

Design for Disassembly and Recycling

Companion to the video: Script and Illustrations

When it comes to sustainability, how your product ends its life is often as important as how it lives.

Will your product spend thousands of years trapped in a landfill, along with the valuable raw materials it contains? Or will it get reincarnated into a new product right away, requiring less material to be dug up somewhere else?

Well, that all depends on how you design it.

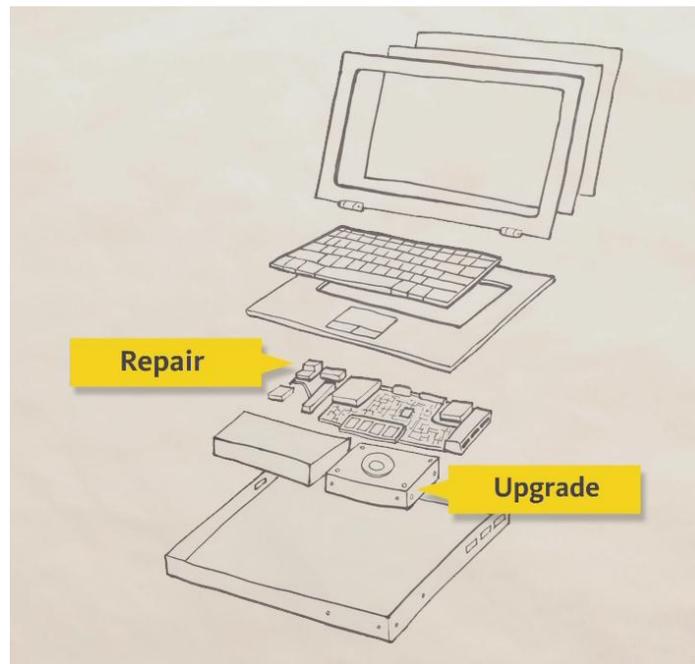
Some products are easy to design for end of life. You can choose to not mix a bunch of materials together like you see in a typical juice box. Instead use an aluminum can, a single simple material that's recyclable everywhere.

But what about something like a laptop? That's more complicated. How it ends its life depends largely on how easy it is to disassemble.

If your laptop is difficult or intimidating to take apart, chances are, its next stop is the dump.

If accessing its components and materials is easy, all kinds of possibilities open up.

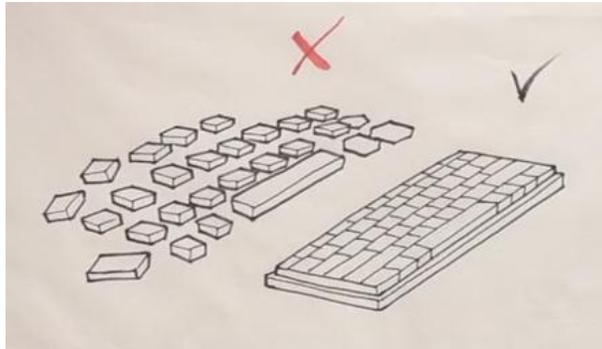
Maybe its user will take it in for repair or upgrade instead of throwing it away. Or maybe an e-waste recycler will extract the valuable metals and plastics, without letting any toxins escape.



Whatever the case, it's a race against the clock. Users want convenience. Recyclers have a very limited time to separate materials and remove hazardous components.

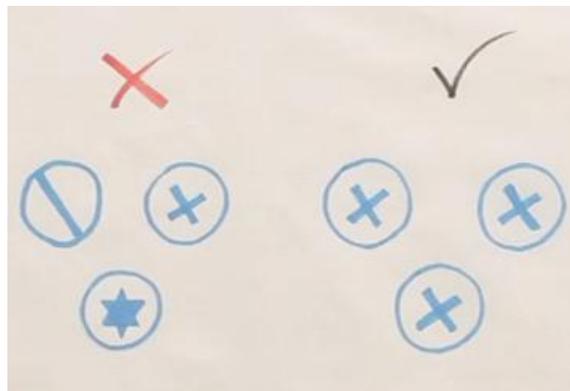
Let's start by looking at some simple strategies to design for disassembly. Many of them will even make manufacturing cheaper.

First, the fewer parts you use, the less there is to take apart. For example, you could integrate all the separate keys of the keyboard into one flexible piece.

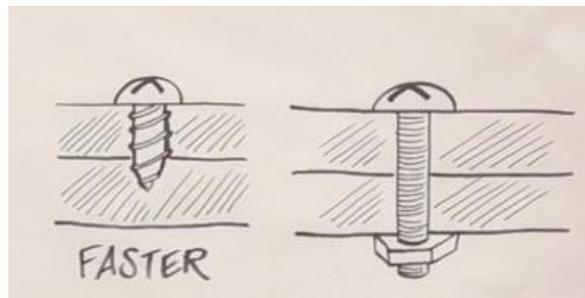


Beyond this, it's an obsession with fastening. And as with parts, the fewer fasteners you use, the better.

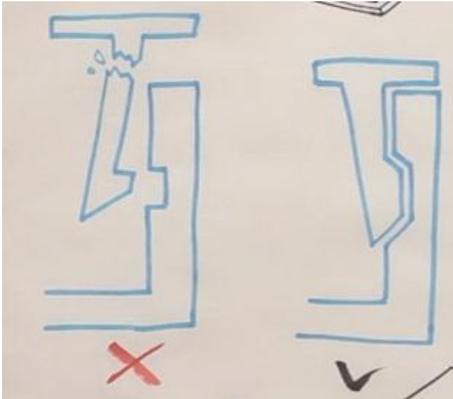
Use common and similar fasteners that require only a few standard tools for disassembly. This helps save time.



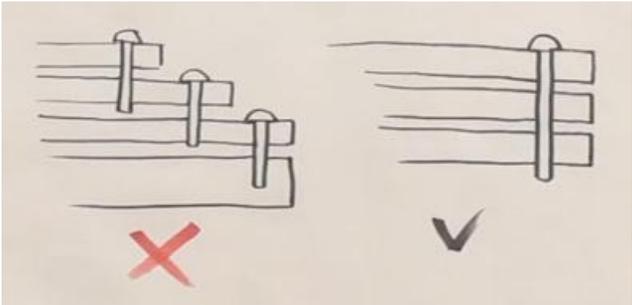
Screws are faster than nuts and bolts. Use nuts and bolts only where screws might strip threads because of repeated use or high stresses.



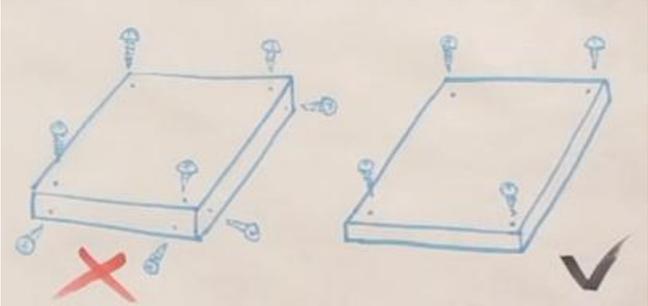
Even better, use snap-together hooks or tab-and-slot fasteners that don't require ANY tools. But make them intuitive – and ensure that they can be done and undone many times without breaking.



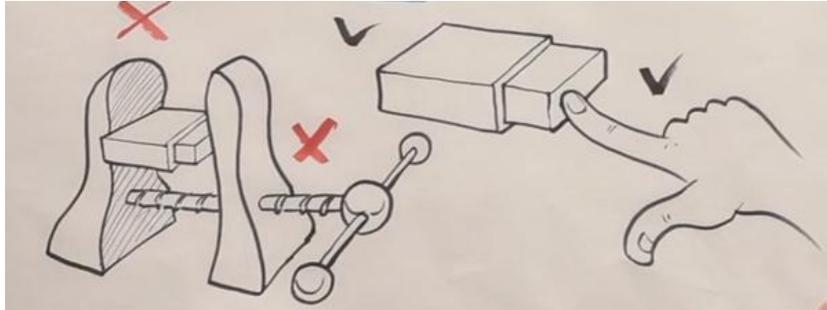
You can minimize fasteners by using a single set to hold down several layers of parts.



Also, make fasteners sure easy to see and accessible on a single axis so the part doesn't have to be flipped over.



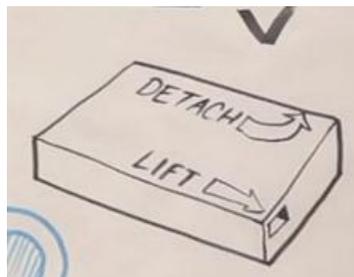
Don't use tight press-fits. Friction fits that can be reversed by hand are better.



Avoid glues. If you absolutely need them, use adhesives that are heat reversible or dissolve in common non-toxic solutions like water.



Finally, build disassembly instructions into the product. If the parts themselves have pictures or text showing how to take them apart, anyone can do it.



The more of these strategies you use, the faster and easier your products will be to take-apart.

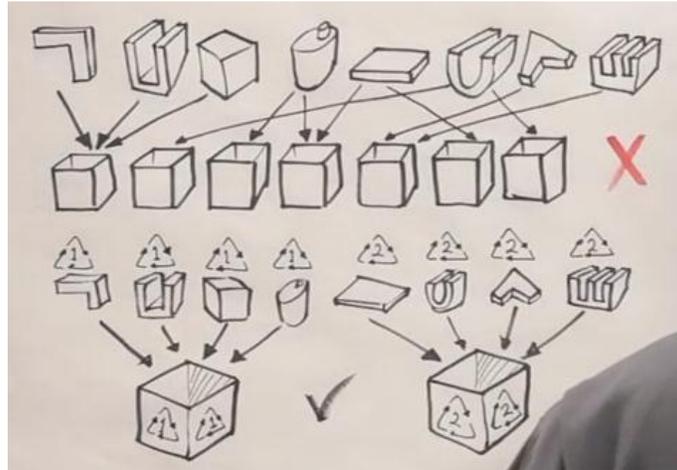
If it's easy enough, your product can win the race against the clock.

While this can lead to a longer useful life by making repair and upgrade easier, no matter how clever we are, our products will reach the end of their lives eventually... and that's where a new responsibility begins.

We need to make sure that anything that can't be safely and quickly broken down by our natural ecology is easy to return to the industrial ecology. There it can be reused or recycled into other valuable products.

Whether this happens depends largely on how you design both the product and the takeback systems. Here are some strategies to help.

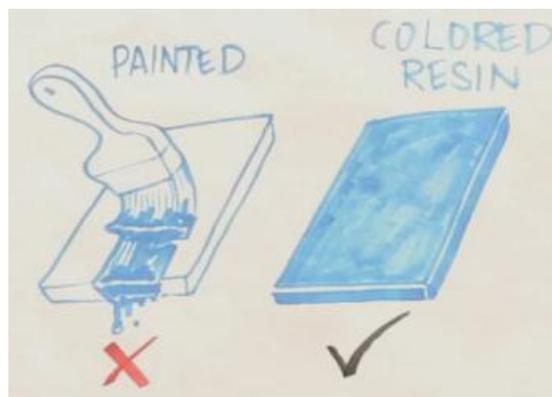
First, minimize the number of different kinds of materials and components, for faster and easier sorting. Often, recyclers shred products and then the particles are sorted by machine. The fewer different kinds of materials, the easier they are to sort.



And it's also important to easily identify and quickly remove hazardous or valuable components that shouldn't be shredded. Like batteries, screens, and circuit boards.

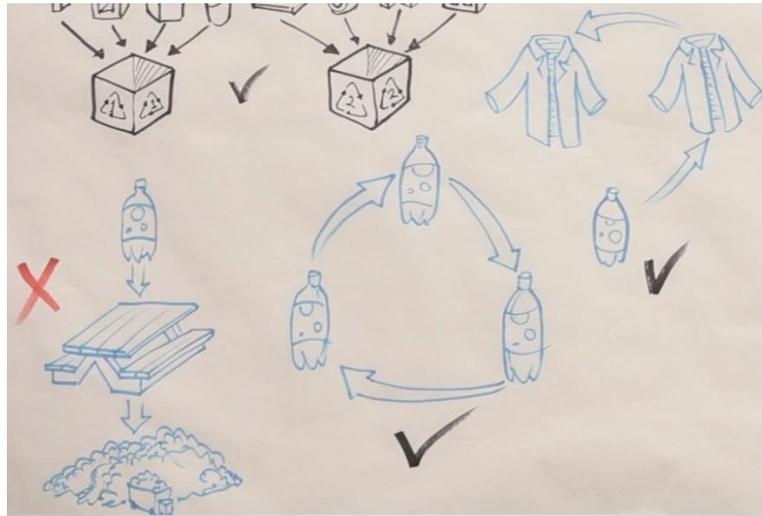
The materials you do use should be commonly recycled and clearly labeled, in case they're dealt with by hand.

For plastics, avoid paints, other coatings, and adhesives, because they can contaminate the material. Inherent color can be OK, particularly common colors like black.



Now, not all recycling is created equal. Some materials can only be downcycled and converted to lower-value items. Plastic comes in so many types, with so many additives and colorants, they often just get bundled together and downcycled.

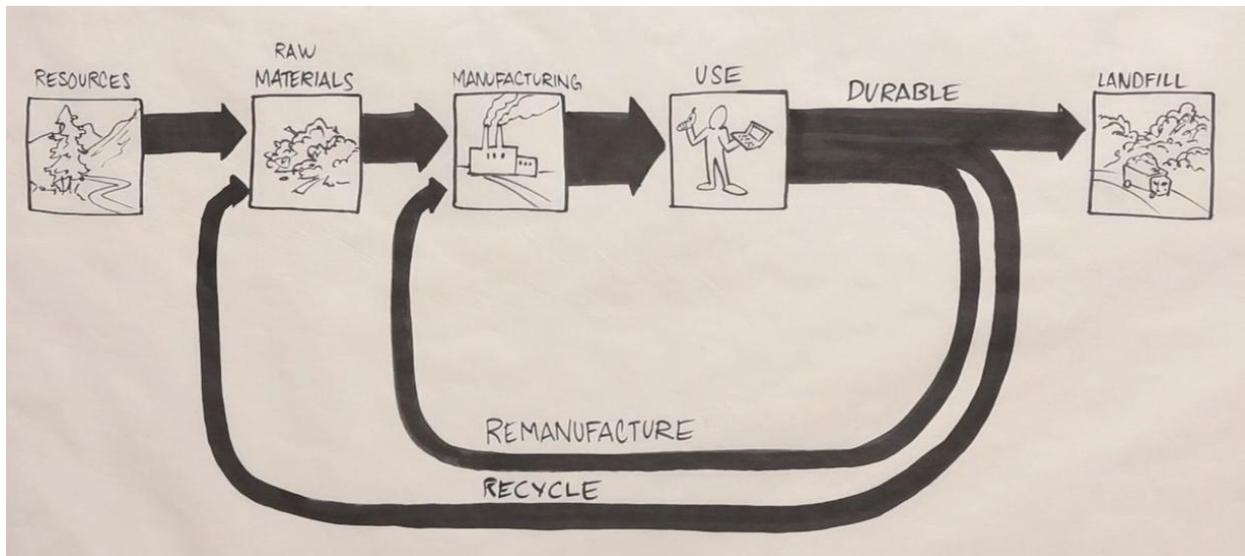
The best recycling allows materials to come back in their new life with the same value they had in their last life. Maybe even higher value.



Even the best-designed product will only get you so far, though, if there's no recycling program to take it. So design your product with this larger system in mind.

Manufacturers are starting to be held accountable for the waste their products produce, especially when it's toxic. This is called extended producer responsibility, and requires many to offer takeback programs. Using these strategies to make your product recyclable will live up to that responsibility and divert material from the dump.

Sometimes you can even do better than recycling, by reusing whole components rather than just materials. This is known as remanufacturing, and you can design for it with these same strategies.



It not only uses less energy and causes less waste, it can also be more profitable. It's already common in some industries. For example, the auto industry remanufactures engine blocks.

So it's up to you. Do you want your product to languish in a landfill? Or to find new life when its first life ends?

These strategies make it easy to design a great end of life for your product. Many of them can also be used to push that end of life further into the future through repair and upgrade. And that's what we'll look at next, in our quest to build the most sustainable products.