

The Printed Washing Machine

Reimagining Manufacture for a Digital Age

Alan Dix, 26th June 2017

Problem

1. **Waste and cost** – The design life of consumer appliances has reduced over the years. This is partly in response to the rise of consumerism meaning that many people change appliances not because they breakdown, but for reasons of fashion and appearance. For those that do not do so, the potential for maintenance is limited as the cost of spare parts often makes repair uneconomic. This also has an impact on those who buy second-hand reconditioned goods, as their reliability is consequentially reduced.
2. **Off-shoring of employment** – Manufacturing jobs have been moved to parts of the world with lower wages, removing the a tier of skilled and semi-skilled jobs in Wales and the UK. As well as the clear social impact of this structural shift, those who are left without any real hope of meaningful employment are ripe recruiting ground for the extreme right and fundamentalism.

Existing digital transformation in manufacture

Current supply chains are built around assumptions of central manufacture, both of the original product and spare parts. Digital technology has already transformed many production lines allowing shorter runs and more flexible scheduling. Furthermore, established manufacturers are recognising the way digital fabrication could be used create spare parts on demand, closer to market and hence reduce the need to maintain complex stocks of rarely used parts or have them shipped from far parts of the world.

However, these changes are incremental, within the existing logistics structures, and are unlikely to unlock the transformative potential of digital fabrication.

Reimagining the logistics of manufacturing and maintenance

Digital fabrication creates the potential for the printing of parts for both maintenance and personalised product manufacture very close to the consumer.

In the case of maintenance, this would make it easier to repair consumer goods reducing the need to replace them simply because some small, part expensive, part has failed.

However, this alone does not address the heavy environmental cost of short-term product replacement as reduced design life is partly in response to consumers' desire for frequent changes. However, digital fabrication could allow goods, to be re-skinned and upgraded. For example, a washing machine might have a new front panel, new programs added or converted to run as part of a household internet of things network.

The same design processes that would enable such radical maintenance and upgrading would also ease customisation at point of sale. In particular, core aspects of product could be created centrally along traditional manufacturing lines and delivered part-constructed to near market final assembly points where customisation could be performed using a combination of off-the-shelf and one-off digitally fabricated parts.

Some of these changes would entail manufacturer-managed customisation centres close to market, but more radically there is the potential for the emergence of digital artisans – maintenance and customisation by the equivalent of the village carpenter or blacksmith, but reimagined for the digital age.

Note this builds on but goes beyond cradle-to-cradle design thinking. Here we are imagining effectively immortal products. There will be waste as parts are replaced whether through wear or fashion, so the need for effective recycling, re-use or re-purposing continues. However, these will be incremental and lower in volume.

Impact

1. **Environmental sustainability** – Less waste as appliances are repaired and upgraded rather than replaced.
2. **Social sustainability** – Skilled and semi-skilled manufacturing jobs close to market, leading to societal improvement and security.
3. **Better products for consumers** – Customisation for individual consumers taking into account preferences as well as abilities (e.g. large buttons for elderly users).

In short, smart, socially beneficial and sustainable manufacture.

Challenges

1. **product design and engineering** – There are obvious challenges for the physical design of products that can be modified and maintained with the degree of flexibility envisioned.
2. **digital and interaction design** – How can effective usability be ensured with extensive near-to-market modifications? This may require modelling tools, automated expert advice systems, or maybe DIY-style popular how-to guides.
3. **brand protection** – Where modifications change the usability aesthetics, or functionality of a device, will this pollute the brand? We do not blame a paint brand for garish colour combinations, but would we give the same leeway to the ostensive brand of a washing machine with a third-party facia?
4. **health and safety** – How can we ensure the safety of massively customised prod cuts? This may require clear boundaries for modification, or automated modelling tools to give stamp of approval.
5. **legal liability** – Closely related to the H&S issue are those of liability – if a modified product causes injury or simply damages clothes, who is responsible?

6. **intellectual property** – Current copyright and patent protection for appliances is largely embodied in the physical production of parts and products. Small-scale digital fabrication suggests the need for micro-licensing and payment regimes not unlike those for digital music. Given recent right to repair cases, would it be acceptable for appliances to 'police' the DRM of components?
7. **business models** – The IPR issues and the growth in long-lasting appliances change the nature of business models, with income as much from on-going licensing rights as initial purchase costs. Indeed, you could imagine a model, not unlike Coca Cola's concentrate distribution, where a few key parts (say a washing machine drum) are manufactured centrally, but otherwise all further manufacture is franchised.

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As a way to explore and invite study of these challenges, we propose to create a washing machine constructed as far as possible from digitally fabricated parts. This may stick closely to existing washing machine designs (indeed an obvious early prototype might take a washing machine and replace parts one by one), or might more radically re-imagine washing and drying as a process (e.g. using ultrasound).