3DAYCar Programme

A Review of Environmental Regulation and the Product
‘The Impact of Standards and Policies’

by
Joe Miemczyk

University of Bath
School of Management
Bath BA2 7AY
Tel: 01225 323873
Fax: 01225 826135
E-mail: mnsjrm@management.bath.ac.uk

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Executive summary

Motor manufacturers take account of the wider needs of society in many ways: some voluntary, but mostly as a result of regulation and policy. In particular, environmental standards are imposed, with varying degrees of success, to ensure that the motor vehicle serves the needs of the customer without compromising the wider needs of society. Manufacturers accommodate these requirements in designing products using well developed tools and techniques which conform whilst satisfying the fundamentals of quality, cost and time.

The aim of this review is to understand whether anticipated changes in product environmental specifications could compromise the ability to achieve a 3DayCar in terms of increasing lead times or product complexity. Literature based sources have been reviewed and representatives from manufacturers and other experts questioned in order to understand these implications.

The most significant developments that are likely to occur by 2010 are:

- The requirement to increase fuel efficiency by 25% and obtain a comparative reduction in greenhouse gases, together with increasingly stringent standards on other areas of exhaust emissions will lead to:
  - An increase in the number of vehicles running on diesel, which will have to be low-sulphur. These vehicles will have to be fitted with particular traps, nitrous oxide catalysts and on-board diagnostic systems.
  - A move towards alternative fuels, particularly liquid petroleum gas (LPG) and natural gas (NG). The number of hydrogen fuelled and hybrid (petrol/diesel-electric) vehicles will also increase but at a slower rate. They will only achieve significant volume by 2020.
  - Eco-labelling of cars to identify their 'environmental cleanliness' together with low emission zones which would only allow access to 'clean' vehicles. If these start to significantly influence consumer buying behaviour then these aspects could truly become a competitive issue, especially if there are substantial differences in the ability of VMs to deliver a cost effective solution.
  - A growth in the use of lightweight material and alternative lighter forms of body structure, such as the spaceframe, which will allow better fuel efficiency.
  - The requirement for manufacturers to be responsible for 85% recovery levels at the end of vehicle life, so that manufacturers will need to facilitate easy disassembly in their product design. In addition, materials must be used for which there is a recycling market or which are re-usables at a cost effective rate to make it viable for manufacturers to offer free take-back of all end of life vehicles.
  - Increasing congestion will lead to the fitting of on-board computer location devices to enable better route choices.
  - Safety and security legislation will ensure that immobilisers and driver and passenger airbags become standard, and there are likely to be external equivalents for greater pedestrian protection.
The effects of legislation changes on a 3DayCar are as follows:

- Fuel technology will have little impact

- The use of alternative, lighter body structures opens up the potential for design for manufacturing advantages and customer order lead time reduction

- Design to facilitate disassembly could detract from the current increasing use of modules in simplifying vehicle assembly. Since a 3DayCar is facilitated by less complex assembly processes, the requirement to take into account the end of a vehicle’s life in product design for assembly may present a barrier to modular production.

- The trend towards globally harmonised standards will aid the reduction of product variants and will, therefore, be of benefit to the rapid build to order process.

In conclusion there is little evidence to suggest that environmental legislation affecting new vehicle standards and design parameters will make producing a 3DayCar more difficult than at present. In fact, there may be opportunities to be gained by adopting the more radical technology being forced by some of these policy trends.
1.0 Introduction

A central theme of the 3DayCar research programme is how do changes in the way systems operate have impacts on the wider society? In order to assess this effect on ‘the voice of society’ it is necessary to understand what the product is that serves the needs of the customer as well as the needs of society in general.

Product standards and policies are established to ensure that the general requirements of society are not compromised. This means, for example, not compromising the safety of the pedestrian as well as the driver. Not compromising human health by the amount of ground level ozone which is produced or benzene absorbed by lung tissue. The health of the natural environment is taken into account by limiting the emission of sulphur dioxide that causes acid rain and results in forest die-back. Global resource use issues are beginning to be considered by attempting to control fuel consumption, a non-renewable resource, that also produces green house gases which are implicated in global warming.

Clearly the voice of society has a major impact in defining the type of product which is being manufactured. These evolving requirements to encompass sustainability (growth without compromising the need of future generations) mean that the impact on producers will increase. The product is being shaped by these societal needs and will continue to be in the future. For this reason it is important to understand how these pressures may constrain or even enable innovative change in the total supply chain.
1.1 The 3DayCar and environmental regulation

**How does regulation impact on firms?**

The 3DayCar can be viewed as a systems and organisational innovation and Government is keen to promote industrial innovation in whatever form it may take. According to a survey commissioned by the DTI, regulation and policy/standards rank in the top ten of constraints to industry in terms of innovation (DTI 1999). Although technological feasibility, funding and economic viability rank above these aspects, they are still significant and warrant examination to understand if and how such constraints impact on the potential 3DayCar innovation.

Clearly environmental legislation only makes up part of the regulatory pressure, but in the automotive sector it can be seen as significant, particularly when viewed in the context of R&D budgets.

**Where do environmental impacts and legislation meet?**

To understand where legislation has an impact, a life cycle approach has been taken, which will be further developed later in this research programme. The main objective of this section of the programme is to identify what the main pieces of legislation are that affect the environmental dimensions of the new supply system. This covers the supply chain from raw material right through to delivery to the customer.

On average, only 5% of a vehicle's actual impact is related to these production and distribution stages of the product life-cycle. A further 5% is contributed by disposal at end of the vehicle life, the responsibility for which is soon to come back to the manufacturer. An overwhelming 90% of the environmental impact of the car is through its use by the customer. Developments in fuel efficiency (hybrid, bi-fuel, electric vehicles, etc), together with the potentially greater impacts of new materials (Keoleian 1998), will shift the balance somewhat from customer use to the production and disposal phases. However, usage of the vehicle will continue to be the most significant part of it's life cycle and the car will remain a heavily regulated product in terms of environmental and safety standards.

Increasingly, regulation designed to lessen the impact of the vehicle in the use phase will impact on the materials used and the way in which vehicles are designed and manufactured (lighter materials, alternative powertrain technology, increased emissions control equipment – engine management systems, etc).

**The required technological shift is a slow one**

If environmental policy is to influence new technology, for example in the shift in material use, fuel types and powerplant design, a very severe learning curve must be overcome. Where the shift is being influenced by ‘technology-based’ environmental standards or taxes, innovation tends to be incremental. In the auto industry safety standards tend to be technically based and the incremental trends are relatively clear to foresee, for example through development in crash worthiness testing. ‘Technology-forcing’ standards are less specific and can be achieved a number of ways. (Kemp, 1997). Environmental pollution standards tend to be ‘technology-forcing’, and so not incremental and very difficult to predict. For example fuel economy improvements can be achieved through alternative fuels, lightweight materials or new powertrain technology such as petrol/diesel-electric hybrids or even a combination of these.

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1 Plastics and aluminium use much greater quantities of energy in their production than steel
If one looks at the auto industry over the last 10 or 20 years, there appears to be little in the way of major innovative change in terms of vehicle design and even performance. Generally there is an implementation lag of about 5-10 years after the technology has improved. Market penetration will then depend upon product life-cycles, policy drivers and market acceptance (ETSU 1997). In the automotive sector, the stock renewal or park turnover is slow (the typical life of a car is 12 years), policy drivers are often ineffective (c.f. graduated VED\(^2\), C.A.F.E. standards\(^3\), etc) and market acceptance fluctuates. It is suggested that these are the reasons which account for the apparently slow change in design and performance.

The industry is subject to globally intense competition, globally diverse markets, an uncertain future. However industry change is accelerating and technological speed is building. In many areas, industry does not know what standards it will have to meet in the coming years and standards vary from country to country [and state to state in some cases] (USCAR 1999). Overall then it is extremely problematical to foresee how environmental standards will influence technological developments and predict what the market will look like in 2010. In the UK, we have not previously seen as stringent changes in standards as are being tabled at present. The likelihood is that these will change the nature of the vehicle park at a rate not yet experienced in this country.

**Design for manufacture – as a way of mitigating standards’ impacts on manufactures**

Design for manufacture (DFM) focuses the design team effort on effective use of parts and processes to produce products that meet the customer and business requirements (Miles 1990, Storey 1994). DFM is a commonly used set of tools and techniques which ensure that the requirements of the product meets the requirements of the process (in terms of cost, time and quality). Time is an important aspect due to its impact on cost, and so efforts are made to ensure that product standards do not require significantly more time or effort to accommodate in the process. As new standards are implemented, DFM is utilised to mitigate the impact of new requirements on the manufacturing process.

Overall current new vehicle standards and regulations will have a greater impact in the next decade than has been seen over the last 10 or so years. Despite this, the ability of vehicle manufacturers to absorb the requirements of external forces is considerable. Using DFM (as well as DFD\(^4\)) is a powerful tool for mitigating the impact, of major changes in design on manufacturing in terms of cost, quality and time.

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\(^2\) Vehicle Excise Duty – the tax paid on the vehicles which currently only distinguishes between vehicles <1.1 litre and those over 1.1 litres. This does not have much impact on the consumer’s buying decision, in terms of a cleaner car.

\(^3\) Corporate Average Fuel Economy implemented in the USA to improve average fuel economy did not have the desired affect and levels have not improved significantly as planned.

\(^4\) Design for Disassembly
2.0 The scope of the review

The aim of this research is to understand whether product environmental standards (both statutory and voluntary) and to some extent general policy, has any adverse impact on the ability of vehicle manufacturers to manufacture and deliver new cars to retail outlets and customers, specifically in terms of time. In addition to environmental standards, a general review of safety trends has been made. It is felt important to address the issue of trends in ownership and how these affect the structure of the car park, as a way of understanding how regulation might influence or be influenced by consumer trends up to 2010.

3.0 Methods used for the study

3.1 Literature reviews

Overall, literature has been taken from as wide a source base as possible to give a broad perspective on a field where coherent understanding of all aspects has not been assembled. Technical details of specific standards relating to environmental and safety standards and policies are not thought to be of benefit as it is the impact of implementation which is of importance for this study. Therefore, the literature focus has been more general in nature. A list of some of the documents reviewed can be seen in the reference section.

3.2 Interviews

The interviews have been focused on vehicle manufacturer representatives where the product standards and policies have a direct impact. Interviews with sponsor environmental representatives have sought to understand whether current and pending product legislation has a significant and specific impact on the processes involved in producing and delivering new vehicles.

It is understood that impacts may also be passed down the supply chain in terms of requirement for suppliers to change product specifications and processes (specifically areas such as testing procedures for fuel tanks). However, since the aim of the review is to gain a macro scale picture of current trends, interviews with vehicle manufacturers are considered sufficient at this stage.

Interviews were also undertaken with experts from industry groups and legislators. The broad scope of this review meant that few individuals were able to answer in all areas, so the number of interviewees was necessarily truncated.
4.0 Environmental standards for new vehicles

The requirements for new vehicles have been investigated up to 2010. Such standards must be maintained by any manufacturing and delivery system suggested by this research programme. Appendix I summarises the likely requirements of new vehicles in 2005 – 2010 and possible technology strategies for meeting these standards.

4.1 Introduction

The European Union is continuing to tighten regulation to enable global agreements to be met and internal targets to be reached. The US has typically been a forerunner in regulation of motor vehicles ever since the notorious photochemical smogs of Los Angeles in the 60s and 70s. As a result of the litigational framework in which companies have to operate in the States, car companies were quick to respond to the EPA\(^5\) demands. However, a combination of political ineptness, corporate influence and public apathy meant that standards such as C.A.F.E. failed to achieve all the benefits which were promised to society. Today US citizens buy big and drive as far as ever.

Has Europe learned from the mistakes made in the US? This has yet to be seen. However, Europe operates in a different legal framework although based on similar principles. Improvements being promised to society by industry and government alike have not been realised as yet, but we have not previously seen as tough a set of policies in Europe as are being considered at the moment. The technology forcing nature of these policies may mean that radical new innovations will have to be adopted, but whether these will be implemented fully by 2010 may be rather optimistic.

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\(^5\) Environmental Protection Agency, the US department which sets air quality standards, etc.
4.2 Fuel economy and the greenhouse effect

The main piece of policy which impacts on the product, in terms of global warming (as identified in the Rio Summit and subsequently the Kyoto Summit), is that of CO\textsubscript{2} (and other greenhouse gas or GHG) emissions. The summits required each global region to adopt targets for achievement by specified dates. The EU has subsequently set a general target of achieving a 12% cut in GHG emissions based on 1990 levels by 2008-2012. For the UK, this translates to an 8% cut by 2008-2012\textsuperscript{7}. In order to achieve this, the motor vehicle has been targeted for specific emissions level improvements over this timescale, due to the arguably large proportion of 22% that these vehicles contribute to GHG emissions (see Fig 1). It should be emphasised that petrol and diesel cars only make up 63% of the CO\textsubscript{2} emissions from road transport.

For motor vehicles using current fuels, a change in the GHG level directly translates to a change in fuel efficiency. Between 1983 and 1992 fuel efficiency had only improved by 3%\textsuperscript{8} in the EC (Wells and Nieuwenhuis 1996). As a result ACEA\textsuperscript{9} and the EC agreed on an increase in fuel efficiency for motor cars of 25% by 2008. This means the average emissions of CO\textsubscript{2} per registered vehicle by 2008 must be \(\leq 140\text{g/km}\)\textsuperscript{10}. There is clearly an assumption here that the consumer will buy the cars offered which meet this level. There is a risk of not achieving the

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\textsuperscript{6} First United Nations Framework Convention on Climate Change in 1992 signed by 154 countries.
\textsuperscript{7} Again compared with 1990 levels.
\textsuperscript{8} Potential gains have been lost due to tighter noise, exhaust emission and safety standards as well as preference for additional features increasing vehicle weight.
\textsuperscript{9} Association des Constructeurs Européens d’Automobiles or European Automobile Manufacturers Association.
\textsuperscript{10} Current fuel economy is around 35mpg with the ACEA/EU agreement bringing this to around 47mpg.
target as it is voluntary and based on demand in the market. The government has stated that it will promote the uptake of fuel efficient vehicles through eco-labelling (See Appendix III) and fiscal measures to influence consumer demand. However, if this voluntary agreement fails to achieve the required reduction in CO₂ emissions then the EU would consider enforcing this standard legally, which could lead to less flexible compliance measures.

![CO₂ Emissions by Market Segment](image)

**Fig 2: CO₂ emissions by market segment - target average level at 140g/km (from: ACEA 1999)**

In order to achieve the agreed standard a number of changes must be made to the current product ranges. Figure 2 shows how far away from the target each market segment is currently. Significant technological changes must be made to achieve the required fuel economy. This can be done in three ways:

- Better efficiency of current fuel
- Change to other fuels
- Reduction of the weight of vehicles through the use of lighter materials

Over the next 5-10 years the technology to be brought to market by vehicle manufacturers will be

- Designing engines for compatibility with improved fuels, instead of for the lowest fuel grade. This will significantly improve the efficiency of current ICE technology without the need for large technological changes (Walter 1997, ETSU 1999)
- Greater use of CNG and LPG, either as a sole fuel source or dual-fuel applications. (ETSU 1999)
- Increased use of aluminium and composite material in new vehicle design (ETSU 1999).

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11 A=mini, B=super-mini, C=lower medium, D=upper medium, E=executive, F=luxury saloon, G=specialist sport, H=dual purpose (ATV, etc.) and I=MPV
12 Internal Combustion Engine.
13 Compressed Natural Gas and Liquid Petroleum Gas.
• Use of on-board diagnostic systems – to monitor emissions and efficiency (ETSU 1999).

• In addition, current trends show increased market share of vehicles such as the -
  • MCC Smart - available now, a small light-weight vehicle which achieves more than 70mpg,
  • VW Lupo - available now, a small light-weight vehicle which achieves 78mpg,
  • Toyota Prius - available summer 2000, which is a petrol-electric hybrid achieving >80mpg,
  • Honda Insight - available 2000, which is also a petrol-electric hybrid achieving 80mpg,

Substantial R&D budgets are currently being spent on more radical solutions to the problem of fuel efficiency. Due to the excessive costs involved, a number of collaborations have occurred already in the field of hydrogen fuel cells, which only emit water vapour and small amounts of NOx, and petrol/diesel-electric vehicles, which allow substantially reduced fuel consumption. It is very unclear whether these new technologies will have an adverse effect on manufacturing capability, but certainly there is potential for sourcing complexity problems to occur. High value items from overseas can have an impact on scheduling flexibility 14, and these advanced technologies could initially fit into this category.

One area that should be examined is whether these new technologies could lead to constrained supply due to reliance on outsourcing very complex vehicle powertrain components and associated equipment especially if they are part of a globally constrained market. There is thus a possibility in the short-term, but once manufacturers have produced their own expertise without relying on Ballard (an independent developer of fuel cell technology), for example, then supply risks are likely to be reduced.

The process of designing for manufacture and assembly is well developed and the issues are already being taken into account by designers and manufacturers throughout Europe. Therefore, it seems unlikely that these developments will have a significantly detrimental effect on plant manufacturing lead-times and flexibility, although multi-market products may still present some difficulties (see global harmonisation in section 4.8). In fact, there are indications that some of these innovations in body structure, initially developed for weight saving potential, could be utilised to enable more effective order fulfilment15.

Ultimately the Lovins style ‘hypercar’16 may become the norm, although this seems unlikely in the 2010 timeframe. However, research carried out at the RMI 17 shows that even radically different design and production structure would not negatively impact on production costs, quality and time. In fact, moving away from the current incremental method of improvement could have significant positive effects on manufacturing. Lovins specifically mentions how lightweight composite structure manufacturing lends itself particularly to build to order due to lower tooling costs and greater flexibility (Lovins, 1998).

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16 A light weight vehicle, developed as part of the USCAR development programme for new vehicle technology, which utilises lightweight body structures, separate body panels and new powertrain technology (hybrid and/or fuel cell).
17 Rocky Mountain Institute.
Increases in fuel efficiency and reduction in GHG’s will give additional benefits in terms of reducing other emissions harmful to human health and the environment. The next section discusses these in regard to exhaust emissions.
4.3 Exhaust emissions

In the UK, emissions from new vehicles have been subject to increasingly stringent standards mainly driven by the Euro standards, which have in turn been influenced by the States and US87 (earlier US equivalent) in particular. For example in the States, the NOx standard for 2004 is a mere 2% of the 1975 standard when catalytic converters were first introduced there (UNECE 1999). At present new cars must comply with the Euro II standard, which limits emissions of CO, NOx, and HCs. As a result of implementation of Euro I all new cars had to be fitted with a 3-way closed loop catalytic converter from 1993. Effectively emissions of CO and VOCs have been reduced by 30-40% as a result of this action (DETR 1999). This also had an impact on production, in that exhaust systems and powerplants had to be modified so that the new technology could be accommodated. Lead-free petrol was also introduced to meet suspected health risks, but also to enable catalytic converters to be operated without the damage caused by lead. Interestingly, this addition had a negative impact on fuel economy (due to weight gain and performance loss). Therefore meeting new fuel economy standards at the same time as reducing polluting emissions will be more difficult.

To assist in the achievement of exhaust emission standards, low-sulphur fuels will be priced into the market to replace conventional diesel fuels. Whilst diesel enables manufacturers to more easily meet the agreed fuel economy standard, they make it more difficult to meet increasingly stringent emissions standards (especially for particulates and NOx even though they have been reduced significantly, see Fig 3). As a result, particulate traps and de-NOx catalysts are likely to be mandatory for certain markets. All these aspects will be required to meet the Euro IV standard that will be implemented in 2006. Other alternative fuels such as CNG also have lower exhaust emissions generally.

![Fig 3: NOx levels by vehicle type from 1970-2025. DETR Sustainable Distribution.](image-url)

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18 Carbon monoxide, nitrogen oxides and hydrocarbons which all cause respiratory problems.
19 Volatile Organic Compounds implicated as respiratory irritants and potentially carcinogenic.
Interestingly, local authorities such as Westminster Council (possibly followed by Camden, Southwark and Kensington & Chelsea) may soon implement low emission zones, which would not allow access to old vehicles that contribute to the majority of the pollution levels. This would be achieved by issuing a green bumper badge to identify acceptable low emission vehicles (Surveyor 1998). How this may influence the market is unclear, but experience in California demonstrates that this is driving manufacturers into stronger consideration of LEVs, ULEVs and ZEVs. If this were to be commonly taken up across European cities, then the impact could be much greater than previous legislation in terms of influencing the type of car produced and purchased in the EU.

In terms of production and distribution, the introduction of catalytic converters had a major impact on assemblers and suppliers as well as oil companies and service centres. However, this was accommodated without drastically affecting current processes, although there were 18 years of experience from the US to build on.

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20 As part of their Air Quality Strategies and Local Transport Plans.
21 California Air Resources Board (CARB) set the percentage of Low emission vehicles (LEV), ultra low emission vehicles (ULEV) and zero emission vehicles (ZEV) to be sold in the state of California.
4.4 Noise

Noise will become more of an issue in general throughout Europe. This will be influenced by the imminent release of a draft directive on noise in the European union. Although it is uncertain whether type approval standards will have to change, benchmarks are already in place to provide measures in terms of noise performance. The SMMT eco-label is already in use for new cars. Consumers now have the choice of waking up their neighbours or not (see Appendix III)!

![Figure 4 – Trends in vehicle noise from 1976 to 1995/6 (Source: Sustainable Distribution 1998, DETR)](image)

Figure 4 shows that cars are clearly not the main contributor to noise on Britain’s roads; HGVs are the main culprits. Although improvements have already been made, vehicle manufacturers are developing further refinements in this area. Making cars quieter does not appear to have any significant impacts on manufacturing ability at present, but incremental improvements will affect future tyre design and engine compartment insulation. This may be viewed as a selling point, but whether customers will really be able to know what <74dB actually means is anybody’s guess!
4.5 End of Life Vehicles

The European Directive on ‘end of life vehicles’ (ELV) requires that in 2001 all new vehicles are 85% recoverable and by 2006 all ELVs must be 85% recovered/recycled. The responsibility for these actions lie partly with the manufacturers and partly with dismantlers. Consumers will have to receive a certificate of destruction to prove proper treatment of the vehicle. Most countries in the EU are already operating some kind of responsible ELV take-back on the basis of market values. Figure 5 shows the 1997 situation in the UK, with 75% recycled.

Fig 5: Percentage of vehicle materials currently recycled. SMMT Acord report 1997

The impact of this legislation is potentially significant. Design for disassembly is likely to be very important to ensure that dismantling costs are minimised. There is pressure to ensure that this does not conflict with design for assembly (Dewhurst 1994). The move to lighter materials such as composites may conflict with ease of recovery (separating materials is more difficult), as might the use of highly complex modules which simply ‘snap-in’. If manufacturers are responsible for aspects of the vehicle take-back, the costs could also be significant (Ends 1999, SMMT 1999). What is particularly frustrating for the industry in Europe generally is that there already exist voluntary programmes to deal with the ELV waste stream (as shown in Fig 6) which rely on market forces to find the optimum solution to a potentially very expensive problem.

Fig 6. Member states who already operate a voluntary framework for ELV take-back (ACEA, 1999).

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22 Recovery relates to energy as well as material recovery. Recovered means that material and energy have been extracted from the waste. Recycling means that only material (metal, plastic or glass) is extracted.
The UK automotive industry has already made a great deal of progress in promoting the need for proper ELV treatment. The ACORD agreement was drawn up between all the major players to achieve the aims, which actually exceed what may be required for the EU Directive. This includes targets for 85% recovery for 2002. However, as Figure 7 & 8 shows, the ACORD agreement has failed to deliver the increase in recovery in 1998, which provides more reason for Government to legislate.

![Recovery Percentage](image1)

![Number of ELV cars](image2)

**Fig 7& 8: Current percentage of cars recovered in the UK and total number of car disposed of in UK (SMMT, ACORD 1999)**

Toyota in Japan already achieves a high recovery figure (average 87%) through Toyota Metal (Toyota Environmental Report 1998). However, there is a reliance on market forces to achieve this in terms of the market for recyclable material. The fact that Toyota owns many of the players through the process chain is a key enabler to making this system work by creating the necessary market. This ownership does not occur so much in Europe and even less so in the UK.

In terms of actual impact on the ability to build and deliver a 3DayCar there has been little analysis in terms of anything apart from costs. This has been estimated at £312million per annum in the UK under current conditions and processes. However this will be further investigated in the next environment stream report in terms of the potential impact on logistics functions.
4.6 Safety

The most significant technologies which are likely to increase in this field are the use of restraint technology and head-on and side-on collision protection including air-bags. It is unlikely that any of these would have an adverse effect on production and lead-times (from the perspective of many commentators interviewed). Looking at previous incremental changes in this field, the major impact appears to be on complexity, but as these options (different locations for airbags) become more standard, the problem will be alleviated.

There are indications that the safety of pedestrians will become more and more of an issue in Europe (Dickison and Davies 1997, Okamoto 1994). It has been proposed that implementation of legislation for the protection of pedestrians will have an impact on the design of future vehicles and further amendments to Directive 70/156/EEC (EC 1996) may well occur within the 2010 timeframe.

The development of intelligent sensors will increase in tandem with pedestrian safety legislation. Further into the future, safety standards may utilise the benefits of telemetry in terms of controlling speeds in urban areas. However, these types of technologies are not expected to be introduced until after 2010 due to the lead time required for European regulation once the technology has been proved. This will have an impact on technical complexity but is again unlikely to adversely affect the ability to meet rapid assembly and delivery times.

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23 Including new materials such as structural foams and honeycomb sections for bumpers and possibly other body sections.


25 Pilot project at Leeds to integrate GPS with speed limit zones so that cars are limited in speed restriction areas (The University of Leeds, 1998).
4.7 Standards for vehicles sold in non-EU markets

Large differences exist in environmental and safety related specification standards globally, in particular between Europe, the US, Japan and South-East Asia. The introduction of ECWVTA in the 1980's means that a common standard is applied throughout Europe, which has been helpful in reducing some of this global complexity (SMMT 1999). However, grey imports to Europe often do not comply with environmental, safety and security standards. Already, some non-EU countries are adopting European standards. These are becoming some of the most stringent in the world, other than for some aspects in the US and Japan. However, there is still a significant difference in type approvals between markets and this means that an increased variety of product must be produced by suppliers and vehicle assemblers. For a plant that produces for 70 different countries this can be significant. Resolving such problems of product complexity is a key to achieving the 3Day Car.

The UNECE Working Party (set up in 1958) is working towards common global standards for new vehicles, so that more of these market differences can be removed. Clearly, a reduction in this complexity would help dramatically those plants that manufacture for many different markets. This work is being carried out through the Global Technical Regulations for wheeled vehicles, equipment and parts (as from 25 June 1998). WP.29 is soon to be renamed “World Forum for Harmonisation of Vehicle Regulations” (UNECE 1999). It has been stated that there appears to be little political will to push this forward, as Governments are not clear about the benefits. Despite this, many governments are signing up to harmonisation and more are expected in the future. Common differences between EU and non-EU are listed in Appendix II. Any progress in this direction will benefit 3Day Car.

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26 European Community Whole Vehicle Type Approval shows that new vehicles meet all 50 legislative tests.
27 For example, Katmandu adopting the EURO I standard.
5.0 Other trends and issues

5.1 Congestion

While overall pollution resulting from new vehicles is likely to decrease, the growth in traffic over the next few years is likely to continue to have an increasing economic impact in terms of hours lost due to congestion. As a result, there will be an increase in the implementation of telematic technologies to enable more effective utilisation of road resource. Road charging transponders will be add-on boxes in the near future, integrated computer systems will spread across all model ranges, and traffic routing systems will increase in popularity. There will be an increase in variants offered to the customer, but none of these technologies will have a significant impact on production flexibility and overall lead-times.

Legislation is more likely to impact on congestion charging infrastructure and transport planning. The use of ‘HOT’ lanes in the US has proved popular in some areas. The impact of this type of legislation appears to have greater impacts on the ability to deliver vehicles to the customer from the factory, than actual vehicle design parameters in the near future.

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29 High Occupancy/Toll lanes – where single users (a car with only one occupant) are charged to use specific highway lanes and lane use is free for cars which have more than one occupant thus reducing the number of cars transporting the same number of people. This was used in Bangkok, and in fact people hired themselves out to travel as extra passengers so drivers could gain access to the urban centre!
5.2 Trends in ownership and the impact on vehicle park

There are a number of factors that are changing the kinds of cars which are bought both in the private domain as well as the fleet market. Some of these factors include environment considerations. When a new car is bought by the general public, environment comes fairly low on the list of points considered by the customer (10th as quoted by one manufacturer representative with fuel economy 7th due to cost). Legislation has not yet had the desired effect of significantly influencing which cars are bought. The fuel escalator has a minimal effect and the VED in its current form has little or no practical influence, although this is due for reform next year to include four bands for CO₂ emissions. The new eco-labelling scheme introduced by the SMMT will give more information (see Appendix III), but how it influences buying behaviour depends on many other factors. Diesel still has a small market share in the UK at only 12-13%, compared to France’s 40% and Germany’s 18%. This has much to do with the high tax on the fuel in comparison with other markets. Low sulphur diesel does not justify this tax differential on environmental grounds (reduced emissions of SOₓ as well as enabling better efficiency for hi-tech diesel engines) and the labelling scheme may help to illustrate this.

The fleet market is different. Company car policies are set in terms of cost to run as well as other specific factors including image (green or not) and prestige. Monks Partnership Ltd report on company car policy for 1999 shows some interesting facts. Overall the percentage of diesel is increasing (now around 10% for SMEs and 18.3% for larger companies, with a maximum of 38%). This will inevitably influence the private buyers market as perception and technology improves. 47% of companies encourage diesel uptake and 61% are seeking to reduce the environmental impact of the fleet generally. Seven companies are encouraging smaller engined cars and five are investigating the use of LPG. Arnold Clarke (large fleet owner) in Scotland has taken 100 dual fuel (petrol and LPG) Vectras for city rental (Automotive-online 1999). Importantly a number of commentators have mentioned that the first uptake of alternative fuelled cars is most likely in the public fleet sector and orders are already starting to be received from power suppliers and local authorities (Wells and Nieuwenhuis 1997).

Leasing is another significant area of growth and a number of industry commentators including Dan Jones have stated their belief that more flexible trends in ownership will take place in the future. Such scenarios include leasing of small commuter cars, from a shared pool, for the journey to work and ownership of a family weekend car or vice versa. Government could not legislate for this directly but there may be a move towards congestion charging (BBC1 “Carmageddon” Sept 99). This may persuade the public to use smaller commuter vehicles in ‘clear zones’ where there are restrictions for access to only low emission vehicles.

New York has recently stated that it will adopt the CARB standards by 2004 bringing it in line with California’s strict influence over the emissions of vehicles sold (Automotive-online 1999). These types of policy structures are being looked at carefully in an EU context and although unilateral adoption of this type of regulation is unlikely, there may be some regions for whom this is attractive (especially ECMT countries who had already implemented US87 before Euro I).
6.0 Conclusions – new cars in 2005-2010

Between 2005 and 2010 new cars will have to fulfil the many criteria. To reduce the impact of cars on global warming, CO₂ emissions must be cut and therefore the fuel efficiency must be improved by 25%. To enable the reduced impact of emissions on the health of society and the environment, the Euro 4 standard for exhaust emissions will cut SOx, NOx, CO and HCs. In addition, improvements in noise standards, safety standards and recycling standards will be forced through legislation.

In order for these improvements to be made, new cars will run on better quality fuels. The market share of diesel will increase, as will alternative fuels such as LPG and CNG. However, hydrogen will only become a significant fuel source between 2010 and 2020. The market share of hybrid (petrol/diesel-electric) vehicles will also increase, although not significantly before 2010. In order to meet the stringent Euro 4 standard particulate traps, NOx catalysts and on board diagnostic systems will also become standard, particularly on diesels. Changes in noise and safety standards are likely only to result in small incremental changes to vehicle standards. However the legislation relating to end of life vehicle recycling will impact on design significantly to enable the burden of recovery cost to be lowered.

Vehicle standards generally are to become more harmonised globally and ownership will accelerate the uptake of these new vehicles.

There are few impacts on a 3DayCar from these developments except in the following areas:-

♦ Design for disassembly could conflict with design for assembly and modularisation, making a 3DayCar more difficult to produce.

♦ The global harmonisation of standards will make producing a 3DayCar more easy because manufacturers could reduce the number of variants a plant has to make.

♦ The impact of radical new build strategies such as the ‘spaceframe’ and composites (which help weight saving) could also enable easier production of the 3DayCar.

Between 2005 and 2010 vehicle standards will have to fulfil many criteria forced on them by legislation intended to improve the environment, in the fields of fuel efficiency, emissions, noise, safety and recycling.

While these changes will impact significantly upon the car as a product, and potentially on cost, the impacts on the ability to produce a 3DayCar are considered to involve relatively few areas.

On the negative side, design for disassembly for recycling could conflict with current trends in modularisation to make assembly simpler.

On the positive side, the impact of radical new build strategies such as the spaceframe and composites, and the global harmonisation of standards can assist by reducing the order lead time and product complexity.

These must be taken into account in the overall design of the 3DayCar process.
References


SMMT\textsuperscript{1} Press release. *ACORD reveals the real cost of recycling*. n. 3497.10/8/98.


SMMT\textsuperscript{3} . ACORD. First Annual Report.


Wells, P. and P. Nieuwenhuis (1998) *The Death of Motoring: Car making and automobility in the 21\textsuperscript{st} Century*.

## Appendix I – Requirements of the car in 2005-2010

<table>
<thead>
<tr>
<th>Driver</th>
<th>Standard/limit etc</th>
<th>How/what</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO2 Emissions</strong></td>
<td>ACEA agreement 140g CO2/km</td>
<td>Light weight – aluminium, plastic, composites.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improved powertrain efficiencies, Hybrid and Fuel cell power plants (low market share).</td>
</tr>
<tr>
<td><strong>Air quality</strong></td>
<td>EURO IV Standard</td>
<td>De-NOx catalysts (diesel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Particulate traps (diesel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low sulphur fuels (diesel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hybrid and fuel cells (low market share)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On-board diagnostics (diesel)</td>
</tr>
<tr>
<td><strong>Congestion</strong></td>
<td>Voluntary IT specs</td>
<td>On-computer location systems</td>
</tr>
<tr>
<td><strong>End of life recovery</strong></td>
<td>End of Life Vehicle Directive</td>
<td>Easier disassembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Component labelling (Plastics)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less composites?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less plastic diversity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aluminium?</td>
</tr>
<tr>
<td><strong>Safety and Security Standards</strong></td>
<td>ECWVTA</td>
<td>Air bags all models?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Side impact bags all models?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immobilisers mandatory?</td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td>&lt; 75 dbA when running</td>
<td>Further engine compartment insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electric motors?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low noise tyres?</td>
</tr>
</tbody>
</table>
Appendix II – How EU standards may vary from other countries

Areas where EU and non-EU differ (SMMT 1999)

<table>
<thead>
<tr>
<th>ISSUE</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions</td>
<td>EU requirements are more stringent, non-EU vehicles may fail tests – except for US and California.</td>
</tr>
<tr>
<td>Noise pollution</td>
<td>Non-EU states impose less rigorous limits</td>
</tr>
<tr>
<td>Fuel type</td>
<td>Higher sulphur fuels in EU may damage non-EU vehicle engines</td>
</tr>
<tr>
<td>Seat belts and brakes</td>
<td>May not be the same standard for anchorage and braking systems</td>
</tr>
<tr>
<td>Front and side impacts</td>
<td>Standards for EU different than for other territories</td>
</tr>
<tr>
<td>Product recalls</td>
<td>Tracing faulty imported parts and vehicle is difficult and consumers may not become aware of risks</td>
</tr>
<tr>
<td>Anti-theft devices</td>
<td>UK anti-theft devices of highest standard</td>
</tr>
<tr>
<td>After sales support</td>
<td>Limited to difficult traceability</td>
</tr>
<tr>
<td>Insurance costs</td>
<td>Non-EU may command higher costs</td>
</tr>
<tr>
<td>Anti-corrosion</td>
<td>Non-EU may be less durable due to different climate conditions</td>
</tr>
<tr>
<td>Product liability</td>
<td>Non-EU may not be liable for any claim if not brought in by manufacturer or importer</td>
</tr>
</tbody>
</table>
Appendix III – The SMMT/DETR Eco-label for new cars

A fuel economy guide which contains fuel consumption data for all new cars is available from the dealer free of charge. In addition to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car’s fuel economy and CO₂ emissions. Regular servicing in particular will help reduce emissions and save fuel.

CO₂ is the main greenhouse gas responsible for global warming.

<table>
<thead>
<tr>
<th>Make/Model: Vauxhall Vectra</th>
<th>Engine capacity (cc): 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel type: Diesel</td>
<td>Transmission: Manual 5 speed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drive cycle</th>
<th>Fuel Consumption*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>7.8 litres/100km</td>
</tr>
<tr>
<td>Extra-urban</td>
<td>4.7 litres/100km</td>
</tr>
<tr>
<td>Combined</td>
<td>5.8 litres/100km</td>
</tr>
</tbody>
</table>

Carbon dioxide emissions g/km: 153
Regulated emission standard: Euro II
Noise level dBA moving: 74.0

*These results do not express or imply any guarantee of the fuel consumption of the particular car to which the label is attached. The car itself has not been tested and there are inevitably differences between individual cars of the same model. In addition this car may incorporate particular modifications.