

Sustaining the race: a review of literature pertaining to the environmental sustainability of motorsport

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Abstract

This paper discusses motorsport from the viewpoint of environmental sustainability amid growing concerns about the impact of human activity on the environment. It reviews the literature that positions motorsport in a global environmental context and explores the often used but rarely defined concept of sustainability. The author suggests that while motorsport is a significant sporting activity for economic and social reasons, there are considerable doubts as to whether it is currently managed and marketed in an environmentally sustainable way.

Executive summary

This paper aims to explore motorsport from the viewpoint of environmental sustainability. This is important because of the growing concerns around the globe of the impact of human activity on the environment. The introduction to the paper outlines the rationale for adopting a sustainability analysis to the management and marketing of motorsport. The sections that follow offer definitions of the respective concepts of motorsport and sustainability. The section on sustainability looks at the origins of the modern environmental movement, from which the concept of sustainability emerged, and then discusses the associated concepts of the 'triple bottom line' and 'natural capital' in order to offer alternatives to more conventional methods of understanding motorsport and the resources it requires. The importance of sustainability in the 21st century and the current situation with regard to the achievement of sustainability are considered, and the latest [date of publication – the GEO-4 report was published in October 2007 – see bibliography for details] United Nations environmental assessment is drawn upon to place sport, and specifically motorsport, in a global environmental context. Literature pertaining to sustainability and sport is reviewed and an analysis of the role of material consumption practices is offered. The paper then evaluates some attempts within motorsport to become more sustainable. The paper concludes that

further research into sustainable management and marketing practices for motorsport is warranted.

Introduction

Motor sport is an important part of the social and commercial fabric of industrialised societies. Around the world, it occupies a highly important place in popular and sporting culture. From the European Formula One racetracks at Silverstone, Nürburgring and Monaco to Canada's Circuit Gilles-Villeneuve, Brazil's Interlagos and to China's Shanghai International Circuit; to the desert plains of Africa for the Paris-Dakar Rally and to the Albert Park and Phillip Island circuits in Australia, in its various forms motor sport is one of historic and global significance.

Motor sport is also very diverse. The phrase, 'motor sport', in fact encompasses a range of categories of racing for motorised vehicles and broadly speaking, is conceived as either track racing, or off-road racing. For four-wheeled vehicles alone, there are a multitude of forms: Formula One, Indy Car, Stock Car, Rally, Drag Racing, Go-Karts, Dune Buggies and trucks are just some examples. Motorbikes are also raced in several varieties including Superbikes, Motocross, Quad Bikes and the derivative Snocross competitions. While motor sport is principally a land-based activity, it also extends to water with both onshore and offshore speed boat racing of various kinds. Within each of the major categories, motor sport is divided further into a range of competitions according to body type, engine capacity and vehicle manufacturer with each having its own technical requirements and idiosyncrasies.

All of these varieties of motor sport, however, share two key commonalities. The first is that the participants place great emphasis on competitiveness; winning competitions, and how this is achieved, is highly valued. As a result, the quantification, measurement and analysis of progress towards winning is a typical characteristic whereby speed, engine size and power, and aerodynamic efficiency are widely discussed by participants, commentators and fans. The second commonality is that all strands of motor sport share a dependence on the physical resources of planet Earth, and for most, a heavy reliance on crude oil as an energy source for propulsion.

However, the global context for motor sport is changing. In recent years, the emergence of the environment generally, and the phenomenon of anthropogenic climate change in particular, as issues of global social, political and economic importance is prompting a re-examination of many forms of human activity. For example, how we use energy, and from which sources we derive it, is now widely debated in the spheres of government, commerce and our broader citizenry. In terms of motor sport, whilst it is widely covered in electronic and print media around the globe, there is no reported scholarly research into the environmental sustainability of motor sport and so researchers are essentially beginning from "scratch". As a result, managers and marketers of motor sport are faced with significant knowledge gaps: these include how we conceptualise the relationship between motor sport and environmental sustainability; how do we measure the impact of motor sport on the environment; how do we manage motor sport in a context of growing environmental stress; and as a result, how do motor sport managers, marketers and sponsors then communicate with their target audiences?

The aims of this paper therefore are twofold: Firstly, to make a contribution to understanding whether motor sport, in a broad sense, is an environmentally sustainable practice through a review of recent scholarly and popular literature pertaining to motor sport and sustainability. Secondly, to develop a basis for debate about developing appropriate management and marketing strategies given the global environmental challenges that are emerging. As a consequence, this paper serves as a launching point for further scholarly research in these areas.

This paper therefore examines motor sport from the viewpoint of environmental sustainability. This discussion is important because of growing concerns around the globe of the impact of human activity on the health of our environment. A wealth of research in recent years suggests that consumption-driven human civilisation has, and will continue to have, a very negative impact on our planet across a range of measures including land, water, the atmosphere and biodiversity. It is axiomatic that this degradation and pollution is a consequence of the consumption of our natural resources. As a result, the continuance of current patterns of human consumption-based activity, including that of sport, is increasingly drawn into question.

Using concepts such as sustainability and natural capital, this paper situates motor sport within the current broader environmental context. It draws upon the latest United Nations' environmental assessment to discuss some of our planet's natural 'capital' upon which motor sport draws for its sustenance. It explores literature pointing to trends in how motor sport is adapting to environmental issues, and raises important questions about the management and marketing of this globally significant sector of sport.

Motor Sport

The Fédération Internationale de l'Automobile (FIA), the global governing body for motor sport, surprisingly does not offer a definition of motor sport in its statutes, regulations or its framework document for competition, the 'International Sporting Code' (Fédération Internationale de l'Automobile, 2008). The FIA does however define the term 'automobile' as:

A land vehicle propelled by its own means, running on at least four wheels not aligned, which must always be in contact with the ground; the steering must be ensured by at least two of the wheels, and the propulsion by at least two of the wheels.

In the absence of an official definition of motor sport, for the purpose of clarity, this paper will adopt the definition offered by Tim Angus, Chris Aylett, Nick Henry, and Mark Jenkins in *Motorsport Going Global: The Challenges Facing the World's Motorsport Industry* (2007, pp. 1-2):

We define motorsport broadly as competitive racing by equivalent machines on a frequent basis, on designated tracks and circuits. These machines include...motorcycles, moto-cross, karts, historic cars, drag, open-wheel, single-seat, sports, GT, Formula Ford, touring cars, rallying, sports compact, CART, IRL, and Formula One.

Angus et. al. note that racing is organised around, 'series, championships, events and meetings arranged by promoters, circuits and racing clubs at all levels (professional race and amateur sport' (p. 1). They note that in the context of the motor sport industry, the term 'motor' refers to the 'provision (construction and preparation) of cars and bikes', while 'sport' refers to the 'infrastructure including clubs, circuits, promotion, insurance...that is needed to participate in or view the sport'. They also suggest that motor sport is part of the 'leisure and entertainment industry' (pp. 1-2).

Angus et. al. identify some important parameters of the global motor sport industry. In 2005, these included that:

- It was worth approximately £50 billion and represented 0.23 per cent of global Gross Domestic Product (GDP);
- There were approximately 600 race circuits (excluding kart tracks);
- There were 56 global motor sport events, and;
- On average, over 52 million viewers watched each Formula One Grand Prix.

Based on these measures, motor sport is clearly a major global enterprise.

Sustainability

In examining the sustainability of motor sport, it is appropriate to define the concept of sustainability. Simon Dresner points out that the idea of sustainability emerged approximately fifty years ago (2002, p. 1). Andres Edwards notes that its origins are in the emergence of the 'environmental movement of the 1960s and 1970s' whose antecedents were the United States' 'New England transcendentalist movement' of the 1800s, which was concerned with the 'human connection with nature' (Edwards, 2005, p. 11). Whilst thinking about sustainability is not limited to the United States, a number of American conservationists including John Muir, Aldo Leopold; and Rachel Carson, author of the influential text, *Silent Spring*, gave impetus to the environmental movement from which the idea of sustainability originates, by linking the welfare of the environment to the ethical behaviour of people (Edwards, 2005, pp. 11-12).

There are differing views what sustainability means and our understanding of this concept has evolved significantly in the last two decades. Meadows, Meadows and Randers (2004) observe that in simple terms, sustainability refers to the capacity of a society to, 'persist over generations' (p. 254). The authors note that a 'sustainable society' is one that is 'farseeing enough, flexible enough, and wise enough not to undermine either its physical or social systems of support' (p. 254). Sara Parkin, the Co-founder of the 'Forum for the Future' in the United Kingdom, argues that the word 'sustainable' refers to the 'capacity for continuance' of a given organism or object. As a consequence:

Sustainability is therefore a quality. It is an objective, not a process. Something either has or has not got the quality of sustainability – the intrinsic capacity to keep itself going more or less indefinitely. We want the environment to have it, so it can support life (Parkin, 2000, p. 7).

In essence, the idea is founded on the ability of life forms, as both individuals and groups, to survive over long periods.

Wilkinson and Yencken (2000) argue that sustainability is based on three 'pillars': 'ecological sustainability', 'social sustainability' and 'economic sustainability' (p. 9). They note however that a fourth pillar, that of 'cultural sustainability', should also be recognised. Parkin contends that sustainability consists of three interrelated *dimensions*: the *environment*; the *social* dimension and thirdly, *economic* considerations (Parkin, 2000, p. 4). The first dimension - the environment – is the, 'real bottom line', as the physical constraints of land, water, air and ecological systems are the determinants that 'set' the 'limits' within which the social and economic dimensions can function (Parkin, 2007). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) extend thinking about sustainability by adding a fourth dimension, that of 'governance' (UNESCO, 2008).

These 'dimensions' are important as they serve as the basis of what is widely known as the, 'Triple Bottom Line' (TBL - see 'Table 1' below), and the 'Quadruple Bottom Line' (QBL), where the environmental, social, economic and leadership impacts of the economic activities of organisations are identified. The development of the QBL may be traced to the work of Ekins, Hillman and Hutchinson (1992, as cited in Parkin, S., 2000, p. 5), and subsequently to

Serageldin and Steer (1994, as cited in Parkin, S., 2000, p. 5) from which the ‘four capitals’ model emerged. The ‘four capitals’ is an attempt to attempt to explain the resources available for human development as different types of ‘capital’: *natural*, *human*, *social* and *manufactured* (Parkin, 2000, p. 7).

A more recent and helpful evolution of the ‘four capitals’ is the ‘five capitals’ model (Parkin, 2000, p. 7 - see Table 1) whereby a fifth *financial* capital is added as a, ‘means of valuing, owning, (and) exchanging (the) other four capitals’ (Parkin, 2000, p. 7). Parkin adopts ‘economic parlance’ for the ‘five capitals’ where ‘each capital is represented’ by particular ‘stocks’ that describe the resources available for human progress. For each capital, humanity is able to decide whether to invest or not invest in the associated stocks from which ‘we can expect a range of benefits to flow’. In the case of *natural* capital, examples of natural stock include ‘soils’, ‘oceans’, ‘air’ and ‘ecological systems’. The *benefits* that flow from such natural stocks include ‘energy’, ‘food’, ‘water’, ‘climate’ and ‘waste disposal’ (Parkin, 2000, p. 7).

Table 1: ‘The Five Capitals’ (Parkin, 2000, p. 7)

Sustainability Dimension (i.e. Triple Bottom Line)	Type of Capital	Stock	Flow of Benefits
1. Environment	1. Natural	Soil, sea, air, ecological systems	Energy, food, water, climate, waste disposal
2. Social	2. Human	Health, knowledge, motivation, spiritual ease	Energy, work, creativity, innovation, love happiness
	3. Social	Governance systems, families, communities, organisations	Security, shared goods (e.g. culture, education), inclusion
3. Economy	4. Manufactured	Existing tools, infrastructure, buildings	Living/work/leisure places, access, material resources
	5. Financial	Money, stocks, bonds	Means of valuing, owning & exchanging the other four capitals

Parkin (2000, pp. 5-6) makes the important observation that environmental sustainability on our planet is subject to four fundamental scientific principles. These principles are:

- 1) The provision of the most essential elements of life – air, water, nutrition – are dependent on the *proper functioning of Earth’s ecological systems* (the interdependent cycles of carbon, climate and so on);
- 2) The only net producers of energy and raw materials (matter) in a *concentrated* form are *green cells*. For example, ‘energy from the sun is used to assemble a range of chemical and molecular ingredients into a tree’ from which we can obtain benefits such as ‘shade, furniture, food, medicine and fuel’. These benefits cannot be obtained if the ingredients ‘remain dispersed’;
- 3) *Energy and raw material does not disappear* – it can have a different form but it still exists. These are the so-called Laws of Conservation;
- 4) *Everything has the overall tendency to return to its elemental state* - the Second Law of Thermodynamics.

These limits therefore constrain the Earth’s capacity for human population and economic growth. By implication, this suggests there are limits to sporting activity as well, including motor sport.

The ‘four capitals’ and ‘five capitals’ models are useful approaches for sport managers as they enable us to conceptualise our relationship with the physical and human resources upon which we draw for our sporting activities. These models also offer a basis for understanding

the environmental degradation that can flow from sport-related development. As Parkin observes:

It can be argued that most if not all of our current environmental and social malaise may be explained by the unevenness of investment across different types of capital stock (Parkin, 2000, p. 7).

This analysis may offer sport managers, including managers and marketers of motor sport, an insight into how to adopt more sustainable approaches to the management of their activities.

In re-evaluating how people might manage or develop their social and economic activities, including sport, the idea of sustainability has been extended to that of Environmentally Sustainable Development (ESD). ESD was formally defined in 1987 in a report titled *Our Common Future* by the World Commission on the Environment and Development (WCED) under the leadership of WCED Chairwoman, Gro Harlem Brundtland, the former Prime Minister of Norway. The so-called ‘Brundtland report’ defined ESD as, ‘the ability of people to meet their present needs without compromising the ability of future generations to meet their own needs’ (WCED, 1987). Parkin argues ESD is a process of successfully managing the different capital flows over time on a genuinely sustainable basis (Parkin, 2000, p. 7).

However, Meadows, Meadows and Randers (2004) note that the term ‘sustainability’ remains, ‘ambiguous and widely abused sixteen years after the Brundtland Commission coined it’ (p. xiv). Nevertheless, for the purposes of this paper, the term sustainability is used to refer to *environmental sustainability* rather than economic, social or cultural sustainability. These other forms of sustainability, however, are inter-related and so should not be considered in isolation.

The Significance of Sustainability

The concept of sustainability is an increasingly important one around the globe. Its importance and influence is noted by Wilkinson and Yencken (2000) who argue that it is an idea that has, ‘become formally adopted around the world’ (p. 9). The influence of this idea is evident in two key spheres of human civilisation: government and commerce.

In terms of government, we see its influence in the form of recently evolved institutions whose purpose is to preserve aspects of our environment. These include the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2008), the United Nations Environment Protection Agency (UNEP) (UNEP, 2008), agreements such as the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC, 2008), known widely as the ‘Kyoto Protocol’, and the European Union Emissions Trading Scheme (EUETS) (EUETS, 2008).

In terms of commerce, we see its influence in the evolution of markets. For example, we now have corporations offering investment advice according to measures of environmental and social sustainability. These include the Zurich-based ‘Sustainable Asset Management’ (SAM) and its Australian subsidiary, ‘Sustainable Asset Management Australia’ (SAMA), (Alberici, 2003). In Australia, major banks such as the ANZ Group are offering ‘sustainable investment products’ (ANZ, 2008), while the Westpac bank apply sustainability measures when assessing applications for finance (Westpac, 2008). There are also some reports that investors generally are placing increasing emphasis on their environmental sustainability credentials (Burrow, 2007, Business 7).

An issue that reflects the extent to which sustainability has been adopted as an operating principle for business is that of anthropogenic climate change. Sectors of the global business community, both before and after Sir Nicholas Stern warned that there is now a compelling economic case for reducing the global level of greenhouse gases (GHG’s), a practice widely referred to as *carbon-constraint* (Stern, 2006). These include:

- the Carbon Trust in the United Kingdom (Carbon Trust UK, 2008);

- the Greenhouse Gas Protocol Initiative jointly overseen by the World Business Council for Sustainable Development (WCSBD) and the World Resources Institute (WCSBD, 2008);
- the growing trade in carbon emissions at the European Climate Exchange (ECE) (ECE, 2008) and the Chicago Climate Exchange (CCE) (CCE, 2008), and;
- the role of the International Carbon Bank & Exchange (ICBE) in facilitating renewable energy investment, manufacturing and ‘carbon safe products, standards and fuels’ (ICBE, 2008).

Sustainability: the Current Situation

To locate motor sport within its current global context where sustainability is viewed with increasing importance, it is worth pausing to consider the global environmental situation in which we find ourselves. Whilst the idea of sustainability has clearly gained greater recognition around the globe, efforts to achieve sustainability for our environment so that, as Parkin puts it, it ‘can support life’, have been less successful. For an up to date assessment of global sustainability efforts, the latest United Nations’ environmental assessment of our planet’s natural ‘capital’, *Global Environmental Outlook: Environment for Development (GEO-4)*, is helpful. *GEO-4* is an assessment of the health of our environment from 2004 to 2007 across the four key indicators of land, water, atmosphere and biodiversity. The study was conducted by ‘expert groups’ that consulted with over ‘100 governments’ and ‘50 partner organisations’, and was subject to two rounds of ‘government and peer review’ (UNEP, 2007a, p. 2).

The *GEO-4* assessment is an authoritative account of current global efforts to achieve sustainability. It provides an overview of environmental issues; state-and-trends of the environment between 1987 and 2007; human dimensions of environmental change; and an outlook for the future using four possible scenarios up to the year 2050: a) ‘Markets First’; b) ‘Policy First’; c) ‘Security First’, and; d) ‘Sustainability First’ (UNEP, 2007a, p. 2).

GEO-4 draws the general conclusion that, despite some progress, across the globe we are long way from achieving environmental sustainability. On the contrary, in the words of the *GEO-4* authors, ‘there is evidence of unprecedented environmental change at global and regional levels’. These include:

- Warming of the Earth’s surface evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (UNEP, 2007b, p. 72). While the global average temperature increased by 0.74°C in the 20th century, the IPCC estimate further warming during the 21st century [is likely] to be between 1.8 to 4.0°C.
- ‘More than 2 million people globally die prematurely every year due to outdoor and indoor air pollution’ (UNEP, 2007b, p. 72).
- ‘The ‘hole’ in the stratospheric ozone layer over the Antarctic – the layer that protects people from harmful ultraviolet radiation – is now the largest it has ever been (UNEP, 2007b, p. 73). The ozone layer is expected to recover, but not until between 2060 and 2075 as a result of long lag times’.
- ‘Unsustainable land use and climate change are driving land degradation, including soil erosion, nutrient depletion, water scarcity, salinity, desertification, and the disruption of biological cycles’ (UNEP, 2007b, p. 72).
- ‘The per capita availability of freshwater is declining globally, and contaminated water remains the greatest single environmental cause of human sickness and death (UNEP, 2007b, p. 183).
- ‘If present trends continue, 1.8 billion people will be living in countries or regions with absolute water scarcity by 2025, and two-thirds of the people in the world could be subject to water stress’ (UNEP, 2007b, p. 129).

According to *GEO-4*, the responsibility for these changes are mostly due to human activities in an, ‘increasingly globalised, industrialised and interconnected world, driven by expanding flows of goods, services, capital, people, technologies, information, ideas and labour’. However, the responsibility for global environmental pressures lies mainly with industrialised countries where ‘20 per cent of world population produced 57 per cent of gross world product’ and, ‘accounted for 46 per cent of greenhouse gas emissions’(UNEP, 2007a, p. 4). This link between globalisation, industrialisation and environmental damage, particularly in advanced economies, in turn highlights the role that material consumption plays in processes of adverse environmental change. This is of direct relevance to motor sport because although its contribution to environmental problems has not been quantified, motor sport design, research, manufacturing, competition and governance emerge almost entirely from these same industrialised countries.

Alarming, the report also finds that biophysical and social systems are vulnerable to reaching ‘tipping points’, beyond which there may be ‘abrupt, accelerating, or potentially irreversible changes’ (UNEP, 2007a, p. 5). The four *GEO-4* scenarios show an increasing risk of crossing tipping points, even as some ‘global environmental degradation trends are slowed or reversed at different rates towards the middle of the’ 21st century. This means that, ‘changes in biophysical and social systems may continue even if the forces of change are removed’, and is exemplified by the stratospheric ozone depletion and the loss of species.

In the context of discussion about human impacts on the environment, it is worth noting, however, that *not* all scientists accept the proposition underlying one of the most urgent environmental problems – climate change - that anthropogenic GHG emissions are the principal cause. Such a group are broadly characterised as ‘climate sceptics’ and Pittock observes that scepticism is an essential tool in science (2005, p. 77). The overwhelming weight of scientific opinion however supports the view that anthropogenic GHG emissions are the *major* factor in contemporary climate change. Dr. Paul Fraser, Chief Research Scientist in the Marine and Atmospheric Research Division of the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), notes that the latest IPCC summary report is, ‘supported by 30 peer-reviewed scientific papers’, and contains ‘approximately 10,000 peer-reviewed, cited references’ (Fraser, P., 2007, Business 8). The Council of the American Geophysical Union (AGU), a ‘worldwide’ scientific society’, echo this claim stating that, ‘the Earth's climate is now clearly out of balance and is warming’, and that:

Many components of the climate system—including the temperatures of the atmosphere, land and ocean, the extent of sea ice and mountain glaciers, the sea level, the distribution of precipitation, and the length of seasons—are now changing at rates and in patterns that are not natural and are best explained by the increased atmospheric abundances of greenhouse gases and aerosols generated by human activity during the 20th century (Killeen, T., Otto-Bliesner, B. L., and Prather, M. J., 2008).

AGU President, Timothy Killeen, argues that the AGU uses ‘strong’ language to ‘convey urgency and to try to firmly dispel the scepticism of climate change among a minority of climatologists that has lingered over the mainstream scientific consensus’ (Shih, 2008, p. 24).

Furthermore, most major scientific groups endorse the IPCC’s view that, ‘that most of the warming observed over the last 50 years is attributable to human activities’ (Wikimedia Foundation Inc., 2008). These groups include, but are not limited to, the InterAcademy Council; the national science academies of the ‘G8+5’ nations; the World Meteorological Organization; the Royal Meteorological Society (UK); the American Meteorological Society; both the Australian and Canadian Meteorological and Oceanographic Societies; the International Council of Academies of Engineering and Technological Sciences; the European Academy of Sciences and Arts; the National Research Council (US); the International Council for Science; the European Science Foundation; the Federation of

American Scientists; the International Union of Geological Sciences; the American Institute of Physics; and; the American Statistical Association.

In summary, while it is true that *not* all scientists accept humanity's pivotal role in climate change, it is clear that an overwhelming majority of the scientific community does.

Sport and Sustainability

This paper builds upon previous attempts to explore the environmental sustainability of sport. Dingle (2007) examines the relationship between the earth's natural resources, the production of sporting goods and the provision and consumption of sport services. It is asserted that doubts exist as to the sustainability of some sport because it is fundamentally reliant on the consumption of non-renewable resources such as crude oil, used for transport and the production of plastics, and rubber, for use in a range of sporting goods (pp. 4-5). It is also claimed that sport played in large stadia is responsible for GHG emissions (p. 7), a contributing factor to anthropogenic climate change, because the electricity needed for stadium lighting and other equipment is in many countries generated by carbon-intensive coal-fired power stations (p. 5).

Smith and Westerbeek (2004) identify various impacts of sport on our environment and they acknowledge that sport generally 'represents a threat to the environment' through 'land clearing' and 'emissions' albeit at a 'comparatively low level' (p. 146). They cite other examples of environmental degradation through sport including:

- the use of 'fuels in motor sports';
- 'habitat destruction' through the development of sport facilities such as 'golf courses and ski resorts';
- 'unsustainable manufacturing processes such as the glassing of surf-boards';
- 'the lack of "clean" transport to sport venues';
- the use of water and chemicals for 'turf-grass management', and;
- 'ozone depleting refrigerants in ice rinks' (see pp. 138-139).

Chernushenko, Stubbs and Van Der Kamp cite a range of impacts in a significant contribution titled *Sustainable Sport Management* (2005). The authors list a range of environmental damage resulting from sport facilities and events including:

- pollution from liquid spills (fuels, cleaners, solvents, etc.);
- air pollution from increased vehicle traffic plus noise and light pollution;
- consumption of natural resources (water, wood, paper, etc.) and of non-renewable resources (fuels, metals, etc.);
- creation of greenhouse gases (through electricity consumption and transport);
- 'soil and water pollution from pesticide use', and;
- 'soil erosion' during construction and event implementation (p. 6).

Chernushenko et. al. describe such impacts as the, 'ecological footprint' of sport (p. 5).

Lowes and Tranter (2007) note that such environmental impacts vary according to the type of sport being played (p. 168). They cite the policy of the Australian Conservation Foundation (ACF) that divides sport into three categories according to their level of damage:

1. 'sports that are largely ecologically sustainable, but can still be improved in some form;
2. sports that are largely ecologically sustainable, but which may be significantly improved in sustainability because their core activity is not inherently unsustainable;
3. sports that can never be ecologically sustainable, nor made significantly more sustainable, due to the inherent nature of their core activity' (ACF, 2008).

Unfortunately, the ACF fail to say which sports fit into the above categories and so this remains an area for further scholarly research and debate.

Smith and Westerbeek however also make two key points about the sustainability of sport in general: that sport has become green, and is likely to continue to do so in the long-term. They argue that sport has become green for two reasons: firstly, because ‘governments and other corporate industries have recognised the marketing and education potential of “green sport”, and secondly; because ‘it is an industry that has contributed to environmental damage in the past, and is therefore being called to ransom by the community at large’ (p. 138). There are several examples of a trend towards ‘greener’ sport. A notable case is that of the International Olympic Committee (IOC) decision to:

- establish a ‘Sport and Environment Commission’ in 1996 to offer policy advice pertaining to ‘environmental protection’ and ‘sustainable development’ in relation to staging Olympic games (IOC, 2008);
- adopt the environment as the ‘third dimension of Olympism’ (Smith and Westerbeek, p. 135);
- include in the IOC Charter a requirement for all Olympic games to ‘demonstrate a responsible concern for environmental issues’ (UNEP, 2008)

Other examples include:

- the 2006 ‘Global Forum for Sport and Environment’ held in Lausanne, Switzerland which brought together sport and environmental stakeholders to review ‘sports impact on and contribution to the environment’ (UNEP, 2008a)
- the ‘Melbourne 2006 Commonwealth Games’ that aimed to use minimal ‘water’ resources, generate minimal ‘waste’ and be provided on a ‘carbon neutral’ basis (Department of Victorian Communities, 2006);
- the use of fuel derived only from renewable sources for *Earthrace*, a powerboat capable of circumnavigating the Earth (Schmidt, 2006);
- the non-profit Australian organisation, ‘Sport 4 the Environment’ (S4E), that aims to encourage ‘all sporting organisations to develop and implement environmental change’ (Sport 4 the Environment, 2008).

Smith and Westerbeek argue that sport will become increasingly dependent on sustainable practices:

It is absolutely clear that the sporting sector will experience increasing pressure to ‘clean up’ such environmental blemishes. The viability of clubs, associations and events will depend on the support of a public which will demand change, or seek sport-experiences elsewhere (2004, p. 139).

The authors make it clear that sport, like other sectors of society, is not immune from pressures to become sustainable.

The Role of Consumption in Sport

Smith and Westerbeek highlight the role that sport plays in the phenomenon of material *consumption* (pp. 139-140). ‘Natural capital’ such as land, water and energy are needed for the production of sporting goods. Dingle (2007, pp. 4-5) highlights the dependence of sport through sporting equipment that incorporates plastics and rubber – materials that are principally manufactured from the carbon-intensive resources of crude oil and natural gas (American Plastics Council, 2004). ‘Natural capital’ is also required for the transportation, facility construction, and spectator and athlete accommodation associated with sport events. By-products of these consumption-based sport processes include a variety of waste materials as well as air and water pollution.

Jackson and Michaelis (2003) argue that patterns of material consumption are reflective of broader patterns of consumer behaviour that are typical of industrialised societies. They note the deeply embedded and multi-factorial nature of modern consumerism:

We appear to be locked into current consumption trends by a combination of past choices, technology, economic incentives, institutions, our own psychology and the culture and social systems we inhabit (p. 7).

Jackson and Michaelis conclude that current patterns of global material consumption are unsustainable however, they suggest that sustainable consumption is possible into the future with a 'change management' approach from governments in conjunction with appropriate 'non-governmental initiatives' (pp. 10-11).

Consumption in Motor Sport

The manufacturing, usage and maintenance of motor vehicles, including motor sport vehicles, requires extensive consumption of natural resources. Firstly, motor vehicles are typically manufactured from a large array of individual components for steering, suspension, propulsion, transmission, cooling and braking systems. These systems are also mostly dependent on electrical wiring looms whose wires are generally made from *copper* that are covered with plastic protective sheaths synthesised from *crude oil*. Other vehicle components are manufactured from a long list of minerals including 'aluminium, barite, calcite, iron, lead, mica, nepheline syenite, nickel, petroleum products, clays, silica and zinc' (Natural Resources Canada, 2008). Automotive components made from plastics, rubber, glass, lubricants, coolants and fuel are all synthesised from naturally occurring minerals and metals.

Whilst many of the components related to comfort in the mass market versions of motor vehicles are mostly removed or modified from their racing varieties, motor sport vehicles are still dependent on essentially the same range of natural resources for their manufacturing, use and maintenance. Motor sport is thus entwined in a broader pattern of natural resource consumption around the globe; one that was clearly implicated in the degradation of the environment globally by the United Nations Environment Programme in the *GEO-4* report.

Motor Sport and Sustainability

Motor sport, like all sport, is situated within broader social, economic and environmental contexts. However, as indicated in the introduction to this paper, there appears to be no scholarly literature that discusses motor sport's relationship with the natural resources upon which it relies for its sustenance.

Lowes and Tranter's analysis of motor sport events staged in Australian cities is a notable exception. They highlight the range of 'messages' associated with motor sport (p. 172) that reflect the widespread media coverage that its various forms receive. Positives that motor sport is credited with for modern passenger cars include the development of 'safety features' such as impact protection, and; reduced emissions through improved engine technology. The authors however note though that such advances can occur independently of motor sport through the research and development of car manufacturers.

Perceptions of motor sport however are largely built on marketing campaigns that encourage interest, attendance, media reporting and audiences for the media coverage. Lowes and Tranter describe this promotion as a culture of 'glorification' of motor vehicles and speed, and document its influence on car enthusiasts by citing increases in car accidents and riskier on-road behaviour by motorists on public roads during periods of peak interest in Australian motor sport events (p. 173). Given the success of motor sport promoters in successfully attracting public interest to their events, it may also be argued that they are also inadvertently encouraging their audiences to add to the environmental impact of motor sport by inviting them to participate in patterns of consumption referred to earlier. In this sense, consumption of natural resources is amplified as motor sport spectators are encouraged to buy and drive cars, modify them to enhance their speed, purchase car-related products – especially carbon-intensive petrol derived from non-renewable resources like crude oil - and then travel to motor sport events in what are often carbon-intensive forms of transport such as cars and jet aircraft.

Such overt marketing of carbon-intensive sport and associated spectator and audience consumption, is inconsistent with the growing global awareness of the environmental

problems facing humanity, especially climate change where government policy and market behaviour is already adapting to encourage mitigation and conservation. The changing environmental and policy circumstances in which we find ourselves that are so clearly documented in the *GEO-4* report, pose a challenge for the marketers of motor sport.

There is however a range of popular literature available that suggests that, at least to some extent, motor sport is responding to these pressures for change. Firstly, in 2009, the FIA is embracing the idea of environmental sustainability. The FIA's 'Institute for Motor Sport Safety' (FIAIMSS) has proposed to the FIAIMSS General Assembly that its 'remit' be expanded to include environmental sustainability as well as safety. This would involve promoting:

"...research into sustainability, disseminat[ing] the results of that research and provid[ing] information on the best environmental procedures, practices and technologies that can be applied to motor sport. This will cover areas such as vehicle design and technology, infrastructure management, emissions monitoring and control, offsetting procedures, energy optimisation and storage, and preservation of the natural environment".

The FIA Institute proposes the training of, "officials, circuit and race personnel in environmental procedures and practices", and:

"encourag[ing] environmental education and awareness of participants, officials and members of the public at international motor sport events, and [the] monitor[ing of] motor sport and motoring environmental trends in order to identify research and regulation priorities".

This is a startlingly development in the attitude of motorsport towards its relationship with the natural environment. It represents an official concession that motorsport is becoming cognisant of the need to manage and market itself sustainably, and is consistent with a wider acceptance of the changed environmental circumstances we find ourselves in globally.

Secondly, motor sport's adaptation to sustainable approaches is occurring within a broader *industry* context where automotive manufacturers, driven in part by tightening vehicle emissions standards (Cogan, 2008), have identified a range of alternative fuels for motor vehicles. The International Organization of Motor Vehicle Manufacturers (IOMVM) (2008b), argue that car manufacturers are developing 'clean, fuel-efficient technologies that run on diverse fuels' such as 'biodiesel, ethanol, hydrogen, and compressed natural gas'. The IOMVM cite the development of 'hybrid technology', that uses both 'conventional combustion engines (gasoline or diesel) and electric engines', as evidence of 'dramatic change occurring this century'. This statement is given added weight by the fact that thirteen electric cars premiered at the 2007 International Motor-show in Geneva, Switzerland (IOMVM, 2008a), and that most of the major car manufacturers in the United States including General Motors, Chrysler and Jeep, have introduced concept cars at the 2008 Detroit Motor Show that employ either electric, hydrogen or hybrid technology (Dowling, 2008, Drive 6; North American International Auto Show, 2008).

In terms of motor sport, the decision to abandon leaded fuel for the Indy Pro Series (IPS) competition from 2008 onwards, (Sunoco, 2007; Schmidt, 2006) is a prominent example reported in popular literature of a move to more environmentally friendly practices. The IPS announced in March 2007 that it would adopt the Sunoco 260GTX brand of unleaded fuel. The decision means that Tetra-Ethyl Lead (TEL) will be excluded from future race fuel for the series. However, although another motor sport website, the *Hot Lap.com* (Alabama Motorsports Park, 2008) declared that the new fuel was developed, 'as a result of its partnership with the U.S. Environmental Protection Agency and its fuel supplier, Sunoco', it is not clear what the motivation for this decision was.

Formula 1 racing is another area of motor sport that has recently begun to embrace more environmentally-friendly technologies. *Green Car Congress* (Millikin, 2007a) reports that a,

‘mechanical kinetic energy recovery system (KERS)’, currently under development for Formula 1 by three British companies, has been awarded the ‘Engine Innovation of the Year’ at the 2007 Professional MotorSport World Expo Awards. The KERS is significant because it is claimed that it can recovery 400 kilojoules of lost energy per lap which translates to an additional 80 Brake Horse Power (BHP) for Formula 1 cars. The companies involved in the design believe that KERS represents a ‘more compact, lighter and environmentally friendly’ approach than electric batteries to ‘recovered vehicle kinetic energy’.

Current efforts toward technological innovation in Formula 1 racing is well documented in *F1 Racing Green* (Francis, 2008), a special edition of an Australian magazine, *F1 Racing*. Whilst it offers a pro-Formula 1 racing slant that tends to understate the sport’s likely environmental impact, it nevertheless highlights some efforts to minimise this impact including the ‘Honda Earth Car’, tyres derived from plantation rubber trees, and the FIA’s recent commitment to become a carbon-neutral organisation. To the editor’s credit, an opinion piece by Jonathon Porritt, Co-founder of the Forum for the Future, is included where it is claimed that Formula 1 cars emit approximately ‘2400 grams of carbon dioxide [CO₂] per mile (almost nine times as much as an ordinary new car today)’, that equates to 17 tonnes of CO₂ per season. When air travel is included, this figure rises to 54 tonnes of CO₂ per driver per annum but excludes GHG emissions associated with transporting equipment and other team members to races (p. 27).

Rally Car racing is a further area of motor sport where more environmentally-friendly technologies are being developed. *Green Car Congress* (Millikin, 2007b) reports that an ‘Oaktec Honda Insight’ won its class at the 2006 Formula 1000 Rally Series using E85 ethanol-blend (i.e. 85% ethanol) fuel. The Honda’s win is significant because it had to defeat conventional petrol-fuelled, non-hybrid cars to win. This achievement highlights the existing ‘green’ credentials of the Honda Insight as, it is claimed, it produces the lowest CO₂ emissions of any production car in the world (85g/km). The report notes that the President of the FIA’s Alternative Energies Commission, Mr. Bruno Moretti, stated that hybrid-engine type cars such as the Honda Insight are, ‘certainly part of the future of motorsport activity’.

The English website, *Green Motor Sport Ltd.com* (GMSL) (2008), is another notable example of popular literature reporting moves to more sustainable practices in motor sport. With a stated ambition of becoming:

...the premier motor sport company solely devoted to environmental racing and applied green performance technology...;

this electronic publication refers to hopes to achieve ‘environmentally conscious motor sport’, ‘stimulating & exploiting’ research into future sources of energy and ‘reducing motor sport’s carbon footprint’. GMSL also hopes to ‘bring new Zero Carbon technologies into the market place’. Examples of the environmentally-friendly technology that it hopes to promote include the ‘G-Motor’, a water-cooled 48 volt ‘high performance, high frequency’ electric motor aimed at propelling karts and, ‘hybrid fuel cells’.

Energy Efficient Motorsport (EEMS) (2008) is another motor sport publication highlighting efforts to adopt more sustainable practices. This English website states that its long-term objective is to, ‘engage the automotive industry to use motorsport to accelerate the development and public acceptance of alternative “green” automotive technologies’. One area of EEMS effort is the development of alternative fuels to diesel and petrol. EEMS discuss possibilities like alcohol, bio-diesel, hydrogen, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG) as well as hybrid electric-petrol propulsion systems. In addition to fuel development, EEMS promote their research into, ‘carbon fibre and other advanced composite materials’ for ‘chassis structures, suspension components, transmission casings and engine parts’. ‘High strength alloys and metal matrix composites in braking systems, engines, transmissions and other areas’ represent further examples of ‘new material application’.

The EEMS site also highlights some case studies of progress in the use of alternative fuels for motor sport. These include the 'Team Nasamax Bio-ethanol Project'; the 'Mardi Gras LPG British Touring Car Championship Project', and; the 'Taurus Sports diesel engine-powered Le Mans car'. Interestingly, the EEMS publication claims that, 'social responsibility, including elements such as energy efficiency and ecological awareness, is certain to be an intrinsic part' of the future of motor sport.

In a story posted on the website of the United Kingdom Motorsport Development Board (2007), another example of using alternative fuels for motor sport is highlighted. The site reports that 'Dunlop MSA', a British Touring Car Championship team, has switched to bio-fuel. An owner of the team stated that they are aiming to become the first touring car team to achieve a 'podium finish' in order to, 'showcase the potential of green fuel'.

The *Green Car Congress* website also reports that Japanese car manufacturer Toyota won the 2007 Tokachi 24-hour endurance race with the 'Supra HV-R' hybrid-engine powered race car (Millikin, M., 2008). The vehicle uses 'four wheel energy regeneration and drive' technology and a 'quick-charging super capacitor system', for energy storage. This follows the commercial success of its hybrid electric and petrol powered cars, such as the Prius, which have recorded sales of one million cars over the last 10 years (Motor Authority, 2008).

A final example of attempts to make motor sport more environmentally friendly is the 'Imperial Racing Green Project' at Imperial College in London (Williams, 2008). The project is for undergraduate students and is aimed to encourage students in the college's Faculty of Engineering to, 'design, build and race a zero-emission electric hybrid fuel cell racing car'. One of the project leaders suggests that, 'all new vehicles in 15-20 years time will be electric, with either an internal combustion engine, or a fuel cell'.

In summary, the motor sport publications discussed here are all popular in nature rather than scholarly. As popular literature, they are sometimes prosaic in nature and, are largely uncritical reports rather than critical assessments. As they are drawn mostly from the internet, this selection is also limited by the fact that they do not represent all available popular literature pertaining to the sustainability of motor sport. They nevertheless represent an important slice of literature pertaining to the sustainability of motor sport because they highlight the attempts being made to make motor sport more environmentally sustainable. Whilst further research would be necessary to determine if these efforts are actually sustainable, they tend to confirm arguments in the scholarly literature discussed earlier in this paper that sustainability is now a major global concern, and that sport – including motor sport - is not immune from pressures to reduce current patterns of resource consumption that are implicated in the environmental issues discussed in the *GEO-4* report.

Conclusion

In the introduction to this paper, it was proposed that motor sport, a significant global sport for social and economic reasons, be discussed from the viewpoint of environmental sustainability. The reason for this lies in the volume of scholarly and popular literature extending back some decades that suggests that environmental degradation is a problem of urgent and global significance that, as a result, has prompted considerable thought and debate about how human society can become sustainable. This paper therefore aimed to review a selection of literature pertaining to sustainability in order to enable the practice of motor sport to be situated within its contemporary social and environmental contexts.

As a consequence, a number of themes in the literature pertaining to the sustainability of motor sport are discussed in this paper. Firstly, sustainability is a widely researched area of knowledge around which some key conclusions can be drawn. It is an area of global interest which is increasingly embedded in global discourses about human development; it is centred on the idea of the ability of ecological systems to preserve or sustain life over long periods; it

consists of three interrelated *environmental, social and economic dimensions*; and although human understanding of this concept is evolving, it is not immune from some ambiguity.

Secondly, the health of our physical environment is increasingly drawn into question through evidence that current patterns of consumption-based human civilisation is strongly implicated in rapid and unsustainable environmental damage.

Thirdly, the sustainability of sport is one of emerging scholarly examination. Some literature emphasised that sport relies upon extensive consumption of natural resources for its continuance, while other work cited the range of negative impacts it has upon our physical environment. However, some scholarly literature argued that most sport is likely to become *greener* in its approach in coming decades, and that in fact, it is already making some effort to do so. A range of examples were cited of sport organisations and events showing their awareness of these impacts, and in some cases, adapting their activities to become more sustainable. Overall though, more research in this field is needed.

Fourthly, whilst some literature suggested that motor sport is a globally significant sporting activity, given the evidence of the global environmental problems facing humanity, there is considerable doubt as to whether it is marketed and managed in an environmentally sustainable way. The dependence of motor sport, and its followers, on the consumption of natural resources for the manufacture and ongoing use of racing vehicles and the passenger cars they inspire, is cited as an example of its relationship with unsustainable patterns of consumption that are linked to the major global environmental change cited in a recent United Nations environmental assessment. Furthermore, the changing environmental circumstances in which we find ourselves, that are so clearly documented in the *GEO-4* report, appear to pose a major challenge for the marketers of motor sport. In a situation where environmental problems are changing government policy and creating new markets, marketers of motor sport are likely to need to give serious consideration to making their events genuinely sustainable.

In terms of attempts to make motor sport sustainable, a range of popular rather than scholarly literature was available for examination. This literature reinforced the argument of some sport management scholars that sport will become *greener* in the long term. This literature indicated that some motor sport organisations are not only aware of global concerns about environmental degradation; they also recognise the need for sustainable practices of their own. A range of examples illustrated the active role that some motor sport teams, engineers and administrators are playing in minimising their harm to the environment. Some of the literature reviewed also indicated that more environmentally-friendly technologies, fuels and practices were likely to play a significant role in the future of motor sport.

Finally, it must be said that motor sport is clearly not alone in terms of doubts as to whether it is a sustainable sphere of activity. Whilst further research is needed to determine to what extent it *can* be considered environmentally sustainable, sport generally is open to question because of the evidence that has emerged that industrialised and consumption-driven societies around the globe are causing much of the environmental problems we face. Indeed, given human transport needs, motor sport arguably represents a sphere for automotive design and innovation that may assist future attempts to resolve some environmental problems.

Looking ahead, the balance of evidence suggests that further research into the sustainability of motor sport is warranted as scholarly literature pertaining to motor sport and sustainability is very limited at this stage. There are some good reasons to think that most sport, including motor sport, will try to become sustainable in coming decades, and we ought to know more about *how* and *why* we will approach such adaptation.

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