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# Getting Out of the Vicious Traffic Circle:

## Attemps at Restructuring the CulturalAmbience of the Automobile Throughout the 20th Century

von

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**Zusammenfassung**

Alternative Antriebs- und Fahrzeugkonzepte tun sich in der Durchsetzung schon seit Jahren sehr schwer, obwohl immer wieder von Technikern und Ingenieuren darauf verwiesen wird, dass die konstruktive Qualität von elektrischen Antriebssystemen oder anderen neuartigen Fahrzeugkonzepten vorhanden sei. Oft genug konnten daher Verschwörungstheorien Raum greifen, in denen sachfremde Tatbestände für die fehlenden technischen Durchbrüche verantwortlich gemacht wurden. Im vorliegenden Beitrag wird argumentiert, dass die Innovationsforschung selbst einen zu engen Blick auf die Prozesse der Etablierung neuer Produkte eingenommen hat. Anhand von fünf Fallbeispielen, der Durchsetzung des dieselmotorischen Antriebes für Strassenfahrzeuge, des EV1, des ersten elektrisch betriebenen Serienfahrzeuges von General Motors, der Konzeptstudie "Pivco", einem Elektroautomobilprojekt des Ford-Konzerns, des NSU-Wankelmotors sowie des neuartigen Fahrzeugkonzeptes "Smart" wird hingegen versucht, ein umfassendes Verständnis von Innovationsprozessen zu entwickeln, das nicht bei der "technischen Erfindung" eines Gerätes halt macht. Die These ist, dass neue Geräte zur Durchsetzung am Markt auch einen entsprechenden Funktionsraum benötigen (cultural ambience), der mehrdimensional sozusagen immer gleich mit"erfunden" werden muss. Die technisch-konstruktive Arbeit ist daher nur ein Teilbereich eines erfolgreichen Innovationsprozesses. Parallel müssen weitere Vorkehrungen im Branchenumfeld, bei der Gesetzgebung, bei den Nutzerperzeptionen und Bedeutungszuschreibungen sowie den kulturellen Aneignungsweisen vorgenommen werden. Ohne die entsprechenden "Anpassungsmassnahmen" droht auch den interessantesten technischen Projekten aus Mangel an Relevanz die Bedeutungslosigkeit.

Summary

For years, alternative vehicle and propulsion concepts have had a very difficult time catching on, even though technicians and engineers have repeatedly pointed out that the design quality of electric propulsion systems or other novel vehicle concepts is available and feasible. Often enough, this state of affairs allowed free rein for various conspiracy theories, in which extraneous issues were made responsible for the lack of technological breakthrough. This paper agues, however, that innovation research has itself focused too narrowly on the process of the establishment of new products. On the basis of five case examples —the implementation of diesel engine propulsion for street vehicles; the EV1, the first electrically propelled standard car by General Motors; Ford's prototype electric car study "Pivco"; the NSU Wankel engine; and the "Smart" car manufactured by DaimlerChrysler — an attempt is made to develop a comprehensive understanding of innovation processes which does not stop at the "technical invention" of a device. The thesis is that a new device requires a relevant cultural ambience, which must be more or less invented alongside it in multiple dimensions. Technical-constructive work is thus only one part of a successful innovation process; parallel to this, complementary measures must be taken with regard to the overall sectoral environment, law-making, user perceptions and attributions of meaning, as well as the cultural appropriation of a given device. Without the appropriate "adaptive measures", even the most interesting technical projects runs the risk of sinking onto oblivion for lack of relevance.

## The Problems: Archaic Systems and Outdated Solutions

More than most technical artifacts, the automobile has a Janus face. Its use is associated with freedom and power, but also with frustrations and accidents. Whereas most of us love driving down the freeway at high speed, we are also painfully aware of the consequences of this behavior. In order to save time, we take the car to work, but, as soon as we get stuck in the first traffic jam, we swear at everyone else who has gotten the same bright idea. The price for our behavior is well known: an annual death toll that counts hundreds of thousands worldwide; highways and streets that turn into huge parking areas in rush hours; unhealthy amounts of particles and chemical compounds in our cities; and, long-term effects on the earth's climate. As a result, the area of automobility has become a dear subject for political debate and regulation. Authorities react to some of the threats posed by the car by introducing complicated parking rules and by excluding private car traffic from some parts of our cities. Politicians in various countries try to exercise pressure on automobile manufacturers to develop safer and cleaner vehicles. However, due to the Janus character of the car, this pressure seems to be of only limited effect.

The Janus face of the car is not new. In his novel *The Flivver King: A Story of Ford-America* (1969), originally published in 1937, Upton Sinclair documents the fights that were commonplace at the turn of the century between enthusiastic car pioneers and other, annoyed road-users. Whereas the young Henry Ford dreamt of a world of unrestricted mobility, Detroit's horse owners were outraged by the smoke and noise that his horseless carriages emitted (McShane and Mom 1999). Concerns about its environmental problems have in fact accompanied the gasoline automobile all along. In 1910 the Chief of Police in Berlin proposed to forbid all gas cars, and by the 1930s the relationship between car emissions and the disastrous air quality in the Los Angeles area had been firmly established. Since those days, the history of automobile engineering is also the history of alternative power plants, about attempts at developing engines that could solve some of the problems associated with the gasoline engine. It remains to be explained, however, why almost all of these attempts have failed.

Cars become safer and engines become cleaner, but their number increases—as do the average speed and power of their engines. Is it possible to get out of this vicious traffic circle? Considering that the thermal efficiency of the gasoline car by ordinary driving conditions hardly exceeds 20%, and that it is run on petroleum products, we believe this question to be highly relevant. If the goal is to make mobility more sustainable, then the historical record may be of considerable assistance—or, better yet, a new interpretation of this record. As it were, historians of technology generally tend to take the easy way out in arguing that all alternative power plants have failed, because the gasoline engine has proved to be technologically superior (Mom 1998). This answer appears quite similar to the standard answer given by representatives of the contemporary automobile industry. Regardless of whether the electric, the natural-gas, or the hydrogen car is on the agenda, the common argument is that these designs still have a long way to go until they are able to match the gasoline automobile (Fiala 1994). We suggest that such a technology-centered answer to a large extent begs the question.

If we are interested in answers that go beyond the purely technical, then social-scientific analyses seem to be the place to go. Although surprisingly few social scientists have addressed the problems of automobility in a comprehensive manner (Jürgens *et al.* 1989), most of those who have done so have gotten trapped in simplified conspiracy theories. Even though the days are gone, when everything bad in the world could be explained by reference to powerful coteries of fat, cigar-smoking men with golden rings and black bowlers, ideas of conspiracy still loom large. The automobile system is now said to be upheld by more or less unholy alliances of ministers, executives, and union leaders, and conservative engineers are criticized for deliberately undermining all alternative proposals.

Although these analyses might have something to them, they tend to be heavily production and policy oriented, and not to pay enough attention to questions of usage and meaning. Hereby, they largely mirror the standard approach in the social sciences toward technology—an approach that has only recently begun to be seriously challenged (Lie and Sørensen 1996). Furthermore, those social scientists, who have actually studied the context in which the automobile is used and culturally constructed, have typically taken up very limited themes. It is certainly important to answer the question why people choose to drive instead of biking or using public transit (Bamberg and Schmidt 1994). To our mind, the problem is that such studies treat traffic and mobility only in instrumental terms. As Wolfgang Sachs has shown in his pioneering book *For Love of the Automobile* (1992), the car is much more than just an efficient means of transportation. Like most consumption items in our society, the automobile is embedded in a world of meanings and cultural practices that influence how its so-called technical performance is judged.

To escape the narrow focus on artifacts as functional instruments, we return to the concept of *cultural ambience* that the historian of technology John M. Staudenmaier (1985: xx) launched some years ago to highlight the "atmosphere" which "permeates" a technology, and without which it cannot survive. If an artifact or a system is to function properly, then it has to find for itself a *space* within this ambience. An inventor who only focuses on matters technical will never be able to get his gadgets out of the workshop. Market success requires that the invention accommodates to the existing cultural ambience, or that elements of this ambience can be modified to accommodate the novel devise. Quite naturally, the inventor faces particularly serious problems when the new item requires users to develop radically new cognitive models and new routines (Weber *et al.* 1999). In more common cases, when novelties are supposed to fit into an established ambience, strategies have to be developed for how the appropriate spaces within the ambience are to be opened up (Knie *et al.* 1999).

In our subsequent analysis of the cultural ambience surrounding the automobile and in our discussion about what strategies might contribute to the reorganization of this ambience we focus on four dimensions: *organization and network*, *routine and daily practice*, *meaning and discourse*, as well as *law and politics*. For a technology to remain successful in the long run, it is necessary not only to create a manufacturing organization, but also to construct a network of organizations that are devoted to the continuous maintenance of the technology and its sub-elements. For an artifact to be accepted by potential users, it is necessary to convince them that the item can be easily and advantageously integrated into the routines of daily life. To reach public acceptance, it is of utmost importance that the new technology acquires meanings and connotations that make it possible to comprehend and comment upon in a serious manner. And, finally, care has to be taken for the new technology to find political and legal acceptance. An item that does not find for itself an organizational, an daily-practical, a discursive, and a political space, will not succeed.

Applying this perspective on five exemplary case studies from the history and contemporary situation of the automobile, we will in this chapter make a few tentative propositions. It is obvious that the present automobile system is upheld by powerful organizations in extremely strong networks, and we argue that fundamental changes can only be achieved by *enlisting* some of these organizations (Latour 1987). It is also pretty clear that the gasoline car is deeply entrenched in the daily practice of the majority of the population in the OECD countries, and we suggest that this situation can only change if an alternative solution is able to present itself as not threatening this practice. Strongly connected to the daily behavior of professional and private drivers is the *meaning* that these actors assign to the automobile (Pinch and Bijker 1987). We expect that electric or hybrid cars will only be able to establish themselves after they have found a place in the *discursive framework* in which these drivers participate (Hård and Jamison 1998). And, finally, it is without doubt the case that the gasoline automobile is upheld by a legal system and political-fiscal interests that disqualify new solutions. Also here, adjustment might prove to be the safest strategy.

## Cultural Blinders and Technological Icons

It might seem self-evident that anyone who wants to market a new technical solution has to take into account at least the four dimensions just listed. History shows, however, that few actors realize this complexity, and that fewer still are actually able to handle it. As we want to show in this section, one important reason for their one-dimensional focus on things technical has to do with deeply seated patterns in our society.

For pedagogic reasons, it is always a good idea to begin an undergraduate course on the history of technology by asking the students what they most strongly associate with this historical subdiscipline. If you do, then you are most likely to receive two types of answers. Either certain machines are mentioned, such as steam engines or airplanes, or individual inventors are named, such as Leonardo da Vinci or Thomas Alva Edison. If you follow up on the last suggestion by asking about Edison's largest achievement, then you are most likely to get the following answer: "His invention of the light bulb." Now observe the students' surprised faces, as you tell them that this is in fact not correct. Edison made important changes in light-bulb design, but he did not invent this device. His largest contribution to the history of electricity is rather to having created a technical, organizational, institutional, and cultural ambience for the light-bulb. The success of the Edison Illuminating Company lay with its ability to design a complete technical system, to assure financial and legal support, and to launch incandescent light as a convenience in the leading circles of American life (Hughes 1983).

Presumably, a class of ordinary college juniors or sophomores to a certain extent reflect knowledge and ideas that are widespread in larger segments of the population. The view of history of technology as the history of simple machines and single inventors is in any case strongly present also in popular scientific magazines, in books for the youth, and even in historical museums. A visit to your local newsstand or bookstore, or, for that matter, to the

Smithsonian in Washington, D.C., or *La Villette* in Paris will convince you about the ubiquity of this view in our progressive and individualist culture. Here, you will find articles about Nobel Prize Laureates, biographies of famous inventors, innumerous exciting gadgets, and more or less incomprehensive machinery.

The history of the automobile is no exception to this rule. At the *Deutsches Museum* in Munich you can behold Carl Benz's first horseless carriage from the year 1886, and, if you are lucky, you may even experience this 0.9-horsepower vehicle being taken for a short drive by one of the attendants. Of course, Benz is one of the great men who is honored with a bust in the museum's Hall of Fame. Things are not much different at the Henry Ford Museum in Dearborn, Michigan, although here the story is retold on quite another scale. Two impressive exhibitions stand out: one is called "Henry's Story" and the other one "The Automobile in American Life." Despite the impression given by these titles, the exhibitions do not tell us much about the *lives* of Henry Ford and his fellow Americans. At the center is not Henry as a human being, nor the central place of the automobile in American culture. Instead, the visitor may behold Ford's first single-handedly constructed carriage and an almost endless series of American-made automobiles from all through the $20^{th}$ century. Technological icons all around.

When standing in front of an 85-year-old Ford Model T, the world in which it was created and used tends to fade away. Even for the proud member of a veterans' club, who dresses up in his best turn-of-the-century apparel on a beautiful May Sunday morning, the cultural ambience in which his car was once immersed remains of minor interest. For the antiquarian, as for the most of us, the automobile is a machine, whose connections with matters social or cultural are seldom taken seriously into consideration. Just think about the yearly automobile exhibits in Geneva, Detroit, or Frankfurt, where the audience is blinded by the glamour of the latest models. Who talks here about anything but new forms, new gadgets, and new technical solutions?

To put it differently, when approaching the automobile or other technical artifacts, we tend to dress up with cultural blinders. Just as the jockey puts blinders on his horse in order that it not be disturbed by surrounding events, we—regardless of whether we are museum visitors, students, or drivers—tend to wear blinders that protect us from seeing the complex and perhaps problematic relationships in which technology is embedded. Whereas we only see Henry Ford and his Model T in the rear mirror, we tend only to take notice of the exciting technical novelties on the road ahead. When traveling at high speed on the road of progress, we do not pay much attention to things non-technical. The cultural meanings surrounding the automobile, the social inequalities which it perpetuates, and the environmental problems which it creates are factors that remain peripheral.

To function in a technical sense, a light-bulb requires a power plant, generators, and wires. To function in an economic, social, and cultural sense, much more is needed, however. Before Edison could go about constructing his first network in Pearl Street on Manhattan, he first had to erect an organization that could build and run the technical system, negotiate legal matters with the New York authorities, create an awareness in the public for the new product, and convince potential users of its superiority. Considering that there already existed two lighting systems in New York City—gas and arc lighting—it was no mean task for the Edison Illuminating Company to get acceptance for yet a third system. Users would be ready to replace their petroleum, gas, or arc lamps with light-bulbs only after having been convinced the new system would prove to be cheaper, better suited to their everyday needs, or more trendy. In order to smuggle the light-bulb into the living-rooms of the wealthy—that is, to open up a space for it in their daily life, the company was forced to create a legal space for it, as well as to get it accepted discursively and cognitively. As a nice illustration of how the last task was handled, it can be mentioned that "candle power" was used to designate how much light a certain bulb emitted (Nye 1990: 17).

The same goes for the early history of the automobile. Before a kind of Ford-style mass motorization could set in, a number of legal hindrances had to be removed—the most well known of these being the British Red Flag Act (Tengström 1994). Roads had to be improved, traffic rules had to be formulated, and a network of garages and gas stations had to be erected. Only after these legal, technical, and organizational spaces had been created could an artifact such as the Ford Model T make its appearance. What remained for the Ford Motor Company in the years around 1910 was to create an economic, social, and cultural space for its new product. This was done in three ways. By continuously lowering the prize of the Model T and by playing on the American ideology of liberal democracy and equal opportunity, the company contributed to the rapid redefinition of the automobile from an expensive toy for the upper classes to an accessible and desired object for the middle class and the rural population (Hounshell 1984). Driven by romantic ideas of conserving the rural character of American culture, Henry Ford himself paved the way for these rapid changes on the discursive level.

As we all know, Ford and his companions were extremely successful. Fairly rapidly, a new cultural ambience developed around the internal-combustion car. Henry Ford's rural image quickly gave way to a modernist and futurist perspective, according to which the automobile came to symbolize speed, power, and freedom (Wagner 1998). Simultaneously, the technical, legal, and organizational structures of the automobility system took shape. The following five case studies describe attempts at challenging this system, in particular attempts at developing alternative technical solutions that to greater or lesser degree also proved to challenge this ambience.

## Dealing with Stable Structures: Five Case Stories

### *Diesel Road Vehicles: The Well Adjusted Alternatives*

This section does not deal with Diesel jeans, although a history of this clothing brand could have been well suited for an analysis of how the creation of meaning and images is a prerequisite for market success. Instead, it deals with something much less trendy diesel trucks and buses. Showing that this area of automobile technology could establish itself relatively quickly, it argues that this feat was made possible only because the diesel was taken up by well established organizations in the field of mechanical engineering, because the involved actors managed to get rid of the negative image that used to plague the diesel, because the new engine allowed drivers and companies to continue old practices, and because the diesel did not present any serious challenge to existing legal and fiscal systems (Hård and Jamison 1997). The message is that adjustment seems to be the price that has to be paid for success. Did, by the way, Diesel jeans succeed because they were only slightly different from Lee and Levis'?

The road toward adjustment was long and winding. If, in the first decade of the 20th century, an engineer had announced that he was designing a diesel road vehicle, then he would not have been taken very seriously. From the very beginning in the 1890s, when the first diesels had been built, this engine had only been used for stationary purposes and in sea-going vessels. Due to its excessive weight and slow speed, it was typically employed in factories, in electric power plants, and in large ships. Since it was, furthermore, relatively difficult to vary the engine's speed (r.p.m.), alternative applications were hardly discussed. In particular, the diesel was considered utterly inappropriate in areas where low weight per horsepower, high speeds, and flexibility were wanted—such as by road vehicles or airplanes. When engineers at the German firm M.A.N. began to conceive of a diesel truck toward the end of the 1910s, this was thus a truly courageous thought (Knie 1991). At this point in time, the diesel was just a as radical an alternative as were gas turbines and Wankel engines in the 1950s.

Although, today, diesel hardly stands out as a radical alternative to gas—and certainly not an environmentally beneficial alternative, the history of the diesel vehicle can still be read as a history of a successful breakthrough. If we are interested in getting out of the perpetual traffic circle of today's automobility, then we may draw healthy lessons from the early history of the road diesel. After all, this engine is the only prime mover that has challenged the gasoline hegemony on a substantial scale. Especially in Europe, the diesel has become the standard engine in trucks and buses, and it has made considerable inroads in some segments of the car market—primarily on the taxi-cab niche and among French and German customers.

When M.A.N. initially announced that it had a truck diesel on its agenda, other firms met this piece of news with skepticism. Only the French company Peugeot chose to take the challenge seriously (Hård and Knie 1999). Among the technically interested public, response was more positive. Peugeot's first prototype—shown to the public in 1922—received immediate praise in popular magazines such as Omnia and La science et la vie. Delighted by the prospects that French companies would open up completely new spaces for the diesel, technical journalists wrote a number of enthusiastic reports. Even though the test drivers noticed a few drawbacks, such as the engine running pretty roughly and emitting "light smoke," expectations were high. Peugeot was said to be on its way of developing "the engine of the future" (Dumont 1983: 379, 386).

Ecstasy around the first diesel vehicles was short, however. Because the engine proved not to meet the expectations of daily driving, the first generation of diesel trucks never got a foothold on the market. Low speed, starting difficulties, prohibitive roughness, and—for the commercial driver—unfamiliar behavior became insurmountable problems. A commentator in the engineering magazine Le génie civil had to admit in 1927 that the diesel had not yet overcome these drawbacks. By this time, Peugeot had already decided not to market its first model. Despite concerted attempts at redefining the meaning of the diesel engine, it remained a stationary and naval engine throughout the 20s.

In the automotive sector, new spaces opened up for the diesel only in the following decade. Potential customers began to exhibit a profound interest in diesel truck and bus engines, and the word "diesel" received a new meaning. Contemporary commentators felt that "dieselization" symbolized the future, a new era for the industry. The French magazine La vie automobile wrote in 1930: "With its recent adoption of the rapid and light diesel engine for road transportation purposes, the heavy-truck industry has reached a turning-point in its history" (p. 457). From our point of view it is particularly interesting to observe what was meant by this "turning-point." Although certainly an exaggeration in 1930, the author explained to his readers that the move from gasoline to diesel implied almost no difference either to the driver or to the garage mechanic. Driving practices and organizational structures were said to be hardly challenged by this new technology. For the driver, the main difference was that he had to wait half a minute or so for the cylinder head to get warm before setting off. Changing gear and accelerating was also somewhat different, but, by and large, drivers should be able to turn from gasoline to diesel with relative ease. In other words, the argument was that the engine and the fuel were new, but—at the same time—that the new technology nonetheless could be integrated into established structures and daily practice without ado. In 1932 the same magazine concluded: "The success of the diesel in now uncontested" (La vie automobile 1932: 442).

This success was a result of complex developments on several levels. When engines became easier to start, bus drivers were ready to accept the diesel. When they became smoother and emitted less black smoke, passengers and politicians could also stand it. And, when they became faster and more powerful, truck drivers and owners started to become convinced of their usefulness. French and German road-vehicle manufacturers led the way, but in the U.S., Great Britain, and Sweden other companies entered the game, forming new organizational networks. Engine-producing and engineering companies developed diesel models that were sold to established truck and bus manufacturers. For instance, the Cummins Engine Company developed a design that was installed in trucks made by the White Motor Company in the early 30s, and Jonas Hesselman's engineering company designed a diesel that was fitted into Scania trucks in the same decade (Rowell 1986; Hesselman 1948).

The tension that we meet in the above-mentioned analysis is commonplace in the history of alternative technologies. The best technological solutions are those that, on the one hand, appear technologically novel and exiting, but, on the other hand, do not threaten existing structures and patterns. The close fit that developed between the diesel and the gasoline systems indeed seems to prove that our French commentator was partly right. In the beginning truck and bus manufacturers even mounted diesel and gasoline engines in the same type of vehicles, and they claimed in advertisements that it would be possible for a truck owner simply to replace a gasoline with a diesel engine (La vie automobile 1931: 621). Although the drawbacks of this practice soon became obvious (due to the higher weight of a diesel engine, considerable adjustments had to made if it is to replace a gasoline engine), the similarities of the two engines remained substantial. The step from gasoline to diesel turned out not to be so large as—decades later—from the reciprocating to the Wankel engine.

Direct comparisons between the two prime movers could be carried out on a relatively fair basis. The ceteris-paribus-syndrome, which in comparisons between gasoline engines and other alternatives almost exclusively leads to the victory of the former (since variables are usually chosen that suits this engine), did not necessarily affect the diesel negatively (Knie and Berthold 1995). The main problem that electric cars faces because of this syndrome—shorter driving range than the gas car—did not hit the diesel. On the contrary, comparisons between the gasoline and the diesel typically indicated that a diesel truck made use of only two thirds of the amount of fuel that a gas truck needed (Le véhicule industriel

1930: 27). Since diesel oil in most countries remained cheaper than gas—although diesel tax increased as the use of diesel vehicles spread, the outcome was quite positive for the diesel: larger driving range and lower running costs. More problematic factors for the diesel were higher cost price and higher weight, which for some time made it interesting only for truck owners who demanded much power and drove their vehicles very long distances.

In their efforts to market the truck diesel, manufacturers had no problem in adjusting to well established (gasoline) parameters and definitions. In order to prove the diesel's ability to carry heavy loads over long distances French manufacturers arranged a number of trips in French Sahara in the early thirties. In form, they were identical with trips that had become commonplace in the French framework. Together with representatives of the French departments of state and of the colonies the Laffly company and the Peugeot subsidiary C.L.M. organized a 8,000-mile test trip from Alger to Lake Tchad and back in 1932, and in the same year the Berliet company made a return trip over 3,900 miles between Alger and Gao. Hereby, not only reliability and sturdiness of the diesel truck should be proven, but its importance for the colonial expansion policy could also be illustrated. The message to the French public was clear: "The Sahara has been conquered" by the diesel.[1]

To conclude: although the diesel had originally been plagued by a definition that made it hopeless as a road-vehicle engine, it managed in the 1930s to accommodate to the cultural ambience that had already established itself around gasoline trucks and buses. Diesel and gas vehicles could be driven by the same people without them having to develop excessively new behavior; they could use the same technical infrastructure; their fuels were distributed by the same companies; they were manufactured by largely the same firms and could be maintained by the same garages. And, finally, the meaning of the diesel complemented rather than counteracted its gasoline cousin. From about 1930 onward the diesel has been seen as the "working horse" of the road, the most "universally applicable" and "economical" engine (Diesel Report 1977).

### *The Wankel Adventure: Technical Elegance and Market Arrogance*

All radically new technical solutions have to face deeply seated ideas of what constitutes a real automobile engine. To accept the diesel proved to be cognitively fairly easy, since both the diesel and the gasoline are internal combustion cylinder-engines and usually work on a four-stroke basis. Indeed, since the times of Thomas Newcomen and James Watt, heat-engines have traditionally been built with pistons, cylinders, and complicated crank-cases that transform the reciprocal movement of the pistons into rotary motion. Anyone who wants to challenge this long-standing definition has to be prepared to take on quite formidable educational tasks. When the German firm NSU attempted to market an engine without reciprocally moving pistons in the years around 1970, it had apparently not been prepared for this task.

In the 1950s NSU, situated outside Stuttgart in southern Germany, has grown to become the world's largest manufacturer of motor-bikes. As the market for motor-bikes began to decline, it became increasingly obvious for the NSU management that a complementary product had to be found. Not least since its customers began to show an ever increasing

[1] Archive de la Fondation automobile Marius Berliet, Lyon: file "Peugeot (F) – 120G / 1201G (1921-1928)."

interest in cars, it lay close at hand for the company to consider entering the automobile market. Since the company's relative smallness made it virtually impossible to consider mass production of cheap cars, it chose to develop a strategy of technical uniqueness. By providing the market with something radically new, they hoped to be able to make an inroad into the automobile area. To this end, NSU turned to an eccentric inventor, Felix Wankel, together with whom it already had carried out a few experimental projects. Known for his unconventional boat engines, Wankel ran a design firm at the Bodensee, not far from Stuttgart (Korp 1994).

Wankel's long-standing dream had been to develop an engine with a rotating piston, thus getting rid of the crank-case. In Wankel's mind, such an engine would not only be more esthetical than an Otto-cycle engine; it would also be smaller and, hopefully, more fuel efficient. As he was approached by NSU, Wankel had already made a few very compact and—in particular, at high r.p.m.—silent prototypes. The fact that the engine had relatively few parts promised to be a clear advantage from a manufacturing point of view.

Stieler von Heydekampf, the NSU director, was enthused. After having been informed about Wankel's ideas and discussed the topic with his chief engineer, he told his engineering staff in the early 60s that they could now go ahead and build their "dream car." By allowing his engineers to develop what might prove to be the engine of the future, Heydekampf hoped to maximize the "human capital" of his company. If NSU would, after all, not be able to make it on the automobile market on its own, then its knowledge base would at least be of interest to any larger firm in this branch of industry. Already at this time, Heydekampf seems to have been aware of the high costs of entry in the branch, and he was firmly convinced that technical elegance would be the best way of making the firm attractive for potential buyers (Knie 1994).

NSU pursued the road toward technical perfection with great vigor. When its first car equipped with a rotary engine, the NSU Ro 80, was shown to the public in 1967, this was definitely a milestone in the history of the automobile. Not only did the engine represent a quantum leap, also the aerodynamically designed body—made possible through the compactness of the engine—pointed toward the future. The immediate response in the press equaled the French response to the first diesels in the 20s. A number of prominent people soon declared that they were going to buy a Ro 80.

The extreme focus on technical pioneering work proved to have its price, however. The company forgot to create an appropriate cultural ambience for the car. In order to attract technically interested, trendy professionals (later known as yuppies), the price of the NSU Ro 80 was set quite high, on the same level as a medium-sized Mercedes-Benz. However, no sales apparatus was set up to match the needs of this demanding customer group. Being used to inspect the latest models in the fancy showrooms of established car dealers, MDs and architects were now expected to make their way to one of the shabby NSU motor-cycle outlets. In sharp contrast to the recently much discussed little "Smart" car—treated more at length below, no attempts were made on the side of NSU to create a completely new image and a fitting marketing apparatus around the Ro 80. The corporate strategy known as branding had not yet been invented (Aaker 1991).

Those yuppies who actually got themselves together and signed a contract with an NSU dealer faced an additional problem. As opposed to ordinary reciprocal engines, the rotary engine runs increasingly smoother at higher r.p.m. This means that the driver is not only triggered toward driving ever faster—thereby risking life and limb, but also that he or she tends toward overdriving the engine—thereby risking breaking it into pieces. To avoid these dangers, a new driving style had to be acquired and a new practice had to be developed. For NSU these problems came as a surprise, and the firm had a hard time dealing with them. Why should it be necessary to create a customer-oriented organization and teach people new habits, if you are selling the best car in the world?

The limited focus of the company can also be explicated by its inability to make effective use of the Wankel engine's largest political advantage: its advantageous fuel emission values. Remember, the late sixties were the years when environmental problems began to be really hot, and a number of political and administrative measures were taken to "save the earth." In the area of automobility, the Musky Bill—passed by the U.S. Congress in 1970—is the most well known. As is also well known, however, the outcome of this bill did not turn out as originally intended (Grad 1975). After a concerted lobbying campaign on the side of the powerful automobile companies, the regulatory rules slowly but surely became more and more lax. If NSU already in the late 60s had taken the opportunity to prove to the world that it did not only sell the world's technically most elegant car, but also one with extremely low $NO_x$ emissions, then they might have been able to acquire a clear competitive advantage.

Of course, it would not in any case have been an easy task for such a small company as NSU to get heard on the political scene. It thus seems as if not only the dealer and the image problems could have been taken care of, had NSU on an early stage looked around for an established partner. As things now turned out, it did so far too late. When Volkswagen finally bought the whole company and fused it in the mid-70s with another of its daughter units, Audi, the Wankel project was already dying. The last NSU Ro 80 left the factory in 1977, and the highly qualified NSU engineers went back to work on reciprocal engines.

We observe in Wankel's and NSU's stubborn focus on technical perfection traits that to some extent might be particular German. More than half a century earlier, the Daimler company had distastefully, and perhaps typically, claimed to be knowing much more about automobile technology than their customers (Hård and Knie 1999). The ultimate consequences of this attitude were similar. Daimler had in the 20s had to give up its first diesel-truck project, and NSU was in the 70s forced to give up making its revolutionary car. Technical excitement does not guarantee market acceptance. Only if the new product is placed within a cultural ambience is success possible. In the Wankel case, this ambience would have had to include, at least, an appropriate sales and repair organization, a successful redefinition of what constitutes an automobile engine, and enough power to ensure mass production and political influence.

### *An EV1 in the Sun: Failure Preferred?*

One company that definitely possesses large enough amounts of political influence is General Motors (GM). Nevertheless, even this huge corporation was not particularly pleased, when the California Air Resource Board (CARB) in 1990 announced that—beginning eight years later—all large automobile manufacturers would be forced to sell an increasing amount of so-called "zero-emission vehicles" (ZEVs) (cf. Fogelberg's chapter in this volume). The new regulations did not appear out of the blue, however. Expecting harder times, GM had begun to prepare for the solar or the electric-car era well in advance. With great pomp and circumstance its dynamic chief executive officer, Roger Smith, had presented the company's electrically propelled "Impact" on the annual Los Angeles Auto Show already in January 1990. With this model the biggest of the Big Three seemed to signal their readiness to taking on the political challenge. Smith announced that GM within reasonable time would be able to put the new design in series production.

The path leading toward this apparent readiness had emerged only slowly. After having purchased Hughes Aircraft and established a close collaboration with Paul McCready, a Californian expert on light-body design, GM had in the 80s indeed acquired an organizational basis on which a successful electric-car project could be built, but it would, nevertheless, prove rather difficult to secure such a project internally in the organization (Shnayerson 1996). Only after Jack Smith, a hard-headed and feared rationalization boss, had given the electric car his blessings, could the project managers feel on safe ground. For Smith & Smith, the Impact promised to give GM a competitive advantage in face of a politically changing ambience.

For those interested in the spread of electric vehicles, the years following the spectacular introduction of the Impact and the CARB regulations were rather disappointing. The original enthusiasm, that had brought herds of journalists, politicians, and social scientists to Sacramento, disappeared. The death of the gasoline car turned out not to be just around the corner, and the starting date for the new ZEV rules was constantly suspended. When GM's first series-manufactured electric cars—now under the name "EV1"—finally could be found in the streets of California and Arizona in December 1997, the topic seemed to have faded into oblivion.

With the introduction of the EV1 GM has certainly made an attempt to raise the electric car from the dead. It can be doubted, however, if this really is a radical and whole-hearted attempt. For one, the corporation seems to follow a strategy of continuous adjustment to frameworks set by the gasoline car. Furthermore, although GM has understood the need to market its new product better than NSU did with their Ro 80 back then, the Detroit-based corporation has, nevertheless, encountered similar problems. First, none of the classical, prestigious GM brands were prepared to commit itself to market and deal with the electric. Buick, Chevrolet, and Cadillac did not dare risking name and goodwill by being connected to such an insecure project. It was therefore decided that the EV1 should be handled by GM's Saturn dealers, a decision that appears to have given the public the wrong signals. Whereas Saturn cars are typically bought by women or families as second or third cars, the EV1 has been marketed as an automobile for future-oriented, trendy men. Second, the introduction has had something parochial to it: only about thirty Saturn dealers in parts of California and Arizona has actively taken part, and no attempts have been made to erect a technical and commercial support network outside these states. Although this strategy might give potential customers a feeling of uniqueness, it might also have given them a feeling of being guinea-pigs.

The reason for the geographically limited introduction is not necessarily the outcome of a conscious marketing strategy—although it is obvious that the erection of an appropriate fuel-delivery system on a continental basis would have been prohibitive. With the pioneering character of the new car come certain drawbacks that are easier to handle in the dry and warm climate of the Southwest. Due to starting problems at low temperatures, the car indeed has acquired a kind of "sunny-side" or "sunny-boy" meaning. With a base retail price of $33,995, it is indeed a beach-buggy for the better-off guys.[2]

Like NSU, GM has admittedly succeeded in producing a, in many respects, pioneering (and exclusive) vehicle. Just as the Ro 80 had a kind of drop-like form, the EV1 has been given a consequently futuristic design, which clearly signals that we here have to do with something more than just another, ordinary two-seat's sports-car. But, even more radical is the way in which a potential customer is allowed to acquire an EV1: he or she cannot buy it, only lease it! With this innovative move, GM has not only paved the way for an alternative propulsion system, but has also shown that new technologies might be compatible with new legal forms. More or less inadvertedly, GM thereby breaks open the age-old relationship between private ownership and individual mobility.

Requiring three hours for "refueling," and allowing a maximum range of 79 miles between charges, the EV1 is a vehicle that definitely demands a new discursive space. Since, furthermore, the driver is not allowed to take the car outside the market area in the American Southwest, certain restrictions accompany the signing of a leasing contract. The acceptance of the EV1 by the customers thus necessitates a new understanding of what a car is. However, since most users only seldom drive more than 30-40 miles at a time, new spaces in daily routines are not necessarily required. Surprisingly, there is no sign that GM has emphasized this argument in their market strategy. The suspicion lies close at hand that GM is not particularly willing or prepared to take on the task of creating appropriate living conditions for their new child. Indeed, their own prophecy of only being prepared to meet a "limited customer demand" has been fulfilled. As far as is publicly known, less than 1,000 leasing contracts have been signed to date (Knie et al. 1999).[3] Perhaps the cobbler is happy to stick to his last?

### *The TH!NK Electric: A Norwegian Challenge*

The electric vehicle has had considerable difficulties in establishing for itself a positive connotation, not only in the American, but also in the German public debate. Even representatives of environmental movements, who have generally been strongly opposed to the gasoline engine, have tended to disqualify the electric as the "coal car" or the "atomic automobile." Since only a few percent of German power is produced on a sustainable basis, an electric vehicle has seldom been regarded as an acceptable solution. Under pressure from the automobile industry, on which every seventh job in the Federal Republic is said to be directly or indirectly dependent, few politicians have ever dared demand substantial changes in the automobile culture. After all, Germany is not only Nicolaus Otto's, Carl Benz's, and Gottlieb Daimler's home county. Its people is also proud to having launched the classic Beetle, the *Autobahn* system, and a number of high-quality automobile brands, such as the Mercedes and the B.M.W.

The situation is decidedly different in Norway. Not only is the electricity production of this country almost completely based on hydropower. It is true that Norway at times imports

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[2] http://www.ev1.com (4/8/99).

[3] In Los Angeles Times, November 11, 1999, the number 600 is mentioned; (http://www.latimes.com/news/highway1/19991111/t000102489.html).

nuclear power from Sweden and oil/coal power from Denmark, but these imports are by and large equaled out by the export of hydropower at other times of the year. One of the most well-known environmental organization in the country, *Bellona*, is thus—in contrast to its German sister movements—not at all against the electric car. Furthermore, since there has never been any production of gasoline automobiles in Norway, it is not necessarily politically suicidal to support alternative means of transportation. This should not be taken to imply, however, that the electric vehicle has received considerable support throughout the years. At the early research and development stage, support, if any, came from local energy companies and a few large private firms—even oil companies (Buland *et al.* 1996). The government did only begin to get seriously involved, when it turned out that the manufacturing of electric cars might become a real possibility.

If Norwegians cannot proud themselves of having any large automobile inventors or manufacturers in their ranks, they can at least point to having fostered a long range of highly successful sportsmen and sportswomen. Considering that this country only counts 4.3 million inhabitants, its successes in a number of sports—not only skiing—must be said to be remarkable. The pivotal event in this regard was the Winter Olympic Games that took place in the small Norwegian town of Lillehammer in 1994. Competing with Russia and the U.S. for the first place in the Games, the Norwegians proved to themselves and the world that they were able to achieve greatness.

During the Games, a fleet of small little cars could be seen driving about between the different arenas in the Lillehammer area. Few visitors probably paid much attention to these creatures, and still fewer observed that they were in fact electric automobiles. Those who did notice the cars were surely surprised to learn that these electric vehicles had been designed and manufactured by a Norwegian firm, the Private Independent Vehicle Company (PIVCO). To be able to show its little "City Bee," as the vehicle was called, to journalists from around the world was, quite naturally, an extraordinary opportunity for PIVCO. After the Games were over, the company could also continue to make good use of them for public-relation purposes.

As it turned out, the Games indeed proved to be an inroad to the international market. With a self-consciousness and purposefulness that calls the best Norwegian athletes to mind, PIVCO decided to take on the toughest of all car markets: the Californian one. Only one year after the Games were over, PIVCO could pride itself of having signed a contract for the deliverance of forty City Bees to be used in and around San Francisco. The principal idea behind this project was to allow employees of a handful of private companies to use the electric in connection with the rail-based Bay Area Rapid Transit system (BART). Instead of driving their gasoline cars from home to work and back each day, the employees should be encouraged to take their electric cars from home to their nearest BART station, or from a BART station to work. In other words, the vision was to create a kind of integrated, park-and-ride traffic system, in which the electric car was supposed to complement rather than compete with public transport.

PIVCO's ability to be at the right place at the right time is remarkable. However, its initial success relied not only on its sense for public relations. In contrast to many innovative companies, PIVCO understood early on that technical solutions is only one of several factors that are needed for market success. In an almost Latourian fashion, the company first developed a complete scenario about the new vehicle and its cultural ambience, and then went ahead to trying to convince other firms and institution about the desirability of this scenario (Latour 1987). Central in its technological vision was the notion of the "private independent vehicle" (Dierkes et al. 1996). At least until the follow-up model TH!NK was launched in 1997, PIVCO all the time used to argue that it was not developing an electric automobile. The City Bee should not—as a traditional ceterius-paribus comparison would indicate—be regarded as an small and slow automobile with a limited driving range. Instead, it should be regarded as something completely novel. It was neither a bad car, nor a good bicycle. It was a PIV, which should provide the driver with new solutions to his or her mobility needs. A prerequisite was, in our words, that organizational, cognitive, social, and economic spaces were established around the vehicle. In the Californian case this implied that companies such as BART and Pacific Gas & Electric provided institutional support; that potential employees could be convinced that the new vehicle was beneficial for them; that the users were interested in making room for the City Bee in their everyday practices; and that the vehicle was economically accessible.

With the signing of the BART contract PIVCO's name began to appear more often in the Norwegian press. The idea spread that a Norwegian company was about to conquer the American West Coast. The unlikely seemed to be within reach: Norwegian road-vehicle production! To reach this goal turned out not to be so easy, after all. As with most pioneering undertakings, the Californian project proved to be plagued with all sorts of problems. An ensuing rent-a-City-Bee project at the Oslo airport also had its bugs, and was consequently cancelled after a fairly short time. The biggest problem, however, seems to have been the raising of capital. To the delight of the Norwegian public, PIVCO decided in 1997 to build a factory for the annual production of 5,000 vehicles in Aurskog in southern Norway—in sharp competition with a Swedish production site. To this end about 40 million Euro were needed. Despite the substantial public coverage that the project now received, and despite the nationalist discourse in which is was framed, private investors remained reluctant. The risk was simply deemed to be too large. Ten yards before the finishing line, PIVCO's famous ability to enlist influential actors seemed to have disappeared. None of the earlier collaborators—such as Norsk Hydro, Statoil, Oslo Energy, or the Norwegian Post—was ready to put in the last cents. The government declined taking over. It became brutally clear that the network of firms which PIVCO had spun around itself had been far too weak, and its members far too uncommitted. PIVCO's strategy had been well suited for the research and development stage, but it proved utterly inappropriate for large-scale production. Shortly after bankruptcy had been announced, the most unlikely of saviors appeared: the Ford Motor Company.

At present, no-one knows what this American gasoline-car focused firm can do with a Norwegian electric vehicle—apart from exposing it at traditional automotive shows. Although Henry Ford bought an electric car to his wife back in the good old days, Ford directors and managers have shown no enthusiasm for alternative means of transportation throughout the years. Will Ford be more committed than GM to nurture a cultural ambience around an alternative vehicle? On historical grounds, we doubt it.

*The Smart Flivver: A Brand New World?*

"It would take considerably more lead-time to design, develop, and test a completely new powerplant and get it into production in quantities that would be meaningful than to pursue the improvements in the internal combustion engine." This statement, made by the then vice-president of the Ford Motor Corporation, Mr. Mirsch, in 1968, can be said to symbolize the traditional attitude of the automobile industry and of the engineering community (quoted in Jamison 1970: 30). Alternative means of propulsion have always been met by various arguments in favor of internal combustion. To a large extent, the history of automobile engineering can be written as a history of orthodoxy. The recent case of the small "Smart" car proves this point.

At strategic points on the Western-European Continent a number of high, see-through parking-towers began to mushroom in 1998. For any observer with a bit of fantasy, they look like the small, plastic parking-houses which children play with—complete with elevators and all. The small size and the bright colors of the cars behind the glass windows reinforce this image. The cars are only 8.3 feet long, and they come in colors such as "mad red," "aqua green," and "true blue."[4] When getting out or their ant-hill and dashing down the street, these smart vehicles catch everyone's attention.

The Smart seems to be very different, at least on the surface. Underneath the surface, things are more familiar, however. Of course, design novelties abound, most notably in the way the body has been constructed. Its propulsion system is not at all that revolutionary, however. Although equipped with only three cylinders and placed underneath the floor at the front of the car, it is still an internal-combustion, gasoline engine. Soon, a diesel version will also be available.

There is strong evidence that the choice of propulsion system has something to do with the fact that the Smart is manufactured by a daughter company of one of the world's classical automobile firms, the Daimler-Benz AG, now part of the DaimlerChrysler Group. The person who, at the end of the 80s, had initially launched the ideas that led to the Smart car was Nicolas Hayek, the director of the Swiss watch-making consortium, SMH (Truffer and Dürrenberger 1997). His vision had been to create a completely new car with a different image around it, thereby drawing on the positive experience from the production and marketing of the "Swatch." One possible component in this concept had been electric propulsion, an idea that he continued to foster until the he finally lost influence over the project. When Daimler-Benz acquired full control of the Smart toward the end of 1998, it was decided to abandon the idea of mounting a hybrid engine into the car.

Hayek has experienced many ups and downs with his ideas about a small and light car, easy to drive and park in congested urban areas. Despite Hayek's status, the project was for some time not considered viable. It thus came as a surprise, when Hellmut Werner, the then director of Daimler-Benz, in 1994 announced that his company would enter into cooperation with the Swatch Group—after Volkswagen shortly before had declined to do so. The outcome was a new organizational solution: the foundation of a joint company, Micro-Compact-Car AG (MCC), with the aggressive motto "reduce to the max." Everything that could be made smaller and lighter should be so. It was, however, from the very beginning clear that MCC would not be allowed to make use of neither Daimler-Benz's name in their advertisements nor of the Mercedes star on their cars. Mercedes-Benz's prestigious retail network would also not be made available for this little strange vehicle. MCC had to build an organizational and discursive space around its car on its own.

[4] http://www.smart.com/ (1/12/2000).

Although thus forced to create a brand new image, MCC could continue to draw on its contacts with Daimler-Benz financially and technically. It seems that the influence of the Swatch people—experts in light-body design, among them—had begun to decline already before the Swiss group sold their last shares. The prototypes became increasingly conventional, and the reduction policy was, in many instances, reversed. The market version thus turned out to weigh 1,590 lbs. and make 53 miles to the gallon. Certainly nice figures, but hardly revolutionary.

The revolutionary aspects of the Smart project lie elsewhere. The Smart is not advertised as just another and perhaps better car, but as an element of another lifestyle. Since there is room for no more than two persons and limited amounts of baggage, it certainly does not square with a traditional family concept. The envisioned customer group consists of trendy and flexible people without children, so-called *dinkys*. The—ordinarily quite young—Smart driver is depicted as dynamic, open, and progressive. He or she is interested in new technology, but, first and foremost, he or she want to continue living an active life without constantly having a feeling of not being environmentally conscious.

In their public relations Smart tries to combine the trendy with the practical. Cooperation with railroad companies and airports has been established, with the goal of giving Smart owners permanent access to a vehicle—even when far away from home. MCC thus creates an impression of wanting to aim at two user groups (looking surprisingly close to the typical Handy users): not only trendy, young people, but also mobile professionals. Instead of driving long distances, the dynamic representative is supposed to combine the train or the airplane with the Smart. It remains to see, whether this *Verbundsystem* solution will catch on.

Originally, MCC had more elaborate ideas about how to create new cultural spaces for the Smart. The idea to be allowed to use and pay for only half an ordinary parking slot was too difficult to get acceptance for, and the suggestion to allow 16-year-olds to drive a Smart was rapidly put back in the drawer. The openness for alternative meanings and new routines is obviously there, but the radicalism has largely faded away. Traditional concepts seem to substitute for unconventional. After all, the Smart is no longer a "Swatch auto," but "an integral member of the six passenger car brands at DaimlerChrysler."[5] Does it, by the way, not remind you of a small Mercedes A?

MCC now faces the danger of falling between two stools. In the process of becoming increasingly conventional, the Smart is being judged by the same criteria as other, ordinary cars. Applying standard ceterius-paribus criteria, the German journalist, Jo Busse, concludes that—compared to what the Smart performs—it is not cheap enough, that it consumes too much fuel, and that it does not square good enough with daily needs. In the typical manner of technical journalism he concludes distastefully: "It might be suitable as a colored toy for yuppies, but in all other respects it is a failure."[6]

### *Accommodating to the Existing Ambience*

In 1991 Noel Perrin, a professor of environmental studies at Dartmouth College, took the plane to Santa Rosa, California, to pick up his newly acquired electric car. His goal: to drive

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5 http://www.smart.com/ (3/18/1999).

it all the way back across the American continent to Vermont. As Perrin himself nicely describes in his book, Life with an Electric Car (1994), this proved to be a daunting task. It was notoriously difficult and expensive to have the vehicle recharged at gas stations or motels, and it was constantly annoying to be hooted or even laughed at by fellow drivers of other observers. To be able to drive the car in an appropriate manner also required Perrin to develop new driving patterns. On a lucky day, in a relatively flat part of the country, he could cover about 100 miles. Driving in mountainous regions was a nightmare.

Perrin's little book illustrates how virtually impossible it is to handle a technology that is not adjusted to its ambience. Of course, an electric car is not built for cross-country driving, and—in this sense—Perrin could be said not to have been quite fair to this technology. But this is not the only problem. What should he do, when the owner of the only motel in town did not allow him to recharge his car at night? In other words, what do we as users of an alternative technology do, when there is no space for it in the minds of people in the surroundings? Or, what should Perrin do that bitterly cold winter day, when he wanted to return from work earlier than usual—and the batteries of the electric were not yet recharged? To what extent are we willing or able to change our daily practice to fit the new artifact? And, to continue this series of open questions: What do we do, when our little city car proves to be unable to keep pace with ever tougher, officially sanctioned, safety standards—that is, when the legal space for the novelty becomes too narrow? Or, what do we do when the pioneering electric-vehicle company goes bankrupt, and there is no organization there to fulfil the service contract?

With these questions we point to a few areas that Robin Cowan and Staffan Hultén have overlooked in their introductory discussion in this volume about what factors are particularly important for the successful introduction of new vehicles. Although we agree that "a crisis in the existing technology," "dedicated R&D," "scientific results," and "technological advance outside the industry" might certainly be of importance, we have tried to argue in this contribution that such technology-centered solutions are always incomplete. The diesel did not make its way into road vehicles because of any crisis in gasoline engine technology, nor because it was in any abstract sense technically superior. The Wankel did not make it, despite concerted R&D investments on part of the NSU company. The EV1 and TH!NK do function very well under ordinary, urban driving conditions; and, there are already enough Smarts on European streets for anyone to conclude that this vehicle functions in a technical sense.

Our contention is that an overly strong focus on technical factors often begs the question. Therefore, historians and sociologists of technology increasingly tend to go beyond these factors and ask what hides behind them. For such an undertaking the three other factors listed by Cowan and Hultén are more helpful: "regulation," "changes in taste," and "market niches." With a friendly interpretation we could say that these categories to some extent square with what we have called legal, discursive, and organizational spaces. The diesel made its rapid breakthrough in the 1930s largely because it was picked up and given an appropriate market niche by existing organizations in the vehicle industry; if the Smart ultimately proves successful, then it will do so because MCC has managed to convince the public and its customers that this vehicle is something truly new and not just an inferior

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[6] *Lübecker Nachrichten*, 1999, quoted from http://www.ln-online.de/7151.html (3/18/99).

Mercedes A; and, if the EV1 and TH!NK are going to make it on the tough Californian market, then they need all the legal assistance they can get from the state authorities.

It follows that it is never enough to create well functioning technological support network around an artifact. Although this is certainly a necessary prerequisite, it is never a sufficient one. There were plentiful of current outlets along Noel Perrin's road across the States, but he still had problems in getting access to them. Of course, it was necessary for diesel-truck manufacturers to convince drivers that they could easily get hold of fuel, but this never seems to have been such a big challenge as to design the engine in such a manner that it was accepted by conservative drivers—probably because heavy oil was already widely used for heating, for ships, and for electrical power plants. Instead of discussing, in the first instance, technological support networks, we find it more important to bring out the cultural ambience in which these networks have to operate. The Wankel would have fared much better, had the NSU people made active use in the late 1960s of the increasing environmental consciousness in their advertisement campaigns. And, electric cars will only make their way onto our streets in large numbers after potential users have been convinced that these vehicles are "sexy," modern (or, perhaps, post-modern), and cool, and that their performance squares perfectly well with the present user behavior. In this regard, we believe that GM, Ford/PIVCO, and all the other manufacturers of electric cars could have something to learn from the MCC.

Linking up with Cowan and Hultén's discussion about lock-in and closure processes, we would finally like to call attention to one theme that has been running through all the cases presented in this essay. Keywords are accommodation to existing definitions and adjustment to established practices. PIVCO's City Bee used to be called a "personal independent vehicle," but its successor TH!NK is marketed as an "automobile." GM expects its next EV1 model to have a driving range that is almost twice as long, thus slowly getting closer to performance of a gasoline car. After the Smart has become closer affiliated with DaimlerChrysler, its technical solutions become increasingly Daimler-like. Had we followed the diesel story up till the present day, we could have added the observation that, for the driver, a modern TDI diesel behaves identically with a GDI gasoline. Our stories thus support the contention made in recent scholarship that new technical solutions tend to become increasingly similar to existing structures.

This contention must, however, not be the end of the story. If we try once more to remove the cultural blinders that always seem to be jumping back at us, then we see that our case stories have also been stories about the development of innovative daily practices, the formation of alternative mindsets and definitions, the passing of new laws and regulations, and the emergence of unusual corporate constellations. By conquering the Sahara, French truck manufacturers gave the word "diesel" a new meaning; the lasting impact of the EV1 might not be its propulsion system, but the leasing model; the final outcome of the Smart project might not be a brand new car, but a new brand, as well as a new meaning of mobility. For the new millenium we suggest that analyses about technological closure processes and debates about alternative technologies be replaced by a discourse about alternative meanings, alternative practices, alternative legal solutions, and alternative industrial networks. Only in this way can a new understanding be achieved within our field of scholarship and new spaces be opened up within the cultural ambience that permeates the present automobile system. Only in this way can we manage to get out of the vicious traffic circle of present-day automobility.

## References


Aaker, David A. 1991. *Managing Brand Equity: Capitalizing on the Value of a Brand Name.* New York: Free Press.

Bamberg, S., and P. Schmidt, "Auto oder Fahrrad? Zum empirischen Test von Handlungstheorien," *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, Vol. 46, 1994, pp. 80-102.

Buland, Trond, Heidi Gjøen, and Mikael Hård. 1996. *The Electric Vehicle in Norway: Scenarios and User Patterns*, STS working paper 12/96. Trondheim: Norwegian University of Science and Technology.

Canzler, Weert, and Andreas Knie. 1994. *Das Ende des Automobils*, Heidelberg: C.F: Müller.

Dierkes, Meinolf, Ute Hoffmann, and Lutz Marz. 1996. *Visions of Technology: Social and Institutional Factors Shaping the Development of New Technologies.* Frankfurt a.M. and New York: Campus Verlag and St. Martin's Press.

Dumont, Pierre. 1983. *Peugeot d'hier et d'avant-hier*. Fontainebleau: Edifree.

Fiala, Ernst. 1994. *Was nach dem Auto kommt. Zur Naturgeschichte der Mobilität*. Freienbach: Eurotax.

Grad, Frank P., *et al.* 1975. *The Automobile and the Regulations of Its Impact on the Environment: A Study*, Norman: University of Oklahoma Press.

Hård, Mikael, and Andrew Jamison. 1997. "Alternative Cars: The Contrasting Stories of Steam and Diesel Automotive Engines," *Technology in Society*, Vol. 19, pp. 145-160

Hård, Mikael, and Andrew Jamison, eds. 1998. *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900-1939*, Cambridge, MA: The MIT Press.

Hård, Mikael, and Andreas Knie. 1999. "The Grammar of Technology: German and French Diesel Engineering, 1920-1940," *Technology and Culture*, Vol. 40, pp. 26-46.

Hesselman, Jonas. 1948. *Teknik och tanke. Hur en motor kommer till*. Stockholm: Sohlmans.

Hounshell, David A. 1984. *From the American System to Mass Production, 1800-1932: The Development of Manufacturing Technology in the United States.* Baltimore and London: The Johns Hopkins University Press.

Hughes, Thomas P. 1983. *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: Johns Hopkins University Press.

Jamison, Andrew. 1970. *The Steam-Powered Automobile: An Answer to Air Pollution*. Bloomington: Indiana University Press.

Jürgens, Ulrich, Thomas Malsch, and Knut Dohse. 1989. *Moderne Zeiten in der Automobilfabrik*, Heidelberg: Springer.

Knie, Andreas. 1991. *Diesel – Karriere einer Technik. Genese und Formierungsprozesse im Motorenbau*. Berlin: edition sigma.

Knie, Andreas. 1994. *Wankel-Mut in der Autoindustrie: Aufstieg und Ende einer Antriebsalternative*. Berlin: edition sigma.

Knie, Andreas, and Otto Berthold. 1995. *Das Ceteris paribus-Syndrom in der Mobilitätspolitik. Tatsächliche Nutzungsprofil von elektrischen Straßenfahrzeugen.* FS II 95-104. Berlin: Wissenschaftszentrum Berlin für Sozialforschung.

Knie, Andreas, Otto Berthold, Sylvia Harms, and Bernhard Truffer. 1999. *Die Neuerfindung Urbaner Automobilität. Elektroautos und ihr Gebrauch in Europa und USA*. Berlin: edition sigma.

Korp, Dieter. 1994. *Der NSU-R0 80*, Stuttgart: Motorbuch-Verlag.

Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers Through Society*. Cambridge, MA: Harvard University Press.

Lie, Merete, and Knut H. Sørensen, eds. 1996. *Making Technology Our Own? Domesticating Technology into Everyday Life*. Oslo: Scandinavian University Press.

McShane, Clay, and Gijs Mom. 1999. "The Golden Age of the Horse and its Substitution by Mechanization and Motorization: A Bibliographical Introduction," *paper* presented at the Annual Meeting of the Society for History of Technology, Detroit, October 7-10.

Perrin, Noel. 1994. *Life with an Electric Car*. San Francisco: Sierra Club Books.

Pinch, Trevor J., and Wiebe E. Bijker. 1987. "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," in Wiebe E. Bijker, Thomas P. Hughes and Trevor J. Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, Cambridge, MA: MIT Press, pp. 17-50.

Rowell, John W. 1986. "The Diesel Came to Indiana in the Horse-and-Buggy Days," *Indiana Magazine of History*, Vol. 82, pp. 303-333.

Sinclair, Upton. 1969. *The Flivver King: A Story of Ford-America*. New York: Phaedra.

Sachs, Wolfgang. 1992. *For Love of the Automobile: Looking Back into the History of Our Desires*. Berkeley, CA: University of California Press.

Shnayerson, Michael. 1996. *The Car that Could: The Inside Story of GM's Revolutionary Electric Vehicle*. New York: Random House.

Tengström, Emin. 1994. *Private Cars and Political Decision-makers: A Historical Survey and a Critical Review of Current Transport Policy*. KFB Report No. 1993:21. Stockholm: Swedish Transport and Communications Research Board.

Truffer, Bernhard, and Dürrenberger. 1997. "Outsider Initiatives in the Reconstruction of the Car: The Case of Lightweight Vehicle Milieus in Switzerland," *Science, Technology, & Human Values*, Vol. 22, pp. 207-234.

Wagner, Peter. 1998. "Sociological Reflections: The Technology Question during the First Crisis of Modernity," in Hård and Jamison, pp. 225-252.

Weber, Matthias, et al. 1999. *Experimenting with Sustainable Transport Innovations: A Workbook for Strategic Niche Management*. Enschede, NL: University of Twente.

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