CARS IN THE FUTURE YEARS OF THE 21ST CENTURY

Cezary Szczepaniak

Vehicle Institute, Construction and Operating of Machines
Lodz University of Technology
Zeromskiego 116, 90-924 Lodz, Poland
tel.: +48 42 6312392, fax: +48 22 6312398
e-mail: sczepaniak@p.lodz.pl

Abstract

The fact that we live in a new era of informational civilization compels us to fulfil new requirements also in the area of transportation and motorization. The paper deals with the problems of the cars of the first years of our century. Basic assumptions for the concepts of such cars are as follows: alternative forms of personal transportation are inevitable, cars must be environment friendly and friendly for human beings, and general design concept of the cars will not be changed. Some examples of such vehicles are presented using the concept of ultra light automobiles described by Q.R. Riley. The paper also describes "zero emission" cars and there are mentioned ideas of the vehicles with engines which are yet known in the sphere of science-fiction only. Design requirements for construction of future cars, ideas on construction of cars of the future as well as requirements which should realize motor vehicles friendly to humans and the environment, example solutions of various technical nature which can contribute to fulfilment of requirements imposed on SPNS and the proposal according to the author (R. Q. Riley) of Alternative Cars In the 21st Century [3] are represented in the paper.

1. Introduction

There are no doubts today that a new era of civilization defined as the information civilization exists in the most areas of the globe. As any other civilization era, the current one can be characterized by a cultural plane where all scientific and technical achievements as well as factors determining the level and development of humankind life are concentrated. The new era demonstrates especially high achievements in the area of information and other fields where information makes an operation basis.

The new information era and stimulated development of various fields of life creates new, huge tasks for those fields that often result from threats related to their development up to now. Transportation, as a field providing mobility of people and goods, makes an example of human activity area where changes to the existing structures and methods are required.

Cars make the basic land means of transport and they determine the motorization or level of motorization of the whole groups, countries or societies. Automotive industry development and constantly increasing number of cars in use on a global scale, mostly in the areas of high population density, create various threats for people and their natural environment. Those threats are noticed on a local scale i.e. district, town or even the whole country as well as on a global scale e.g. greenhouse effect or ozone hole. These two phenomena also result from the effects of mass motorization.

The outgoing civilization era can be characterized, among others, by high impulsive and chaotic motorization development, without consideration of negative effects like threats to the environment resulting from that development. These threats include:

- toxic compound and solid particle emissions to the atmosphere,
- generation of noise and vibrations,

- ground and water contamination with fuels, operations fluids and road de-icing chemicals,
- life and health threats caused by car accidents. (41.5 thousand people died in car accidents in the EU in 2005),
- daylight loss resulting from atmosphere contamination, landscape devastation.

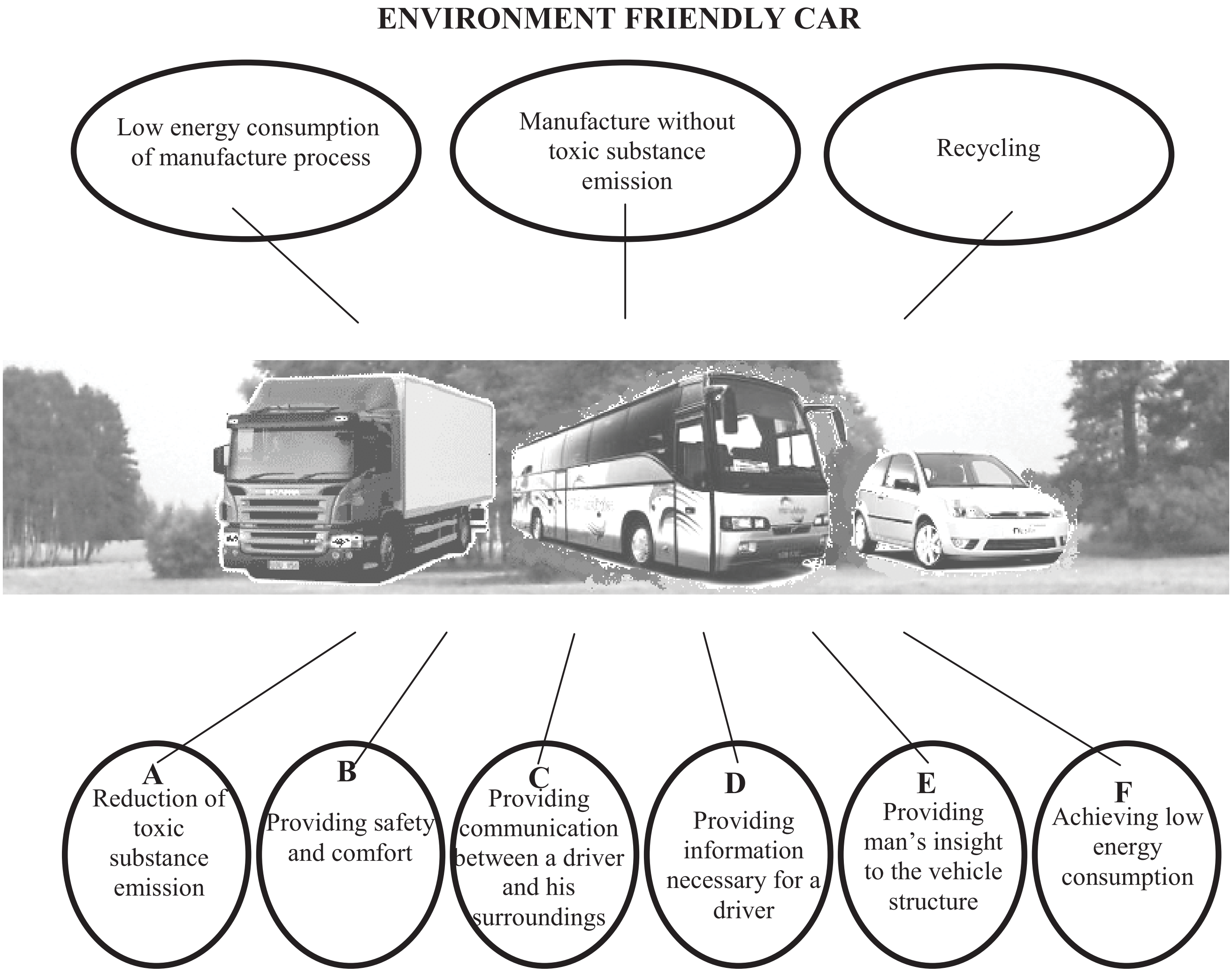

Fig. 1. Requirements that need to be met by environment and human friendly motor vehicles

Demographic forecasts prepared by UN predict significant increase of urban areas and high increase of inhabitants of currently existing metropolises around the world. For example, there will be 93 metropolises in the world in 2025 according to these forecasts. Each of them will be inhabited by over five million people. This forecast predicts that Los Angeles will have 15 million inhabitants, Mexico City - 30 millions and London will be inhabited by 10 million people.

Assuming that every fifth inhabitant will be a potential passenger car owner, there might be as many as 3 million cars in Los Angeles, 6 million in Mexico City and 2 million in London.
It's hard to imagine the atmosphere pollution effects not only in these cities, resulting from simultaneous use of just a part of that number of cars located in these urban centres. Atmosphere pollution in the urban areas will have not just local effects. It can threat the whole ecosystem of the earth.

Natural human environment threats presented above, resulting from the use of motor vehicles force us to search for structure improvements and manufacture process improvements that will make the use of cars friendly to people and the Earth. It is a basic assumption which has to be fulfilled by new motor vehicles introduced nowadays and strongly highlighted in the cars of the future. Expressing the above idea in short, the future cars will have to be human and environment friendly. This thesis is supported by a fact revealed by sociological research that a Man will never give up possessing and the joy of using his own car and the public means of transport will never be competitive as far as the comfort of using one's own car is concerned [1].

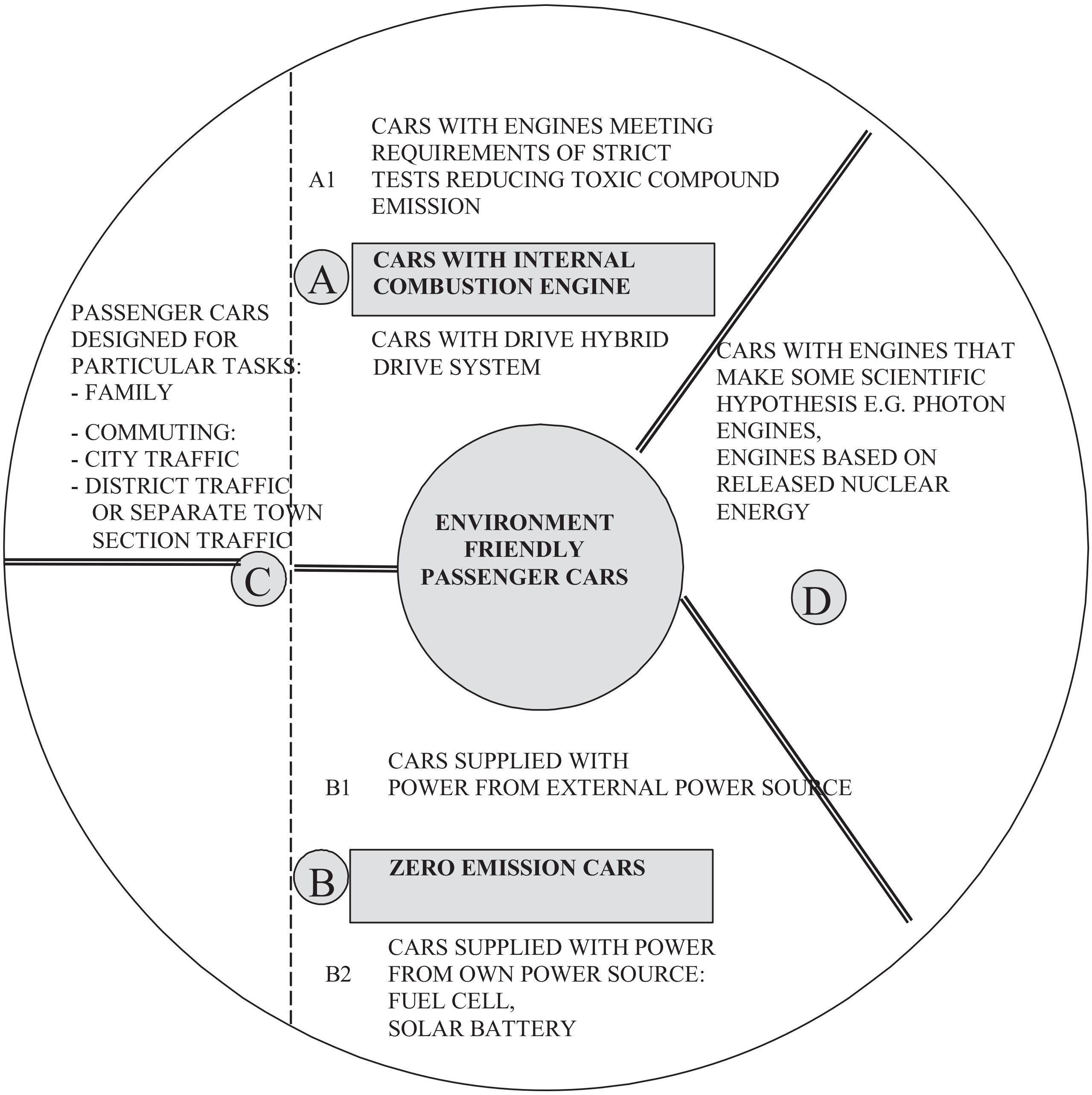

Fig. 2. Ideas for environment friendly car structure

Figure 1 presents all requirements imposed on passenger cars that should be met in order to recognize these cars as human and environment friendly. Cars manufactured in the near and distant future will have to meet those requirements. Environment friendly cars will be marked as EFC in this text.

Requirements imposed on EFC are presented on Figure 1 in two fields: requirements related to the car manufacture and requirements related to the use.

Requirements referring to the car manufacture usually include manufacture process energy saving, low emission of toxic substances that can result from operating technological processes and the use of recycling of new parts and components and most of all in the production of all operating fluids. Meeting those requirements is a task not just for technologists and manufacture managers – it also makes a challenge for designers.

Requirements referring to the use of cars are divided into six groups, marked with letters from A to F.

Table 1 presents examples of various technical solutions that could contribute to meeting the requirements imposed on EFC and listed on Fig. 1. Data given in table 1 does not require special comments. These are just solutions concerning main vehicle systems affecting vehicle occupant safety, passer-by safety and driving comfort, listed in table 1, column B. Necessary solutions indicated in that column are divided into two groups. One group, where abbreviated control system names are used, e.g. ABS etc., includes control systems that directly affect driving dynamics in various traffic conditions. The second group lists additional car equipment which directly affects the driving safety and comfort.

Tab. 1. Examples of various technical solutions that could contribute to meeting the requirements imposed on EFCS

A	B	C	D	E	F
Reduction of toxic compound emission	Providing safety and comfort	Driver's communication with surroundings	Information necessary for a driver	Man's insight to the vehicle structure	Providing low energy consumption
- ICE engines reduction of toxic compound emission; - Zero-emission engines; - Hybrid systems;	- ABS, ASR, ESP, ATC, LKA; - ACC, ASS and others; - Automatic breaking; - A/C; - Auto sense wipers; - Automatic door closing; - Keyless entry; - Light reminders; - Voice recognition; - Automatic high-low beam switching; - Airbags; - Sleep prevention systems; - S.O.S. systems;	- Mobile phone; - CB radio; - Cassette player; - Digital player; - Fax; - TV;	- Head- Up display; - Digital indicators; - Navigation maps; - Service reminders; - Diagnostic display; - Collision warning; - Fire alarm; - Low tyre pressure warning; - Communication between cars;	- Autodiagnostics; - Levelling; - Anti-theft lock; - Light control; - Navigation system; - Park assist system;	- Vehicle weight minimization; - low traction and air resistance; - Energy-saving engine;

Execution of some solutions listed in column D and E requires creating vehicle relations with external infrastructure, e.g. as provided by smart transport systems where cars, as smart vehicles, make a subsystem of that system.

Requirements imposed on EFC, listed on Fig. 1, should be met by all cars to be used on our planet. However a degree of meeting individual requirements can be different for particular types of vehicles and for passenger cars designed for various tasks.

Robert Q. Riley [3] proposes differentiation of passenger car designs as an answer to requirements given in column F, table 1. Design differentiation could be a solution allowing building a car with characteristics close to EFC. The author [3] calls them ultra light vehicles. Specification of proposed ultra lights cars is given in table 2.

A proposal to build ultra light passenger vehicles as the cars of the future, with characteristics close to EFC, should be considered as one of many other options. We cannot forecast common acceptance of car design concept given in table 2 today. However some proposals included in that table seem to be a common knowledge, e.g. a passenger car designer for city traffic. But it is hard to forecast what type of engine will dominate in that type of vehicles.

Tab. 2. Author's proposals [3]

Vehicle type; name	Type of drive	Some technical data	Remarks
General purpose car. Family Car	ICE	m > 450 kg G → 4-5 l/100km	m – vehicle weight
Commuter Car	ICE	Ns ≈ 50 kW m < 450 kg Vmax = 120 km/h	Ns – engine power
Narrow Lane Vehicle	ICE	Ns ≈ 30 kW m < 160 kg Vmax = 90 km/h	Accepted for special organization traffic
City Car	ICE	m < 450 kg Vmax = 90 km/h	80 km means range after full battery charge
	Electric engine	Z = 80 km	
Sub Car	ICE	Ns ≈ 2,5 kW m < 20 kg	Accepted for road traffic only in a particular area, district

2. Future car design assumptions

Some energy system is materialized in each car. As a result, a part of energy supplied from the outside is turned into kinetic energy of the mass making a vehicle. Such energy system is materialized in each car starting from the first car solutions developed by Markus and Benz. Constancy in that energy system materialization does not mean that there is no freedom to design various car systems and components. That design freedom is confirmed by the history of car development. During all those years, car design and technology development involved improvement of main drive systems and drive engines. General car design concept defined in the first solutions still remains unchanged. This thesis can be confirmed by general design solution comparison made on the basis of comparison of drive systems implemented in the first car patented in 1866 and modern car drive systems.

Assuming the rightness of general car design concept constancy thesis, cars as vehicles of the Earth, Mars and the Moon, it can be likely assumed that future cars will be built according to general design concepts of today's motor vehicles.

The above assumptions regarding car designs and requirements imposed on them in order to provide no invasion to the natural environment define a vision of future car design solutions.

3. Future car design ideas

We can state that each car manufactured on the Earth in the next years of our century will possess features that allow recognizing it as a human natural environment friendly vehicle. How to achieve that condition from current state of car design and forecasts for the future based on developments of sciences related to the information technology, telecommunications, material physics, new energy sources and other fields of science that provide results that can be used in technologies, especially in car engineering? It is very difficult to answer such question as the science development is very rapid and dynamic and the use of results of that development in the technology development creates separate questions. However, current level of car design advancement Allow to make some predictions in the future development of cars that will be natural environment and human friendly. Ideas for the future EFC design are presented on Fig.2.

The area of today's and future EFC solutions are divided on Fig. 2 into four sections: A, B, C, D. These parts refer to particular EFC solutions. Section C, including passenger cars of particular types of use shares some parts with sections A and B, as the vehicles placed in that area can meet the requirements concerning toxic compound emission as the cars placed in sections A and B.

Section A includes cars with internal combustion engines. These cars are divided into regular drive system, marked A1, and hybrid driver system – marked A2.

Section B includes vehicles called"zero-emission cars". They are divided into two groups B1 and B2 depending on the drive motor power supply methods. Power sources can be external or the so-called on-board power sources located in a particular vehicle.

Cars in group C are specified here using proposals given in table 2. The author [3] analyzes the passenger car development in the 21st century based on the assumption that vehicle weight makes a significant parameter determining its energy efficiency, fuel consumption and low toxic compound emission level. Moreover, small cars can make lower congestion threats or road traffic jams. However it requires special road traffic arrangement.

Building a smart car is a special aspect of car manufacture in the first decades of the 21st century.

All vehicles that will be used in the future, especially passenger cars, have to be environment friendly. However not all of these cars have to be smart ones. Presented examples include vehicles designed for providing transport in separate city sections, districts or suburbs. Due to their type of use and road traffic specifics, those vehicles will not need e.g. automated motion systems and it could allow them to obtain the features of a smart vehicle in some conditions.

Forecasting the car design development in the following years of that century makes a very difficult issue due to two reasons: the first one is high capital investments in automotive industry which results in high"conservatism" leading to preservation of the current state, the second one: rapid development of science and technology which can defeat conservative powers and result in the manufacture of EFC with zero emission not only in the passenger car segment. But it is very difficult to predict when the conservative powers will be defeated.

Abbreviations:

ESP - Electronic Stability Program
ATC - Automatic Transmission Control
LKA - Lane Keeping Assist
ACC - Adaptive Cruise Control
ASS - Adaptive Suspension System
ICE - Internal Combustion Engine

Reference

[1] Szczepaniak, C., *Transport w Nowej Epoce*, Wydawnictwo PŁ, 2006.
[2] Szczepaniak, C., *Motoryzacja na przełomie epok* PWN SA Warszawa, 2000.
[3] Riley, Q. R., *Alternative Cars in the 21st Century*, Published by S&A Inc. 400, USA.