Emotional Durability Through Modularity Written by: Brian Williams

This handout will present a number of design methods and strategies aimed at producing products with a high level of upgradability and emotional durability. This durability will result in a desire to retain and use the product for longer periods, thus producing a more sustainable design solution. These methods are to be used in conjunction with traditional design methods (such as sketching and brainstorming), as well as the Cradle to Cradle philosophy and the Okala life cycle assessment methods.

Emotional Modularity

This is arguably the most important aspect of creating a product with an optimized lifetime. No matter how durable, clever, modular, or easy to use the product may be, if a consumer grows bored with it, they will be very likely to replace it. However, items that hold a high emotional or sentimental value for the user will be harder for them to replace, and will most likely be used longer. Being able to update the user's experience through form, color, usability, or functionality will renew the pleasure offered by the product, greatly extending the product's lifetime.

Most people can learn how to use space, lines, balance, shape, form, color, proportion, texture, and value. However, only a handful of designers have the natural talent to create truly timeless designs with strong emotional connections. Because of this, they must find other ways that they can design products with long lasting emotional attachment. One way to avoid these problems is to make the emotional connection updatable. Opportunities to update a product's emotional connection with the user include:

1. *Modular aesthetic*
2. *Modular interface*
3. *Modular functionality*

Implementation of Modular Aesthetic

Place the product on a sliding scale based on how aesthetically driven the design is (see Fig. 1). Products that are more technocentric will require more easily-changed aesthetic, because these products rely heavily on modern looks and the "wow factor" to stay new and exciting. The designer must ensure that the user can easily update the aesthetic elements. Products that emphasize more aesthetic appeal (such as the Dirt Devil Cone, or jewelry) rely heavily on the aesthetic design to appeal to an initial buyer, and are likely to remain aesthetically pleasing to the user for longer periods with no changes needed. These need to have more time spent on the aesthetic during the initial design phase, with less emphasis on replacing the aesthetic.

Conducting participant questionnaires and interviews, immersion into the user-product interaction, as well as focus groups and co-discovery events can aid the designer in assessing the importance of maintaining a new aesthetic for a particular product type. Ask consumers about a wide variety of products, and not just the project being worked on. This information can be used later on other projects, and can help to clarify discrepancies in individual taste, etc.

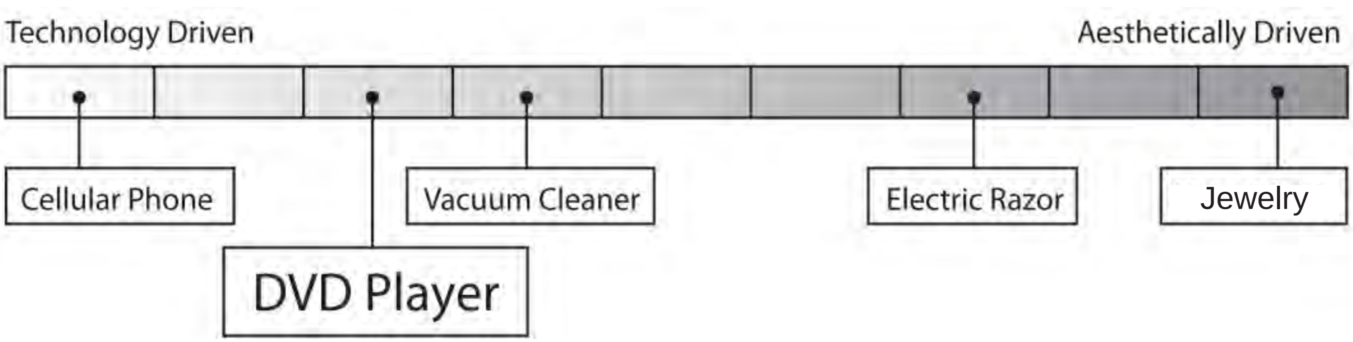


Figure 1

Implementation of Modular Interface

When designing for a modular interface, the designer must consider the user's input and output device, as well as the system that the user is attempting to control. Some user input platforms (such as the touch screen on the iPhone) are extremely versatile. They require no change in hardware to facilitate new functionality, or new "themes."

The high resolution touch screen on the iPhone also serves as a very adaptable output device. User inputs and outputs such as these are more accepting of changes in interface software. A button-oriented interface – if designed carefully – can also continue to offer the needed functionality of a less complex product as the product's interface changes. A simple directional button pad, for example, combined with non-specific buttons (such as buttons that use color to differentiate themselves) can accomplish a variety of tasks – both anticipated and unforeseen.

The more technology-driven or function-driven the product, the more adaptable the interface must be. Software (defined herein as "the coded information on a memory device that allows the user to control a device") can be replaced without discarding physical material, and is exceedingly adaptable.

It is important that the components composing an interface (software, circuitry, memory, input and output devices, etc.) are included in the product in such a way as to aid easy replacement. The more often a replacement will be needed, the more accessible these components need to be.

Implementation of Modular Functionality

It is important when designing for emotional modularity to anticipate new functionality, and design products in a way that can accomodate new functionalities as they arise. This category of upgradability is particularly important in more technologically driven product genres, as buyers typically choose these products based more on their features than on aesthetics or user interfaces, and are therefore more likely to replace them if a product with better functionality becomes available.

Components that are the most likely to need new or improved functionality more often should be given the most accessibility. Anticipating new functionality requires the designer to be in touch with emerging technologies and user expectations in specific product genres. Reading monthly publications about design and/or technology will keep designers aware of the newest trends. It is up to the designers to use their creative vision, and knowledge of trends to anticipate how these technologies will be used to meet emerging user needs.

Design Methods for Modularity

Method 1: Combining Service and Product Design

This method is aimed at dematerialization or transmaterialization of an incumbent product or its components. These two processes reduce the number of components that compose product, without decreasing functionality or usability.

Basic Steps

Step 1: Rethink the benefit.
Step 2: Produce a Venn diagram to re-examine the system as a whole.
Step 3: Use color to identify aspects of the product that can be substituted with service design.
Step 4: Offer the benefit using the fewest components possible

Considerations

It is important that this method be considered in the first stages of the design process, as it will determine what components will physically make up the product, and what components can be offered through a service.

Explanation

Step 1: Rethink the benefit. Before you can solve a problem, you first must understand the problem you are trying to solve. Attempt to break the problem down into its most basic form. The wrong question is, "How can we design a better DVD player?" Instead, ask, "What benefit does a DVD player offer the user who buys it, and how can this benefit be delivered in the best way?" The outcome from the first question will provide another cell phone, but asking the second question could lead to the creation of a new category of product.

Step 2: Produce a Venn diagram to re-examine the system as a whole. Creating Venn diagrams makes it possible to examine systems and subsystems and their interactions at a glance. The designer can take this examination as far as is needed for the specific project at hand. Examining the systems involved in designing a mobile communication device, for example, will require a more in-depth examination than a flashlight (see Figures 2 and 3).

Step 3: Use color to quickly identify aspects of the product that can be replaced with service design (see Fig 2). Memory in a software oriented electronic device, for example, could be replaced with cloud storage. This means that the internal memory chip(s) and associated parts that would normally be required are not necessary to facilitate that function. Instead, a remote server can be used to store information for clients, and can then be used to provide a different benefit or new funtionality at a later date. This is an example of transmaterialization of a hardware component to a reprogrammable server offered through a service..

Step 4: Offer the benefit using as little of the product as possible. Identify opportunities for transmaterialization and de-materialization. The object of this step is to eliminate as many of the components of a product that are not necessary to deliver the functionality that is expected by the

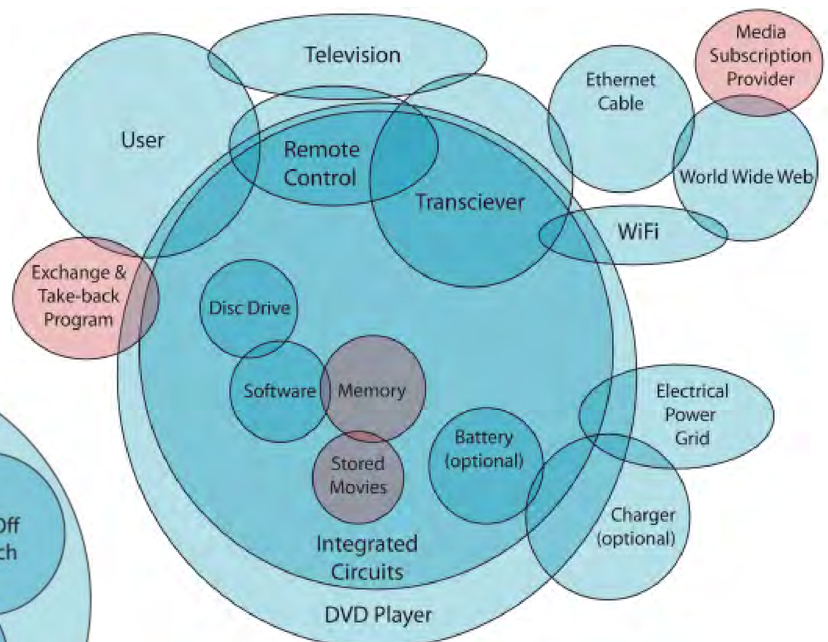


Figure 3: DVD Player Diagram

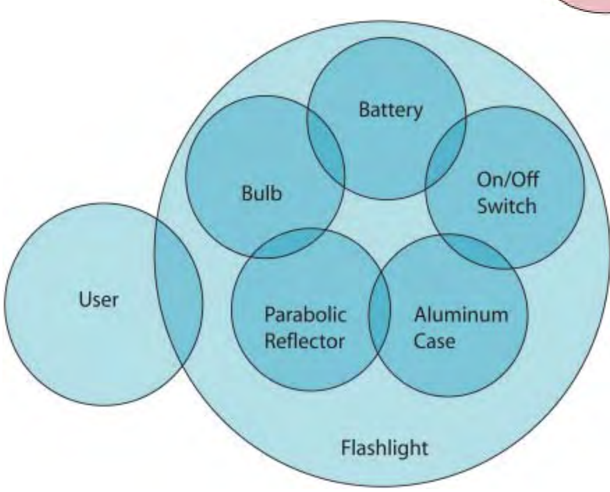


Figure 2: Flashlight Diagram

Method 2: Component Life Chart

The goal of the Component Life Chart is to group all of the components of a given design into just a few manageable groups (three or four at the most) that can be replaced with the same module, or during the same maintenance event, and to identify opportunities to innovate in the earliest stages of the design process. This method should be used to identify components that do not meet the correct criteria for durability or longevity.

Basic Steps

Step 1: Make a list of all of the components that will make up the product.
Step 2: Identify the expected lifespan of each component based on fatigue, changes in technology, and changes in fashion.
Step 3: Produce a chart with four columns to quickly identify life-limiting factors.
Step 4: Group the components based on dependencies and lifespans.

Considerations

Pay special attention to parts that tend to fatigue long before or long after other related components, as these will lead to premature replacement or disposal of fully functioning mechanisms.

Explanation

Step 1: Make a list of all of the components that make up the overall design. This list should include main components, such as circuit boards, structural components, etc.

Step 2: Identify the expected lifespan of each component based on fatigue, changes in technology, and changes in fashion. Research will be required to determine the lifespan of each component based on these factors. Color can be a great way of differentiating between groups of color.

Step 3: Produce a chart with four columns (see Fig. 4). The first column contains the names of the components to be evaluated. The second column is the estimated fashion life. This number is the time it takes for the aesthetic value of the component to diminish to the point where the user decides to replace it. The third column is the estimated technological lifespan of the component. This number is dictated by anticipated technological advances and emergent technologies. The lowest number in each row determines the expected lifespan of the component in that row (illustrated in Fig. 4 in green). The fourth column contains the estimated lifespan of the component based on fatigue caused by normal use of the component.

The final column contains notes on possible opportunities to innovate. Opportunities may include the use of more or less durable materials to increase or decrease component durability to better match the lifespan limitations, eliminating components altogether by transmaterialization or dematerialization, or creative implementation of subcomponents.

If one subcomponent is causing the limitation, attempt to place it into another main component with a matching lifespan, or make the subcomponent independently modular from the main component.

Step 4: Group the components based on dependencies and lifespans. Notice how some components have very long fatigue life and a very short technology life. These components of the design can be engineered with less durability, with more consideration given to optimizing the end of life phase of the component life cycle. Designers should address the issue of the eventual disposal or recovery of each component of a design, and suggest ways that the manufacturer can implement strategies to recover them. Conversely, some components will have very long technology lives and short fatigue lives. These components should be made more durable, with more emphasis on low-impact use and optimized lifetime

Figure 4: Component Life Chart

Component	Fashion Life	Tech Life	Fatigue Life	Notes
1 Chassis	N/A	50+ yrs	50+ yrs	Main structural component. Must not contain aesthetic elements. The one component that is likely not to be replaced.
2 AV Link	N/A	7 yrs	20 yrs	Limited by changes in format. Opportunity to use biodegradable or highly recyclable material.
3 Buttons PCB	N/A	15 yrs	7 yrs	Limited by fatigue. Technologically linked to changes in format. Design user interface to be adaptable to future changes in technology. Suggest use of "nondiscript" interface.
4 Processing PCB	N/A	15 yrs	50+ yrs	Limited by changes in format. Opportunity build in updateable subcomponent to increase tech life.
5 Disc Drive	N/A	15 yrs	25yrs	Limited by changes in video storage format. Must provide ability to replace with new format technologies such as hard drives or new disc formats. Opportunity to use biodegradable or highly recyclable materials.
6 Network Link	N/A	25 yrs	15 yrs	Opportunity to make component more durable. Attempt to increase fatigue life to 25 yrs.
7 Power Supply	N/A	50+ yrs	15 yrs	Use more durable or modular component. Consider using external power supply that can be easily changed to cope with future power needs.
8 Fascia	3 yrs	50+ yrs	50+ yrs	Limited by changes in fasion trends. Opportunity to build-in emotional modularity through modualr aesthetic. Must not have structural function. Bio-materials.
9 Battery	N/A	15 yrs	3 yrs	Limited by fatigue. Recommend standardized & proven battery size and type that can be easily changed and recycled
10 Remote Control	3 yrs	15 yrs	7 yrs	Limited by fashion. Main user/product interactive element. Technologically linked to changes in format. Recommend simple, timeless aesthetic. Use "nondiscript" interface.

Method 3: Component Relationship Wheel

This method will illustrate the relationship of different components based on their life expectancy and dependencies of each component. The goal of this method is to assemble different components together into main modules so that they can be easily replaced during the same maintenance event. This method is appropriate when it is required to identify the physically-, and functionally-dependent relationships between components.

Basic Steps

Step 1: Arrange the list of components of the product in a circle.
Step 2: Draw a black line between components that share a physical connection.
Step 3: Draw lines of a different color between components that are related by anticipated lifespan.
Step 4: Attempt to match the colored lines with the black lines as often as possible.
Considerations: Explore as many variations as possible.

Explanation

Step 1: See Fig. 5

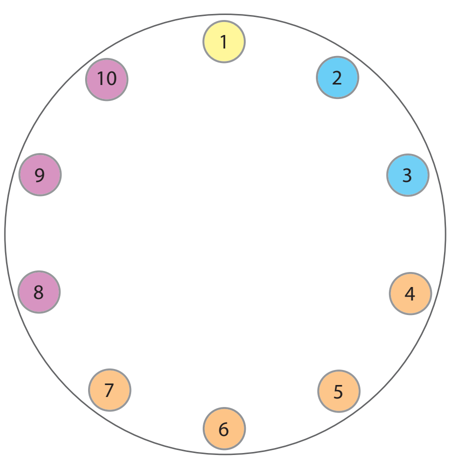


Figure 5

Step 2: See Fig. 6

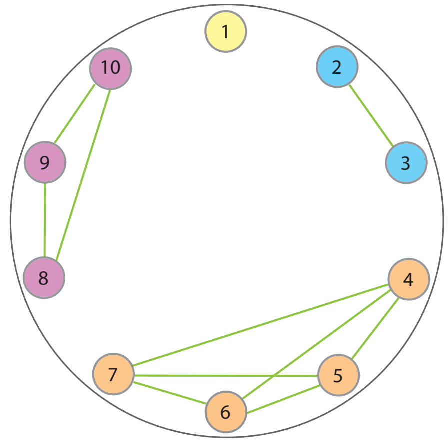


Figure 6

Step 3: See Fig. 7. Refer to information attained from the component life chart to assist with this step.

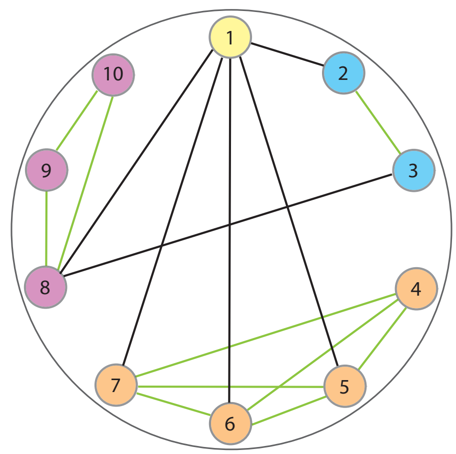
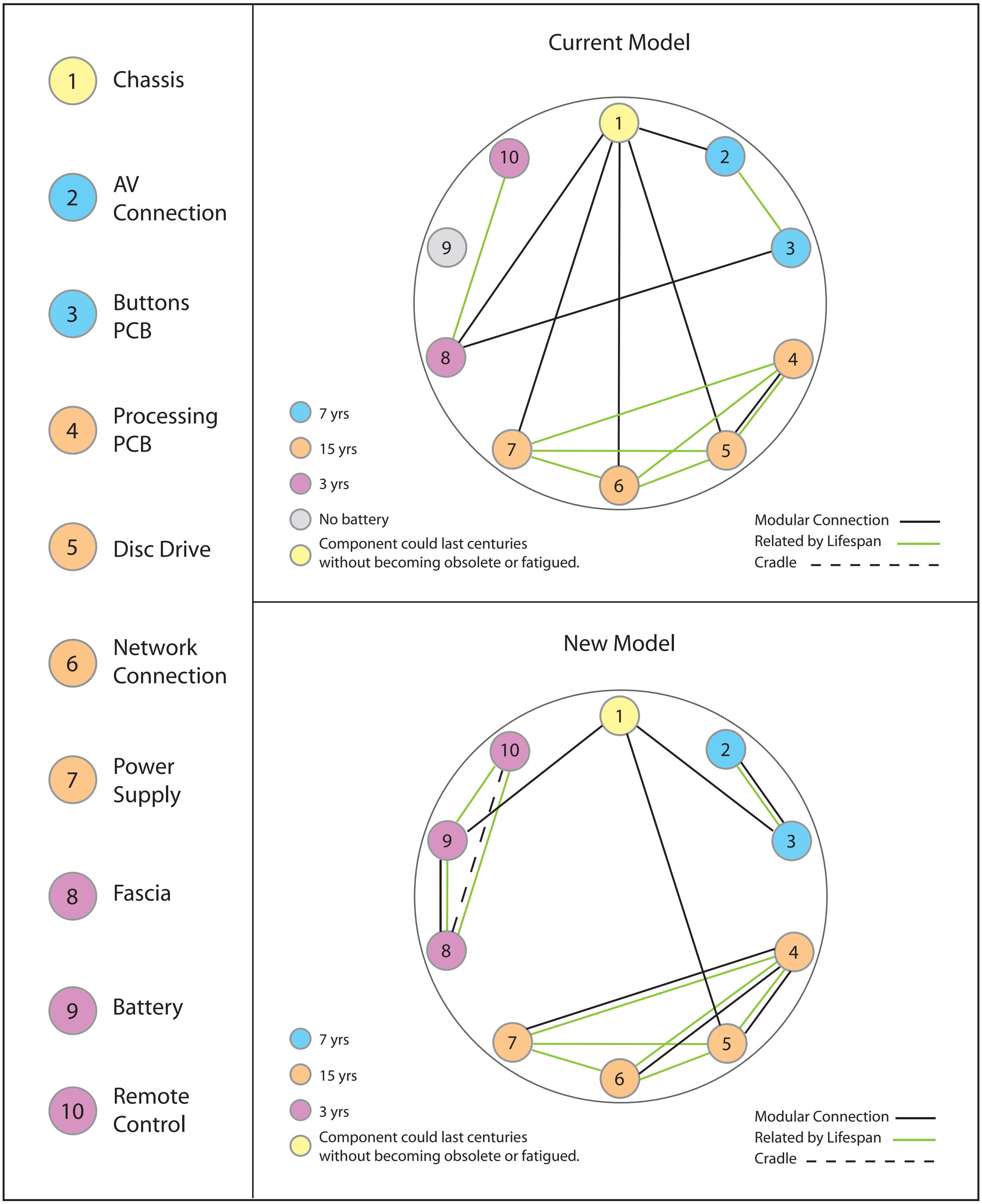


Figure 7

Step 4: Attempt to match the colored lines with the black lines whenever possible. The lines between the components indicate which components will make up each module. Several combinations of components are possible, so several wheels will be generated to show different possible outcomes. The best outcome will be the one explored in the sketch phase.

Figure 8: Component Relationship Wheel



Method 4: Hypothetical Timeline

A hypothetical timeline will help the designer to explore possible replacement schedules for product modules, as well as illustrate to the client the value of modular product development.

Using information gained from the component life chart and component relationship wheel, the designer can begin to contemplate how (and how often) the modules will be replaced, how they will connect to one another, and how to responsibly handle the components at their end of life phase. It will aid in decisions regarding materials of the components (implementing take-back programs and using bio-plastics, for example.)

Basic Steps

Step 1: Illustrate a simple exploded or ghosted view of the product as it will be purchased.
Step 2: Illustrate a simple exploded view of the product after the first, second, third, etc., module replacement event.
Step 3: Examine the frequency of replacement of each module over a given period of time.

Considerations

This is a good opportunity to explore how the user will access the different modules for replacement. Colors corresponding with the earlier methods will add continuity and allow easier communication of information.

Explanation

Step 1: Illustrate a simple exploded view of the product as it will be purchased. This view shows the product in its original configuration (see Fig. 9). It may be useful to use the same color code as the previous methods for easier identification of component modules.

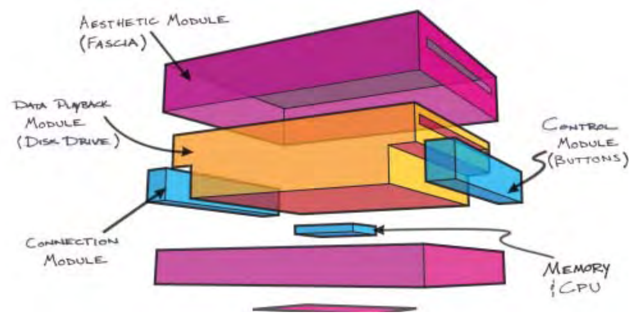


Figure 9

Step 2: Illustrate a simple exploded view of the product after the first, second, and third module replacement event. Information from the component life chart can help to identify which modules will be replaced during each maintenance event.

Step 3: Examine the frequency of replacement of each module over a given period of time. Modules that are replaced more frequently will need to be designed with easy replacement in mind. Consider the advantages and disadvantages of different types of fasteners to determine how to connect the different modules.

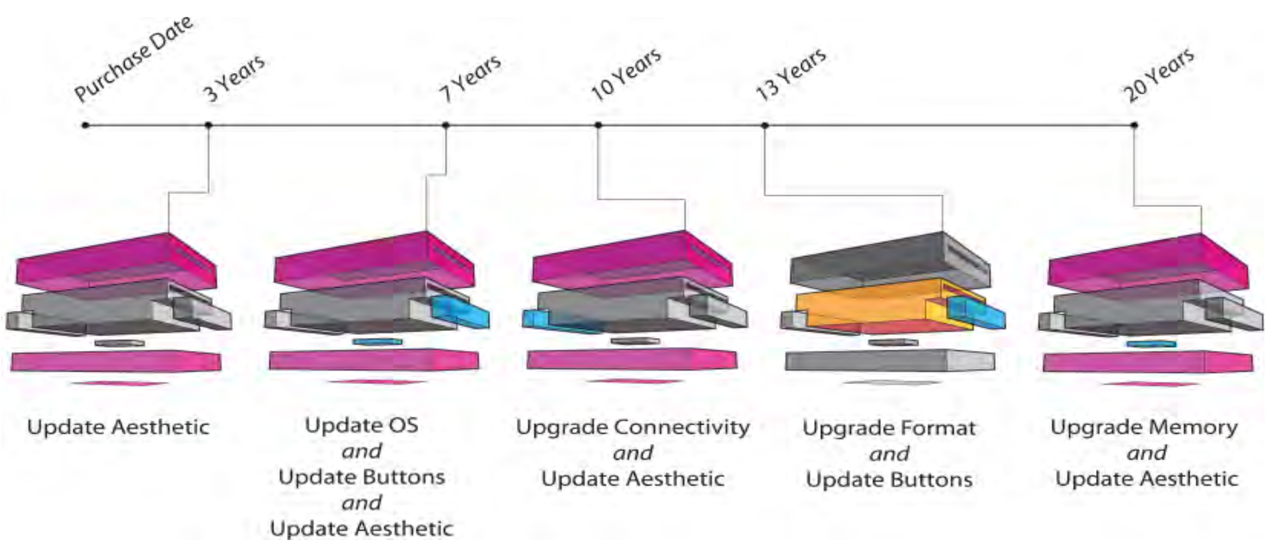


Figure 10: Hypothetical Timeline