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3D printing: towards a freightless future?

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11 December 2012

Additive manufacturing will revolutionise production, but its effects on cargo transport are unpredictable. Thomas Birtchnell offers four possible scenarios.

Currently Professor John Urry and I are working on a project at the Centre for Mobilities Research at Lancaster University for the Economic and Social Research Council on the future social and economic mobilities of objects. Principally we are interested in how niche technologies and innovations might become part of mainstream systems. This would cause disruption and systemic change. So, current systems involved in the making and of movement of all the objects we use in everyday life would need to transition. People get all sorts of objects through global systems of production and consumption, so they're consumers. Before the 20th century, specialists made most of these objects locally near to the consumer. These were things like tinkers, tailors and so on. With the automation of industry, factories sprang up. They employed large numbers of people who did not need to be specialists to make things. In the 20th century, many of these factor owners realised that they could take advantage of global inequalities of all kinds of things to offshore. So people in countries such as India or China were paid much less and had to live in less developed infrastructures and in more impoverished social conditions as a consequence of this. Key to this global production system is this cheap energy for transportation, which John Urry talks about in his recent book *Societies Beyond Oil*. But in talking about the movement of objects we must understand what John Urry, Satya Savitzky and I call cargo-mobilities. This is the huge international port infrastructure, vast container ships, finance and labour systems and processes of offshoring and outsourcing. At the centre of this system is the container. So the container allows objects to move seamlessly as cargo from factory floor to the shop floor. This global production system is currently facing many challenges including the rising cost of energy and fuel, a growing call for reductions in global transportation and energy use due to climate change, the physical limits of infrastructure and the lack of investment and space for growth. So as well as the rising incomes and living standards of workers in developing countries, you're seeing this flattening out of inequalities and also seeing this kind of a limit of the global production systems so cargo is becoming less profitable.

From niche technologies to mainstream systems

In thinking about the future of cargo mobilities, a crucial niche innovation we are focusing on in our project is what's called additive manufacturing. Additive manufacturing began life in the 1980s as a process called stereo-lithography. In this, you have a laser beam which melts a special resin into a solid material. This happens in a layer by layer process until the object is manufactured. So it is an additive process. This is remarkably different from manufacturing in traditional subtractive ways, namely through reducing a block of material through cutting, beating and melting. By manufacturing additively using a computer and a printer very little material is wasted and objects can be made near to the designer or consumer and with customised features. Because this innovation developed from the same

technology as paper printers this is called 3D printing and many of the machines look a lot like paper printers. At the low end of the market are these small desktop machines, like this, which are being used by enthusiasts and hobbyists to make toys, models and accessories for mobile phones. These are developing alongside online repositories of designs and this uploaded, downloaded and shared. Many of these designs are created through 3D scanners. These devices copy an existing object and create an online digital version which can then be printed itself. So far, engineers and architects use 3D printers to make rapid prototypes. So before sending them off to traditional mass manufacturing systems, they can actually make a model and test it. But many businesses through doing this actually realise they can make final objects. So the car company Rolls-Royce, the aeroplane company Boeing, all use very high-end expensive 3D printers worth millions of pounds to make finished parts for their cars and planes. These printers can make objects in metal using lasers to melt powders. These kinds of things are very expensive kind of stuff.

A new system of manufacture close to the consumer

So what appears to be emerging is a new system where you have objects both at the high end and the low end of the market being manufactured near to the designer or the consumer. This has huge implications for cargo-mobilities. In the additive manufacturing system, standardised material feedstock such as liquids, powders, resins, plastic wire, these all being transported in bulk before being converted into objects. In cargo-mobilities what we see is a challenging of these innovations. So you can reduce or augment or even increase transportation and freight (by shipping resources rather than finish goods.) To explore the possible implications of this niche innovation on cargo-mobilities we created four possible future scenarios. Each different future was organised around two key research areas. The first one was to look at how much individuals will engage with 3D printing. We asked: how accessible are computer software interfaces for individuals in the home or in a community and how as well what they make, how can they share or scan designs themselves? Further, how much will individuals depend on mediators and third parties to provide 3D printing for them outside of the home in specialist stores or shared centres? The second research area examined how corporatized 3D printing will be in the future. We asked: how much will this involve companies, intellectual property, patents, investors and this kind of things? So, will communities, volunteers, hobbyists, enthusiasts, open-source innovations... will motivate the new system instead? When we look to this kind of different futures, we look to each world as being self-contained within its certain logic. The future could certainly involve different combinations of these worlds but what we wanted to do is capture what was distinct in each different world and this will allow us to look at different parameters across a spectrum.

Scenario 1: Desktop factories in the home

The first world we looked at was this idea of the "Desktop Factories in the Home". In this world we imagined a high engagement of individuals with 3D printing both in terms of designing and sharing their own files. As well Printers would turn up in the home like papers printers and they will being used for all sorts of everyday tasks. In this world what we see is low corporatization so what this means is that in a similar fashion to music and books there's attention in the disruption based to empiracy, peer-to-peer sharing, open-source software and technology, and reverse engineering of products through home 3D scanning, and this is made unprofitable for businesses, and also inventors and designers too. Instead online repositories for files will allow makers to simply download and print all sorts of objects. This includes toys, tools and kitchenware. There is possibility for printing things like, clothing and electronics. This stuff is at the moment still in a lab. With mixed materials too that's something that hasn't really come to flourishing in terms of innovation. For the whole market it looks like a kind of very simple objects at the moment.

Scenario 2: Localised manufacturing

The second scenario we looked at was called "Localised Manufacturing" and this imagines a world where manufacturing has returned to the global North. In this world individuals are highly engaged with

3D printing but because of various cost and technological limitations they are doing the printing in various print shops so you go up the road and you can go to a print shop and print out what you've designed into your home or perhaps through your third party. A key part of this world is this idea of mass customisation, so what's happening is disruption is occurring due to the inability of traditional manufacturing to compete with the possibilities for bespoke and custom products and this is something that's happening on an individual level. So for instance, shoe was something we looked at. And this could be printed based on 3D scans of an individual's feet and also a unique selection of colours and designs as well. Significant innovations would be used interfaces to make bespoke processes accessible to individuals and this would generate a secondary market for corporations to make profit.

Scenario 3: Community craft

The third scenario we looked at was called "Community Craft". In this we imagined a world where individuals do not engage with 3D printing alone but in communities. This is a world of low corporatization, so you have collaboration and peer-production perhaps in libraries or in community centres or this kind of places. This would allow people to print what they desire and it would be most likely run by the state, so you'd have for example the provision of design repositories, technical specialists, high-end printers to libraries, schools, fab-labs, community centres and public spaces. And this you see designs customised through very simple to use interfaces. This would be controlling things like haptic controllers, so they would allow a very limited knowledge of cab design, which is for example a kind of technical software. Also you see Communities hosting events, and here they'd share their knowledge and their object designs. These would be things like maker fairs now. In a similar fashion, you'd have these kind of Massive Open Online Repositories (or MOORs) where people can swap and trade their designs. And this is already being seen now with websites.

Scenario 4: Only prototyping

The final scenario was called "Only Prototyping". This is where the hype around 3D printing has caused a market bubble to burst. Investors and innovators are disheartened with the technology so there is low corporatization. The technology is being engaged with by individuals, so you're seeing highly specialized tasks such as rapid prototyping being used for 3D printing but not perhaps the everyday printing of objects and designs. There is some key problems with 3D printings to remerge, for example the textures of traditional objects, also perhaps you might find disruptions to investors are pushing their money and venturing to other areas and so they neglected traditional freight. Companies will become the main beneficiaries of this technology so they will integrate it into their business models as well. Additive manufacturing will not just develop as a new system but will instead add to the range of current manufacturing within large-scale factories and workshops. So far I have talked about the worlds themselves and now I shall talk a bit about the implications for mobilities.

Homemade factories, the end of cargo-mobilities?

In the first scenario of home desktop printing, we see travel by consumers has been curtailed because of this idea of desktop printing or perhaps augmented to luxury "unprintable" kind of complex electronic objects. Mass manufacturers of cheap and disposable products have been forced to move up the value chain. Infrastructure for the movement of finished products is being replaced by a competing market of feedstock suppliers, all trying to compel consumers to purchase their own materials and own printing resources. This change has led to greater standardisation and automation of freight and consumer feedstocks, so they can never run low, the consumer is always going to access printing materials. In the second scenario, we see local bureaus, manufacturing return to post-industrial countries. So there is a new market opportunity now for the retail high street for freightless products. Instead of having inventories and warehouses and global production that works behind them you see bureau systems managing their own businesses in this sense too. So this is a kind of a new industry revolution. That's how it's been we talked about currently. In the third scenario of community printing, you see the international freight of finished products, as well as a kind of continuing engagement with 3D printing.

While 3D printing is taking place in people's lives, it hasn't disrupted global freight people still need to use in their everyday lives. In the fourth scenario of only prototyping, companies all have been emboldened by this idea of growth within this new innovation. They've kind of cut themselves short so they removed resources from infrastructures and this is caused bottlenecks and chokepoints. As well you see disinvestment in the retail high streets, and this has caused the loss of customers and also poor services too. In many ways this is a dystopia in all of our scenarios. Small to medium size online retailers increase due to their adoption of the technology. As well you see safety issues emerging too in transport contexts for example, as 3D printed parts are used in transport technologies and they fail and can cause the hype to be disrupted. So in all four worlds there are different consequences for what we call as cargo-mobility system. This has ramifications for policymakers and also business analysts. But what certain is, is that the future of manufacturing will change and you'll see the making of objects take precedence on the consumer level. This is the kind of things we've been working on at the Centre for Mobilities Research. We've really been trying to join the dots between production and the movement of the objects, especially objects we take and use for granted in everyday life.

Movement

Movement is the crossing of space by people, objects, capital, ideas and other information. It is either oriented, and therefore occurs between an origin and one or more destinations, or it is more akin to the idea of simply wandering, with no real origin or destination.

En savoir plus x

Mobility

For the Mobile Lives Forum, mobility is understood as the process of how individuals travel across distances in order to deploy through time and space the activities that make up their lifestyles. These travel practices are embedded in socio-technical systems, produced by transport and communication industries and techniques, and by normative discourses on these practices, with considerable social, environmental and spatial impacts.

En savoir plus x

Associated Thematics :

Policies

- Ecological transition



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Thomas Birtchnell works in the Technologies and Travel project at Lancaster University funded by the ESRC. He is also an associate member of the Lancaster University India Centre. His research interests are geographies of expertise, elites, social inequality, mobilities, innovation, South Asia, and mobile methods.

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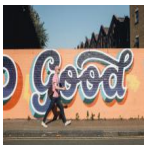
Thomas Birtchnell (11 December 2012), « 3D printing: towards a freightless future? », Préparer la transition mobilitaire. Consulté le 05 February 2025, URL: <https://forumviesmobiles.org/en/videos/510/3d-printing-towards-freightless-future>

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