INNOVATING AUTOMOTIVE BUSINESS BY SELLING MOBILITY: SERVICE SYSTEMS KNOWLEDGE TO FOSTER SUSTAINABLE PRODUCTION AND CONSUMPTION PATTERNS POLICIES

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ABSTRACT

This article focus on the area of the efficient resource utilisation within the automotive industry through the **dematerialization** concept and a service-based strategy. In this context, an innovative approach is presented where **dematerialization** at the automotive industry is achieved by changing the way automotive business is worked out to a model where mobility is provided. This circumstance will lead the automotive industry to a position of a service provider rather than a product seller.
The goal of the dematerialization concept is to substantially reduce the overall material flows in the economy. In the context of dematerialization, this service-based strategy will change automotive user's need fulfilment in such way that material flows and energy flow of this need fulfilment decreases significantly, and therefore its environmental loads.

INTRODUCTION

During the last 150 years the technological development and the progress in science have improved the productivity of labour by a factor of 20. Otherwise, the efficient utilisation of resources has not increased by the same amount, and recent analysis by Dobers and Wolff (1999) displays that resource utilisation improves by 1% a year, far below the total increases in production and consumption.

This resource utilisation has been based on a "business as usual" behaviour of the firms, strongly focused on selling goods, which pushed manufacturing industries in a path of falling revenues from their products, increased competition and increasing production costs. The "usual" answers to this behaviour have been cost cutting, re-engineering, a bigger economy of scale through globalisation, keeping the business focus on improving manufacturing process.

This article is conceptual in character; its focus is within the area of the efficient resource utilisation within the automotive industry through the dematerialization concept and a service-based strategy. In this context, an innovative approach is presented where dematerialization at the automotive industry is achieved by changing the way automotive business is worked out to a model where mobility is provided. This circumstance will lead the automotive industry to a position of a service provider rather than a product seller.

The proposition of this study is a fundamental switch to selling the performance of vehicles instead of themselves, fostering a situation where shareholder value and income increase, while production costs are decreasing; where market capitalisation increases even if production does not. The business focus is now on vertical integration to reach, win and satisfy the green customer.

The EU market for 'products sold as services' in 1998 is estimated at 758 billion Euro, or 10% of GDP. Within this segment, selling the function of products (through e.g. fleet management) accounts for 60% (equal to 6% of GDP); while re-manufacturing services account for 40% (4% of GDP). Actually, manufacturing accounted for 17% of U.S. GDP in 1997 (for 20% in the EU), for 15% of total U.S. employment and 26% of corporate profits.

In this context, the prospects for companies that shift from manufacturing to services are positive. The new way of thinking in the shift to services is based on strategy as a means to creating the future, rather than extrapolating it from the past; in a vertical integration all the way from the plant to the customers, rather than from the suppliers to the plant; and in a management of the 'installed base' of goods focused on a performance-based asset, rather than a production management based on cost reduction

This new business strategy will imply changes in the structure and the rules of the game, and in fact all the leading edge companies interviewed expect to double or quadruple their share of revenue from selling services instead of products by the year 2010.

BACKGROUND

On Dematerialization

Haake (2000) identifies five key instruments as a basis for implementing an environmental management system that can lead to the dematerialization of the sum of the firm's activities: **i)** material flows assessment; **ii)** dematerialised products and processes; **iii)**

holistic internal organisation; **iv)** eco-efficient services.

On this specific regard, implementing dematerialization depends on not only technological solutions, but also on a focus on the consumption side of the economy, as well as "immaterial solutions".

Different types of ecological services can be distinguished: repairing, guarantees, upgrading, leasing, renting and recycling, all of these aiming at a more efficient resource productivity of products, while capable of providing the customers of a firm with more satisfaction. What appears most important to us are the so-called "eco-efficient services", that replace, from the point of view of the customer, the ownership of a product by its use, while the producer stays the owner of the product. Among the mentioned types of ecological services, leasing and renting correspond to this kind of service, which represents a certain departure of the materialistic view of consumption, discussed above.

Finally, life cycle management is the fifth tool by Haake (2000) proposed to deal with dematerialization on the firm level. The life cycle perspective is crucial for dematerialization when we go beyond the simple micro-economic viewpoint, and focus on the economy as a whole. The single firm is only one of other actors in the production chain, and it can, by adopting a life cycle perspective, influence the material consumption linked to a product or a process beyond the frontiers of the firm.

In a service-based economy, whereas the producer controls and integrates all the vertical steps toward the user of the service, life-cycle approach will be the framework to implement a competitive management.

Nevertheless, Forrest (1995) pointed out that a movement toward a dematerialization of industry must be leaded by business, in the sense that change by business is less painful, more efficient, and cheaper for consumers, and for businesses themselves.

Otherwise, the five issues aforementioned taken altogether are aimed at creating a general movement towards a most thorough implementation of dematerialization, not only inside the firm, but also in the economy and society in general.

As a matter of fact, the dematerialization concept is relatively well known among a certain number of large firms, namely there are some relevant examples where eco-efficient concepts are part of the business strategy: Novo Nordisk; Unilever; IBM; Xerox; AT&T (Allenby, 1998); Dow Chemicals (Füssler, 1998); Elf Atochem.

Actually, it is possible to relate the integration of the "material approach" into business management and external discourse to the participation in some specific events and the affiliation to business associations particularly proclaiming these concepts, like the WBCSD (World Business Council for Sustainable Development). The list of relevant groups within this business club includes: Air Liquide; Danone; Lafarge; L'Oréal; Renault; Total; Axel Springer Verlag; BASF; Henkel; Siemens.

Although small in number, these two lists of firms characterises dematerialization as an already occurring general movement in business. The important result is the fact that business by its "nature" should not oppose to the concept of reduction material inputs. The very heart of dematerialization seems to correspond to the fundamentals of business management.

As far as the automotive sector is concerned, and due to its networking characteristics within the whole society, this approach can not only have synergetic effects on the dematerialization in other fields of the economy, but can also lead to win-win situations for the firms directly and indirectly involved with the automotive sector.

Generally speaking, and since every material flow goes back into the environment sooner or later in a more or less harmful way (scraps, solid and liquid wastes, emissions into the air) the goal of the dematerialization concept is to substantially reduce the overall material flows in the economy. In the context of dematerialization, this service-based strategy will change automotive user's need fulfilment in such way that material flows and energy flow of this need fulfilment decreases significantly, and therefore its environmental loads, as a general characteristics of industry dematerialization already pointed out by Haake (2000).

From the macro point-of-view, this conceptual study rises the fundamental question of how to increase the value of all transactions without increasing the environmental load of products involved could be done by dematerialising the economy? One strategy for this seems to be a shift from an economy based on production and consumption of physical products to a service-based economy.

On Product Service

The present industrial economy, which has developed over the last 200 years in today's industrialised countries, is based on the optimisation of the production process in order to reduce unit costs and thus overcome the scarcity of goods of all kinds, including food, shelter and durable goods. Actually, emphasis has been on

more efficient process technologies, and constant improvements in the quality of the goods at the point of sale. (Stahel, 2002)

Recent report on the state of the world has demonstrated that, in industrialised countries, sustainable development has to start with a considerable reduction of the consumption of resources. Such a 'dematerialization' is only possible through innovation, which needs to be driven by the economy. This then defines a new management task, to unlink economic success from resource consumption, i.e. to produce the same sales turnover and profits with a substantially reduced resource throughput throughout the economy. In many cases, this will only be feasible by redefining corporate strategies, orienting them towards selling performance rather than goods.

Therefore, the main task will increasingly be to reduce the financial burden imposed by the operation and maintenance costs relating to these assets.

On this context, several multinational companies have already successfully implemented these new strategies, de-coupling turn-over and profits from resource consumption and manufacturing volume. Namely, Schindler elevators is selling carefree vertical transport instead of elevators; Xerox is offering custom-made reproduction services instead of just selling photocopiers; Safety-Kleen and Dow Europe sell the services of chemicals instead of selling chemicals; Safechem and Dow Germany are renting solvents to dry cleaners; Mobil Oil is selling engine oil quality monitoring instead of engine oil; GE Capital and ILFC lease aircraft and Interface Inc. leases nylon carpets. Schindler, GE and other 'manufacturing' companies today generate 75% of their sales volume through services.

The concept is being considered in different ways by many others, for instance, a great number of companies already practice a voluntary buy-back or free take-back system, such as Eastman Kodak and Fuji for their single-use cameras, or GE Medical Systems for medical equipment by any manufacturer. (see Stahel, 2002) Of course there are the more traditional examples of service providers selling performance instead of goods, for instance, taxi drivers, hotels, railway and ship chartering.

In most of these cases, the product used to perform the service remains the property of the service company. The product is taken back after use and cleaned or remanufactured prior to reuse. This creates a financial incentive for the company to increase the lifetime of the product delivering the service.

The price to pay for success is partly a regionalization of the activities, skills pools and responsibilities of a company. Selling performance also demands success in dealing with regional cultural issues: Ciba-Geigy's strategy of selling yield guarantees instead of pesticides to rice farmers in an African country in the 1980s was a success in eco-efficiency, but not compatible with local power structures.

As proposed by Giarini and Stahel (1993), the "service economy" is an economy which focuses on the optimisation of the utilisation (or performance) of goods and services, and thus on the management of existing wealth (goods, knowledge, nature). The economic objective of the service economy is 'to create the highest possible utilisation value for the longest possible period of time while consuming as few material resources and as little energy as possible'.

Such a service economy is therefore considerably more sustainable, or de-materialised, than the present industrial economy, which is focused on production as a means of creating wealth and on the optimisation of the production process in order to achieve economic growth. In contrast to the manufacturing economy, economic success in the sustainable 'asset management' of a service economy does not come from mass production, but from good husbandry and stewardship.

The terms "value added" in exclusive relation to (production) activities up to the point of sale, 'value write-off' (depreciation) after the point of sale, and 'waste' at the end of the first (and only) utilisation period of goods, are notions of a linear industrial economy, where the responsibility for goods stops at the factory gate, and where 'waste' – everything that leaves the factory gate – is somebody else's problem (and cost).

In contrast to such a linear structure, cycles, circles and loops, have no beginning and no end. The producer's stewardship for his goods is based on a value concept and never stops – an 'economy in loops' thus does not know 'value added' or 'waste' in the linear sense, similarly to natural systems such as the water cycle.

In order to achieve the goal of economic activity based on loops, two main changes are necessary in the economic thinking and organisation:

- Regionalisation of manufacturing and re-manufacturing activities ;
- Re-design of products, fostering technical systems with ease of maintenance and ease of out-of-sequence disassembly.

A service society will not solve all problems for society, and especially not the problems inherited

from the past (e.g. pollution clean-up, unemployment of over-specialised production workers). But it could well restructure it, into firms manufacturing high volumes of global standardised components, and regional firms specialised on assembly, disassembly and re-manufacturing of products.

A sustainable economy could be helped by an appropriate structure, characterised by a Regionalisation of jobs and skills (materials recycling, re-manufacturing workshops, decentralised production of services such as insurance). Such an economy will be characterised by smaller regionalised production units with a higher and more skilled labour input (Stahel & Reday, 1976).

Selling performance instead of goods demands a coherent corporate strategy based on the principles of the service economy. This includes asset management, production, marketing, finance and control. Moreover, as services cannot be produced in advance and stored, and mostly have to be delivered at the location of the client, the impact on peripheral zones could be substantial, as could the effect on the environmental burden on central zones.

The present focus on technology will be replaced by a focus on corporate strategies and the identification of cultural levers to gain a competitive regional advantage.

AUTOMOTIVE SECTOR AS SERVICE PROVIDER

As a matter of fact, automotive sector is begun to close its material loops by adopting durable materials that can be continuously reused to make new cars. This approach will reduce dramatically its pressure on air, climate, and other key elements of its environmental load by completely rethinking how to make a car move. Moreover, this scenario of so well established a segment of the economy is gaining its momentum mainly based on unleashed forces of advanced technology, customer demands, competition and entrepeneurship rather from regulatory mandates, taxes, or subsidies.

The automotive sector shows impressive figures of its influence on our society as a whole. In the United States, this industry employs millions of people, sells a copy of its product every two seconds, and provide unexpected levels of mobility for its users. In 1998 five of the seven largest US industrial firms produced either cars or their fuel. However, this industry has specific consequences on environment, namely, for instance:

- The present US paved area is equal to all the arable land in the states of Ohio, Indiana and Pennsylvania, and requires maintenance costs more than $200 million per day;
- It burns 8 million barrels of oil every day (1700 litres per person annually);
- It emits one-fourth of US greenhouse gases, threatening global climate stability and agriculture;
- It creates 3.5 millions tons of unrecycled scrap and waste every year. (Hawkin, 1999)

In fact, only the car production industry is characterised by a complicated assemblages of some fifteen thousand parts, whose reliability lies on a vast range of conditions. All this material within cars now cost less per weight than a McDonald's sandwich.

Due to this complexity, a process of minimisation of environmental impacts within the automotive industry (including the vehicle life cycle) involves a similar complex task, encompassing different parallel paths. For instance, a complete redesign program to improve fuel-use efficiency can address modifications at internal combustion engine, the utilisation of hybrid-electric propulsion, the change of the material (ultralight cars) and of the shape (ultra-low-drag shapes). The reconfiguration of these key elements could save at least 70 to 80% of the fuel.

In the recent decade many successful approaches have already been followed aiming at sustainable economic development. Examples of successful key concepts are cleaner production processes by new technologies, improved products by ecodesign methods, improved technologies for waste processing, and the introduction of environmental product life cycle management. A redesign program can now be targeted toward dematerialization issues, where the car parts will be designed to be re-used or re-manufactured, and re-integrated in the productive chain through recycling programs (Hawkin, 1999). All these approaches are based on the usual way the automotive industry commercialises its output, namely the car as a product.

On the other hand, the accelerated transformation of production systems and consumption behaviour towards services is recognised as a potential powerful environmentally pro-active concept. In this context, service-based strategy could be a successful approach towards sustainability. This approach intends to change focus to the consumption side, to start looking for sustainable fulfilment of consumer's needs.

However, the shift is huge. A product is a tangible commodity manufactured to be sold; it

is capable of falling onto your toes and of fulfilling a user's need. A service is an activity (work) done for others with an economic value and often done on a commercial basis (Goedkoop, 1999). Another definition is suggest by Kotler (1997), who defines a service as any valuable activity a party can provide, that is essentially intangible and that does not result in the ownership of something.

During the last decade, several alternatives for a mobility-providing service, based on different actors, have been proposed:

- Carsharing: In carsharing, a group of participants uses a pool of cars. This pool can be as small as one car in the case of a private initiative. In commercial situations, the participants pay a subscription and a fee for the time and/or the distance driven. In the Netherlands, many carsharing systems exist, which together had 23,000 participants in June 1997.

  Commercial carsharing is offered by traditional car rental companies as well as new businesses and within companies. One of the best known new businesses in this field is Greenwheels who offer carsharing in the four biggest cities of the Netherlands: Amsterdam, The Hague, Rotterdam and Utrecht. (Goedkoop, 1999)

- Commercial fleet management service of car rental companies offer car renting programs covering maintenance fees, as well as insurance coverage.

- Financial firms offers similar car renting programs rather than selling, or leasing proposals.

Our suggestion on this work is that this innovative automotive service can be marketable as a set of products and services, enhancing the pro-active role of automotive sector by fostering new strategies for sustainable production, as well as by introducing original aspects on the discussion of our consumption pattern policies.

Case study – Preliminary Considerations

To support this approach, a mobility-providing service simulation will be carried out using a vehicle produced at the Brazilian automotive installation in São Bernardo do Campo/São Paulo. The analysis focuses on the assumption that this service will enable consumer need fulfilment in such a way that it brings a significant decrease in the materials component needed for the fulfilment. We understand that for a product-oriented company, adding services will characterise an innovative business strategy, allowing to:

- Create superior value for clients;

- Build up direct customers relations, to intensify contact or to increase contact frequency;
- Supply a total offer: product plus lease service, plus insurance, plus ingredients, plus product upgrading, plus repair, plus call centre, plus take-back, plus refurbishing;
- Anticipate or respond to new or expected policy, legislation or fiscal measures.

During the last 50 years the Brazilian automotive industry evolved from a craftsmanship model to the most modern world-wide factory floor management techniques. In 1957 Brazilian automotive production was 1166 vehicles, while 1999 figure reached 1107751 units, which means among the several parts of an vehicle that each year 41 million new tires are sold in the Brazilian market, and only in the State of São Paulo the amount of lubricant oil peaks 280 millions litres each year (Viveiros, 2000).

QUALITATIVE CHARACTERISATION OF IMPACTS

Dematerialization

Case Study

Popular car, 43.325 vehicles manufactured on 2001

Total Weight 986 kg

Table 1 Energy and Mass Flow due to Popular 986kg Car Production; 2001 Production = 43325 units (adapted from)

Material	Mass Flow	Energy Flow
Ferrous Metals (66,4%)	Unit – 655 kg Total – 28365 tons	194000MW.h
Aluminium Alloys(7.5%)	Unit- 74 kg Total 3204 tons	56390 MW.h
Non-ferrous metals (19.9%)	Unit – 196 kg Total lead – 173 tons	
Plastics (1%)	Unit – 9.86 kg Total Plastics and rubbers – 8928 tons	
Glass (< 5%)	Total – 346 tons	1660 MW.h
Motor oil	Unit – 4.2 litres Total – 62468 litres	
Gear oil	Unit – 2.8 litres Total – 121310 litres	

Assuming the whole annual production will re-enter into the production line each year, either by re-manufacturing or by recycling, the dematerialization process will be characterised by the following figures:

Steel	each ton of recycled steel saves 1140 kg of iron ore, 154 kg of coal, 18 kg of calcium carbonate and needs 26% of the energy necessary to produce one ton of new steel.
Aluminium	each recycled ton saves 5 tons of bauxite, e 95% of the energy to produce the same amount of primary aluminium.
Lead	70% can be recovered as a metal.
Plastics and rubbers	the plastic recycling process consumes 10% of the energy necessary at the primary production. Each kg of plastic thermally recycled saves 1 kg of fuel oil and reduces up to 90% of the waste weight to be sent to landfills.
Glass	each amount of recycled glass uses 63% of the energy used at the primary fusion, saving the same amount of natural resources.
Oils and lubricants	automotive oils represent 1.4% of crude oil products (343000 m^3). In Brazil, 18% is recycled to its original use or to general lubricant or machining oil. This recycling process saves up to 50% of the lubricant consumption.
Tires	tires and automotive rubbers stand for 70 % of Brazilian rubber production. Although rubbers cannot be reprocessed, recycled rubber can be used in several other destinations. It is an excellent fuel, since its LHV varies between 12K to 16K BTU/Kg, higher than coal.

Besides the immediate impact on the saving in natural resources, land use, energy and landfilling, the benefits are increased by the increase of eco-labor associated with dismount and recycling services; and by the lower value of waste and pollutant emissions.

Moreover, and due to the already mentioned fact that 25% of greenhouse gases in developed countries are emitted by automotive sector, especially by the vehicles themselves, representing the main source of pollutants in the urban areas, their emission augments with the age of the vehicle. In the Brazilian context, accordingly to the Brazilian Association of Automotive Engineering (AEA, 1999), the Brazilian fleet younger than 4 years old (32,8% of the 28 million vehicles) emit 8% of total CO cars emission, against 47% emitted by the 30% older than 15 years (see Figure 1). The same Association depicted that a car manufactured in 1979 emits 40 times more CO than one produced in 1999.

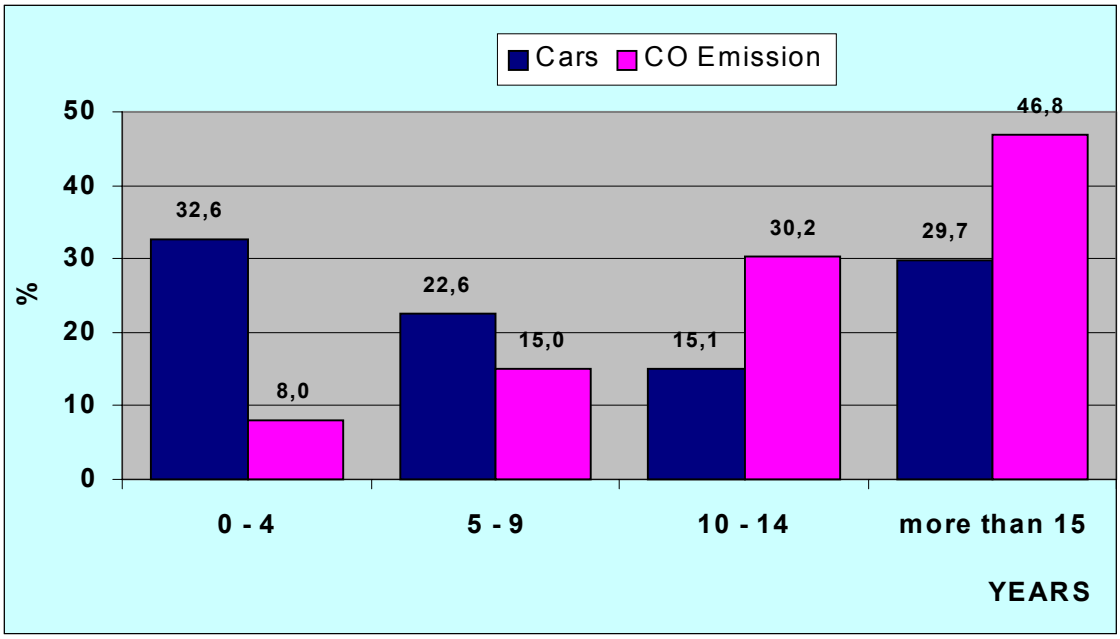

Figure 1 Distribution of the Brazilian Fleet Age, and its relationship with CO emission (AEA, 1999)

As reported by World Bank (1996), the cost of this pollution is equivalent to 0.4% of IGW, including health care and effects on global environment.

FURTHER ISSUES

The automobile's value as a consumer product extrapolates its utilitarian role as a means of transportation. Actually, marketers have redefined the automobile's requisite transportation capacity to levels of speed, power, ruggedness, and go-anywhere conveyance that ensure that the statistical of travel is well obscured in the showroom.

As pointed out by DeCicco and Thomas (1999), only recently the industry began to compete on the basis of environmental performance, and thereby incorporating these new variables into the competitively-driven product improvement equation.

On this regard, a more holistic approach will be needed if environmental issues are to become a reliable aspect of marketing and effective in competitive-leaded designing product.

This technologically innovative union will prove to be capable of fulfilling a client's need and environmentally-friend demands, namely by creating value for clients, adding quality and

comfort; by customising offers or the delivery of the offer to clients; by creating new functions or making smart or unique combinations of functions, and; by decreasing environmental load, bringing additional and perceived eco-benefits.

Up to now, while retaining ownership is a successful strategy for automotive sector, owning the distribution channels may be the only option for consumption goods, 'closing the loops' through integrated business strategy, allowing win-win synergies developed between automotive sector-related companies selling services instead of goods.

RESUMO

Este artigo evidencia a utilização da eficiência de recursos na área da indústria automotiva através do conceito de ***desmaterialização*** baseado na estratégia de serviço. Neste conceito uma abordagem inovativa é apresentada onde a ***dematerialização*** na indústria automobilística é atingida pela mudança de como os negócios automotivos são feitos, onde o resultado para um modêlo é a mobilidade proposta.

Essa situação irá direcionar a indústria automotiva para uma posição de prestador de serviços mais do que um vendedor de produtos.

O objetivo do conceito da ***dematerialização*** é substancialmente reduzir o excesso do fluxo de material na economia. No contexto da ***dematerialização*** esta estratégia de serviço trará mudança nos usuários automotivos preenchendo suas necessidades da maneira como o fluxo de material e energia precisam preencher significativamente sua redução e portanto sua demanda do meio ambiente.

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