Slender Comfort Vehicles

The forgotten challenge

Slender Comfort Vehicles

Modern traffic for the larger part consists of passenger cars, dragging mainly empty seats along, thus wasting road capacity, fossil fuel and clean air. A neglected vehicle concept could well offer a valuable contribution towards diminishing this burden.

by Anthonie van den Brink

The transport revolution, which was created in the latter part of the 19th century by a general adoption of the motorcar, has had a major impact on our life style. It has been built up to its current immense magnitude, during the lifetime of only a few generations; just a blink of an eye when projected against the period that the human race has been moving around on the surface of our planet.

We have grown accustomed to the basic conceptual design of modern cars. Apart from detail features and styling differences, their designs have converted to a few basic groups with similar properties. They all have four wheels and are as wide as to allow two persons to sit side by side. This was the way the car industry progressed from approx. 1900 onwards, after the turbulent nineties when horse driven coaches progressed into various 2, 3 and 4 wheel concepts with a variety of propulsion systems.

Out of this wild creative pioneering period the known two major vehicle species emerged: the 4-wheel motorcar and the 2-wheel motorcycle. All other concepts remained only niche market exceptions or vanished from the scene completely.

Much like in nature, where evolution has formed the creature with those properties that are the most suitable for a given environment, so will in a fully developed market only those products survive, that are the best fitted to fulfill certain consumer needs. We may wonder: "Are our cars still in the early Jurassic stage or can they be considered as the fully developed end product with an adoption level to changing demands similar to the mammals of today?"

The forgotten challenge

To answer this question we could ask ourselves what is the most frequently demanded task in our society of private people transport vehicles?

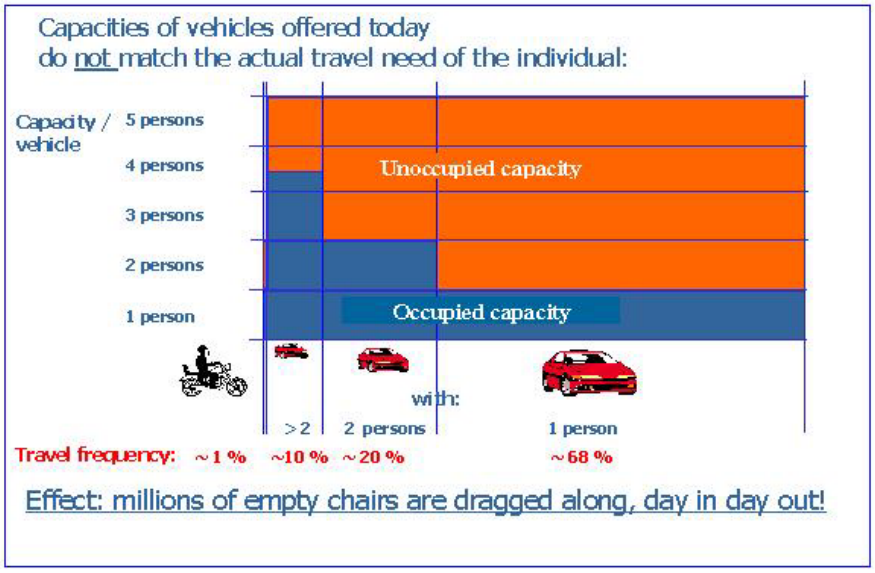
It appears that more then 68% of the trips are made by persons alone, and 90% by at most 2 persons. . For such a demand a motorcycle would be a far more efficient alternative, yet most people prefer to use oversized cars! Why is that? The reason is simple: motorcycles are far more dangerous and less comfortable. Also we prefer to purchase a vehicle that fulfills the maximum need of our household at a given time, even though these extreme needs are only required during rare occasions or were based merely on fantasies of what may occur some time.

Using an analogy: When we fry one egg we take a small frying pan, when we fry 4 eggs we take a large frying pan. For personal transportation we appear to use only large pans, even if we wish to travel alone. And nowadays we hardly have a choice; the automotive industry only offers oversized cars, two man wide and mostly seating 4 - 7 persons. In addition, although of minor importance, the status of a large vehicle also influences the mindset towards these oversize cars.

Despite this dogma many people have come with the vision that a blend between a bike and a car should be able to create a perfect vehicle for the transport of one or two persons. Inspired by this several artists created numerous futuristic pictures, movies and illustrations showing such efficient slender vehicles. In our fantasy world such a vehicle existed already: A "Slender Comfort Vehicle" being efficient and ecological, and at the same time providing speed, agility and fun to drive.

The advantages of such a Slender Comfort Vehicle (SCV) are obvious: **With approximately half the frontal projected area and half the weight of an equivalent "double wide" vehicle, it would use only half as much fuel and floor space.** A dramatic reduction indeed, especially when one considers the fact that they could cover 90% of our trips. The presence of a body shell will provide safety and comfort to the driver similar to that of current cars. All by all such concept would make the perfect vehicle.

Yet, why do such vehicles not exist to form a natural part of our current



traffic mix and our vehicle fleet at our

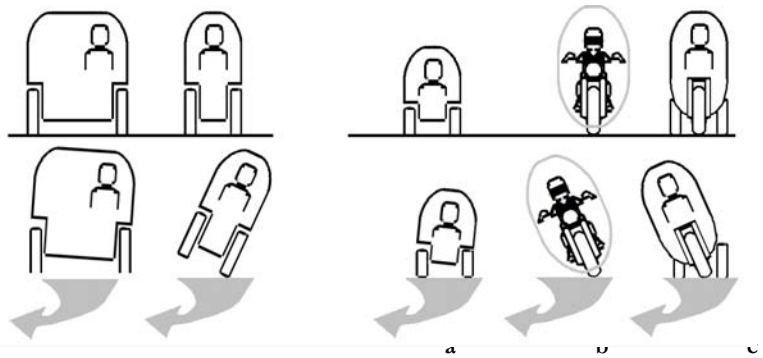
homes? Already since the 19th century many narrow vehicles have been designed ranging from "enclosed motorcycles" to slim three or four wheels cars. Why did they all fail? Let us analyze the problem:

When the width of a car is reduced to half, cornering becomes a problem, as slim vehicles are more prone to fall over (see figure). Lowering the speed or lowering the height would prevent toppling over. However neither low speeds nor a low eye height are desirable attributes in modern traffic. This leaves us with the third option: Tilting when cornering.

This is actually what a 2 wheeler does, and is nothing new. However if one wishes to have the comfort and safety of a car it needs to have an enclosed and solid passenger cabin. However, with such a cabin the balance control cannot be left to the driver, as the vehicle becomes too heavy and the driver needs to be able to put his feet out at low speeds. A system needs to be created that takes over this function. In other words it is not a vehicle package design problem, but a pure technological problem being the need for a sophisticated balance control system. Such a balance and tilting control system needs to be capable of maintaining the ideal tilting angles under all the imaginable driving circumstances, such as at all speeds and accelerations, during rapid emergency maneuvers, heavy side winds, and irregular or slanting road surfaces. At the same time it should also be predictable intuitive and easy to use. Last but not least it should be safe and completely fail proof thus virtually eliminating electrical systems.

This appears to be a real challenge and explains why so far no acceptable system has been conceived despite the fact that many people tried: A patent and literature search identified approximately 70 attempts exerted both by small inventors but also by creative engineering teams in major automotive companies.

History has shown several attempts to create SlenderComfortVehicles, they can be divided into three categories:



a. The 'Low and Slow' approach. By reducing vehicle height in accordance with the reduction in width, combined with a limited top speed/cornering speed, a 4-wheeler can become a realistic SCV. Lowering height however means lowering the height of vision of the driver in traffic. This, as well as lowering speed, can lead to dangerous situations and is no more a valid option in modern traffic.

b. The Enclosed 'Motorcycle'. The driver balances the vehicle and makes sure that the centre of gravity always stays in line with the two contact points on the road. Under normal conditions, such a vehicle is nice to drive, but in difficult situations (slippery road) the required driving skills often exceed available skills, resulting in loss of control. Also to automate the simple action of 'stopping and putting your feet down' is very difficult and unpractical to realise.

c. A controlled Tilting vehicle.' If an automatic tilting system can be realised whereby leaning can be controlled automatically, the problem will be solved. Then the driver can steer the vehicle just like a normal car. The tilting system (we called it DVC = Dynamic Vehicle Control), being the "core" of the concept, thus needs to control the vehicle and at the same time shall give the necessary feedback to the driver. It shall need to use the reliable and safe combination of hydraulic and mechanical technologies, a proven technique in critical car functions (such as power steering, brakes, etc.). Then it shall be able to actively tilt a SCV in corners and participate dynamically and safely in modern day traffic.

From dream to reality

Unaware of this history Brink Dynamics started its first research in 1989 in a sincere and pragmatic effort to do something about the menacing proliferation of cars and their greenhouse gasses and formed in 1991 a small R&D team to research and develop enclosed narrow vehicles, using a hydro-mechanical system for controlling the balance of such tilting vehicle. Eighteen generations of control systems, 5 vehicle test prototypes, 7 years with many disappointments and cheerful days later, the company achieved its goal: the first good functioning, reliable, fail-safe and road-approved SCV with sporty performances (0-100 km/hr in 8 sec, top speed 190 km/hr).

A breakthrough invention made in 1994 by Chris van den Brink and Harry Kroonen was necessary to make it all possible.

The invention consists of a hydro-mechanical system that splits the steering input of the driver into a front wheel steering angle and a tilting angle. At varying speed and road conditions, it always automatically adjusts the balance between front wheel angle and tilting angle, ensuring the optimal (balanced) situation.

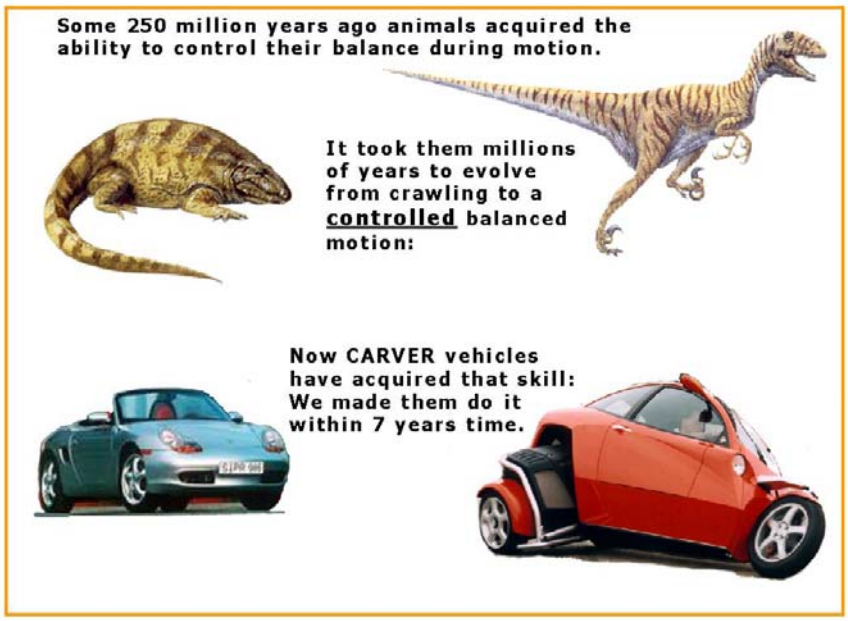
For instance at low speeds the driver's steering input is fully directed to the front wheel and the vehicle remains upright. At higher speeds the input is more and more translated into a tilting angle and not into front wheel angle. The invented system uses a combination of hydraulic and mechanical technologies. It shows a high reliability, quick response and a natural "feel". The system mainly comprises a DVC (Dynamic Vehicle Control) unit, being a reliable and safe system that enables a SCV's to actively tilt in corners and to participate dynamically in modern day traffic. Thanks to its proven reliability homologation was obtained according to EU-regulations.

To the basic system several components were added to refine the characteristics: Power steering for light and direct steering, Banking Angle Feedback for a continuous interaction between driver and his vehicle, Anti-steering torque for an optimal vehicle

agility and safety, even in panic situations, Emergency system back up system through a fully independent stand-by hydraulic control. This all resulted in a driving performance that is complete, safe, natural and an enjoyment to experience.

When mass-produced, their costs can be below that of equivalent conventional cars. Considering such price potential and their attractive driving properties, SCV's should be able to fill the market gap that exists for transportation of 1-3 persons successfully. It will be especially suitable for commuting and the many other trips where only one or two persons wish to travel from A to B.

Such a SlenderComfortVehicle concept can not only open new markets but can also form a substantial contribution towards reducing energy consumption and related greenhouse gas emissions due to their 50% reduction in frontal projected area and vehicle weight. We now stand at the foot of the tree of practical Slender Comfort Vehicles that can divert into at least as many branches of designs and styles as our cars and motorcycles have evolved so far. To lay the seed for such an evolution of Slender Comfort Vehicles, we started the production of a small series of vehicles equipped with DVC's. The first vehicles are named "CARVER", hinting to its cornering behavior.



Surprising attributes

With this DVC system SCV's appear to possess unique and pleasant driving qualities. Due to their airplane like cornering, SCV's offer a delightful driving sensation. Also they exert no side strains on the back, since there are no side forces as we feel in "normal" cars. In winding roads SCV's are therefore less tiring. With its low weight they show a sporty performance even with small engines. Due to its appearance at this moment it draws a lot of attention in traffic.

Part of our long-term development program is focused on improving the energy efficiency of the propulsion system in a following phase. Our aim to curtail fuel consumption and CO_2 emission is a pragmatic one. Besides the ~50% reduction as the result of using the SCV concept we also invest in the further development of practical but fuel efficient propulsion systems that can be realized without the need for a complete restructuring of the fuel processing and distribution infrastructure. A dramatic improvement over the current average of e.g. the global passenger car fleet of 8 liters / 100km can thus be achieved.

We estimate that SCV's propelled by using such technology would be capable of achieving average fuel consumption levels under normal driving behavior of close to 2 liters of gasoline per 100 km, without making any sacrifice on its sporty performance.

Design challenges to come

These developments together with a wider adoption of SCV's could bring about a major reduction in the need for fossil fuels and may make the Kyoto targets less unattainable, provided however that a wide market adoption would be achieved.

Adoption of products, as it is related to ones personality and taste, is mainly governed by emotional decisions. The challenge of vehicle designers is to combine the right emotional values in the design of new vehicles, to find a ready market acceptance, with the essential properties of environmental friendly transport systems. In how far personal transportation will develop into a real sustainable scenario shall much depend on the creativity of SCV designers being able to achieve this, as well as on the emotional and rational behavior of governments, manufacturers, marketeers and consumers of current and future generations.

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