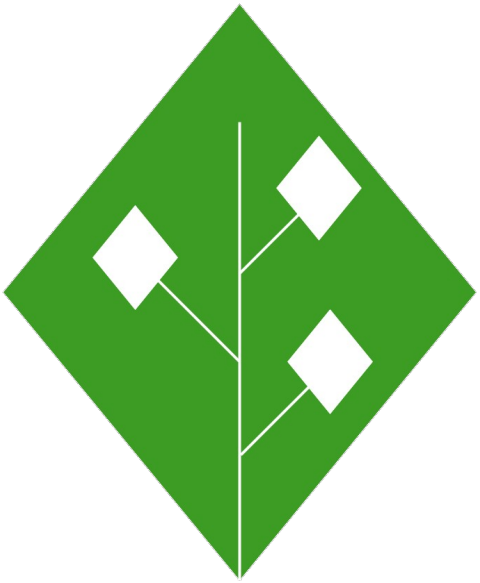
Project Recoding

INF5011



Group 1

Lena Drevsjø

Magda Fotiadou

Johan S. Steinberg

University of Oslo

Content

1 About

The initial goal behind this project was to create a more environmentally friendly and sustainable laptop. Our base idea was to create a modular laptop. If consumers change the part of the laptop that is out of date, instead of buying a new laptop, that in itself improves sustainability. In this way, a modular laptop enables consumers to choose a more environmentally friendly approach. Special modules could also focus on sustainability like a solar panel module or an e-ink screen. We later broadened our approach to also include a symbolic change. We decided to base our design on the Apple laptops, to focus on and improve their 'negative symbols' — e.g., factory working conditions, and the locked nature of these laptops and their OS. To us, that means fair trade, an open source approach, and including users in the design process.

2 Background

2.1 Recoding

The overall goal of our project from a theoretical perspective is to use the concept of *recoding*, to 'recode' the Apple laptop so it 'positively' affects consumers and users. Recoding is to transform the sign value of things — things get a different meaning or lose their current meaning completely (Fry 2009 as cited in van der Velden 2014). We hope to do this by looking at improvements in the sustainable, environmental and human-rights related angels of the industry, and make consumers aware of how they can make a change and have a say in the industry.

2.2 Technical Code

Apple has been a press favorite on what they often call innovative design. We will borrow concepts from critical theory of technologies (Feng and Feenberg 2008) to think about how their design is constrained by technical heritage and constrained by standards from social demands. 'Technical heritage' is how "every design community inherits from its predecessors certain practices, assumptions, and ways of viewing the world" (ibid., p. 115). Feng and Feenberg gives the term *technical code* to how a device is formed by social standards that have emerged over long periods in societies — "standard ways of understanding individual devices and classes of devices" (ibid.). **How can we bring new values into the design process to make changes towards the desired technical code?**

3 Environmentally Friendly and Sustainability

3.1 Recyclable

For our modular laptop to be environmentally friendly and sustainable, we want it to be recyclable. That means the materials used in the laptop need to be recyclable, that — where it is possible — the parts are made with recycled materials, and that it contains as little toxic waste as possible. As the laptop is modular it will be easier to recycle the different parts.

3.2 Longevity

The longevity of the modular laptop is important. If we can get people to not buy new laptops if some parts of the laptop are broken, but change them instead, that will be better for the environment. That is where the concept of modularity comes in.

3.2.1 The Concept of Modularity

Wikipedia (2014) frames modularity as “the degree to which a system's components may be separated and recombined”. We chose a modular laptop for our project, and the modularity is, as mentioned, a part of our plan to make the laptop more sustainable and environmentally friendly. For example: when a part of the laptop is broken, you can replace it with a new one without having to send the laptop on expensive repair services or buying a new laptop. This way the need to buy a new laptop when some parts are broken or slow will, hopefully, decrease. And with recyclable parts it will be even more sustainable.

3.3 Low Energy

3.3.1 Electronic Ink Screen

The e-ink screen is a type of electronic paper that uses low energy. It is made up of millions of microcapsules which contains positively charged white particles and negatively charged black particles suspended in a clear fluid. When a positive or negative electric field is applied, corresponding particles move to the top of the microcapsule. There it will be visible to the user, and you can see the screen perfectly, even in the sun, and there are no backlights that consumes a lot of energy. The manufacturers use the word ‘bistable’ to explain that even if all the power sources are removed, the image on the e-ink screen will still be there. That means the display only consumes power when something is changing (EInk, 2012). An e-ink screen can be envisioned as a module that can be plugged on the compartment of the display, as shown in the prototype. In case the users need to save power, they may close the laptop and use the e-ink screen instead. This final form resembles a tablet.

3.3.2 Solar Panel

Solar panels uses renewable and clean power, which will help us make the laptop more sustainable and environmentally friendly. The energy from the sun converts with help from the solar panel into electric energy that can be stored in the laptops battery (Wikipedia, 2014). But a solar panel can only produce a limited amount of power, and most installations contain multiple modules (Wikipedia, 2014). That means we can only extend the battery life, not fully charge it.

4 Fair Trade

According to Wikipedia (2014) fair trade is an organized social movement with the goal to help producers in developing countries achieve better trading conditions and promote sustainability. To better the working conditions and the terms of trade is important, so that farmers and workers in developing countries can invest in production, communities and a sustainable future (Fairtrade Norge, 2014). Fairtrade International have a set of standards that aims for this. The key objects of the standards are to:

- “ensure that producers receive prices that cover their average costs of sustainable production;
- provide an additional Fairtrade Premium which can be invested in projects that enhance social, economic and environmental development;
- enable pre-financing for producers who require it;
- facilitate long-term trading partnerships and enable greater producer control over the trading process;
- set clear core and development criteria to ensure that the conditions of production and trade of all Fairtrade certified products are socially, economically fair and environmentally responsible” (Fairtrade international, 2011).

5 User Inclusion

5.1 User Centered Design

User-centered design (UCD) is a broad term to describe design processes in which end-users influence how a design is shaped. It is both a broad philosophy and variety of methods. There is a spectrum of ways in which users are involved in UCD. For example, some types of UCD consult users about their needs and involve them at specific times during the design process; typically during requirements gathering and usability testing. At the opposite end of the spectrum there are UCD methods in which users have a deep impact on the design by being involved as

partners with designers throughout the design process (Abras, Maloney-Krichmar and Preece, 2004). Donald Norman built further on the concept of UCD on his book The Psychology Of Everyday Things. He offers four basic suggestions when it comes to how design should be (Norman, 1988):

1. Make it easy to determine what actions are possible at any moment.
2. Make things visible, including the conceptual model of the system, the alternative actions, and the results of actions.
3. Make it easy to evaluate the current state of the system.
4. Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.

These recommendations place the user at the center of the design. The role of the designer is to facilitate the task for the user and to make sure that the user is able to make use of the product as intended and with minimum effort. Table 1 suggests ways to involve users in the design and development of a product/artifact (Preece, Rogers and Sharp, 2002):

Technique	Purpose	Stage of the Design Circle
Background Interviews and questionnaires	Collecting data related to the needs and expectations of users; evaluation of design alternatives, prototypes and the final artifact	beginning stages
Sequence of work interviews and questionnaires	Collecting data related to the sequence of work to be performed with the artifact	early stages
Focus groups	Include a wide range of stakeholders to discuss issues and requirements	early stages
On-site observation	Collecting information concerning the environment in which the artifact will be used	early stages
Role Playing, walkthroughs, simulations	Evaluation of alternative designs and gaining additional information about user needs and expectations; prototype	early and mid-point stages

	evaluation	
Usability testing	Collecting quantitative data related to measurable usability criteria	final stages
Interviews and questionnaires	Collecting qualitative data related to user satisfaction with the artifact	final stages

Table 1. Approaches on user involvement

Another approach to involving users is Participatory Design. The intention is that the users become an equal partner in the design team, and they design the product in cooperation with the designers(Preece, Rogers and Sharp, 2002). In recent years this approach has gained momentum for designing novel systems (Abras, Maloney-Krichmar, and Preece, 2004) and according to (Irani et al., 2002) has been successful because it takes advantage of cultural logics and practices. Table 2 summarizes the advantages and disadvantages of user centered design (Preece, Rogers and Sharp, 2002):

Advantage	Disadvantage
The products are more efficient, effective and safe.	The production is more costly.
Users' expectations and levels of satisfaction with the product can be managed.	Time consuming procedure.
The **users develop a sense of ownership over the product.**	The involvement of various team members (ethnographers, usability experts) and stakeholders may be required.
Products require less redesign and integrate into the environment faster.	May be difficult to translate some types of data into design.
The collaborative process may generate more creative design solutions to problems.	The product might be too specific, and hence not transferable, which in turn makes it costly.

Table 2. Advantages and disadvantages of user centered design

5.2 Crowdfunding

Crowdfunding is a method of collecting many small contributions by means of an online funding platform, to finance or capitalize an enterprise (Freedman and Nutting, 2014). The crowdfunding model is fueled by three types of actors: the project initiator who proposes the idea and/or

project to be funded; individuals or groups who support the idea; and a moderating organization that brings the parties together to launch the idea (Ordanini et al., 2011). Standardized Internet platforms enable clear mechanisms through which investors can invest in early-stage entrepreneurial firms. Through this model, the role of the consumer changes: they become empowered investors, key resources and co-creators of value, acting within social networks. Crowdfunding models promote collaborative interactions and include elements of crowdsourcing frameworks (Dell, 2008), in which the members of a community share ideas to solve a problem or pool their efforts to create favorable exchange conditions for the community's benefit (Ordanini et al., 2011). Three major types of crowdfunding sites are distinguished (Muller et al., 2013): profit/investment focused, creativity focused (also known as reward-based, the most relevant to our project) and charity focused crowdfunding.

Rewards-based crowdfunding is where contributions are exchanged for current or future goods or services. They are commonly offered in one of two models (Cumming, Leboeuf and Schwienbacher, 2014): 'Keep-it-All' (KIA) where the entrepreneurial firm sets a fundraising goal and keeps the entire amount raised regardless of whether or not they meet their goal, and 'All-or-Nothing' (AON) where the entrepreneurial firm sets a fundraising goal and keeps nothing unless the goal is achieved.

Significantly, all rewards-based crowdfunding campaigners retain their intellectual property rights (Cumming, Leboeuf and Schwienbacher, 2014): patents, trademarks, and copyrights. In other words, Kickstarter is not a producer or publisher or marketer, but an intermediary. The low rate of fraud is a result of "the influence of the community"; the ability of backers and prospective backers to interact with each other and the campaigner, via questions, comments, and responses on the crowdfunding campaign's discussion forum, and in particular "discuss the merits and probability of success." The continuous presence of the crowd deterrs abuse.

6 Open Source

In his book, The Cathedral and the Bazaar, Eric Raymond (2010) studies software engineering methods within open source, based on his observation of the Linux Kernel development process. He examines two contrasting free software development models. According to the Cathedral model, the code developed between releases is restricted to an exclusive group of developers. The Bazaar model, on the other hand, proposes an open-to-all development process. Raymond specifically states that "the Linux world not only didn't fly apart in confusion

but seemed to go from strength to strength at a speed barely imaginable to cathedral architects".

In accordance to the design and funding choices, the importance of having users is once again stressed. Raymond (ibid.) writes "Users are wonderful things to have, and not just because they demonstrate that you're serving a need, that you've done something right. Properly cultivated, they can become co-developers". Each of the users included, approaches the task with a different perceptual set and analytical toolkit, a different angle on the problem. With regard to user centered design, Raymond mentions that the next best thing to having good ideas, is recognizing good ideas from the users. He believes that the closed-source world cannot win an evolutionary arms race with open communities that offer better quality, higher reliability, lower costs and increased choice.

Contrary to physical commons, using software does not decrease its value and unlike the traditional exchange-economy terms, open-source is governed by a gift-culture. Within gift economies social relations are not regulated by the possession or exchange of money or commodities. They are characterized by the creation and maintenance of social relationships based on the economy of gift exchange (Bergquist and Ljungberg, 2001). According to Bergquist and Ljungberg "gift giving creates social interdependencies and becomes a web upon which social structure is organized". One could understand this culture as a kind of amalgamation of collectivism and individualism: giving to the community is what makes the individual a hero in the eyes of others. Such a presence is important in regards to converging different values and goals and guide the focus on the common goal.

7 Symbolic Change

We decided to have Apple laptops as our 'base' to have a more concrete product to base our symbolic changes on. Apple's issues related to symbolic specificities we want to change are:

- Apple has a large fan base, indirectly they are encouraged to buy new releases of Apple laptops.
- Apple laptops is extremely locked to their OS. In opposition with other PC brands they do not need to provide users the opportunity to install a new OS, e.g., Ubuntu.
- Apple receives almost yearly press on their factories in developing countries and the bad working conditions there ("Criticism of Apple Inc.," 2014).

In related order to above, we want to do this by having exchangeable parts — modules — to promote sustainability (and special modules like solar panel can further promote this), provide the best possible way for users to choose their OS to promote freedom of choice and giving the user the opportunity for involvement, and a fair trade policy. This involvement is further promoted by including users in the design process.

8 Change of Consumers Behavior

If the current population and consumption trends continue, it is appreciated that by 2050, there will be a need for 2,5 planets to support the population and their needs (Lacy and Keeble, 2013). There is a need to change the consumers attitude to make them use something like this environmental friendly laptop, and for making a more sustainable world. Unilever ("Encouraging Behaviour Change | Sustainable Living | Unilever Global," n.d.) has made five points for how behaviour change towards products and technology can have a lasting impact, if they are applied consistently to the interventions. These points they call Five Levers for Change:

- "Make it understood. Do people know about the behaviour? Do they believe it's relevant to them? This lever raises awareness and encourages acceptance.
- Make it easy. Do people know what to do and feel confident doing it? Can they see it fitting into their lives? This lever establishes convenience and confidence.
- Make it desirable. Will doing this new behaviour fit with their actual or aspirational self-image? Does it fit with how they relate to others or want to? This lever is about 'self and society' because humans are social animals.
- Make it rewarding. Do people know when they're doing the behaviour 'right'? Do they get some sort of reward for doing it? This lever demonstrates the proof and payoff.
- Make it a habit. Once people have made a change, what can we do to help them keep doing it? This lever is about reinforcing and reminding" ("Encouraging Behaviour Change | Sustainable Living | Unilever Global," n.d.).

9 Making Modularity 'Hip'

In todays society we see two ways we can use to make a modular product popular. First, creating awareness on the need for sustainability. If peoples understands how an environmentally friendly way of living is something the earth needs, then, promoting the sustainable angle is a selling point. Second, appealing to people on the notion that modularity opens up a greater possibility for personalisation. If this also creates a deeper personal attachment to the product the owner may want to keep the product longer. But personalisation

through modules may also be a contradiction for our goal. If people wastefully buy new modules to further personalise their laptop it will create unnecessary waste.

10 Existing Modular Technologies

The existing initiatives regarding modular technologies display a gradual increase in the interest of the public in sustainable and customizable solutions. This may act as a motivating factor for actors within the industry to make the shift from planned obsolescence to products characterized by transparency and an increased lifespan. For some of the projects the role of the community is pivotal throughout. It proposes requests and partakes in crowdfunding. Some of the products described below are commercially available, some are released prototypes, some are being crowdfunded, while others still remain in a conceptual phase. Regardless of that, their design principles and the impact they had, has been a source of inspiration when re-coding a rather 'back-boxed' laptop such as the ones offered by Apple.

The solutions described below encompass solar notebooks, laptops comprised by other existing devices, modular desktops, docks that use mobile phones or modules as the main processing unit, and modular smartphones. A lengthy overview can be found in Appendix B.

Product	Type of Modularity	Available	Comment
SOL	Solar Notebook	Yes	detachable panel
Samsung NC215S	Solar Notebook	Yes	panel on the lid
Asus Transformer Book Duet	Tablet/Notebook Windows/Android	Yes	4 modes of use
Lifebook	Combined independent Gadgets to create functional laptop	Conceptual phase	Aims to reduce repetition and wasted hardware, seamless synchronization
Project Christine	Modular Desktop	Conceptual phase	Build and customize without technical knowledge, automatic syncing , replace parts without voiding warranty
ICE xPC	Modular Computer	Crowdfunding phase	Works as the processsing core, small as a phone, used with a dock

Ubuntu for android	Modular Computer	Conceptual phase	Android mobile used as the main processing core on Ubuntu desktops
X7A	Modular Computer	Crowdfunding phase	swappable I/O and Processor Boards, runs with only 10% of the standard power
Project Ara	Modular smartphone	Prototype	Interchangeable components connected on an endoskeleton. Strong dependence on making the project attractive
ZTE Eco-Mobius	Modular smartphone	Conceptual phase	four independent modules: LCD, core, camera, and battery.
Phonebloks	Modular smartphone	Prototype	Main incentive: grow the community to steer the change from a flat to a circular technology. Increased life span, reduced waste
B-Squares	Modules	Crowdfunding phase	Assemble customized configurations thanks to magnetic contacts that allow modules to snap together and transmit signals

Table 3. Existing modular technologies

11 Timeline for Change

Figure 1 is a timeline to show the steps from where we just had an idea, to the release of our product.

The timeline starts with an idea. An idea of a modular laptop that is sustainable and environmentally friendly, which is made with a low fidelity prototype (drawing 1 in Figure 1). Then comes the high-fidelity prototype of our idea (drawing 2), and to get our idea out, we need public relations (drawing 3). When our thoughts and ideas are known, we invite users to help us further (drawing 4). To get even further we need crowdfunding (drawing 5), and get someone who focus on Fair Trade to produce the modular laptop (drawing 6). When this is done the v.1.0 environmental friendly and sustainable modular laptop is ready for release (drawing 7).

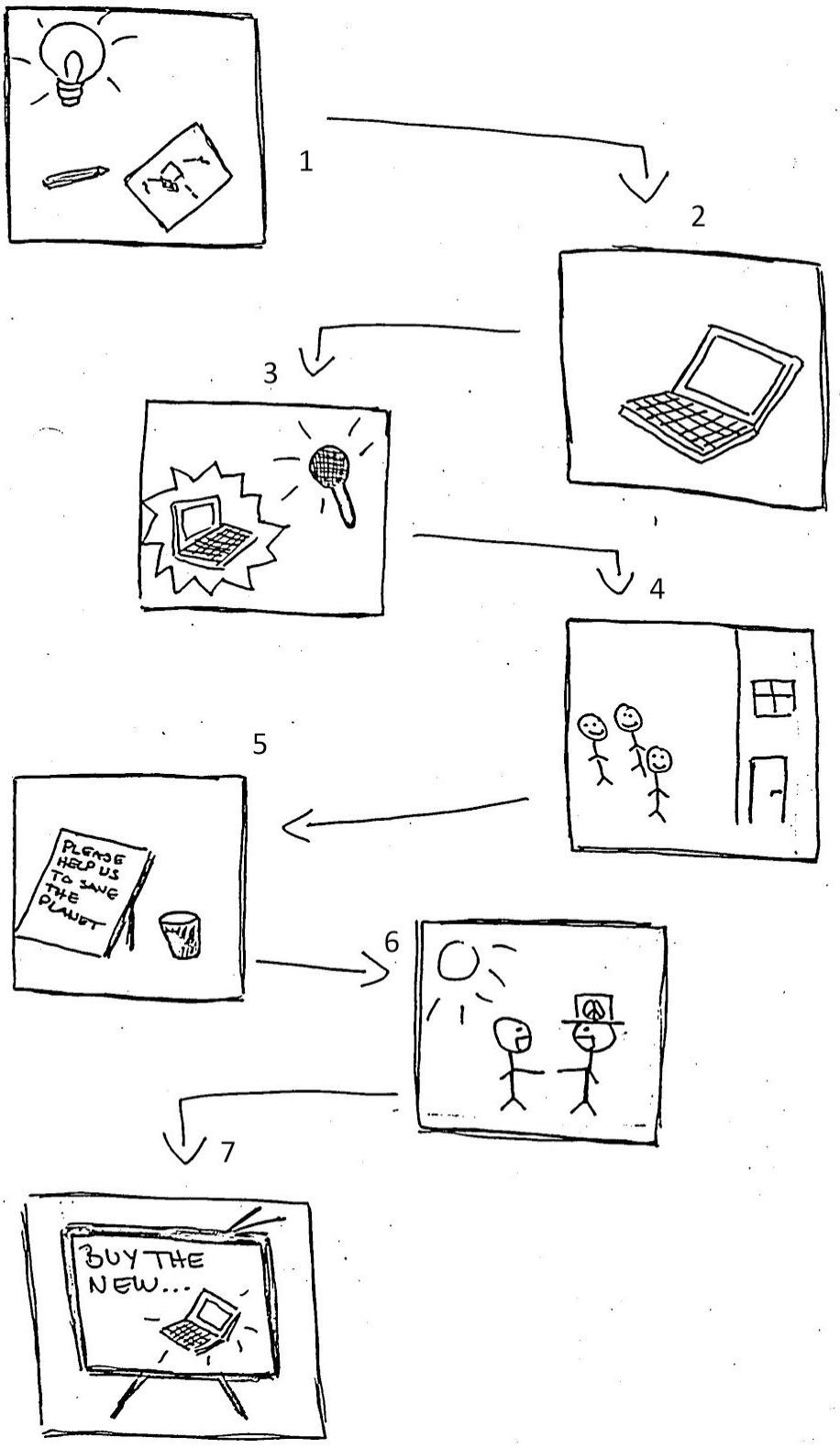


Figure 1.Timeline for change

12 Design Process and Design

12.1 The Logo

Figure 2. The proposed logo

The green rhombus is meant to represent a leaf, for the fact that fair trade vendors will be included in the process, parts of the skeleton will be constructed from recyclable materials, and that the solar panel is an integral part of the design. The white rhombi are connected and there is space for more. They are meant to portray both the different components that can be incorporated in a modular laptop, and the community backing its development. These aspects are envisioned as something to be extended.

12.2 Initial Prototype

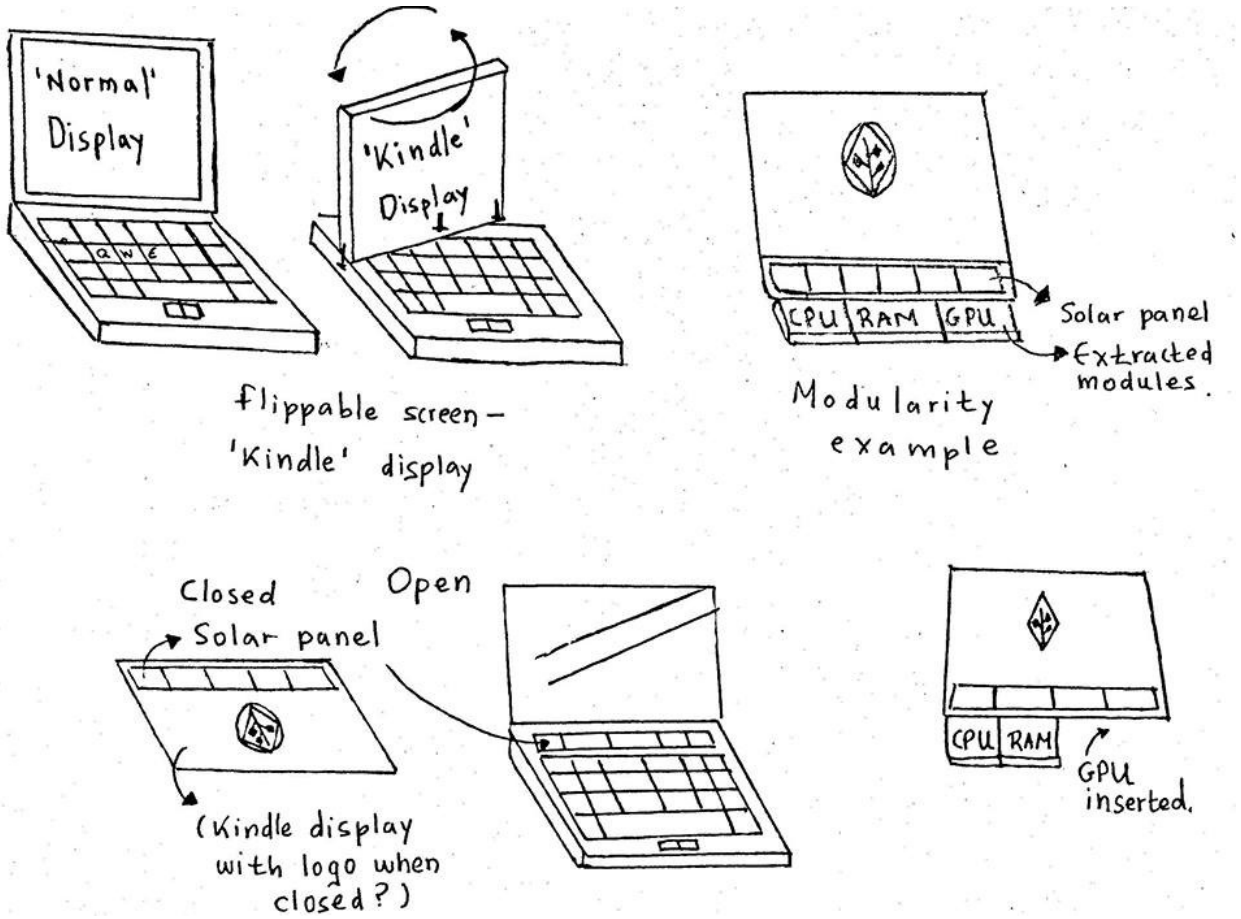


Figure 3. Initial Prototype

The initial prototype considered various ideas such as a flippable, two-sided display that could either work as a regular or as an e-ink display, extractable modules, and a solar panel attached on the screen. With regards to the aim of the project; rendering modularity more appealing for the vast audience, one could argue that a flippable screen and the extractable modules may pose significant technical restrictions, and cause the design to appear ‘clumpy’. This thought brought about the final prototype.

12.3 Final Prototype

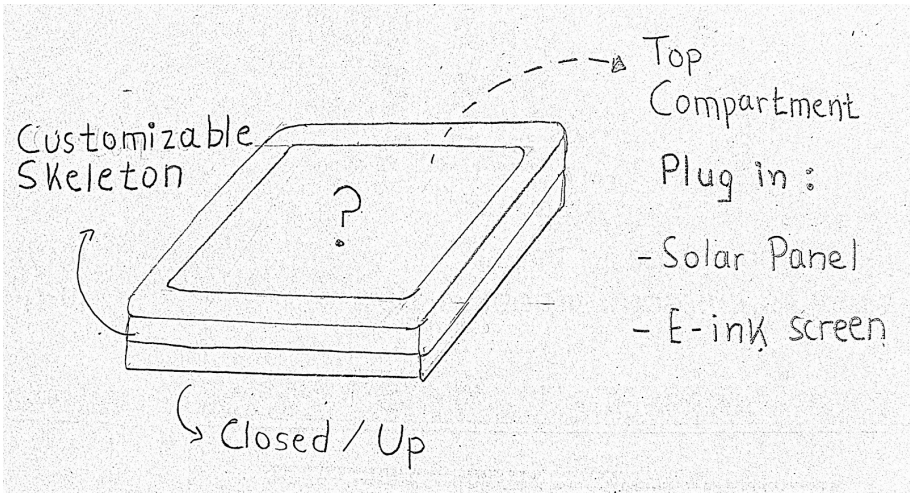


Figure 4. The upside of a closed modular laptop

The laptop is envisioned as a skeleton that connects all the necessary parts together. This skeleton could be enclosed in a plastic sleeve-like case, that may be custom-produced for the user. The regular display is replaced by an apparatus that has a gap on the outer side and a regular screen on the inner side. On the outer side the users may insert modules such as a solar panel or an e-ink screen that could be activated whenever the lid is closed

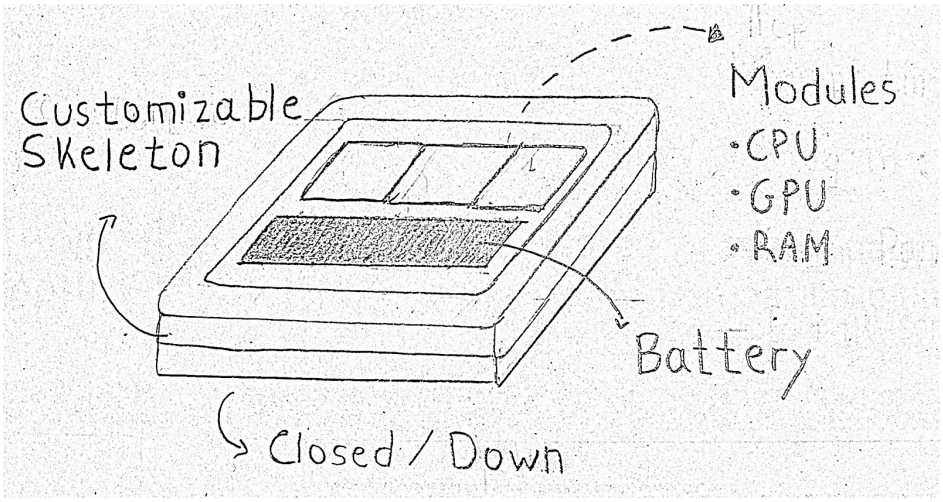


Figure 5. The down-side of a closed modular laptop

The down side of a modular laptop extends the current formation with more compartments where the main processing components can be placed. The user should be able to draw out and replace them without having technical knowledge.

13 Discussion

The idea behind this project was to create a more environmentally friendly and sustainable laptop. We have presented our thoughts and process for a solution in this report. Our concept evolved from the idea of a modular laptop and the sustainability it can provide by creating less waste, easier recycling and the possibility for special modules like solar panel and an e-ink screen. We have looked at the symbolic focus of our product: how it promotes awareness for the environment and should be an overall societally better choice. For that, the production process of a product matters. We want users to be included in the process and their opinions should be heard, and fair trade and open source choices should be prefered.

One thing is that people must become more aware of the problems tied to the use-and-throw culture. They need to know where the products they buy comes from, and what happens to them after they throw them away. With an increased focus on this in societies this may be a selling point for modular technologies.

It is worth noting that the smartphone market has matured into incrementalism. Phones are not improving in massive leaps as they used to. The technological differences are trivial and unlikely to be noticed. What currently distinguishes one generation from another, are millimeters of extra display space, grams of weight and small amounts of extra processing power and memory. Modularity differs radically from the current model, and can thus provide actual change.

However, there exist numerous limitations for this project. Initially, the diverse technical issues need to be studied. Even though there are documented instances of modular technologies, there is still a technical heritage that need to be changed. The architectural components are inevitably highly dependent, and there will be a strong need for standardization. The final design might be bulkier than the average laptop, and this may be counterintuitive with regards to making the product popular. Together with the urge some consumers have to always have the ‘new thing’, how the market often encourages this, and the technical heritage, that are the challenges of how to change what Feng and Feenberg (2008) calls ‘technical code’.

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15 Appendix A: Thought process

Sources that inspired the thought process can be found here:

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B-Squares: http://www.b-squares.com/, http://www.treehugger.com/gadgets/b-squares-brilliant-plot-to-take-over-electronics-with-lego-like-gadgets.html

Conflict minerals: http://en.wikipedia.org/wiki/Conflict_resource

Consumer behavior change: http://www.side2.no/mote/na-skal-bloggeren-mte-h%26amp%3Bm/8486373.html, http://en.wikipedia.org/wiki/Sustainable_consumer_behaviour

ICE XPC: https://www.indiegogo.com/projects/ice-xpc-a-modular-computer-as-small-as-your-phone, http://www.gizmag.com/ice-xpc-modular-computer/30480/

Phonebloks: https://phonebloks.com/en

Project Ara: http://www.projectara.com/ , http://recode.net/2014/06/29/meet-project-ara-the-modular-google-phone-of-the-future/ http://www.technologyreview.com/news/525386/why-googles-modular-smartphone-might-actually-succeed/

Project Christine: http://www.razerzone.com/christine

Recycling: http://www.digitaltrends.com/computing/how-to-recycle-your-old-computer/

Samsung Solar Netbook: http://www.gizmag.com/samsung-nc215s-solar-powered-netbook/18982/

Solar panel: http://www.treehugger.com/gadgets/7-portable-solar-laptop-chargers-worth-considering.html

SOL laptop: http://store.solaptop.com/

The Lifebook Concept: http://www.treehugger.com/gadgets/lifebook-design-combines-all-our-gadgets-into-one-modular-laptop.html

Ubuntu for android: http://www.ubuntu.com/phone/ubuntu-for-android

X7A: http://www.xi3.com/desktops/x7a-modular-computer

ZTE modular smartphone:

http://wwwen.zte.com.cn/endata/magazine/mobileworld/2013/5/articles/201310/t20131029_411072.html

16 Appendix B: Modular technologies

Modular Notebooks

Solar Notebooks

Unlike regular laptops, some models of solar notebooks come with a flap-like structure which functions as a solar panel and can be removed if required. This generates the electricity required to charge its batteries. They may include features such as Internet access, GPS and satellite phones. Other models feature external solar modules connected to the laptop and solar keyboard chargers, where the keyboard looks like a solar sheet with the outline of a keyboard imprinted on it.

SOL

Entirely self sustained laptop. It is equipped with a detachable solar panel, which the developers claim will provide 10 hours of battery life after just two hours in the sun. The producers claim that it never actually needs to be plugged into an electrical outlet, but it still provides this option. The solar panel can detach and connect to an extension cord, so that the computer can be used indoors, and still keep charging with direct sunlight. According to the developers, each SOL computer could approximately prevent a ton of CO2 emission from being released into the atmosphere during its lifetime. The computer runs Ubuntu, and comes pre-loaded with productivity tools, but another OS can be installed if necessary. A satellite communications module can be added for especially remote areas. The target users are students in developing nations and people living in extreme environments, which is why the entire device is designed for durability and built from reinforced materials. The company states that their product can support various initiatives such as: child immunization projects, collection and creation of health records, education in rural schools and wildlife research and protection.

Samsung NC215S

The key feature of this notebook is the solar panel located on the lid, which charges a six-cell battery equipped with PowerPlus technology to provide extended running times (up to 14.5 hours). The anti-reflective coating of the screen provides clear images even in direct sunlight.

Other applications of Modularity

ASUS Transformer Book Duet

The Transformer Book Duet TD300 is a quad-mode dual operating system laptop and tablet convertible. It allows users to switch between Windows and Android in either laptop or tablet modes.

Article:
http://www.thenerdmag.com/asus-transformer-book-duet-td300-ces-2014/

Lifebook

Lifebook is a design idea about combining independent gadgets in order to create a functioning laptop. The aim is to reduce repetition and wasted hardware. The designer, Prashant Chandra writes, "Our life in this IT age consists of these digital devices that we use everyday to do our work, entertain ourselves, enjoy our hobbies, save our memories and share and socialize with our family and friends. Presently we buy each one of these devices separately and then struggle to keep them all synchronised with our data. Also, we always use these devices one at a time. This means a lot of wasted hardware which is repeated in these devices and is sitting idle in one device when we are using the other. If there was a device that could have these devices integrated into one, thereby making synchronization a seamless process and overall cost of ownership lesser than what I would spend for four individual devices, it would truly be my Lifebook."

Modular Desktops

Project Christine

Project Christine is a concept design that allows users to build and customize PCs in any configuration without any prior technical knowledge. They may choose any module on-the-fly in any combination, whether it's the CPU, memory, graphics card, storage or power supply module, and simply plug it in. The PCI-Express architecture of Project Christine automatically syncs the components. As new PC technology evolves, Project Christine can evolve with it. The modularity of Project Christine makes it perpetually customizable, helping eliminate the need to replace entire systems. Each sealed module is entirely self-contained and features active liquid cooling and noise cancelation. With this design, Project Christine's components can be safely overclocked without voiding warranties.

ICE xPC

The ICE xPC™ modular computer is as small as a phone but with the processing power of a portable or desktop computer. It is supposed to work as the core of a pad, notebook or desktop. Central to the design of the xPC and its peripherals is sustainability and the notion of waste minimization. The company emphasizes the simplicity of upgrading the system and champions the benefits of customization, along with the money saved by not having to replace redundant hardware with entirely new devices.

"The ICE xPC is a green computer designed with the future and sustainability in mind," the company says on its Indiegogo page. "To upgrade, you just simply plug-and-play a new ICE xPC into existing peripherals and reuse them, which creates minimal electronic waste. This novel modular computer can save you a considerable amount of money as well as help save the environment."
Article: http://www.gizmag.com/ice-xpc-modular-computer/30480/

Ubuntu for Android

The project is based on the conclusion that multi-core Android phones are not used to their full capacity. One way to fully utilize them would be using them as PCs. Essentially “users get the Android they know on the move, but when they connect their phone to a monitor, mouse and keyboard, it becomes a PC.” The project visualises this connection being established through a dock. One of the main incentives for phone manufacturers according to the website is the reach to a new market. In developing countries, namely, there is little PC penetration, and mobiles may define personal computing for an audience that has no legacy attachment to the desktop. The project is still at a conceptual phase

X7A Modular Computer

The Xi3 Computer Architecture allows users to swap old I/O and Processor Boards for new ones with minimal effort. The X7A runs on 30 Watts, which is only 10% of the power it takes to run a comparable workstation at 300 Watts. This makes the X7A modular computer system one of the most eco-friendly and economical power-user computers on the planet, all while saving the user money in total cost of ownership.

Modular Smartphones

Project Ara

“The smartphone is one of the most empowering and intimate objects in our lives. Yet most of us have little say in how the device is made, what it does, and how it looks. And 5 billion of us don't have one. What if you could make thoughtful choices about exactly what your phone does, and use it as a creative canvas to tell your own story? Introducing Project Ara. Designed exclusively for 6 billion people.”
The Ara team is trying to introduce the notion of interchangeable parts to phone hardware. They want consumers to be able to choose and swap out cameras, batteries and other smartphone components rather than relying to those predefined by handset manufacturers, which often make upgrades impossible. “We believe that the smartphone hardware ecosystem should be,

and can be, a lot more like the Android app ecosystem: with a low barrier to entry, lots and lots of developers, and faster, richer innovation," says Paul Eremenko, a former office head at the Defense Advanced Research Projects Agency who leads the project.

Each Project Ara phone consists of the "endo," a skeleton with preset slots for inserting modules, and the modules themselves. The electropermanent magnets that connect the modules without snaps or hinges and the simple wireless interfaces "help us make modules with as little added complexity, cost, and weight as possible," Knaian says. To whatever extent possible, everything in Ara is interchangeable. Even the device's screen is a swappable tile. The endo will include a tiny battery so users can swap in a fresh battery without turning off their phones. Some of the other interchangeable modules are an infrared imaging lens module, a blood oxygen level reader, processor and memory modules, the identity module and the keyboard module. The project aims to prove that it's worth bringing software-like flexibility to phone like hardware.

Besides the technicalities, project Ara heavily depends on making the product attractive. Andy Berndt, the managing director of Google Creative Labs prefers the term 'blinged out' to describe the notion of modularity. One of his quotes exemplifies their approach to how the product could be marketed in order to be accepted by the vast audiences:

"If you're really into music, you could put some amazing speakers on here," he said in an interview. "If you're really into photography, you would want Leica to make a piece. If you wanted your phone to last all day, you could have the e-ink screen. You could have a valet key for your car. With this kind of swappability, you can just let your imagination go."

The project leader believes that Ara will significantly expand the smartphone hardware ecosystem. He even notes that personal medical diagnostic modules might be particularly useful in the developing world. In order for the project to succeed both customers and hardware companies need to be convinced. Customers in poorer parts of the world represent the next huge wave of smartphone adopters, and by next year Google hopes to conduct a pilot test of Ara devices with a Wi-Fi module, basic processor and memory, battery, and screen. These are projected to cost $50 apiece to make (the retail price has yet to be determined). Google expects to conduct the test in a South or Central American country where cellular minutes are expensive but Wi-Fi hotspots are common. When it comes to the manufacturers, 3328 registrants—from companies that make medical diagnostics and imaging sensors to those making displays and batteries—have signed up for the first Ara Developers Conference, scheduled for April 15 and 16 in Mountain View, California, says Eremenko.

Finally, custom manufactured components may be an option. Google has partnered with the manufacturer 3D Systems, in order to develop 3D printed plastic cases. This customization

allows cases to be manufactured in a wide array of colors and designs chosen by the consumer. An example would be a chip manufacturer like Nvidia or Qualcomm releasing a faster handset processor. If you want to keep your device, you can upgrade just its CPU with the latest version. The only part of your smartphone you would keep consistent would be its general body frame and the display.

Full interview available on: http://recode.net/2014/06/29/meet-project-ara-the-modular-google-phone-of-the-future/
Article:
http://www.technologyreview.com/news/525386/why-googles-modular-smartphone-might-actually-succeed/

ZTE Eco-Mobius modular phone

Developed by the ZTE's R&D department in China, the Eco-Mobius would make it possible to switch out and upgrade individual hardware components. The phone is divided into four independent modules: LCD, core, camera, and battery. The LCD module includes the screen and lens; the core module consists of a removable CPU, GPU, ROM and RAM and other electronic parts. The four modules can be easily disassembled and assembled through a sliding track design.

Phonebloks

Each Phonebloks device consists of a motherboard drilled with holes. On the front, you can mount a detachable display; on the back are all of the hardware features that make the phone work, such as the battery and mobile antenna. The holes in the motherboard contain electrical connectors, which form a circuit with the conductive pins of the blocks, creating a fully functional and fully upgradeable phone.
Phonebloks claim to be an independent organisation helping the mobile industry steer development and production that produces less electronic waste than their products do today. They aim to show the industry, through their growing community, what the public wants and what the planet need “We see ourselves as a means to promote a holistic approach to end or reduce the various ethical and environmental problems existing in the consumer electronic market today. We believe in transformation from, a flat to a circular economy, as well as steering towards new production methods and indeed new products. Logistic solutions and production materials will help us reach a more sensible industry. We see this transformation creating less waste and pollution as well as a longer life-cycle and higher lever of recyclability (or even bio-

degradability) for the end product. We advocate transparency, open source and open innovation and want to be the hub where the industry talk and listen to each other and to the public." Thy aim to steer the industry away from manufacturing products that are sold and repaired or replaced as whole-widgets, to products that are modular, and hence easy to repair or upgrade. This will increase the life-span of the product, and reduce waste at the same time.
Article: http://www.cnet.com/news/phonebloks-a-modular-phone-you-update-a-piece-at-a-time/

Modules

B-Squares

B-Squares is a modular electronics system allowing you to build your own customized electronic devices, like "Electronic LEGOs". At the core of the Patent Pending B-Squares technology are the magnetic contacts at the corners of each Square. These magnetic contacts serve a dual purpose; they allow the Squares to snap together without wires and are used to transmit electric signals between adjacent Squares. This innovative design allows users to quickly assemble Squares into customized configurations without wiring or soldering. Each square block has a different function, but they are all built as as similar on the outside as possible. By taking full advantage of the multiple corner contacts on each Square, the overall circuit of a B-Squares configuration can be changed by simply rotating one of the Squares relative to its initial orientation. For instance, the color of a LED-Square can change by rotating it 90 degrees. The Squares can be connected side-to-side in a single plane, stacked on top of on another, or connected along the edges perpendicularly. According to Jordan McRae and Shawn Frayne of B-Squares, the product is designed to make the consumers comfortable with the concept of modularity, and inspired to create their own devices based on what function they need them to provide. Eventually, such modularity will come to be expected so that as new technology and functionality for devices roll out, items like B-Squares can provide a plug-n-play solution to providing that new functionality for existing products.
Article: http://www.treehugger.com/gadgets/b-squares-brilliant-plot-to-take-over-electronics-with-lego-like-gadgets.html

17 Appendix C: The group process

Date	Present	Theme
4 / 9	All	Deciding recoding project: everyone had many ideas.
18 / 9	All	Magda thought about modular laptop. We tried to think about other modular technologies as well.
26 / 9	All	Modular laptop is final. We talked about what we should try to change?
2 /10	All	Sketching and further theme. Looking into theory.
16 / 10	All	Everyone should start writing on the report.
31 / 10	All	We talked about the next steps. How we should change the attitude of consumers (anti use and throwaway), and creating timelines to achieve this. ● Solar panel ● CPU, RAM
14 / 11	All	Looking into how to finalise.
21 / 11	All	Finished report, sketched final prototype and timeline for change
25 / 11	All	Last day. Report and presentation.