Degrowth and techno-business model innovation: the case of Riversimple

Abstract

There is an emergent understanding that humanity has precipitated an 'Anthropocene' such that we are now operating in a reduced space for humanity in which urgent action is required. This case study paper links degrowth, technological innovation, business model innovation and corporate governance. The arguments are illustrated with the case of an embryonic vehicle and mobility business called Riversimple. The paper shows that radical technology innovations in the vehicle itself are achieved by underlying principles that focus on mass decompounding, powertrain de-coupling, whole system design, and low-volume production systems. The characteristics of the technologies are fundamental to, and in part derive from, the business model adopted by the case, and the governance structures designed to avoid the primacy usually afforded to returns to financial shareholders. While the case is embryonic, the paper argues that an important possible contribution is the ability to commence a disruptive transition to a degrowth future from within existing legal frameworks, social practices, cultural expectations and physical infrastructures.

Keywords

Automobility; degrowth; small scale; corporate governance; car industry; technological innovation

Highlights

- This paper provides a case study of technology innovation for degrowth.
- This paper shows complementary innovations in business model and governance.
- This paper Illustrates disruptive innovation within existing legal frameworks.

1. Introduction

The impact of human activity on earth ecological, meteorological and geological systems has reached a point where there is a consolidating view that we have created the Anthropocene, the geological era of humanity. We have changed fundamental earth systems profoundly and rapidly (Crutzen, 2002; Steffen et al., 2007), leading to the need for a drastic reversal of our impacts. The degrowth agenda has sparked imaginative debate over the future of social equity in a resource-constrained and environmentally-challenged world. In this regard it functions as what Kallis (2015) and Demaria et al. (2013) refer to as a 'missile concept' that is deliberately subversive in seeking to challenge the underlying assumptions that have accumulated around the promulgated belief that economic growth is fundamental, a universal benign goal that societies and individuals should continuously seek. Degrowth thus seeks to challenge the essence of progressive liberal modernism, which holds that quantifiable material welfare increases within a lifetime or across generations are the means by which we can evaluate whether a socio-economic system has failed or succeeded (Latouche, 2009; and see Sekulova (2015) and other contributions in D'Alisa at al., 2015). In contrast,

the roots of degrowth lie in Marxism and in the multiplicity of endeavours for environmental justice within the realm of ecological politics (Kallis, 2015).

At its heart therefore the degrowth agenda is the source of creative destruction that seeks to shatter the existing order while holding up some vision of what the future may be (Schumpeter, 1975; Roth et al., 2015). Crucially, however, the journey from here to there is one of contested transition, as is evidenced by the discourses in The Great Transition forum to which Kallis (2015) has contributed. Indeed Kallis takes the view that:

> '(The) objective is to open up conceptual space for imagining and enacting diverse alternative futures that share the aims of downscaling affluent economies and their material flows in a just and equitable manner'

The urgent task is one of seeking to understand, and indeed promote, the transition process towards a different future given contemporary contexts and constraints such as the breach of sustainable levels of carbon in the atmosphere, and given contested visions of potential futures. Despite the deeply grounded critique of capitalist neo-liberal market structures as the primary resource allocation mechanism in most societies, little has been said about the function of business in the transition to and dynamic reproduction of degrowth. As business appears to be socially and politically unassailable as the primary organisational template able to mobilise and bring to bear technological innovations on a scale and at a pace that can materially alter net sustainability, it seems that this theoretical and empirical gap is deserving of more research attention alongside an evaluation of the impact of technological innovation (Boons and Lüdeke-Freund, 2013; Bocken et al., 2014). It is notable that not only are there many national or even regional 'varieties' of capitalism (Lane and Wood, 2009; Schneider, 2009; Walker et al., 2014), so too are there multiple hybrid forms and business models that fall short of the publicly-listed enterprise focused on short-run profit maximization. If 'downscaling' is regarded as a process rather than an end point, it may also be argued that the research task is to identify whether the alternatives to mainstream capitalism either bring forward qualitatively different technologies, or apply technologies in qualitatively different ways that allow progress towards a degrowth society.

One currently important activity that is highly resource-intensive in its current technological paradigm is that of personal private mobility, as enabled by the contemporary automotive industry. The core technologies and materials of the car rely almost entirely on the extractive consumption of scarce resources via capital intensive factories predicated upon economies of scale and the continued expansion of production to generate profits via growth (Wells, 2010). Using the example of a UK small business in the realm of low-carbon mobility this paper argues that the key to achieving the application of technology in a degrowth world lies both in the nature of the technologies themselves and in the management structure of this case, wherein the financial 'voice' is no longer the most powerful one guiding the business. Ethical management embodying distinct sustainability values (Schaltegger and Burritt, 2015) is allied with an open source structure that provides substance to democratise technology on a 'downscale' and localised template (Curtis, 2003; Fournier, 2008). Hence the paper is premised on the perspective that some technologies, at least as discussed here, are potentially suitable for a degrowth economy even where they have originally arisen in very different settings. The case study company, for example, uses fuel cells

already in production for applications such as forklift trucks used in warehousing. Hence these are not 'alternative' technologies (although they are qualitatively and empirically different to the existing mainstream automotive industry) so much as technologies applied in an alternative manner.

2. Technology, business models and micro-governance in a degrowth context

The case discussed here resonates with ideas promoted under the umbrella term of Micro Factory Retailing (MFR) by Wells and Nieuwenhuis (1999; 2000) in which it was argued that technology innovations with low environmental impact also had to be nurtured within non-traditional business models that allowed survival against powerful competitive forces by changing the terms of competition. The MFR model was predicated on several related observations pertaining to the mainstream automotive industry. The core technology of the industry was understood to be the all-steel body, which determines the economies of scale in the industry and for which the stamping, welding and painting operations constitute about three-quarters of the total investment in a car factory. Typically a modern factory of say 300,000 units per annum output would require around $1 billion to build; and a new model would require about the same with over half dedicated to the design and tooling of that body. In turn, the steel body determined the weight and hence overall (environmental) performance of the car, and remains a key factor in making battery-powered cars unattractive. Furthermore, the ex-works cost of a typical car is about 60% of the total cost, with the rest accounted for in distribution and marketing costs, mostly borne by the franchised dealerships. So, one means to introduce a radical and environmentally-enhanced powertrain technology into the car industry would be to design an alternative business model that does away with the cost of distribution by combining the factory with the retail operations, and to take advantage of alternative material and process technologies that would allow much lighter vehicles but that were not competitive with steel in high volume. Out of this analysis came the MFR concept in which the underlying intention was to define a business structure and market entry strategy that would be competitive with the mainstream on total cost of ownership, because the business had to be able to survive if it were to make a difference in terms of environmental performance. The investment costs are only a few million, and the market is expanded by incremental establishment of new locations in alignment with demand.

To date degrowth proponents have not engaged greatly with the contribution (or lack thereof) of technology – hence the call for papers (Kerschner et al., 2015; Roth et al., 2015). As with other aspects of socio-economic life, technology development has become increasingly centralised, bureaucratic and orchestrated by established vested interests in neo-liberal or 'green growth' framings (Senker, 2015), with the eco-efficiency measures that result fatally undermined by rebound effects and continued market growth. The scope for innovations stimulated by and intended to achieve degrowth appears limited, yet technologies may be re-applied in novel ways and in novel settings, or emerge as novel solutions, as various grassroots energy innovations have shown (Dóci et al., 2015). So, it is apparent that exploration of the potentialities of technologies within a degrowth context is important.

However, if such technologies are to be enfranchising, liberating, and egalitarian, and to make a substantive reduction in net material flows, then there needs to be a synergistic fusion in the application of those technologies to distinct business models. This is because many technologies

have the inherent qualities that would allow application in a degrowth sense or in a traditional growth sense. Outside of the degrowth debate it is apparent that the former faith placed in modernism and the transformative potential of technologies in general has been fractured by contemporary experiences. While some authors have previously highlighted a growing ambivalence with strategies such as ecological modernization (Cohen, 2006), Kerscher and Ehlers (2016) identify four distinct attitudinal categories with respect to technology: Enthusiasm, determinism, romanticism and scepticism. These attitudes towards technology thus emerge out of underlying 'world views' or ontologies, with perhaps the understanding that perceptions of technologies may depend upon the ways and contexts in which they are applied.

In the degrowth concept much is made of forms other than 'normal' business, such as worker co-operatives, yet these too illustrate ambiguities and contradictions – for example The Mondragon Corporation exhibits a strong commitment to growth (White, 2015). Hence technology innovation needs to occur alongside or within 'values innovation' as proposed by Breuer and Lüdeke-Freund (2015) wherein it is argued that technological innovations needs to be linked to profound shifts in the values underpinning business (Schaltegger and Burritt, 2015). Attention has been given to strategies for the macro-economic achievement of degrowth via major structural changes without catastrophic socio-economic consequences (Pueyo, 2014). In other words, to date the rich debate around degrowth, encompassing many perspectives, discourses and views, has been preoccupied with the grand picture. At this juncture, the actualisation of degrowth thus requires the same quality of rich debate but at the micro-economic level of organisations, the technologies they employ in production or service delivery, the technologies embedded in the products and services they deliver, and the management structures that shape not only the need (or not) for growth but also the wider ramifications of those constituent technologies.

One fruitful avenue of research has been with regard to innovation in business models, both for existing and new businesses, as a means to achieve sustainability (Bocken et al., 2015; Schaltegger et al., 2016) or to inform the innovation process (Bocken and Short, 2015; Rauter et al., 2015). Technologies may or may not feature explicitly in these accounts, because changing business or consumer practices can be just as powerful as a means to changing material flows and resource consumption. This is particularly evident in the realm of clothing and fashion, where the materials and technologies employed are relatively stable, but where the shifts in value creation and capture alongside changes in consumer practice can yield substantial reductions in environmental load per unit of consumption (Armstrong et al., 2015).

3. Riversimple: an exemplar

This section discusses Riversimple, an SME that has a unique approach to the technologies of automobility allied with a novel business model and corporate governance concept. Riversimple has a factory in a small town in Wales (UK), some twenty employees, and two prototype products models called the Rasa. It has funding (currently £2 million from the Welsh Assembly Government) to support the protoype programme, and a plan to move to demonstration projects in Swansea (Wales) should the crowdfunding initiative prove successful. It has a plant design capacity for 1,750

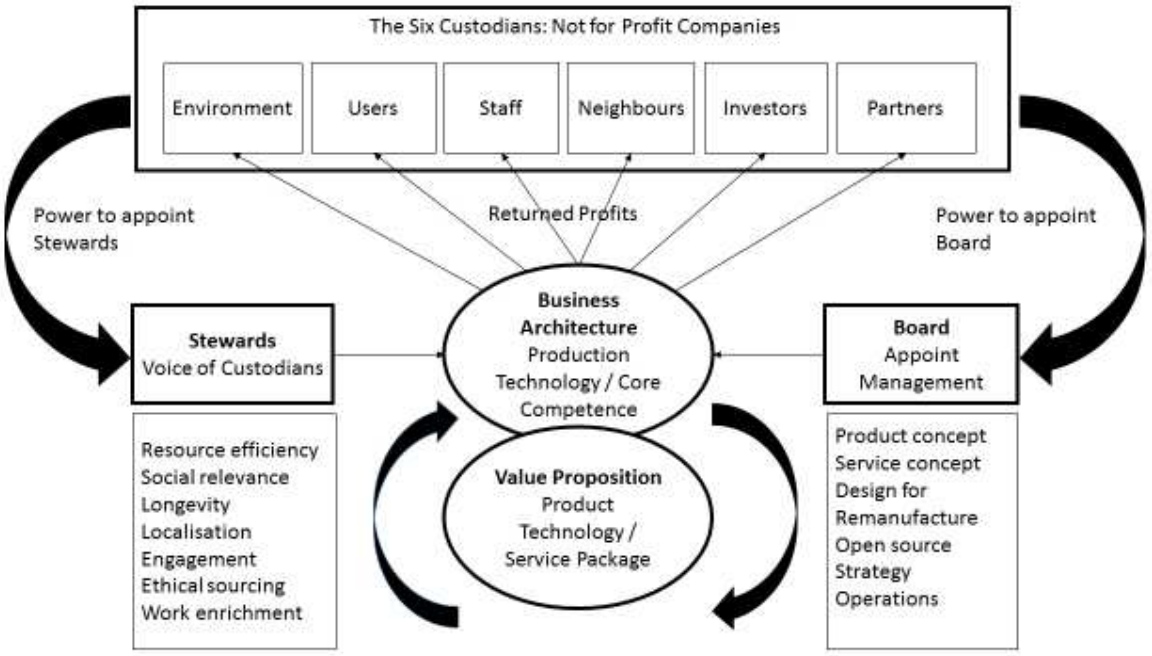
cars per shift per annum, with the intention to locate the plant also in Swansea, Wales. The demonstration project envisages a fleet of about 50 cars with users from private, corporate and public authority sectors, along with three refuelling stations. It is not yet an ongoing example, however, despite many years in development with support for technology projects from government agencies such as the UK Technology Strategy Board (now Innovate UK). Riversimple has one ambition: 'Our aim is mobility at zero cost to the planet.' Such an aim might not be achievable in providing automobility, but the ambition is significant. But there is also an awareness of the social requirement: 'We don't believe eco-cars should be expensive. We don't want our customers to run the risk of unknowable depreciation. Our approach makes eco mobility both affordable and knowable for everyone not just the wealthy few.' (www.Riversimple.com accessed 12/06/15). Riversimple is a business, and seeks to generate a return on investment. It is notable in this regard that Josu Ugarte, former president of Mondragon International, was quoted as saying 'Profits are essential. Riversimple takes a similar perspective, with the view that profit needs to be generated, both to return to investors and to bring forward further technologies. Without profits, it is argued, an enterprise will fail, and employment cannot be sustained (White, 2015), though this does in turn raise the question of how profits are distributed and shared.

3.1 Riversimple: Business model and corporate governance innovations

It is important to understand that for Riversimple the technologies and the innovations in business model and governance structure are all part of one cohesive approach to the activity of providing mobility and aspiring to zero environmental cost (Bocken et al., 2015). This 'whole system design' is thus integral to understanding the potential contribution to degrowth as a 'flourishing' business (Bocken et al., 2013). If successful, the Riversimple concept would radically reduce the number of vehicles required to be produced or used for a given 'quantity' of mobility, and hence would contribute to degrowth.

In principle this is a structure to enable the practical democratisation of technology, and hence may have appeal to the degrowth agenda in which greater participatory control by workers and communities is seen as desirable. The business model and governance structure is illustrated in Diagram 1. In essence, Riversimple has six custodian bodies, separate legal entities who are the sole members of Riversimple LLP. They jointly appoint the board to oversee the day-to-day management and strategy, and the Stewards (one to each of the six areas shown in Diagram 1) to oversee the wider social, environmental and economic implications of the business. Importantly, the 'investors' are only one of the six custodian body, and each custodian body has an equal voice, so the financial concerns are not prioritised to the exclusion of all else. Riversimple, as of early 2016, is engaged on a crowdfunding process to provide the required investments. The stewards, appointed by the custodians, may bring their distinct expertise and interests to bear on the company in one of the six areas but are distinct from the management team that runs the business day-to-day.

Diagram 1: The Riversimple business model and governance structure



The business model at the heart of it all is founded on the characteristics of the underpinning product technologies reinforced and enabled by a 'sale of service' approach in which the business retains ownership of the products as assets. It is notable that the mobility service package includes fuel consumption, thereby providing an incentive for the business to improve the operational efficiency of the product. The stewards have a role in ensuring that, over the long term, the business remains true to its principles rather than seek to extract some form of monopoly rent and increase charges in the future. The concept is predicated upon the product being returned every three years to be 'refreshed' both cosmetically and practically before being made available again to users. In principle such an approach is well-understood in product-service systems as being a mechanism that encourages product longevity by design and hence reduce resource use. Such a model would readily suit car-sharing concepts, though at present they are weakly developed in the UK compared with other locations such as Germany (Hinkeldein et al., 2015). Several cycles of refreshment are possible; but a potential 'gap' in the concept overall is the matching of use cycles with refresh (and ultimately rebuild / recycle). If a user holds a vehicle but does not use it intensively the vehicle may be refreshed unnecessarily. This is a complex issue for any product, but particularly cars but in a degrowth context linking the refresh approach with car sharing schemes may offer a means for the graduated reduction of the total vehicle population and the consumption of resources for new cars (Firnkorn and Müller, 2011). Currently cars suffer high rates of financial depreciation that are both time and mileage related, but also a symptom of over-production. Combined with high repair and maintenance costs, depreciation can mean that cars are scrapped because their economic value has declined below the point of viable repair, but before the physical limits of durability have been reached. The Riversimple design and use of technologies partly addresses this problem, because the most common cause of vehicle scrappage is usually that the steel body has deteriorated beyond

economic support: The composite body offers greater longevity. In addition, for example, the ultra-capacitor supplier will take back the old units, and refurbish them to return to Riversimple. Nonetheless, what if the business model adopted by Riversimple results in more intensive use patterns? In a circular economy this may be a good thing; as economic value is 'pumped' around more quickly and hence is greater for a given unit of ecological resource; but in a degrowth context perhaps the emphasis should be on reducing the use of mobility.

3.2 Riversimple technological innovations

A conventional standard car seats five adults and is comprised of an all-steel body, an internal combustion engine with associated gearbox, fuel tank, and multiple ancillary items. It typically weighs 1400 to 1600 kg. Approximately 14-30% of the energy in the fuel actually drives the vehicle, with the rest lost as heat, driveline inefficiencies and powering ancillary items (DOE, 2012). Most of this energy is then consumed accelerating the vehicle mass rather than the occupants. The engine and gearbox combination is sized to meet the acceleration demands.

The key technological innovations at Riversimple are clearly related to developments elsewhere, yet also rather different in execution. The technologies are not artisanal but are open access with the positive intent of ceding control. The product that lies at the centre of the business is recognisably a two-seat and two-door car (the prototype is called the Rasa), but with distinctive features arrived at through a 'mass de-compounding' approach to the design and a novel vehicle architecture that is termed a New Electric platform. It has the following features:

- A lightweight carbon-fibre reinforced plastic structure that is stiff, safe and reduces energy demand during use;
- A hub motor in each wheel able to supply regenerative breaking; eliminating the need for a gearbox or driveshaft;
- A hybrid ultra-capacitor battery to store and deliver energy;
- A small fuel cell supplied with hydrogen.

Material and energy flows are still present of course. Composite materials as used in the vehicle body are energy-intensive; indeed this is one reason why BMW has used hydro-electric power in Moses Lake, USA to create the carbon fibre required for the i3 and i8 models. Recycling of carbon composites is an area still under development (Pimenta and Pinho, 2011). Furthermore, equipment such as the hub-motors and ultra-capacitors require rare earths, aluminium, copper and other finite materials that require energy to processed or re-processed. Some components (such as the tyres) use rubber that, while from a renewable source, is problematic to recycle. Similar concerns surround the use of scarce materials and rare earth metals in, for example, wind and solar power installations: does the renewable power thereafter supplied justify the (high) environmental cost of obtaining such materials? What about the issues of spatial inequality that the exploitation of such materials raises? (Exner et al., 2015). The strategic focus in Riversimple is on that has been termed 'technical

nutrients'; that is, materials able to be recycled and on a design philosophy that seeks to maximise the technical and economic potential of such recycling.

By decoupling acceleration demands from cruising demands, with 80% of the acceleration provided by the ultra-capacitor, the fuel cell is an order of magnitude smaller than other automotive examples – resulting in a car that is lighter and cheaper. Riversimple therefore is able to use a standard fuel cell designed for use by forklift trucks in warehouses and factories, as opposed to the large, complex and expensive fuel cells deployed in test vehicles by the mainstream automotive industry. Mass reduction in turn means power-assisted brakes and steering are not required, resulting in further mass and cost reductions. Pervasive minimalism is thus key to reducing material demands, which in turn reduce the energy required during driving. From a degrowth perspective then these technologies are combined to offer equivalent quantities of mobility, but with a much reduced mass of materials.

As a package, therefore, the cars are highly efficient. Prototype test mules have delivered in excess of the equivalent of 106 km/litre, with a range of some 480 km, acceleration 0-50 kph of 5.5 seconds, a top speed of 80 kph, and can be refuelled in three minutes. The car is not designed or suited to contemporary motorway driving – it is worth noting that the high speeds of motorway use come with the penalty of greatly increased fuel consumption. Clearly, a relevant consideration is the source of hydrogen fuel used, an issue which is currently outside the scope of the business. The fuel cell could be replaced with batteries, and the same design approach would broadly yield the same benefits. Table 1 compares the Riversimple concept with the BMW i8 and the Tesla Model S, where it is shown that the Riversimple car is substantially lighter than both, and offers a different technology package.

Table 1: Riversimple, BMW and Tesla models compared

Manufacture	Riversimple Rasa	BMW	Tesla	BMW
Model	Prototype	i8	Model S	i3
Mass (kg)	560	1,500	2,100	1,300
Power	Fuel cell and ultra-capacitor	Plug-in electric hybrid with 1.5 litre 3-cylinder combustion engine	Battery electric	Battery electric (Range extender optional)
Vehicle body	Carbon fibre reinforced composite (autoclave)	Carbon fibre reinforced composite, bonded panels	Steel welded panels	Carbon fibre reinforced composite, bonded panels

(Sources: www.riversimple.com; www.bmw.com; www.teslamotors.com. All accessed 25/05/16)

In terms of mainstream fuel cell vehicle competitors, the Toyota Mirai has a retail price in the UK of £66,000, with a lease package of £750 per month that includes everything (including fuel). It has a range of 150 miles if filled at a 350 bar refuelling station; and 300 miles if filled at a 700 bar refuelling station. Toyota planned a 2015 production volume of 700 cars. The Hyundai ix35 SUV has a retail price in the UK of £53,000. It has a 100kW fuel cell equivalent to 134bhp, a 144 litre hydrogen storage capacity in two tanks, a 100mph top speed and a claimed range of 369 miles. From 2016 Hyundai expects to build as many as 10,000 units per year. Both these cars are large, heavy vehicles. The Mirai weighs 1,800kg for example compared with the Riversimple Rasa at 560kg. The Honda FCX Clarity is expected to cost about £42,000 when released in the UK in late 2016. The proposed package of for the Rasa is £370 per month and £0.18 per mile variable cost. This can be compared with others as follows: Riversimple Rasa net per mile cost £0.44, Smart ForTwo £0.34, BMW i3 range extender £0.54, and VW Golf 1.6 TDI 3 door £0.43.

A further feature of the Riversimple technology approach is openness. The business actively wants others to share and even improve upon its technology and approach (see http://www.40Fires.org Accessed 20/06/15) rather than extract monopoly rent through patenting. A somewhat hidden feature is that, as a result of the business model in which the business retains ownership of the cars and 'refreshes' them on repeated three year cycles, there is a strong emphasis on longevity and repairability. Moreover, suppliers are encouraged to adopt the same stance, such that the technologies that are supplied by independent companies (like the super-capacitor) are not bought by Riversimple but leased.

The core technologies in the composite structure have the potential to be used in digital 3D printing (as evidenced by e.g. Local Motors – see localmotors.com), which could in turn allow individuals and communities to create bespoke solutions to their mobility needs (Kostakis et al., 2015). Even in the current formulation, the Riversimple business model envisages manufacturing facilities that would be very small by existing industry standards, delivering up to 5,000 units per annum – which is pretty close to the daily output of a plant like VW Wolfsburg. Low-volume manufacturing potentially reduces the risk of over-production and allows the company to gain a foothold in the market against incumbent competitors, and is achieved by the combined selection of product (and material) technology design, and process technology design.

It is also important to compare the approach offered by Riversimple with other forms of mobility with low ecological impact such as the general category of electric two-wheel vehicles, of hybrid constructions such as the Twike, and of very lightweight vehicles such as those represented by the 'voiture sans permit' category in France (Fishman and Cherry, 2015; Rose, 2011).

4. Discussion: Pathways, strategies and transitional phases

The degrowth literature is strong on socio-economic and ecological critique, both of capitalism and of alternative production modes (Fournier, 2008). There is also an emergent vision of grassroots social change and pathways (Videira et al., 2014), along with some ideas for the macro-level of

governance at national and international scales. As the exploration of degrowth ideas expands, so too will other voices be heard, enriching the concept but also with a more tangible focus on the achievement of change. Reformist positions that reject the absolutism of degrowth (Kallis, 2011) or business as usual have also been offered (Boonstra and Joosse, 2013; Jakob and Edenhofer, 2014; Geels et al., 2015); inevitably there is much agreement and disagreement over the art of the possible, the pace of change, and the ultimate desired destination (Escobar, 2015). It is worth noting that even if degrowth is indeed a necessity, it does not make it inevitable – humanity has an established history of failing to respond to impending ecological disaster (Diamond, 2005). Still, the voices for green growth such as Ferguson (2015) recognise the tension in their position, but seek to advocate 'avoiding direct and disempowering discursive conflict' with entrenched pro-growth positions. Others such as Kuchler (2014) argue that such conflict avoidance is futile, because the ideological dominance of rationalist cost-minimisation economism remains the ultimate arbiter of futures decisions. Indeed Kallis and March (2015) contend that degrowth has political conflict at its heart as a constitutive element – though quite what is meant by this rhetorical position is not clear. Hence there is a sense in which the core debate is around whether change should be revolutionary (and hence possibly conflictual), or reformist (and hence possibly ineffectual). Technology innovation does not per se resolve these debates, but can as in the case of Riversimple provide a means to allow diverse resolutions.

One critical problem at this juncture is that the sort of macro-scale changes discussed by Kallis and others with respect to pollution, resource extraction, property, credit, the public control of money, or employment institutions are distant ideals. Brave micro-scale alternatives have a long history (in the UK there was the ill-fated Lucas Aerospace Shop Stewards Alternative Plan for example), but equally have largely failed to flourish in the hostile context of over-arching neo-liberal economies. As Kallis et al. (2012) note, one key question is how will production be organised in a degrowth world. It is a theme taken up by Bloemmen et al. (2015) in their treatment of the microeconomic dimensions of degrowth in community agriculture, and in which the themes of normative values and innovative governance are prominent. It is proposed in this paper that the journey Riversimple has embarked upon is a meaningful transitional solution that is achievable while 'inside' contemporary economies, while simultaneously providing a potential constituent ingredient of the radically different degrowth future. Certainly, for the founder Hugo Spowers the enduring legacy is not sought with regards to the technologies of the car itself, or even with the redefinition of personal private mobility. Rather his ideal is that the business model and governance concept be replicated and applied in multiple arenas and markets as a structure to enable the democratic localisation of zero burden provision. Hence Riversimple could be understood as an under-developed form of collective and politically-motivated precursor to degrowth as defined by Kunze and Becker (2015), or as the sort of creative commons of design and manufacture post-capitalist production model as defined by Kostakis et al. (2015).

On the more positive side, a further provocative feature of the Riversimple case is that it opens up the possibility that even within existing legal structures it is possible to design an activity that offers a transitional pathway to degrowth, which in turn suggests that capitalism in its infinite variety may yet provide radical business innovations to resolve its own contradictions. Riversimple has yet to achieve market success, while its current existence is dependent upon state funding. It raises the question of what sort of legal changes, if any, are required to provide the framework for degrowth to occur. Just as the capitalism envisaged by Adam Smith's invisible hand is far removed from

contemporary corporate structures, so is the model envisaged in Riversimple far removed from the vast corporate structures of the contemporary automotive industry. Schumacher (1973) was concerned that corporations and the technologies they nurtured had expanded beyond the ability of individuals to comprehend them; Riversimple provides a means to recapture a comprehendable scale. Hence while capitalism clearly has exhibited a powerful destructive logic, it also has a creative logic than cannot be ignored (Brie, 2015). Moreover, as Buch-Hansen (2014) argues, the 'varieties of capitalism' school of thought demonstrates that contemporary capitalism exhibits great diversity, and we may expect degrowth to do the same. Hence the solutions in a country like the UK may not appeal or be viable in other capitalist contexts.

5. Conclusions

The Riversimple exemplar is compelling in the two senses in which it undermines contemporary capitalism from within and thereby contributes to creative destruction for degrowth. First, it uniquely combines very low impact technologies in pursuit of minimalism in mobility with innovations in business model and governance structure to create a 'triple alliance' holistic structure. Certainly, there is a strong undercurrent of technological optimisation and rationality in the approach. Yet, it provides an adaptable template that seeks to put meaningful power and influence in to concepts like localisation through a small-scale business model designed to operate in spatially-bounded markets. Second, and just as importantly, it provides a way of shifting the terms of competition away from the dominant, centralised, capital intensive, resource-intensive business structures prevailing today, of which the automotive industry is a classic example, and in so doing actively contributes to undermining the economic basis of that industry. The inability so far of Riversimple to achieve its aims is equally significant. In this regard, while the future success of Riversimple can be measured by the number of cars that the conventional industry fails to produce and sell, and a net reduction in the total number of cars in use, thus far the technology development has gained support but the business concept has not. The reduction in cars in use would occur in a manner similar to that observed already for car-sharing schemes (Firnkorn and Müller, 2011). As noted above, a successful Riversimple may result in more intensive use, particularly if the low-cost aspirations are realised. The concepts within the technology and business / governance model adopted by Riversimple are readily adapted to more collectivist, socially-framed initiatives. They would work as well with the Autolib scheme in Paris for example.

In conclusion, the focus on the technology dimensions of degrowth is certainly welcome and necessary in relation to the more abstract though deeply theorised formulations of the macro-economic aspects. This paper seeks to illustrate the idea that an equally richly theorised and empirically robust understanding of the micro-economic level is partially but not completely covered by thinking about technologies, and that the practical implementation of degrowth needs a combination of the over-arching policy dimensions and the grassroots activist dimensions.

Acknowledgements

The author would like to thank the editors and reviewers for their insights and encouragement in the preparation of this paper.

References

Armstrong, C.M.; Niinimäki, K.; Kujala, S.; Karell, E. and Lang, C. (2015) Sustainable product-service systems for clothing: Exploring consumer perceptions of consumption alternatives in Finland, Journal of Cleaner Production, 97, 30-39.

Bloemmen, M.; Bobulescu, R.; Le, N.T. and Vitari, C. (2015) Microeconomic degrowth: The case of Community Supported Agriculture, Ecological Economics, 112, 110-115.

Brie, M. (2015) Contribution to debate on John Bellamy Foster's essay on Marxism and Ecology http://www.greattransition.org. Accessed 15th September 2015.

Boons, F. and Lüdeke-Freund, F. (2013) Business Models for Sustainable Innovation: State of the Art and Steps Towards a Research Agenda, Journal of Cleaner Production, 45, 9-19.

Boonstra, W.J. and Joosse, S. (2013) The social dynamics of degrowth, Environmental Values, 22(2), 171-189.

Bocken, N.; Short, S.; Padmakshi, R. and Evans, S. (2013): A value mapping tool for sustainable business modelling, Corporate Governance: The International Journal of Business in Society, 13(5), 482–497.

Bocken, N.; Short, S.; Rana, P. and Evans, S. (2014), A Literature and Practice Review to Develop Sustainable Business Model Archetypes, Journal of Cleaner Production, 65, 42-56.

Bocken, N.M.P.; Rana, P. and Short, S.W. (2015) Value mapping for sustainable business thinking, Journal of Industrial and Production Engineering, 32(1), 67-81.

Bocken, N.M.P. and Short, S.W. (2015) Towards a sufficiency-driven business model: Experiences and opportunities, Environmental Innovation and Societal Transitions, 18, 41-61.

Breuer, H. and Lüdeke-Freund, F. (2015) Values-Based Innovation Framework – Innovating by What We Care About, The XXVI ISPIM Conference – Shaping the Frontiers of Innovation Management, Budapest, Hungary. 14-17th June 2015.

Buch-Hansen, H. (2014) Capitalist diversity and de-growth trajectories to steady-state economies, Ecological Economics, 106, 167-173.

Cohen, M.J. (2006) Ecological modernization and its discontents: The American environmental movement's resistance to an innovation-driven future, Futures, 38, 528-547.

Curtis, F. (2003) Eco-localism and sustainability, Ecological Economics, 46(1), 83-102.

Crutzen, P.J. (2002) Geology of Mankind: The Anthropocene, Nature, 415(6867), 23.

D'Alisa, G.; Demaria, F. and Kallis, G. (2015) Degrowth: a Vocabulary for a New Era, London and New York: Routledge.

Demaria, F.; Schneider, F.; Sekulova, F. and Martinez-Alier, J. (2013) What is degrowth? From an activist slogan to a social movement, Environmental Values, 22(2), 191-215.

Diamond, J. (2005) Collapse: How societies choose to fail or succeed, Los Angles: Viking Press.

Dóci, G.; Vasileiadou, E. and Petersen, A.C. (2015) Exploring the transition potential of renewable energy communities, Futures, 66, 85-95.

DOE (2012) Where the energy goes: Gasoline vehicles, United States Department of Energy, http://www.fueleconomy.gov/feg/atv.shtml (Accessed 30th May 2015).

Escobar, A. (2015) Degrowth, postdevelopment, and transitions: a preliminary conversation, Sustainability Science, 10(3), 451-462.

Exner, A.; Lauk, C. and Zittel, W. (2015) Sold Futures? The global availability of metals and economic growth at the peripheries: Distribution and regulation in a degrowth perspective, Antipode, 47(2), 342-359.

Ferguson, P. (2015) The green economy agenda: business as usual or transformational discourse? Environmental Politics, 24(1), 17-37.

Firnkorn, J. and Müller, M. (2011) What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm, Ecological Economics, 70(8), 1519-1528.

Fishman, E. and Cherry, C. (2015) E-bikes in the Mainstream: Reviewing a Decade of Research, Transport Reviews, 36(1), 72-91.

Fournier, V. (2008) Escaping from the economy: the politics of degrowth, International Journal of Sociology and Social Policy, 28(11/12), 528-545.

Geels, F.W.; McMeekin, A.; Mylan, J. and Southerton, D. (2015) A critical appraisal of Sustainable Consumption and Production research: The reformist, revolutionary and reconfiguration positions, Global Environmental Change, 34, 1-12

Hinkeldein, D.; Schoenduwe, R.; Graff, A. and Hoffmann, C. (2015) Who would use integrated sustainable mobility services-and why? Transport and Sustainability, 7, 177-203.

Jakob, M. and Edenhofer, O. (2014) Green growth, degrowth, and the commons, Oxford Review of Economic Policy, 30(3), 447-468.

Kallis, G. (2011) In defence of degrowth, Ecological Economics, 70(5), 873-880.

Kallis, G.; Kerschner, C. and Martinez-Alier, J. (2012) The economics of degrowth, Ecological Economics, 84, 172-180.

Kallis, G. (2015) The degrowth alternative, http://www.greattransition.org/publication/the-degrowth-alternative. Accessed 12th October 2015.

Kallis, G. and March, H. (2015) Imaginaries of Hope: The Utopianism of Degrowth, Annals of the Association of American Geographers, 105(2), 360-368.

Kerschner, C.; Wächter, P.; Nierling, L. and , Ehlers, M-H. (2015) Special volume: technology and Degrowth, Journal of Cleaner Production, 108(A), 31-33.

Kerschner, C. and Ehlers, M.-H. (2016) A framework of attitudes towards technology in theory and practice, Ecological Economics, 126, 139-151.

Kostakis, V.; Niaros, V.; Dafermos, G. and Bauwens, M. (2015) Design global, manufacture local: Exploring the contours of an emerging productive model, Futures, 73, 126-135.

Kuchler, M. (2014) Sweet dreams (are made of cellulose): Sociotechnical imaginaries of second-generation bioenergy in the global debate, Ecological Economics, 107, 431-437.

Kunze, C. and Becker, S. (2015) Collective ownership in renewable energy and opportunities for sustainable degrowth, Sustainability Science, 10(3), 425-437.

Latouche, S. (2009) Farewell to Growth. Cambridge, UK: Polity Press.

Lane, C. and Wood, G. (2009) Capitalist diversity and diversity within capitalism, Economy and Society, 38(4), 531-551.

Pimenta, S. and Pinho, S.T. (2011) Recycling carbon fibre reinforced polymers for structural applications: Technology review and market outlook, Waste Management, 31(2), 378-392.

Pueyo, S. (2014) Ecological econophysics for degrowth, Sustainability (Switzerland), 6(6), 3431-3483.

Rauter, R.; Jonker, J. and Baumgartner, R.J. (2015) Going one's own way: Drivers in developing business models for sustainability, Journal of Cleaner Production, Doi:10.1016/j.jclepro.2015.04.104

Rose, G. (2011) E-bikes and urban transportation: emerging issues and unresolved questions, Transportation, 39(1), 81-96.

Roth, S.; Perez-Valls, M. and Kaivo-oja, J. (2015) Innovation and degrowth: call for papers, Prometheus. Copy obtained from: http://www.criticalmanagement.org/files/pdfs/cfp-innovation-and-degrowth.pdf. 28th April 2016.

Schaltegger, S. and Burritt, R. (2015) Business Cases and Corporate Engagement with Sustainability: Differentiating Ethical Motivations, Journal of Business Ethics, Doi: 10.1007/s10551-015-2938-0

Schaltegger, S.; Hansen, E.G and Lüdeke-Freund, F. (2016) Business Models for Sustainability: Origins, Present Research, and Future Avenues, Organization & Environment, 29(1), 3-10.

Schumacher, E.F. (1973) Small is beautiful: A study of economics as if people mattered, London: Blond and Briggs.

Schumpeter, J.A. (1975) Capitalism, socialism and democracy, New York: Harper [Originally published 1942].

Schneider, B.R. (2009) Hierarchical Market Economies and Varieties of Capitalism in Latin America, Journal of Latin American Studies, 41(3), 553-575.

Sekulova, F. (2015) Happiness, Chapter 24 pp113-116 in D'Alisa, G.; Demaria, F. and Kallis, G. (2015) Degrowth: a Vocabulary for a New Era, London and New York: Routledge.

Senker, P. (2015) The triumph of neoliberalism and the world dominance of capitalism, Prometheus, 33(2), 97-111.

Steffen, W.; Crutzen, P.J. and McNeill, J.R. (2007) The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?, AMBIO: A Journal of the Human Environment, 36(8), 614-21.

Videira, N.; Schneider, F.; Sekulova, F. and Kallis, G. (2014) Improving understanding on degrowth pathways: An exploratory study using collaborative causal models, Futures, 55, 58-77.

Walker, J.T.; Brewster, C. and Woody, G. (2014) Diversity between and within varieties of capitalism: Transnational survey evidence, Industrial and Corporate Change, 23(2), 493-533.

Wells, P. and Nieuwenhuis, P. (1999) Micro Factory Retailing: a radical business concept for the automotive industry, Sewells Automotive Marketing Review, 5, 3-7.

Wells, P. and Nieuwenhuis, P. (2000) Why big business should think small, Informa Automotive World, July/August, 32-38.

Wells, P. (2010) The automotive industry in an era of eco-austerity, Cheltenham: Edward Elgar.

White, A. (2015) Worker Cooperatives in a Globalizing World, Available from http://www.greattransition.org/publication/worker-cooperatives, Accessed 4th October 2015.