that lasts, one must consider the underlying reasons to why people want to get rid of or change furniture. As previously mentioned, a common reason for throwing out furniture is because it has become aesthetically outdated – furniture is replaced in such a speed that it does not have the time to become physically worn. Nevertheless, people have started to see the need for change, and more and more buyers are asking for longer lasting products². And if the aim is to design long-lasting furniture, then aspects such as aging and wear become much more important to consider.

Aging and wear of furniture

In the case of furniture, the terms aging and wear are perceived in quite different ways. While wear is associated with damages and deterioration stemming from frequent use, aging is often seen as the gradual change the furniture goes through over time. Wear is in other words actively created, while aging is the result of the exposure to external influences such as heat, sun radiation, humidity or air pollution for a longer duration of time.

Aging often has a more positive ring to it than wear, as some of its effects can appear charming and add character to the furniture, for example patination or colour changes in wooden materials. What is often referred to as "natural wear" can also help add value, for example the kind of wear has not damaged the material but that shows its history; how it has been used and handled over the years. This natural wear is though only appealing if the furniture is made out of high quality materials to begin with, as lesser quality materials tend to show their inferiority with age³.

Negative, damaging, wear on the other hand often manifests as saggy and stained chair seats, scratches and black rubber marks on chair legs, and chipped corners on armrests. These kinds of wear often lead to chairs being thrown away, and should therefore be avoided or mended as soon as possible. Interviews and perception test data are however showing that the condition of the textiles is a determining factor for how people perceive the chair as a whole. As long as the textiles are looking fresh, users seem to some extent be willing to put up with other wear.















Circular furniture flows



How furniture or parts of furniture can be circulated instead of directly going to a landfill, based on the EMF⁴ model.

Circular economy has in recent years emerged as a more sustainable alternative to the linear "take-make-dispose" society that rules today. This model aims at making the most of the material we produce by recirculating it as long as possible, thus saving both money and on the environment.

There are many different ways of "closing the loop" so to speak, for example by reusing, refurbishing and recycling the furniture or parts of the furniture. In order to keep as much of the value of the product as possible over time, one should always seek to go through the inner loops first and work outwards. The most value is retained by seeking to keep the integrity of the chair intact for as long as possible⁴ , for instance by sharing, maintaining and reusing. This however requires furniture either with higher durability or that is easily maintained. If the furniture for functional or aesthetical reasons is not able to go on this way anymore, it is time to see if refurbishment or remanufacturing is an option. This could either concern the whole product or only parts of it, for example reupholstering seats and so on. Lastly, if no other options remain, material recycling should be performed.

The circular business models that are implemented in connection to this can have varying levels of circularity built in to them. Renting furniture or providing office interiors as a service are some examples where the supplier retains the ownership of the furniture and therefore has an incentive to own long lasting, high quality furniture.

Environmental labelling in a circular economy

As the furniture starts moving more in circles than in a straight line forward, the lines between one product life and another gets muddled; where does one life end and where does the next start? In the case of environmental labelling, this complicates matters. Because what happens to the certification of a chair if it or parts of it are refurbished and then reused? Regulations and requirements change over time, for example banning materials or chemicals which once were permitted. Knowing exactly what the furniture contains can also be difficult, for example if one buys used furniture that another company has produced with the intention of refurbishing and reselling it. A product which content cannot be verified is not allowed to be sold within the EU/EES⁵.

Some guidelines regarding the labelling of recirculated furniture have been developed in the last couple of years⁵, specifying the relabelling process depending on the circumstances: for example if the product is the company's own, if the new customer is the same or a new one, or if the product needs refurbishment or not. As of today, the big environmental labels in Sweden, Möbelfakta and Svanen, have however no direct plans regarding creating a certification system for recyclable furniture (that are possible to refurbish and resell)⁵. In case of such a label, requirements such as providing a declaration of contents, allowing for easy disassembly, and fulfilling a certain recovery rate would be central⁵.



Designing for

In order to design furniture that is suitable for public environments, one must have an understanding for its users and their needs and requirements. There are a myriad of different public environments; libraries, schools, lobbies and lunch rooms, all with different users and expectations. Most of them are exposed to high levels of wear and tear, with many different users, using them continuously. Wearing at the front of upholstered seats, staining from people spilling food, and wearing and soiling of armrests are the most common types of wear, stemming from frequent use.

Naturally, we expect different standards in different places depending on social and economic prerequisites, but generally as it comes to places that are tax funded people tend to be more forgiving towards signs of aging and wear. A basic rule is though that wear on fabrics and surfaces stemming from use is acceptable, but dirt and stains less so. Evenly, but quite extensively, worn furniture is also more acceptable to people in general than furniture in an otherwise perfect condition but with some glaring scratch or stain. Important is though that the furniture is not damaged or broken: rickety chairs are not found acceptable by most users⁶.

In offices, furniture is however most often discarded for aesthetical reasons rather than because of excessive wear. Relocations of offices lead to replacements rather than transfers, and managers often want to update the interiors every five years to keep the office contemporary³.

public environments

Since people in general are more careful with furniture they own themselves⁷, it could be fruitful for the public sector to involve the users in the decision making, like for e.g. the "Design med Omtanke" ("Design with Care") initiative in The County Council of Västra Götaland in Sweden⁸.



The higher the value, the worse the type of aging or wear is. Users where asked about how important they thought that it was that the different types of aging and wear did not appear on upholstered seating furniture.

The figure below shows how severe users find different types of wear. A high value means it is very damaging to the users' perception of the chair, whereas a low value means there is more tolerance towards the specific type of wear. As can be seen, ricketiness is the least acceptable, while there is a tendency to tolerate colour change or pilling of textiles more"⁶.

What to think about regarding Material selection

To be able to make furniture that ages well and that withstands both the tough environments of the public sector as well as a prolonged life span due to recirculation, choosing the right materials is crucial. As there are numerous different materials and surface finishes to choose between, and with often contrasting requirements such as low price and high quality, it is no simple task. There is also a dilemma in choosing between long lasting materials and environmentally friendly materials: e.g. chrome plated frames may not be as environmentally friendly as powder coated ones, but they withstand more wear and look untouched for much longer⁹. Interviewed experts seem to prefer short-lived materials that need maintenance over long-lived materials that are impossible to material recycle. Here are some general recommendations to help choose materials that age and wear well and that allow for circulation.

IN GENERAL:

- Follow the quality requirements set by existing standards or environmental labels, for example Möbelfakta, Svanen and Ecolabel⁵.
- Do not use unethical materials. Be aware of where the material comes from, how it is produced and what will happen to it once discarded¹⁰. Leather for example is a material most people think age well³, but one should be aware of the ethical issues that can be connected to it.
- It can be suitable to use different material on different parts depending on the level of interaction and with the user, e.g. leather or solid wood where one has their hands which is softer and warmer to the touch¹⁶.

- Choose material after application. Some materials are more sensitive to specific factors, e.g. many plastics are sensitive to UV radiation and become brittle and bleached with sun exposure³. If such materials are chosen, buyers should be informed of how to best keep and maintain the furniture.
- Surfaces with high shine, e.g. coated metal, is perceived to age poorer when they wear and become dull or scratched than already matte materials, e.g. rubberized surfaces or brushed metal¹².
- Metals with coating are more vulnerable to be perceived as worn as small scratches or dents stand out⁹.
- Choose materials that are easy to keep clean and fresh looking¹².

RECOMMENDATIONS: IMPORTANT ASPECTS FOR RECYCLING OR RESOURCE EFFICIENCY

- There is value in choosing high quality materials. "If you choose materials of high quality, you never have to throw away the furniture. The furniture can be maintained and restored, and is possible to resell as it has a second-hand value"¹².
- Natural materials, e.g. solid wood, metal, leather etc., are perceived to age better than synthetic ones such as plastics and composites³. 11 out of 11 interviewed experts stated that leather wear and age beautifully.
- Choose materials that are possible to renovate or mend¹². Thin veneers are hard to renovate since it is easy to damage the veneer when removing the surface treatment.
- Coatings are generally impossible to remove entirely, so be mindful of the decision and its effect on the product's recyclability¹². Use surface treatments that are easily maintained, restored or removed, or that age well such as wood stains and laguers¹².
- Use pure/uncontaminated materials when possible as they are easier to material recycle^{3,10}.
- Use as few material types as possible to facilitate separation for material recycling^{3,10,11}
- Use materials with as little quality loss as possible when recycled, e.g. aluminium¹⁰.
- Use recycled materials if possible. If the construction contains more than 10 per cent plastics, at least 50 per cent should be from recycled plastics, to fulfil

the Svanen requirements¹³. If furniture consists of at least 50 per cent metal in weight, at least 20 per cent should be recycled metal (50 per cent for aluminium)¹³.

 Chrome is a durable finish, e.g. for stackable chairs, but only Cr³⁺ is allowed in the public sector^{13,14}.

RECOMMENDATIONS: IMPORTANT ASPECTS FOR LONGEVITY

- Avoid materials containing chemicals that are untested or likely to be prohibited later on^{3,10}.
- By using metals of similar colour in a product or coatings with similar colour as the underlying materials, wear will appear less distinct⁹.
- If possible, use surface treatments that age and wear well¹⁸, for example wood oil (however not in environments with severe wear) or transparent coatings²².
- If possible, choose renewable material, e.g. sea weed for braided seats¹². Natural materials often age nicely and have less environmental impact.
- Avoid materials that degrade over time, for example by growing weak and brittle³.
- Avoid materials that become discoloured, for example white plastics that turn yellow³.
- Use thicker material layers or surface finishes on faces subjected to more extensive wear, e.g. thicker veneer^{10,22}.
- If surface treatments are applied to plastics it is not allowed to affect the recyclability of the plastic parts, to fulfil the Svanen requirements¹³.
- Plastic parts need to be labelled to make recycling easier. Plastic components with a weight over 50 grams must have a permanent label according to standard ISO 11469 or similar^{13,14,15}.
- Plastics, pigments and dyes should not contain hazardous substances, such as lead, tin, cadmium, chrome, mercury, phthalates etc^{13,14,15}. PVC is not allowed, except for in artificial leather for health facility environments requiring regular sterilization¹⁴.

What to think about regarding

Product construction

To design furniture that is capable of withstanding frequent use decade after decade is a challenging undertaking. It requires a well-thought-out construction with joints that both endure long time use as well as being easily taken apart to facilitate maintenance, repair and material recycling at end-of-use. Constructions can also be designed to be modular, thus allowing for continuous modernizing, part replacement due to damage or wear, or because of changing user needs. Some general recommendations on how to construct chairs for public environments are presented here.

IN GENERAL:

- Stackable chairs facilitate transportation and storage, which is resource efficient as it saves on both energy and space²⁰.
- Allow for the possibility to assess the condition of the chair, for example by providing standards for different conditions describing the level of wear acceptable. This could allow for more standardized maintenance and refurbishment¹⁰.
- Think about ergonomic aspects when designing and that the chair can be used by people of varying body shapes and needs⁹.
- To allow for easy access to information about how to repair or maintain the furniture, it can be tagged using for example QR-codes, bar codes or short notes^{12,10}. To be eligible for the Svanen certification there needs to be a permanent label with information about manufacturer, production date etc. as well as information about sub-suppliers¹³.
- Facilitate cleaning of the furniture by avoiding creating nooks and corners where dirt can collect¹⁶.



RECOMMENDATIONS:

- A modular design can both provide a flexible functionality as well as parts and material recycling²¹.
- Select joining techniques which facilitate disassembly for easier parts and material recycling^{3,11}. Wielding, rabbeting, gluing, and riveting easily taken apart^{3,10}.
- Self-locking constructions enable joining without additional fasteners als¹².
- When using glue, choose appropriately strong glue. If the glue is king it much more difficult to mend¹⁸.
- les without the use of glue¹⁰.
- Visible joining methods make disassembly and repair easier. Hidden and tear that users do not accept, so it should be easy to repair"^{12,6}.
- of the structure!^{10,11}
- defects that make the product completely or partially usable¹⁵.
- for removal¹¹.
- Enable for the furniture to be fastened with chucks in case of remanufacture¹⁰.

easier separation which facilitate maintenance, repair, replacement of

makes separation difficult, while screws, clips, snap-fits, and Velcro are

that can act damagingly such as nails and pins puncturing the materi-

stronger than the material, the material breaks and not the seam, ma-

Convex and flat surfaces on upholstery are possible to cover with texti-

centre pins are for example difficult to locate, and if they come loose the chair becomes unstable. "Ricketiness is a common result of wear

 Make removal of worn parts easier by minimizing the number of joints and the accessibility of them - but without compromising the strength

• Spare parts should be available for at least 5 years after production, to be able to prolong the life of the product. This include damaged or

• Use standardised screws and bolts that do not require specialised tools

What to think about regarding

Visual appearance

Making furniture that lasts physically is one thing, but equally important is making something that people would want to keep. As one interviewed Quality and Environmental Manager at a Swedish furniture company put it: "The difficult thing is to create furniture that not only is sustainable in regard to its materials and structure, but also in its look and style". Examples of furniture that remain desirable over time were by most professionals identified as "quality furniture" or "designer furniture"; in other words, furniture that has the potential of becoming classics. Furniture classics are however often developed over a long time by skilled professionals¹⁰. By taking into consideration the reasons for why furniture becomes outdated, as for example aesthetic, technical, social, functional or economic changes, designers increase their chances of designing furniture that stays current and useful for a longer time.

It is also important already in the design stage to decide how the chair is going to age; should there be no visible wear at all or should it age gracefully with the wear showing – take for example Kristine Bjaadal's chair Underskog²⁴ where a hidden pattern emerges on the seat as the textile is worn down. Thinking through the aging process in advance can lead to a design that holds up or even increases in value over time.



"The essence of the furniture can be found in the shape and form, the balance, the details, the proportions, the lines and the meetings between two different materials - that's where you can tell if a product has quality; if the meetings are beautifully executed"¹⁶.

> Examples of timeless designs that were frequently mentioned in the interview study were Arne Jacobsen's "Sjuan", "Myran" and "Svanen".

RECOMMENDATIONS:

- A design that can be altered or updated over time has a chance of surviving changing needs and trends. E.g. allowing for easy needs²².
- Create a thought-out construction and design. Interviewed experts said that furniture that showed an attention to detail were more likely to withstand changing trends and fashions and become classics³.
- One way to prolong the products life is to create furniture that users can
- Versatile chairs which suite different environments and settings are easier to relocate and resell. E.g. big pieces of furniture are difficult to sell and resell in lager cities where people often move and have limited space²⁰.
- Wear is not as noticeable on furniture that still has a cohesive look despite wear, e.g. furniture with same coloured metal details that age similarly, or materials with transparent or similarly coloured surface finishes^{9,18}.
- Think about how you execute the joining of different parts and materials; there is a lot of potential for creating interesting details. "It is in the has quality"¹⁶.
- Even though "classic designs" have a higher chance of enduring changing trends, it is important to remember that designs considered timeless classics today were often once seen as new and innovative¹⁰. Don't be afraid of being original!

reupholstering or a modular design that can be altered according to user

get emotionally attached to, furniture that ages well and has character^{16,}.

connection between two different materials you can detect if the product

Component 1: Seats

On chairs in public environments, seats are the parts most exposed to damaging wear and tear. This stem both from people sitting on the seats: crossing their legs, adjusting and moving around, but also from people spilling food and putting up muddy shoes on them. Rough fabrics such as jeans and in outerwear can also wear severely on the upholstery.

There are higher requirements on upholstery in public environments than there are for private consumer furniture. For example, the textiles are often prepared with flame retardants and chemicals acting as dirt- and water-repellents, which can be both health hazards and make reuse or recycling difficult. Because of this, textile material research is highly relevant as it could help enable more circularity for furniture in the public sector.

Wear and loosening textiles at the front of the seats







CONSTRUCTIONAL **RECOMMENDATIONS:**

- There should be no sharp edges under or near textiles which can pierce holes in the textiles⁹.
- Do not have a gap between the seat and the backrest where dirt can collect¹⁶.
- If possible, construct the seat so that the textile can be taken off and washed or changed³, for example by using zippers or Velcro.
- Avoid gluing fabrics directly onto the padding. This is often done to get a tight fit when the foam padding has a concave shape, but convex and flat surfaces are possible to cover without the use of glue¹⁰.
- Few textiles used in public environments today are recyclable due to high chemical contents¹⁰. If impossible to find recyclabe textiles, try to select textiles and padding materials from renewable sources.

MATERIAL RECOMMENDATIONS:

- Since the seat is especially exposed to wear, choose materials which withstand wear well³. Follow the required Martindale values for the application⁹.
- Wool is naturally dirt-repellent and keeps its freshness longer than other fabrics^{3,10}.
- Do not use fasteners which damage the frame or other parts with repeated changing of textiles¹⁸. E.g. do not use nails that make big holes in the material.
- Thick, double woven textiles are possible to turn upside down when worn and thus "reuse"¹⁸.
- If possible, choose renewable materials for the upholstery, e.g. sea weed for braided seats, or straw for the padding¹².
- Use a padding material which lasts for a long time, or is easily replaced. Some types of plastic foam can grow hard with time and pulverise which can make reupholstering difficult and be dangerous to breathe in³.
- Choose a material that does not change in colour or texture with wear as wear on seats appear especially glaring³.
- At the moment it is not possible to recycle many textiles, e.g. wool. Seek to instead minimise the textiles that are used¹⁰.
- Try to use materials suited for the application which do not need coatings and chemicals to endure the environment and stress. E.g. Hemp could be a possible material for padding since it carbonises rather than catches fire. Wool is more flame resistant than cotton, and is usually not treated with flame retardant for use in the public sector¹⁵.
- The shape of the textile is a contributing factor when it comes to flame resistance e.g. thick closely woven fabrics endures better than "fluffy" fabrics¹⁵.
- Seats with textiles should ideally have an Eco-label, Öko-Tex (Oeko-Tex) Standard 100 or Svanen label to show that the material meet their demands^{13,14}.
- Do not use chrome tanned leather¹⁴.
- Artificial leather and woven plastics are not allowed if they contain PVC-plastics¹⁵.

Component 2: Armrests

Along with the seats, armrests are the parts most exposed to wear and tear on chairs in public environments today³. Hands are frequently touching and gripping them for support wearing away surface layers and finishes and leaving grease stains and smear behind. This everyday use requires materials that both endure wear and tear well and that feels good for the user to touch.



Think of whether the chair is going to be accompanied by a table or if it is going to stand alone. If it is going to be used with a table, armrests are not always necessary but rather inconvenient. If there still should be armrests, they should allow for the chair to be pushed in under a table without any friction as this wears both on the table and the armrests. In the case of a standalone chair where users will sit for longer periods of time, the armrests should be long enough to support more than just the elbows^{6,23}.

MATERIAL RECOMMENDATIONS:

- Choose materials that either are durable or age and wear well, e.g. solid wood and leather³.
- Avoid soft materials, e.g. softer plastics, on armrests that are exposed to frequent use as it easily scratches⁹. Less durable materials should be easy to remove and replace when worn out.
- Choose materials and surface finishes that withstand moisture and oil as hands often can be both greasy and sweaty, e.g. leather or wood¹⁹.
- Choose materials that can be cleaned from dirt due to the extensive use²⁰.
- Choose materials that feel nice to touch; wood and leather for example often feel nicer and warmer to touch than metals¹⁶.
- Areas that are in direct contact with skin should not include allergenic substances such as chrome or nickel¹⁵.
- If the armrest includes textiles it should ideally have an Eco-label, Öko-Tex (Oeko-Tex) Standard 100 or Svanen label to show that the material meet their demands¹³.
- If leather is used one should not use chrome, especially Cr6+, tanned leather¹⁴. Other metals which are not allowed by Möbelfakta are lead, arsenic and cadmium.

Typical damages appearing on armrests; wear, grease stains and scrathes.







CONSTRUCTIONAL RECOMMENDATIONS:

- Avoid sharp edges since they chip more easily. Rounded edges withstand wear better over time⁹.
- Allow for easy attachment and removal of the armrest to facilitate repair or replacement²².

Component 3: Backrest/frame

Though often also upholstered, backrests are not subjected to as much wear and tear as the seats are. Mostly because they are not leaned on with the same kind of forces, but also because they are not to the same extent subjected to staining. They are nevertheless important for how the users perceive the furniture overall, and have a big influence on the comfort. Here are some recommendations for how to design backrests.



CONSTRUCTIONAL RECOMMENDATIONS:

- The angle of the backrest should not be too steep or lean forward as this makes the chair uncomfortable to sit in⁶.
- Avoid sharp edges since they chip more easily. Rounded edges withstand wear better over time⁹.
- Make a sturdy frame and make it easy to mend if the joints loosen¹⁸.

MATERIAL RECOMMENDATIONS:

- In severe environments, it is better to make the frame out of more durable materials, like metals, while contact surfaces, for example armrests, are made of materials with better sensory qualities, as for example wood, textiles or leather²².
- Make repainting the last solution since painted areas can wear poorly and are difficult to remove¹². If repainting can help save furniture from being thrown away, it is however recommended³.
- If the backrest has a neck rest it should withstand oily hair and hair products, and be able to clean or wash¹⁷.
- If leather is used one should not use chrome, especially Cr6+, tanned leather¹⁴.
- Pigments and dyes should not contain hazardous substances, such as lead, tin, cadmium, chrome, mercury, phthalates (in plastics) etc^{13,14}.

Component 4:

Legs

In public environments, legs are often subjected to extensive wear. Shoes kicking and rubbing off against them leaving stains and rubber marks, scuffs and scratches from people moving them around, bumping them into other things, and worn down feet after being pushed back and forth.

MATERIAL **RECOMMENDATIONS:**

- Durable materials, such as metals, withstand severe environments better than softer ones and can look undamaged even after long periods of use³.
- Try to avoid paint or coatings which can chip off or get dented^{6,9}.
- Chrome (Cr3+) as a surface treatment is very durable and is allowed for stackable chairs or other applications that need to endure high levels of wear and tear³. Its use is however restricted, and Cr6+ is not allowed^{13,14}.
- When metal legs with high shine coatings is worn unevenly, and becomes matte, it is perceived as $ugly^{3,6}$.
- To keep the recyclability, use materials that do not need additional coatings such as paint, e.g. anodised aluminium¹⁶.



CONSTRUCTIONAL **RECOMMENDATIONS:**

- Avoid creating crossbars that collect dirt and dust, design them so that they either are self-cleaning or easy for others to clean¹⁶.
- Avoid sharp edges since they chip more easily. Rounded edges withstand wear better over time⁹.
- When designing legs out of wood, think about the grain direction and the shape of the leg. Karl Johan chairs for example have tapering, curved legs that often are made out of Mahogany, a short grained material. This makes it difficult for the legs to hold under large loads, and once broken they are very difficult to mend¹².

Read more:

As this guide's focus is on aging and wear in a circular economy, it is not comprehensive enough to do more than give a short overview of all the different aspects there are to consider when designing sustainable, long-lasting furniture. Nevertheless, the hope is that it can help provide some insights and inspiration for designers or other people reading. To learn more about how to design for circularity, have a look at the list of links and sources below that offers more detailed and comprehensive information!

- Hållbarhetsguiden: http://www.svid.se/Hallbarhetsguiden/
- Circular design guide: <u>https://www.circulardesignguide.com/</u>
- Material selection: https://www.circulardesignguide.com/post/materials
- Circular opportunities: https://www.circulardesignguide.com/post/circular-interventions
- Design for Disassembly: <u>http://teclim.ufba.br/jsf/ecodesign/dsgn0204.PDF</u>
- Design for Durability: https://sustainabilityworkshop.autodesk.com/sites/default/files/core-page-files/autodesk-sustworkshp_designfordurability.pdf
- Ellen MacArthur Foundation: https://www.ellenmacarthurfoundation.org/
- EU Eco-label: <u>http://ec.europa.eu/environment/ecolabel/</u>
- Möbelfakta: <u>http://www.mobelfakta.se/</u>
- Svanen: <u>http://www.svanen.se/</u>
- Sustainability requirements by Upphandlingsmyndigheten: http://www.upphandlingsmyndigheten.se/hallbarhet/stall-hallbarhetskrav/kontor-och-textil/mobler/mobler/







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