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Sustainable business models and the automotive industry: A commentary

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Abstract This commentary reviews the position articulated in an article published in 2004 that the business model prevalent in the automotive industry was inadequate to meeting the challenge of sustainability, and reviews the key developments since then. The most noticeable developments the commentary traces are the growth in academic interest in business models, a more responsive government policy particularly in respect of new technologies, and the practical application of the concepts and ideas mooted in the original paper, notably with respect to electric vehicles.

As part of the 25th anniversary volume of IIMB Management Review, we feature a previously published article, selected on the basis of its citation index, along with an appropriate commentary by the author. The commentary revisits the question addressed in the original article and discusses the changes that have taken place. The original article "Creating Sustainable Business Models: The Case of the Automotive Industry", from Volume 16 No 4, December 2004, is featured first, followed by the commentary on sustainable business models and the automotive industry.

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Creating Sustainable Business Models: The Case of the Automotive Industry

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The relationship between business and sustainability has become one of the central debates for the long-term future of human health and happiness, both in those countries that have already experienced industrialisation and in those that are undergoing the transformative impact of the process. It is already apparent that in certain critical respects the prevailing business models may be inappropriate and inadequate to meeting the challenge of sustainability. While there is a significant school of thought that argues for 'factor *x*' resource efficiency improvements that will allow even the poorest nations in the world to attain the material standards of living existing in the industrialised nations (von Weizaecker, Lovins, & Lovins, 1997), this paper argues that substantial and enduring beneficial change may be realised through the radical re-design of the prevailing business models (Elkington, 2002; Hart, 1997).
Underneath this fundamentally simple idea is a more controversial theme: that there is an intimate causal relationship between such issues as the characteristics of product technology, the industrial processes required to create that product, the structure of the industry that emerges to supply the product, and the business models employed by firms operating in that sector of the economy. This set of inter-dependencies suggests that, for example, it can be difficult for an established sector to absorb new technologies or, put another way, that new technologies in product and process create and enable new business strategies. As a result, the search for sustainable business solutions cannot be reduced to technological fixes alone, or to the piecemeal reconfigurations of parts of the value chain that some analysts advocate (Angell & Klassen, 1999). Moreover, a sustainable product cannot be produced by an unsustainable industry. Equally important is the idea that the 'normal' business challenges being grappled with by management today are intimately bound up in the environmental and social challenges: in other words business management and strategy pertaining to environmental issues and the wider themes of sustainability are no longer marginal, they are absolutely central (Schmidt, 2001).

Product, process, structure, and the prevailing business model

Time and place: why context matters

The application of environmental thinking and the wider theme of sustainability into the business and management realm have unfolded over many years. There has been a growing realisation that business involves more than the narrowly determinist pursuit of profit maximisation and instrumentalist rationality (Elkington, 2000). Business is part of civil society; it is embedded in the social, political, and cultural evolution of the community from local to international level. Indeed, business is fundamentally a social institution, not apart from or autonomous from the social structures within which it exists. This is precisely why crude models of globalisation have foundered, and more recent theorisation of international strategy has sought to emphasise the distinct and multi-dimensional character of localities (Ricart, Enright, Ghenawat, Hart, & Khanna, 2004). Hence, in contemporary discourse, business is expected to embrace and give substance to concepts such as corporate social responsibility, business ethics, and product stewardship. At the same time, it is evident that in certain key respects business in, say, India, is different to that in Argentina, or business in 2004 is different to that in 1904. Time and place make a difference.

The debate over sustainability ranges long and wide and by no means centres upon the purpose and contribution of business. Nor is business immune from such a debate—it is often an active participant. Sustainability has always been a tri-polar concept: economic, social, and environmental. An activity is only sustainable if it works in terms of economic stability, social welfare and environmental equity. Many of the techniques and procedures being deployed to gain an empirical understanding of corporate sustainability themselves demand a system-wide analysis but neglect the possibility of structuring business models in different ways. The rich theoretical and methodological field of industrial ecology for example, using tools such as Life Cycle Analysis and mass balances, can quantify the environmental burden of existing practices or compare different ways of making the same product but has not been widely used to re-design the industrial ecology of entire product supply chains or to offer alternative business models.

The view taken here is that sustainability is really a process of becoming more sustainable. It is a relative concept with many shades of 'progress' possible. In this case, the process of being more sustainable becomes a practical problem for business management. The danger, however, is that of measuring and evaluating radical (and more sustainable) alternatives through the metrics of established practice, and through the norms of a business model that has emerged in a quite different context to solve quite different problems. Table 1 summarises market forecast

expectations upto 2020, where it can be seen that the growth will come outside the traditional manufacturing and market locations. Further, businesses need models that allow them to 'fit' with localities in order to be enduring and successful — and hence sustainable.

Table 1 Market growth forecasts (cars, millions of units).

Region/year	2001	2005	2010	2020
North America	19.6	21.5	23.0	24.0
Western Europe	16.6	15.0	15.0	15.0
Asia Pacific	12.4	18.5	21.7	30.0
Central/Eastern Europe	2.5	3.0	4.5	10.0
South America	2.4	3.0	4.0	7.0
Middle East	1.3	2.0	3.0	3.0
Africa	0.8	1.0	5.0	12.0
TOTAL	55.6	64.0	76.2	101.0

Source: Centre for Automotive Industry Research, Cardiff Business School.

Inter-connectivity: relationship between product, process, and economic structure

Manufacturing involves taking materials (themselves manufactured) and subjecting them to a series of transforming processes that shape and join them into a product designed to perform some set of functions. Traditionally, this process has been thought of as linear. The product is designed first. Then a process is designed to enable the product to be made. Then a sales and marketing strategy is put into place to sell the product. Collectively these elements may be said to constitute the basis of the business model, the working set of assumptions that say 'this is what we make, this is how we make it, this is how we compete'. An extended view of this set of relationships would also include the consumer with the notion of 'this is how our product is used'.

It is relatively straightforward to translate these ideas to the automotive industry. For the purposes of this paper, the automotive industry is defined quite narrowly to mean those vehicle manufacturers and their suppliers producing cars or parts thereof — the focus is very much on the final assembly of such cars and on the business model deployed by vehicle manufacturers. However car manufacturers are definitely the dominant features of the automotive industry landscape and the arguments presented here could be transferred to other automotive (non-car) products. The product characteristics are clear: an all-steel body and an internal combustion engine, along with the required subsystems, constitute the technical definition of the product in 99% of the industry. The production process at the level of the vehicle manufacturers is also clear: they manufacture the core product elements (the body and the engine), and then assemble all the other components into a complete vehicle. Independent suppliers are used for lesser components. Generally such suppliers are smaller and economically weaker than the vehicle manufacturers. Hence the structure that has emerged is one in which the large, dominant economic entities are the vehicle manufacturers who form the focal point for extended supplier networks on the input side, and geographically extensive distribution networks on the output side (Nieuwenhuis & Wells, 2001).

The core production technologies (stamping, welding, painting, machining) involved are heavily determined by the choice of product technology with the result that there is considerable per-unit cost advantage in large, centralised manufacturing plants that capture economies of scale. In turn this means that the industry is capital intensive and highly concentrated, requiring very large investments both in the manufacturing system and in each new model design. A typical modern car plant with a two or three-model capacity of 350,000 cars per annum will require an investment of at least US$2.5bn, while each new model platform will require US$1bn. This production—consumption system emerged to meet particular conditions. In the early days of the motor industry, in the 'craft' phase of car manufacturing, manufacturers could only deliver customised vehicles in low volume and at high price. As a result, there were very many small companies that could be classed as vehicle manufacturers — typically several hundred in each of the major industrialised countries. The business model was one of designing while manufacturing, passing on the resultant high costs to affluent consumers. Ford changed the business model by introducing mass assembly of more standardised vehicles at low unit prices, but crucially the vehicle body technology (the rudimentary steel chassis) employed was pre-industrial in character. Hence, in this instance the redefinition of the business model preceded the redefinition of the product and process technology — but also provided the framework within which the all-steel body made economic sense.

In the 1920s, E G Budd in the US pioneered a radically different technology: the all-steel body. With a series of overlapping patents, Budd defined the pressing and welding techniques required to construct a car body from a three-dimensional 'jigsaw' of sheet steel panels. The all-steel body gave some immediate and important product benefits: strength, stiffness, greater design freedom, suitability for painting, greater precision, enclosed car bodies; and was much better suited to flow manufacturing techniques with a significant fall in unit costs under high volume production. Following the Budd innovations, the all-steel body became the single most important element in vehicle design.

Equally, the manufacturing processes required for all-steel bodies became the core investment for vehicle manufacturers. Even now, in contemporary high-volume car plants, it is the press shop, welding lines and paint shop (all required as a direct result of using all-steel bodies) that account for the majority of investments required. Equally, for each model produced it is the tools and dies to make the body that account for the largest investments.

The sales and marketing strategy involves using a distributed network of independent franchised dealerships to reach the market. Profitability and competitiveness are achieved by expanding the market through lowering of real price and through cost reduction achieved through scale. Revenues are predicated upon the continued sale of new cars, and profits growth on continued expansion of the market. It is clear that this approach was best suited to situations where demand for any form of low-cost motorisation meant that consumers were willing to accept standardised products. The prevailing business model throughout much of the 20th century, with the automotive industry as a typical example, can be summarised as one of commodification (Sonntag, 2003). The vehicle manufacturers had little concern for the fate of their products once they had been sold. Neither did they have much concern for the environmental performance of their products. Moreover, the continued pressure for scale economies demanded by the product-process technologies underpinned much of the economic dislocation that characterised the industry over many years.

Challenges: why the existing automotive industry is unsustainable

In reality, as is argued below, the environmental, social, and economic challenges to the prevailing order and business model in the automotive industry are closely related. They are separated here for clarity of analysis, but the co-determination of solutions to all is absolutely critical. The choices of product technology (all-steel body and internal combustion engine) are the primary determinants of environmental performance in manufacturing, use, and disposal: there is a substantial literature on this (Davies, 2003). There is an equally substantial literature on the social impact of the automotive industry and the economic pressures it faces. However, these sets of literature tend to be partial: they deal with only one or two aspects of the industry and/or the product and do not capture the totality of the industry. It is often assumed, for example, that the environmental problems of the automotive industry will be solved once toxic emissions have been eliminated: hence the burgeoning interest in hydrogen fuel cells as a panacea. Or it is assumed that because, under the prevailing business model, alternative fuels, materials, and designs are not cost-competitive with the industry norm, there is no chance of introducing these alternatives (or at least that the industry needs massive help in the form of research funding from government, or tax incentives for consumers to purchase 'green' cars). In other words, it is assumed that a radical new technology such as the hydrogen fuel cell is introduced into the industry and that nothing else changes: cars are made, bought and used exactly as before (For a more complete treatment of these issues see Kemp, Hoogma, Schot, & Truffer, 2004; Nieuwenhuis & Wells, 2003).

Economic

The core problem for the automotive industry is that it is insufficiently profitable, particularly given the capital intensity of the industry (Nieuwenhuis & Wells, 2003). The problem really relates to the growing gap between the production system and the market it is intended to serve. This gap takes a number of forms

- High capital intensity and fixed costs of production together with a business model based on market share leads to over-supply in some product areas and under-supply in others.
- Over-supply of overly standardised models may result in discounting, rapid depreciation, and premature scrapping of vehicles.
- Manufacturing inflexibility can include an inability to adjust output with demand and difficulties in switching from one model to another, again resulting in price reductions to 'shift the metal'.
- Reliance upon continued new car sales as the main source of revenue leads to a business model where the primary income source is car finance followed by parts sales, but this too demands that greater numbers of cars be sold at cost.
- Shorter model lifetimes lead to lower model lifetime volumes and hence difficulty in recovering investments.
- High capacity utilisation break-even points may enhance the pressure to over-supply and the need to maintain extensive logistics lines to a large number of sales outlets.
- Production concentration and extensive distribution systems lead to long delivery times for customer-ordered cars and high levels of stock in the system.
- High capital costs with very 'lumpy' investment in plant and models lead to high risk, resulting in conservative new model introductions of 'general purpose' vehicles.
- Asset longevity combined with high fixed costs may give rise to an unwillingness to embrace the radical product and process strategies that would render such investments redundant.

These pressures arise from many sources, but one factor thought to be important is that of changes in the nature of market demand, particularly in the saturated markets of the established industrialised economies. This point is illustrated in Table 2 where the changes in the UK market over the period 1994 to 2002 are summarised in terms of the number of brands, models, and variants available.

Table 2 Number of brands, models, and variants in the UK market.

Brands	Models	Body	Styles	Variants
1994	54	205	300	1303
1995	56	211	309	1580
1996	57	218	321	1624
1997	53	225	318	1611
1998	54	231	382	1637
1999	52	240	332	1759
2000	57	262	357	1931
2001	58	260	351	2042
2002	57	263	387	2472
2003	56	264	374	2823

Source: Wells, P and Morreau A. (2003), '*The evolution of car markets: More choice or less?*', www.Just-Auto.Com, 1st September, 2003.

Table 2 shows how the numbers of models, body styles, and variants have increased over time: indeed the number of variants has more than doubled. Inevitably, and despite a small amount of growth in the market, this means that per-model, per-body style and per-variant volumes have fallen.

The automotive industry has sought many strategies to resolve the above problems, notably globalisation (to expand markets), consolidation (to share costs over a greater number of brands and models) and platform strategies (to reduce vehicle development costs). Other related measures include aggressive purchasing regimes to squeeze costs out of the supply base, and heavy brand advertising in an attempt to retain the premium pricing that brand awareness can attain.

Furthermore, diseconomies of scale can also develop, while the process of forming large groups through merger and acquisition is fraught with hazard. After initial euphoria the share price of DaimlerChrysler has slumped because of the difficulties of achieving synergistic integration — and this is indicative of the problems in translating theoretical benefits into real-world actions. So, the traditional solutions appear to be running out of curative power, and the business model is almost incapable of further development beyond a continued downward spiral of cost reduction and commodification (See also the more general critique of globalisation in Rugman & Hodgets, 2001; and, from a rather different perspective, the plea for relocalisation in Hines, 2000).

Social

It is undeniable that the established automotive industry has made considerable progress in terms of working conditions and practices, although the disciplining pace of the assembly line remains. Attempts at work enrichment, by Volvo in Sweden for example, foundered on economic cost in a business model that achieves profitability through cost reduction. Two features of the social dimension of work in vehicle manufacturing are of interest here. First, work remains narrowly task based, with cycle times in the region of 45 s. Second, employment overall is not stable. Many plants have introduced a wide range of 'flexibility' arrangements with the workforce, while more profoundly in the established industrial regions plant closures continue to have significant negative impacts on their localities.

One key problem is that because plants are very large, work and wealth generation is concentrated into particular locations, not decentralised across the country and society as a whole. Agglomeration economies historically tended to reinforce this trend, leading to cities such as Detroit and Stuttgart being heavily dependent upon car production. But such agglomeration forces tend to have profound negative consequences in many areas of development, leading to over-crowding, rural depopulation, and other problems. In many emerging economies there is a strong pressure to find economic means to prevent further migration to urban areas.

Environmental

Traditionally, the environmental performance of a car has been seen in terms of toxic emissions from the exhaust (Nieuwenhuis, 1994, chap. 7) and, more recently, in terms of the manufacturing process (Graedel & Allenby, 1998).

Other environmental burdens created by the car include those associated with material consumption, the disposal of cars (so-called End of Life Vehicles), vehicle noise, and even the visual 'pollution' of cars. However, there are two features of environmental performance that are worth highlighting in terms of the linkage with the business model of the existing automotive industry.

One aspect of these burdens that is often overlooked is that of over-production. In reality, incremental improvements in per-car environmental performance in toxic emissions or at the manufacturing plant can be overwhelmed by the growth in car ownership and use, a form of 'efficiency trap'. As has been delineated above, over-production is essentially hard-wired into the business model defined by the capital intensive all-steel body product technology and production technology. Approaches such as industrial ecology tend to be 'blind' to the problem of over-production. The automotive industry, as the largest single manufacturing sector in the world, constitutes a major consumer of raw materials accounting for about 16% of global steel use (and nearer 40% of high-grade wide strip steel), 30% of aluminium, 5% of plastic, 85% of magnesium die casting and significant proportions of other materials such as rubber and copper (Wells, 1998). These materials may be recycled, but in reality only a very small proportion is ever recycled back into cars: most are 'downcycled' into less technically demanding applications, or indeed simply thrown away.

The other aspect of these burdens closely related to the existing business model is that of carbon dioxide emissions. Clearly, were a hydrogen fuel cell to be fitted to an all-steel car then that car would have zero CO_2 emissions at the point of use. However, fuel efficiency in contemporary cars is a function of the thermal efficiency of the engine and powertrain (how well it converts the energy in the fuel into useful energy at the wheels), and the overall design of the vehicle — particularly the aerodynamic efficiency and weight of the vehicle. The crucial issue is that seeking to drive down CO_2 emissions has systemic impacts on car design, with consequences for the production system, industry structure and the viability of prevailing business models. It is worth noting that the impact of the Zero Emissions Vehicle mandate in California, introduced by the California Air Resources Board, has the same systemic impact because it demands a different source of motive power in the vehicle. In turn, given that the alternatives have nowhere near the energy content of petrol, vehicle structure design also becomes critical: an all-steel body is too heavy.

The resolution of the CO_2 issue is likely to involve many dimensions, including for example petroleum pricing, transport policy, urban planning and social attitudes. Within the industry itself, if a more radical design philosophy were to be embraced, it would mean that the core elements of the product, the all-steel body and the internal combustion engine, are under threat. Thus, the basic business model is also being questioned — not least by those involved in the design of alternative products. Leading thinkers such as the GM designer of the fuel cell Hy-wire vehicle, Chris Borroni-Bird, have already noted that such vehicles could lead to radical manufacturing and marketing strategies (Burns, McCormick, & Borroni-Bird, 2002).

Creating innovative business models

If the automotive industry was to be created anew what would it look like? A starting point is a working definition of a sustainable automotive industry. For the purposes of this paper a sustainable automotive industry is one that creates life-enhancing employment for communities over a long period of time. It has zero net consumption of physical resources in production. It is consistently profitable while being able to withstand short-term fluctuations in economic circumstances. And it produces products that themselves do not pollute or otherwise degrade the environment, are fit for purpose, and are designed for longevity. All of these features suggest that, over time, manufacturing as such (of new, complete products) would become only a small part of the business model, that concepts such as product-service systems are more appropriate. It is recognised that profitability is absolutely vital for sustainability. However, profitability is a necessary but insufficient condition for sustainability: the environment and social dimensions must also be included.

Unlike many tasks in management research, this problem is not reducible to a study of existing practice. Quite simply, these innovative business models do not yet exist, at least in complete form. Several examples do exist in conceptual form, including the Ridek, OSCar, Hywire, EcoRover, the MDI Air Car, TH!NK, and Indego (Anon, 2004; Burns et al., 2002; Dower, 2003; Proctor, 2004; Wells, 2002a,b; Wells & Nieuwenhuis, 1999a). The first task is to identify those elements of existing practice out of which might emerge the architecture of the innovative business models. This is more than just identifying the key product technology — although this in itself is a complex task. Rather, it means understanding how the entire product-process-structure-business model shape can be rebuilt around innovative technologies. Some of the emergent practices may be deployed currently in order to resolve problems with the existing business model, but actually be better deployed in an innovative structure. Finally, it is a creative task because possible solutions have to be invented or hypothesised; there has to be an intuitive leap.

A more considered understanding of the analysis presented here would reveal that there is not 'one best way' — a notion that is the antithesis of the best practice and benchmarking school of thought, that multiple solutions can co-exist in the market at a global level, not least because not all places are the same.

In view of this approach, the business model offered here, that of Micro Factory Retailing (MFR) is a hypothetical concept developed by the author (Wells & Nieuwenhuis, 1999b) and is not seen as definitive so much as indicative. The potential contribution of the MFR business model to resolving the challenges facing the traditional automotive industry are outlined below in terms of economy, society, and the environment.

Sustainability and the MFR business model

Economic dimension

This concept is in essence very simple: the manufacturing operation and the distribution/retail operation are combined in the one entity. It is an interesting feature of the various alternatives to the all-steel body that they are viable and competitive with the all-steel body at low volumes (i.e. under 20,000 units per annum) because of the lower fixed costs of the technologies concerned. So the trade off becomes this: either centralise manufacturing and produce in high volume with a very large plant while using an extensive (even global) distribution system; or do away with the distribution system and decentralise manufacturing in small volumes and in small plants. In this regard, another interesting feature of the automotive industry is that between 25% and 40% of the market price of a car is attributable to the distribution system. So, if it is possible to design a business model under which the market is served with local manufacturing-distribution units then there is a significant cost saving to be gained. Perhaps more important than the simple investment cost comparison are the many strategic possibilities which flow from MFR (Wells, 2001). A few potential advantages are listed below:

- Investments in new assembly capacity can be incremental, and can more easily expand or contract in line with the market. Each MFR unit would have an investment cost a fraction of that for a traditional manufacturing plant — although the cumulative investment cost for the same production capacity may be higher.
- The incremental expansion of capacity can also have a geographic component in that new plants can be added to develop new market territories.
- New products can be introduced incrementally, on a factory-by-factory basis and high product variety via modular design will become possible. The overall financial risk associated with new products will be much lower than with contemporary approaches.
- Through duplication of MFR sites substantial investment savings could be realised by means of the multiple ordering of machines and equipment and the use of a standardised layout.
- The factory becomes the location for repair, spare parts, in-use modification (e.g. body panel change, engine upgrades, refitting of interior trim), which allows the manufacturer to benefit directly from profitable aftermarket activities and give substance to the concept of life cycle earnings streams.
- There is no conflict of interest between production and retailing (a conflict that frequently appears in the traditional industry). The vehicle manufacturer can have direct control over the retail business and captures a greater share of the downstream value chain.
- The inherent flexibility of MFR is the practical basis upon which new levels of customer care can be built. MFR makes possible flexible response, shorter lead times, and late configuration.
- The MFR concept takes advantage of the possibilities offered by the Internet, which becomes the main medium by which customers order vehicles, spares, etc.

Social dimension

The business model has two main aspects by which social sustainability is potentially superior to that offered within the traditional automotive business model. The first aspect is that of enhanced customer access to environmentally-friendly products, more closely aligned with their particular needs, along with long-term support. The second aspect relates to labour, where MFR creates the possibility of more varied, interesting and rewarding work along with more stable employment patterns distributed more widely across spatial areas. Typical potential advantages could include:

- The factory could become the repository of different vehicle structures or adaptations that existing owners or users could use to change the characteristics of their vehicle (hence fit for purpose): modular refit allows functional flexibility.
- The consumer may benefit financially from a reduction in depreciation of the vehicle (the single largest cost of new vehicle ownership); in existing systems this depreciation is created by a combination of product wear, overproduction, and the step-change introduction of a new model.
- Customers can be taken around the plant, can meet the people who will make their car, and can thereby feel 'closer' to the product. Information on customer life-styles, aspirations, and mobility needs goes direct to the factory to inform product development.
- The MFR concept clearly resonates with social and political objectives in many countries world-wide by creating local employment in high-value manufacturing activities. It also embodies the growing desire to increase labour and reduce fixed investment in order to reduce cost, increase flexibility and increase social cohesion.

- Stronger worker commitment to the product and to customers. These small factories escape from the 'mass' culture of traditional high volume manufacturing.
- Related to the previous point is the fact of the lower social impact of plant closures, as a smaller plant would be closed in each location. Plant closures would not devastate entire communities, as has happened within the existing industry.
- A version of the MFR is therefore also potentially suited to investments in emerging markets. In these markets the investment costs of a major plant would be prohibitive. Micro Factory Retailing could replace the existing approach of kit-assembly in such locations.

Environmental dimension

More significantly, this change in product technology (which as a by-product can yield lightweight cars of lower environmental burden) and the associated process technologies not only changes the terms of competition, it provides the basis for a more sustainable business model. For example, alternative vehicle architectures and materials are much more conducive to modular repair and retrofit, which in turn means that the economic cost of such activities will be much lower. Therefore the economic incentive to scrap a vehicle is lower, vehicle longevity can increase dramatically because it can be continually renewed and updated with the latest technologies (with the attendant environmental benefits). The vehicle becomes more of an asset to be retained by the vehicle manufacturer and leased to the consumer, thereby generating stable and long-term income streams. Potential environmental advantages over the traditional approach include:

- The factory becomes the centre for trade-ins, used vehicle sales, and End of Life Vehicle recycling and hence becomes the embodiment of product stewardship. It becomes the means by which material recovery and remanufacturing are made viable at the local level because transportation costs are often the major barrier to such efforts.
- The factory can undergo a transition over time from an essentially new car production focus, to one more involved in service and repair. That is, the factory does not depend absolutely on the continued sale of new cars. This helps to mitigate the tendency to over-production with all manner of associated environmental and market benefits.
- MFR is one means to take advantage of modular supply strategies combined with commodity or off-the-shelf purchasing. In transport terms, it is more efficient to move components and sub-assemblies rather than complete vehicles.
- Products can be customised to local market conditions. The low-volume breakeven points in alternative technologies allow for much greater levels of product variety, and hence much closer 'fit' to the particular purpose.
- Manufacturing processes have a lower local environmental impact compared with traditional high-volume manufacturing and even give the option of doing without a paint plant which is generally regarded as the largest single problem area in traditional car assembly.
- MFR does not require a large, flat, dedicated site with extensive support services. A modern car plant occupies several square kilometres of land. Compared with this, MFR requires a classic 'light industrial' facility.

None of the above actually directly relates to the issue of ownership. For example, this type of structure could be achieved through the fragmentation of an existing vehicle manufacturer, or by a new-entrant start up, or various intermediate business forms. Moreover, local ownership might be one means whereby communities derive the additional social benefits of local control: a key problem with traditional globalisation is that local communities or indeed entire countries feel powerless in the face of large multinational companies.

Conclusions

The co-integration of economic and sustainable concerns, in this case through the medium of the automotive industry, reveals that business management strategy stands upon the threshold of a turbulent but innovative era. It further suggests that sustainability is not a 'bolt on' addition, but an issue that goes to the heart of the structure and conduct of business.

However, the existing industry will mount a formidable defence, indeed the automotive industry has shown itself to be one with impressive barriers to entry. Neither should it be assumed that the existing large vehicle manufacturers are unable to migrate to a structure of this nature. Only one thing seems certain: new product technologies do more than just change the character of the product itself, they enable innovative business models and new structural relationships. For those involved in business management, it further suggests that strategy and the creation of new business models requires an embedded understanding of products and sectors alongside a 'whole system' perspective. Finally, the analysis suggests that in this sector (and potentially in others too) the days of economies of scale, product

standardisation, and least purchase price cost to consumers being the means to market success are numbered. The new paradigm is still emerging, but could well be one dominated by diversity, product-service systems, and least cost lifetime 'usership' to consumers — as well as least burden to society at large and the environment.

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Sustainable business models and the automotive industry: A commentary

Introduction

In the almost ten years since the initial publication in IIMB Management Review of my paper on sustainable business models for the automotive industry there have been a great many new developments. There are three main areas where these new developments are evident. First, the academic literature on business models has burgeoned, albeit chiefly with regard to the traditional concerns of management and strategy rather than sustainability. Second, government policy has become more sensitised to the need to consider business models, particularly with respect to the introduction of new technologies. Third, but not least, the practical

application of the concepts and ideas in the original paper has emerged in the automotive industry, most notably with respect to electric vehicles. This commentary article will discuss the three main areas of development, and conclude with some ideas regarding the future of research in this area.

Business models in the academic literature

Initially it is fair to say that scholars working with the idea of business models were treated with some scepticism by those concerned with the more traditional disciplines of strategy, competition, leadership, organisational behaviour, supply chain management, and marketing. In comparison, business models seemed diffuse, lacking in theoretical or empirical rigour, and unable to yield significant insights to explain corporate behaviour or performance. Nonetheless, some of those early scholars (notably Osterwalder as in Dubosson-Torbey et al., 2002; Osterwalder, Pigneur, & Tucci, 2005) caught something of the flavour of the times with their work on business models associated with the dot.com boom era of the late 1990s. Fundamentally, there was a growing realisation among the academic community that there were some interesting and potentially important co-determinations between technological and organisational change. The ideas incubated in the e-business enclave then rapidly found application in other industries and corporate settings. As a consequence, work on business models gained greater theoretical and empirical status with mainstream academic journals (Schweizer, 2005) and with journals such as Long Range Planning going so far as to dedicate a special issue on the theme (see for example the papers by Baden-Fuller and Morgan (2010); Chesbrough (2010); and Teece (2010)). Equally, business models have become a feature of journals that more closely straddle the academia-industry divide (Shafer & Smith, 2005).

As research has unfolded, some of the tensions in the business model concept have become apparent. For example, what is the relationship between continuity and change in business models (Demil & Lecocq, 2010)? What is the relationship between strategy and business models (Teece, 2010)? How can we start to categorise and classify business models (Zott & Amit, 2010; Zott, Amit, & Massa, 2012)?

Where progress has been rather less evident is in the specific application of business models to the issues of corporate sustainability. Yet even where some of the academic research has not necessarily used the language of business models, related ideas that effectively deal with business structure and organisation have gained currency. Hence themes such as product-service systems (Pawar et al., 2009), open source innovation (Vujovic & Ulhøi, 2008), new forms of value creation and capture (Velamuri, Neyer, & Möslein, 2011), and socially-relevant production (Thompson & MacMillan, 2010) have emerged with the potential for considerable application for future research on business models for sustainability (Wells, 2013).

Business models and government policy

While this is an aspect of business models research that is more difficult to be precise about, there is a growing sense that government policy in respect of (particularly) new technologies recognises that in parallel with innovations in technology must go innovations in business organisation. This recognition seems to draw from several sources. First, in the face of struggling economic performance in many countries there is a desire to ensure that public funds are not squandered on the development of technologies that never gain market acceptance. Hence in the UK, for example, the Technology Strategy Board is actively seeking bids for funding that combine technological innovation with business model analysis. Second, those concerned with the macro issues of science policy or economic performance are increasingly seeking the "levers" or "mechanisms" that translate national R&D into improved material welfare. Interestingly, in the academic realm the growing influence of transitions theory (Geels, 2002, 2005; Geels & Raven, 2006; Geels & Schot, 2007; Geels et al., 2011) has brought a simultaneous interest in understanding how large-scale socio-technical transitions of the sort needed to attain greater sustainability are to be achieved: with again the focus on organisational theory and business models as an important strand of research. Third, compared with the cost of developing new technologies, the cost of developing new business models appears minimal — and hence is attractive to government.

Sustainable business models, the automotive industry, and electric vehicles

For the automotive industry, as was raised in the 2004 paper for this journal, there are many significant structural trends that have been acting to challenge the assumptions that underpin the existing business model (Hamilton, 2010; Roland Berger, 2011; Senxian, Jenkins, & Rowell, 2009; Subic & Koopmans, 2010) but equally if history is any guide the industry may be able to defer, delay, or even postpone legislative imperatives for change (Calef & Goble, 2007) or draw on government for continued support (Stanford, 2010) in the face of market difficulty. As is often the case, corporate survival is not just necessarily about superior performance; and in an industry as pivotal as the automotive sector the jobs and wealth and mobility it provides are strong political cards to ensure continued support. It could further be argued that the growing global reach of the automotive industry associated with both burgeoning new markets in India, Brazil, China, and elsewhere, and with the growing significance of global supply chains, have been mechanisms that have enabled the continued survival of the existing automotive industry business model.

The market for electric vehicles to date has been greatly dependent upon government at national or international level (regarding carbon emissions) or local/city level (regarding air quality). Through a combination of legal strictures and fiscal inducements, government can define a market space for electric vehicles and mobility services (Ceschin & Vezzoli, 2010). Electric vehicles cannot be deployed without parallel developments in charging infrastructure, taxation and incentive regimes, type approval processes, insurance policies, repair and maintenance facilities, and much more. The orchestrated nature of this process challenges traditional vehicle manufacturer dominance of and focus on the production, distribution, and marketing of finished vehicles. Consumers, both retail and corporate, are faced with new technological and financial

risks with uncertain outcomes if they wish to purchase electric vehicles. Payback times for buyers of innovative vehicle technology are long; typically longer than the usual lease or contract purchase period for buyers of new vehicles. Electric vehicles are likely to show greater longevity than traditional vehicles, ultimately reducing the scope for new vehicle sales but putting greater emphasis on lifetime revenues earned by a vehicle. It is clear that to achieve a transition to electric vehicles existing vehicle manufacturers and their traditional suppliers have required new competences and skills, knowledge, and experience on a scale and across a range not hitherto experienced (Accenture, 2011; Subic & Koopmans, 2010). Moreover, the growing concern over vital future material shortages, either absolute or "geo-political" in character, further raises questions over the durability of the contemporary "fire and forget" automotive industry business model predicated largely (if not entirely) upon the continued consumption of virgin raw materials. These concerns have become particularly acute with respect to the supply of lithium for the battery packs of electric vehicles.

The implication of the "ecosystem" way of understanding change in and around the automotive industry is that previously distinct systems can no longer maintain boundaries or barriers against other systems. Rishi, Stanley, and Gyimesi (2008) define these ecosystems as being automotive, energy, consumer electronics, communities, geographies, social networks, other industries (software, telecommunications, financial services), and government. Dammenhain and Ulmer (2012) take a view that is narrower, but more detailed. In their framework, the e-mobility ecosystem comprises vehicle manufacturers, suppliers to them, the electric vehicles, the IT provider, the e-mobility technology supplier, the e-mobility provider, the public sector, the utility, the distributor, and the charging/changing operator. No matter what precise definition is used, it is this merging of complexity and the spontaneous eruption of new possibilities between and across previously distinct ecosystems that means that standalone business models cannot really be understood in isolation any more.

Theoretically then, as a consequence of the above forces, the conditions are potentially right for an extended automotive industry with multiple stakeholders to be brought into new and constantly changing added-value configurations, including circular value creation systems, grounded in new business models (Kley, Lerch, & Dallinger, 2011).

Indeed there is evidence of attempts to create such innovative business models as in the case of Better Place in Denmark (Christensen et al., 2012), or in the case of the Nissan-Sumitomo 4R model to find "end of life" uses for post-consumer automotive battery packs from vehicles such as the Nissan Leaf. In the realm of recharging infrastructures there is a plethora of different concepts and approaches to finding ways to make the provision of electricity to vehicles a viable business — though to date none has really escaped the need for public subsidy (Wells & Nieuwenhuis, 2012a). To date however many of these alternatives have struggled for market acceptance, and it is pertinent to consider why that might be so.

First, at a fundamental level it may be the case that the innovations around electric vehicles are simply insufficient compared with the established technologies, and so the vehicles cannot readily appeal to consumers and may in fact offer rather marginal sustainability benefits. Under these circumstances it may be that business model innovation is unable sufficiently to compensate for such fundamental weaknesses.

Second, examples such as Better Place depend upon the mutual intersection of business models by multiple parties, a feature that has not been widely considered in the academic literature. It may be the case that such intersections, which are a necessary feature of an established value creation structure, are difficult to orchestrate in the first instance, and hence vulnerable. The recourse to bankruptcy of Better Place in May 2013 is an indicator of the problems here.

Third, it is notable that the more successful ventures such as the Paris "Autolib" scheme involve the strong commitment of public authority as a key partner in the value creation system. The vehicle supplier in this instance is essentially unknown to the public, with branding and management controlled by the city authority. Hence in instances of absolute market failure it would appear that the traditional solution of state intervention remains the most plausible answer.

Conclusions and a future research agenda

Since the 2004 article there has been a growing interest in business model innovation in general, and an emergent interest in the automotive industry with respect to electric vehicles in particular. The frailties of the existing automotive industry business model have indeed been exposed by the ongoing economic crisis that has unfolded since 2007, but even this has not been sufficient to cause a wholesale shift in the industry at large or allowed significant penetration of new entrants around electric vehicle technology. It is pertinent, perhaps, to compare this lack of progress on electric vehicles with the explosive market for electric two-wheel vehicles — a sector robustly ignored by government policy and yet prospering remarkably both in mature markets (Germany; Netherlands) and emerging markets (notably China).

An important future research agenda is that which seeks to uncover the relationships between sustainability (sustainable mobility), government policy and regulation, and innovative business models. There has been much research on the "cost of regulation" for the automotive industry and for consumers, notably for example with regard to the US Corporate Average Fuel Economy regulations and the forthcoming European Union carbon emissions regulations (Shiau, Michalek, & Hendrickson, 2009; Skippon, Veeraraghavan, Ma, Gadd, & Tait, 2012; Small, 2012). Little of this work has explored the positive side of regulation, as a stimulus to technological or organisational innovation for example though there have been critiques of policy weaknesses (Schwanen, Banister, & Anable, 2011). There is some evidence that there are potential "early adopters" of electric vehicle technology (Campbell, Ryley, & Thring, 2012).

More generally, there has still been a relative paucity of studies on business model innovation for sustainability. Equally, the ability of incumbents to resist change is somewhat under-appreciated (Wells & Nieuwenhuis, 2012b); perhaps we need therefore a better understanding of continuity as much as we need to understand change. It is difficult to know how far the lack of progress in electric vehicles is attributable to the technology per se, and how much to the lack of penetration of innovative business models either by new entrants or established brands. There is probably a relation here with

entrenched expectations and norms in consumers who, for a wide range of reasons, may prefer to retain the existing system even though it is clearly sub-optimal in many ways. The niche experiments such as the Daimler Car2Go car-sharing scheme continue (Firnkorn & Müller, 2011), but remain distinctly marginal to the mainstream business of churning out large numbers of steel-body vehicles with petrol and diesel engines. There is therefore an urgent need to understand more clearly the scope and barriers to growth afforded by business model innovation, both in the automotive industry and more widely — particularly with respect to sustainability.

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