Digital disruption for the circular economy - reinventing spare parts manufacture and appliance repair

Broken/unwanted household appliances left outside for collection, Camden, London ©eden21,2017

Caterpillar could soon be using 3D-printing ('3DP') to produce spare parts, as may VW, Deutsche Bahn and Mercedes. For household appliances, one French supplier provides an online platform - 'Happy 3D' - offering its customers free digital blueprints for certain spare parts. However, widespread access to free spare parts is not necessarily good news for product manufacturers or (spare) parts providers. It raises questions around how, in a future increasingly likely to be characterised by disruptive business models, manufacturers can retain brand loyalty and maintain revenue streams.

As an industry game changer, eden21 is proposing the development of electronic proprietary product keys (PPKs) for spare parts manufacture via 3DP. Each PPK would contain a manufacturer's proprietary part design file, downloadable from an online virtual spare parts warehouse platform. For a licence fee, each PPK could be downloaded for use on a 3D-printer, located either at home or in a repair café. Alternately, the PPK user-licence would be built into the part's reproduction cost at a local 3DP-Hub or service centre. This system would support the development of a vibrant 'repair economy' for everyday household and garden appliances.

To repair or not to repair….

Extending the life of household and garden appliances is central to a more circular economy. However, where owner-led repairs are concerned, this will only happen at scale if it becomes both easier and cheaper for consumers to do so. Presently, repair costs (parts and engineer call-out) are often only marginally cheaper than buying a new product. Doing it yourself is often unappealing - spare parts tend to be expensive and can have long delivery timescales. Parts may also be unavailable once a model has been discontinued. Consumers may feel unable to adequately diagnose faults, or lack the knowledge to (dis)assemble their products. And they don't necessarily have the right tools available for the repair. As a result, even the most ethical consumers often feel forced into buying new products. Until the 'reach' of producer responsibility systems extends to all appliances and repair is incentivised, the discarding of unwanted or broken items (as per the above photo) will remain all too commonplace.

3D-printing – making repair cheaper

3DP is an obvious solution for (spare) parts manufacture and will be central to the creation of a repair economy. Increasingly 3DP can be used at home, accessed via community spaces (e.g. repair cafés, maker-spaces, fab-labs etc.) and commercial 3DP-hubs. Whilst the availability of 'open-sourced' parts is growing rapidly (one site stocks 17,600+ parts), these are largely restricted to either generic prototypes of components, or parts with low functionality, such as appliance handles and phone covers. Therefore, they principally exclude proprietary designs for everyday appliance spare parts. Also, few proprietary parts are presently designed for 3DP and whilst the technology is rapidly advancing, it cannot yet displace all traditional parts manufacture (e.g. complex items such as printed circuit boards).

From 'makers' to 'fixers'

Up until now, most community interest in 3DP has been from 'makers' (designers and engineers) rather than 'fixers' (repairers). Makers use a growing number of commercial online 3DP-hubs, where their prototype designs can be uploaded for reproduction. These 3D-hubs provide rapid turnaround compared with traditional prototype manufacture and offer selection based on: material type, surface finish and delivery/collection options.

3DP technology is rapidly developing: For example, Autodesk's 123D suite enables 3D-models to be created from digital photographs and 'stitched' together using photogrammetry. The resulting design file can be used to create physical objects via 3DP. There are obvious benefits here for designers and prototyping, particularly rapid turnaround compared with traditional manufacture. The real game changer however, is moving beyond prototyping to mainstreaming spare parts manufacturer - whether for cars, household appliances, or even Lego® blocks. This will require 'design for reproduction', where all new parts are designed and existing ones re-engineered for additive manufacture, including 3DP.

Community Repairs
The repair café community could play a key role in mainstreaming (community) appliance repair, by empowering consumers through the provision of training and sharing expertise, and resources (e.g. tools and equipment). Preliminary research on repair cafés indicates there are up to 2,000 worldwide and growing – 1,200+ officially within the Repair Café Foundation. An initial customer follow-up survey at Farnham Repair Café indicate that within a year after observing the repair process, 50% had attempted a repair themselves. Home-based repairs will remain best suited to larger, less portable appliances. Whereas for smaller appliances repair options may increasingly include community repair cafes or even parts centres in shops.

3DP advances will ultimately enable complex parts to be produced, often without assembly. Materials types for 3DP are also rapidly developing (e.g. ABS – medical, rubber – durable, ASA – UV resistant etc.). 100% biodegradable materials will be used for short-life applications (e.g. food packaging and conference displays / stands), with significant benefits for managing materials at end-of-life. Bio-printing, located within hospitals also has exciting applications to build structures to create living tissue.

Right to Repair – a business threat or opportunity
A repair economy is more than cheaper spare parts. Building consumer confidence requires knowledge in terms of: simple fault diagnosis and user-friendly (dis)assembly instructions. Some manufacturers see 3DP as a threat, both to IP and foregone lost revenue from spare parts sales. Others view repair information as proprietary and work to shut down independent repair shops. But, public-facing data goes to the heart of the movement to repair everything we own. Online community repair organisations (e.g. iFixit) work with more enlightened manufacturers to enable service manuals to be translated into user-friendly guidance. One of the largest online parts platforms now provides videos for some appliance repairs. Manufacturers are already evaluating the opportunities and threats from 3DP on after sales care and customer loyalty. But, what if an owner's ability to repair and upgrade their own appliances became central to their purchasing decision and brand loyalty?

Proprietary Product Keys (PPKs) – an industry game changer
Manufacturers will increasingly look to download design files for their proprietary parts from an online cloud, enabling local parts reproduction, matched to demand at regional assembly plants or local service centres. These will be produced either via their own 3DP centres, or in collaboration with 3rd-party commercial 3DP-hubs. This is compatible with appliance repair where leased via 'product as a service' (PAS) systems. However, re-inventing spare parts manufacture for households - both for new appliances outside PAS systems and those in existing ownership - requires a different approach. eden21 is proposing the introduction of electronic PPKs as a key enabler for reinventing spare parts manufacture via 3DP in a repair economy; where each PPK contains a manufacturer's proprietary design file for a spare part, downloadable from a global online digital parts warehouse platform.

How will PPK's work?
Each PPK will provide the interface between a manufacturer's proprietary part design file (e.g. dishwasher spray-arm) and 3DP. This will enable reproduction from a standardised 'Computer Aided Design' digital file (.STL, .OBJ or other format). PPK's are like software product keys certifying that a copy of a computer program (e.g. Windows 365) is original. Accessed via an online virtual spare parts warehouse platform, customers will conduct component searches via appliance make and model number – in the same way as currently happens with online spare parts platforms. Once the user-licence has been paid for, a PPK can be downloaded directly to a personal or business 3D-printer.

Benefits of using PPKs will include:

➢ appliance manufacturers will receive income from licencing PPKs, where proprietary design-IP for parts is protected and revenue streams continue (potentially indefinitely) after appliance models have been discontinued. Ensuring ongoing revenue streams is necessary to enable manufacturers to fund future R&D and product innovation;

➢ 'on demand' (spare) parts production takes place without waste and associated environmental impacts from manufacture, distribution and logistics are minimised;

➢ 'just-in-time' systems eliminate the need for capital intensive inventories and associated spare parts warehousing/logistics. Economies of scale manufacture become effectively irrelevant, eliminating traditional large production runs to realise marginal unit cost savings;

➢ manufacturing 'recolonization' by eliminating the need for cheap outsourcing to countries with lower labour / material costs and less stringent environmental controls; and

➢ consumers will benefit from cheaper spare parts, with the result that (manufacturers') regional service centres will need to become more price competitive and themselves further innovate to retain business over consumer-led appliance repairs.

Commercialisation challenges

There are several issues that PPK commercialisation will need to address. These include:

- ensuring compatible digital formats for design files;

- protecting manufacturers' intellectual property through secure encrypted file transfer and payment for single- or multiple-use 3DP user-license; and

- warranty considerations – a complex and somewhat grey area which may require tailored solutions for 3PD reproduced parts and appliance repair. For example, could or should reproduced parts carry some form of manufacturer's warranty? Also, would repairs by third-parties (e.g. householders) invalidate any remaining manufacturers' appliance warranty?

Next steps

eden21 is keen to explore collaborative partnership working in this space. Please contact us to discuss.

Dr Stuart McLanaghan is a business sustainability professional and entrepreneur, operating at a senior/executive level across the food, environmental services and manufacturing sectors. He works with organisations and businesses to develop circular economy solutions and deliver sustainable resource management. As a British Standard's Committee member and one of its drafting panel, he played a pivotal role developing BS 8001 – the world's first standard to help organisations implement circular economy principles.

📞 *+44 (0)7917–653173* | ✉*stuart@eden21.co.uk* | 🐦 *@stuart_eden21* | *www.eden21.co.uk*