The Open University
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Can hi-tech products be sustainable?

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Sustainability

It depends on who you ask!

Environmentalists:

Minimising impact on non-renewable resources

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Consumers:

Delivering lasting benefits

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Consumers:

Delivering lasting benefits

World of Finance:

Still showing good Return on Investment (RoI) after (3?) years

Unfortunately, this is usually in conflict with the other two.

Financial sustainability

- Companies are only doing what their shareholders told them they wanted them to do
- That's not all bad – we are shareholders, too!
- If the company isn't financially sustainable, it soon won't produce anything (see above)!

Identifying the paradox

- There are at least four financial disincentives to environmental / International Development sustainability objectives:
  1. Durable long-life products cost (a little) more to make than throw-away ones
  2. It takes longer for the consumer to buy a replacement

     (not a problem until the market is saturated)
  3. After-sales service adds cost that is hard to recover
  4. A product that is easy to support is easy to copy or imitate

- First minimise these costs, then try to find an innovative finance model to cover what's left

The Engineer's Ethical Dilemma

a) Pride in my job says that I should add to the sum of human capital, by creating something that endures, and is not dependent on me
b) Financial considerations say that I should:
   i. Make the user dependent on the product
   ii. Arrange it only continue to function as long as the user goes on paying me to support it.

- Hi-tech makes it very easy to implement (b).
- My job is dependent on adopting (b).
- Without a job, I can't do either (a) or (b).

?

Design for maintainability

- Which car will go on longer?
  - Both contain 10,000 components that can be replaced
  - The Morris has a fan switch
  - The Mercedes has a Climate Control Unit
    - …which itself contains nearly a thousand components and many megabytes of code!
    - It cannot be repaired, only replaced
  - 9,999 of the Morris components are still available new – most from several manufacturers!
    - Most are also made of a single material – easy to recycle

Is Innovation always good?

- In Cambridge, Innovation is the buzzword to open all doors
- In the Developing World, it's actually a bad word:
  - Complicated, inscrutable, expensive, unreliable, short-lived
  - Totally dependent on external support from the Developed World (the new neo-colonialism)
    - Support is difficult or impossible where infrastructure is lacking
  - Hi-tech solutions to life-critical issues could be a disaster!
- Is "*We could do this new thing, but we should not*" ever an option?
- As we focus on the newest and latest, we are forgetting the old ways of doing things
  - So is hi-tech making us stupid?

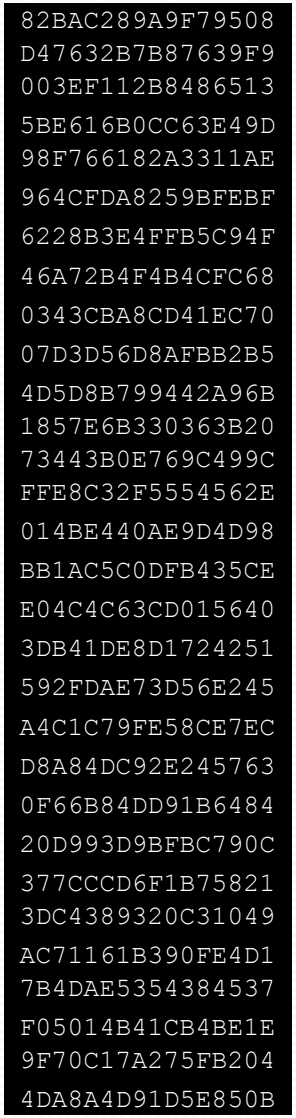
Products with integrated circuits

Alamy stock photo

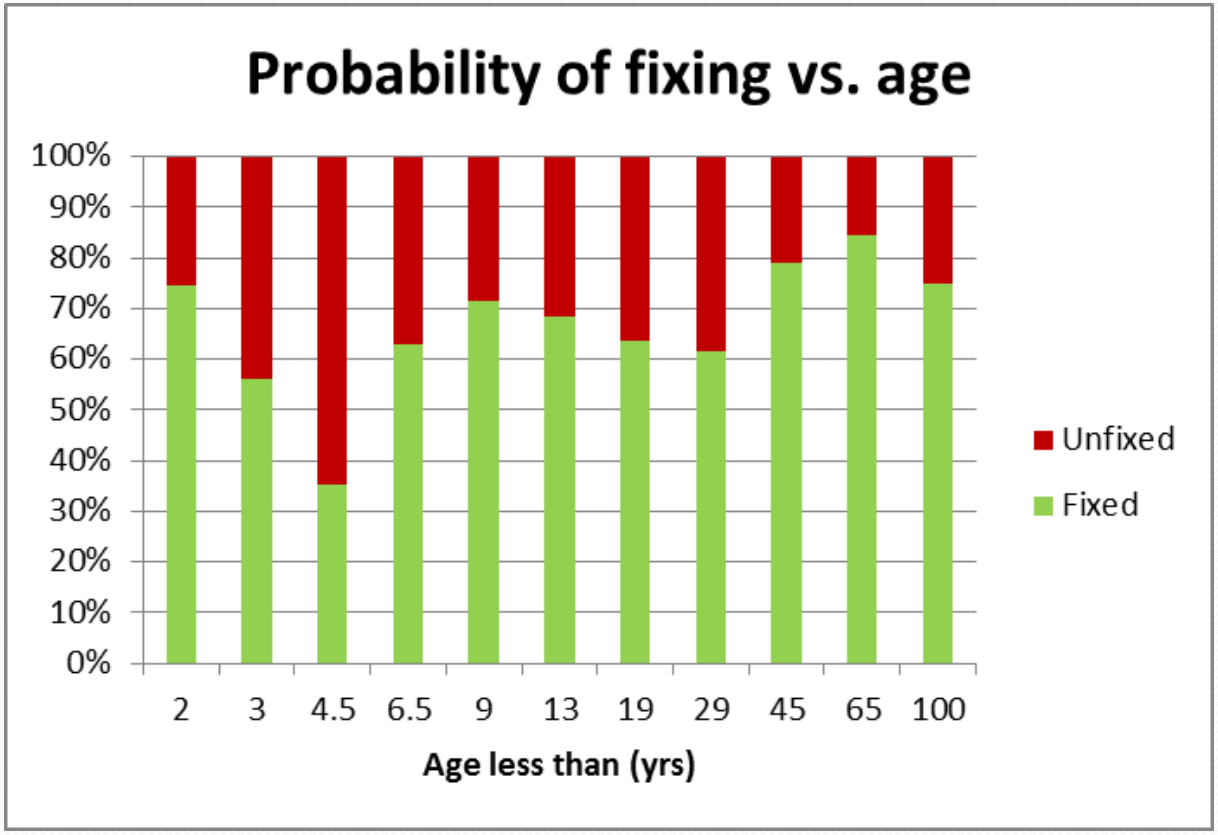
- No-one (not even the guy who made it) can repair a zapped silicon chip.
- Therefore the lifetime of every product containing ICs is limited by the availability of spares
  - IC manufacturers call an “All-time buy”
  - The cost of re-engineering a chip from scratch is prohibitive
  - Building in redundancy doesn’t solve the problem

Products with software

- Software is inscrutable – and designed to be so, because:
  - It contains most of the company's IPR
  - It must be hard to hack
- Software needs continual maintenance:
  - Against new virus threats
  - To fix bugs as they are discovered
  - To accommodate changing circumstances
  - To ensure compatibility with other new software and hardware
- Software needs support
  - A patient and understanding helpdesk, in the language of the user
  - If the company is no longer interested in supporting the product, it will be difficult to keep it operating

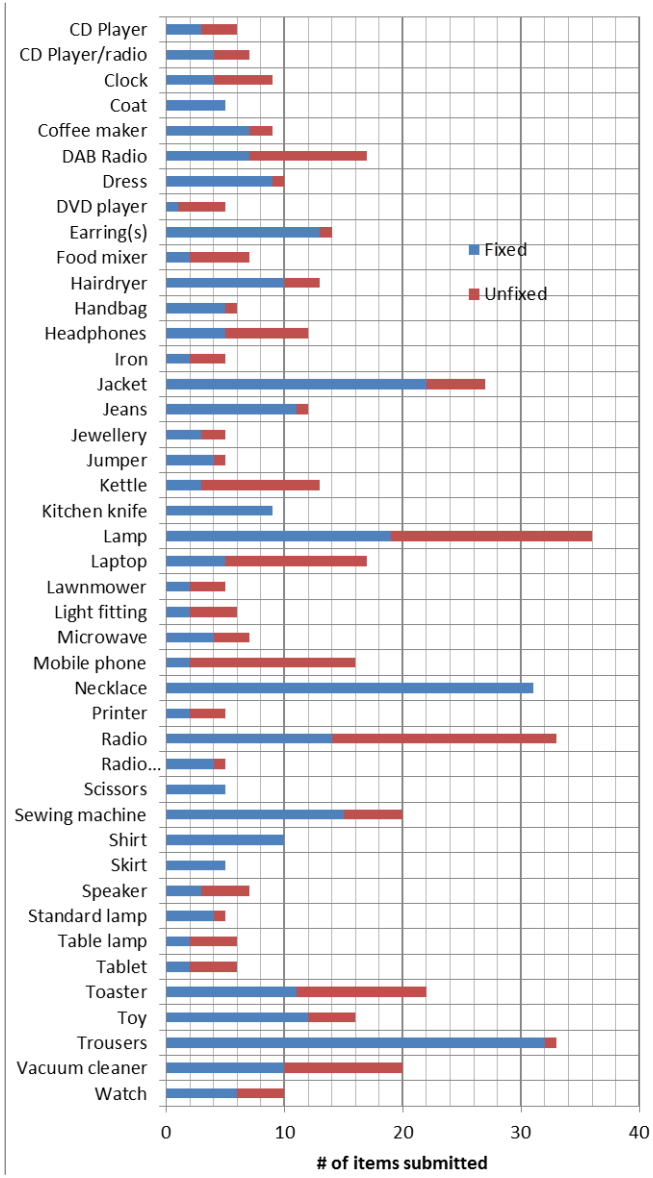


Product lifetimes

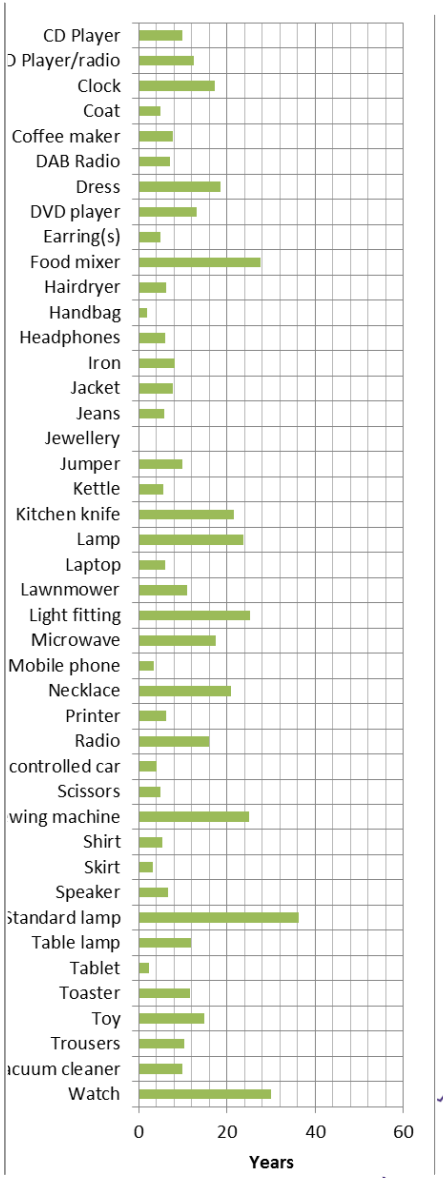


- Sample size: 986 items brought to Cambridge Area Repair Cafés, Feb2017-Feb2019 (some ages estimated)

Item types



Average age



Commonest Product types

Cambridge Area Repair Café Group

Repair Café

Toss it? No way!

Post-sales product support is expensive

- Warranty returns (safety recalls)
- All-time-buy spares stockholding ties up cash
  - Very hard to know how many to buy
- Spares distribution networks must be paid for
- Customer support hotline – training staff, running
- Software updates – authoring, distributing
- Field service engineers – training
  - Poor economies of scale
- Disposal/recycling costs, WEEE
- All of this expense comes after the sale has been banked and profit taken

Products or services?

- Products have a life of their own
  - Products add to the sum of human capital, and can benefit whoever owns or inherits them, but…
    - Products need services to keep them running
- Services only exist as long as we provide them
  - Many services are only needed because maintenance of modern products require the use of specialised equipment, and training in how to use it
    - Hi-tech makes self-service impossible
- So we do need both

Selling a service is more profitable

Bialetti Coffee Maker
Cost of 1000 cups of coffee: **£75**
Waste: 7.5kg of coffee grounds (compostable)
Maintenance: almost nothing to go wrong!

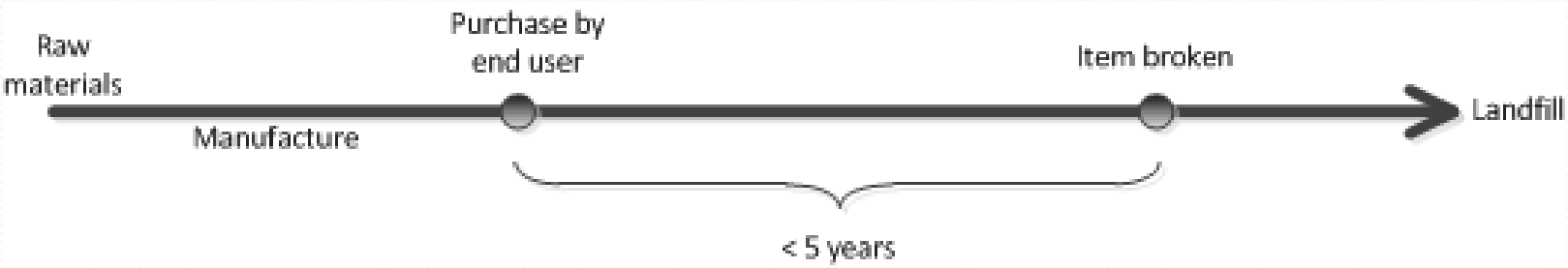
Nespresso Coffee Machine
Cost of 1000 cups of coffee: **£595**
Waste: 8kg of mixed coffee grounds and aluminium foil (only recyclable via selected stores)
Maintenance: challenging!

When is it advantageous to the customer to have a service instead of a product?

- A naïve market that cannot differentiate between a product that will last, and one that won't
  - *Caveat emptor* is not reasonable or fair
- When the market cannot afford the capital outlay
- When the product is only needed occasionally and can be pooled
- When the cost of providing maintenance is high
- When the cost of not providing maintenance is higher (life-critical applications)
- When the supplier remains responsible throughout the product's lifetime, and for final disposal

The life story of a product

- The life of a product



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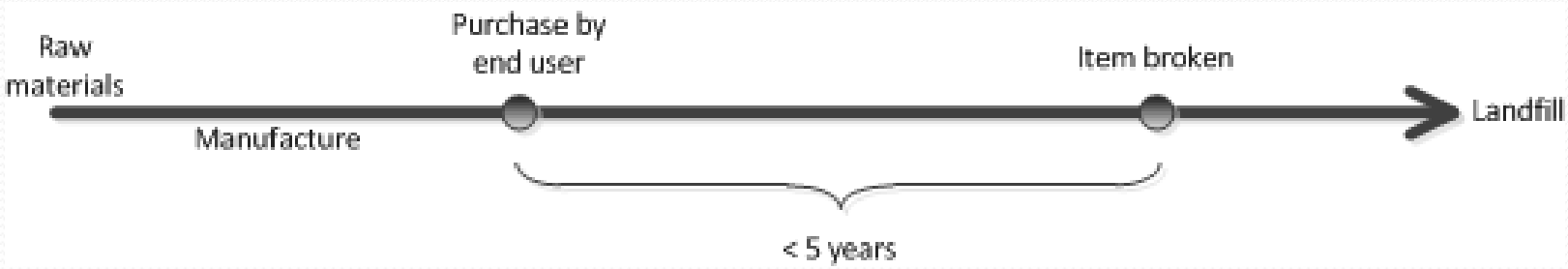
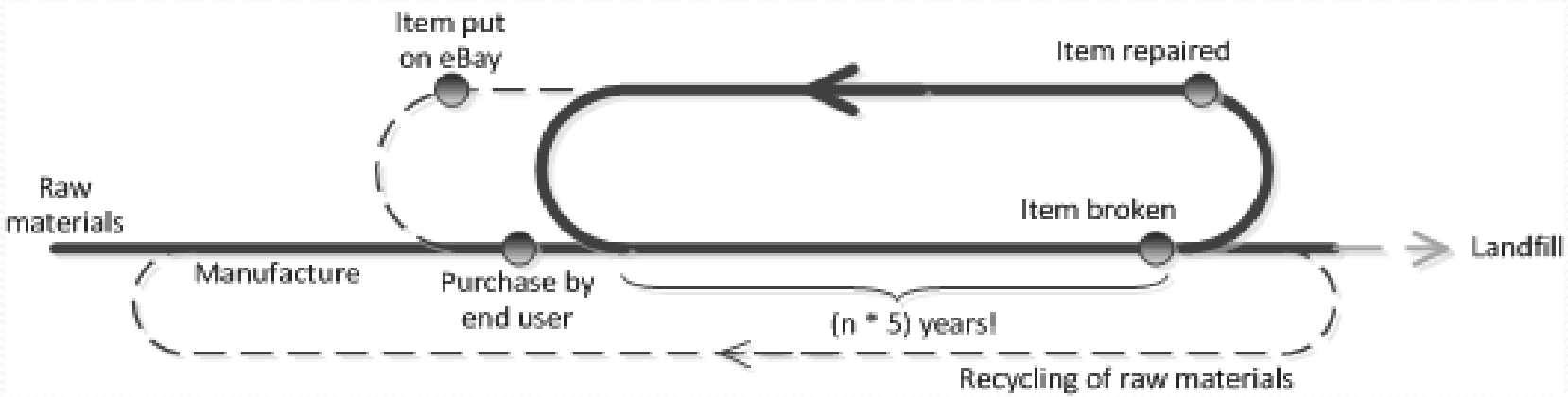


- It doesn't have to be this way!



A strategy for sustainability

- Differentiate your brand from the cowboys:
  - Offer a long (and effective) warranty – and make it a selling point
    - Trust that you won't get a lot of customer abuse returns
  - Unfortunately, brand loyalty is weak in the Developing World
- Consider why repair shops are disappearing
  - We have made them no longer profitable, because repair is so difficult – *but we can fix this!*
- When the consumer decides – "*Do I try and get it repaired, or just throw it in the trash?*"
  - Ensure the repair option is available, easy, simple and effective
    - The repair facility is the only place where a decision to repair or dispose should be taken
    - This is also the only place where a recycling strategy is possible

We love something new!

- We cherish old things handed down through generations
- We quickly adopt the latest shiny gizmo, and delight in its clever features
- These are inconsistent!
- We won't be able to hand on our hi-tech products to the next generation, no matter how carefully we treasure them
- (*DO* we ever treasure them?)

So what *can* we do?

- Design our products to be as resilient as our company will let us
  - Be aware of the failure modes we haven't managed to protect against
- Have a plan for when products fail
  - Recover failed products from the field, and modify designs to mitigate – a "policy of continual improvement" – don't "start again" until really necessary
- Plan for supporting the product for as long as possible
  - Devise a way of funding this
- Avoid single-source parts
  - Where absolutely unavoidable, take up all-time-buy offers
- Provide a service manual
  - Include block diagrams showing power components that might need replacing

Workshop

- Discuss with your neighbour either:
  1. A situation in which you faced the Engineer's Ethical Dilemma, and how you dealt with it
     - Did you manage to hold out, and make something that endured?
  2. Whether we can ever elect not to try something new
     - If we don't develop drones with machine guns, our enemies will
  3. How to build an electronic product that can be maintained for 100+ years (steam engines can be!)
- If time permits, report your conclusions to the audience