

Stifling Innovation in Cycle Technology

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Abstract

This paper argues that a healthy future for non-motorised transport requires a diverse cycling culture that encompasses many and varied design solutions. It is therefore important that innovative solutions should be encouraged wherever possible and that artificial barriers to their acceptance should be removed.

In Western Europe and North America, encouraging modal shift requires not just reinforcing existing markets but encouraging new ones and it is in this context that development in terms of rider seating position, comfort, ease of use features are most important.

However, at present, the current shape of the cycle market, heavily influenced by images created by cycle sport, works against innovation except in a few limited areas. Product designers working to improve the cycle as general road transportation generally work outside to the mainstream of the cycle industry and have few forums in which to exchange ideas or develop solutions.

A key example of the way in which cycle design is unnecessarily stifled can be seen in the rules governing the UCI definition of a road cycle. Rules are required for the purposes of competition, but the failure of sport governing bodies to grant recognition to the possibilities of other designs (e.g. though allowing multiple classes or other events) serves only to delegitimise alternative designs and experimentation

The paper concludes by suggesting ways in which a more open approach to technological innovation could be encouraged to the benefit of cycling culture in general

Introduction

Since the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 we have begun to understand the primary need for biodiversity in maintaining and creating sustainable ecosystems. The principle of biodiversity is now firmly enshrined within the frameworks of understanding sustainable development. Given the widely used model of sustainable development having environmental, social and economic dimensions, it is also becoming increasingly clear that the same principle of diversity drawn from ecosystems analysis as a means to promote stability and resilience can also be applied to social systems. Healthy social and cultural systems are those that exhibit diversity - the greater the diversity, the more easily sustainable a system is, and the more resilient it is to disturbance and the better able it is to adapt to change.

When we apply this metaphor to mobility options we can see that our transport systems are largely monocultures, dominated by and responsive to the needs of the oil-dependent private car and to road freight. Creating modal shift in transport from the car to the cycle – if it is to be a voluntary shift - requires that we make cycling an increasingly attractive option. However, when we examine what we are trying to get people to shift to, we see that current cycle design, despite the abundance of specialist modifications, adaptations and designs possible, is dominated by the diamond frame bicycle. In Europe and the USA, cycles

designed and adapted for specific purposes, to make them more attractive or usable by a wider section of the community, are confined to a specialised, low volume production, high cost area of the market.

It is a frequent popular assumption that technologies develop rationally, as if they 'evolve', so that the designs we have today must necessarily be the best possible¹. This view, however, fails to take into account the ways in which technologies are shaped by powerful social, political and economic forces over time. The Social construction of technology is now a recognised academic field of study. In respect of cycle technology, the argument of this paper is that potentially beneficial developments in have been, and continue to be stifled due to the confluence of a number of social factors. In order to build a more diverse cycling culture, to raise the profile and social value of cycling and to build cycles that can encourage modal shift in the industrialised nations, these barriers must be challenged.

The association of cycling with innovation and contemporary technologies can be one important bridge to creating modal shift. Innovations in materials, componentry, style, seating positions and the production of specialist products aimed at particular aspects of the market can all offer potential new riders major incentives to adopt cycling as a viable and desirable mode of mobility. These developments can also be seen to provide a social milieu in which the bicycle and other forms of non-motorised transport need no longer be seen as having low social value and being second-class modes of transport. In the context of a wider culture, we should understand the factors that currently limit innovation to being a largely a marginal and marginalised activity in order to challenge these barriers and to overcome them. It should be stressed that the current stifling of innovation is not the result of a conspiracy or any wilful action, but the unforeseen consequence of a number of contributing factors and decisions – an accumulation of aggregate factors rather than any specific single causal one. We can, however point to certain significant shapers of the public perception of cycling, of which cycle sport is a leading exponent.

The Role of Cycle Sport in Stifling Innovation

Sport requires rules. By very definition, sporting behaviour is activity carried out within a framework of constraints. Most sporting activities, however, represent particular codified forms of action that do not have correlated activity outside of themselves. Organised track athletics, for example, does not govern walking or seek to organise pedestrian activities. Cycle sport has a peculiar relationship to other forms of cycle use. Rather than being a dissociated specialist activity, it understands itself as being the summative point of all cycling activity.

Cycle sport is governed globally by the UCI (Union Cyclisme Internationale - International Cycling Union), founded in 1900 and now one of the biggest international sporting federations². Its constitution lays out its global and comprehensive terms of reference. These commence: "The purposes of the UCI are: a) to direct, develop, regulate, control and discipline cycling under all forms worldwide; b) to promote cycling in all the world and at all levels; c) to organize, for all cycling sport disciplines, world championships of which it is the sole holder and owner; to encourage friendship between all members of the cycling world" (UCI 2002 Article 2)

The basic principle in its government of cycle sport is "to assert the primacy of man over machine" (UCI 2005 p.54). In order to maintain this perfectly reasonable stance, the UCI therefore regulates cycle design and equipment tightly. An early example of sporting

¹ See Cox & Van de Walle 2006 for a critique of this perception in relation to bicycle technology

² For all rules and regulations see <http://www.uci.ch/>

regulation was in the decision to ban variable gearing from races. Experimental development of variable gearing continued because of the very real advantages perceived by tourist riders unburdened by the regulation of sporting competition (Berto 2005: 74). Only in 1937 was the derailleur accepted into the Tour de France. Similarly, in 1913 a decision was made to forbid any form of fairing which, by increasing aerodynamic efficiency, might lead to higher speeds being set, as Oscar Egg and Etienne Bunau-Varilla had ably demonstrated (Schmitz 1999: p2ff).

Perhaps the most far-reaching decision to dictate the size and shape of the bicycle in sport was the decision of April 1, 1934 to restrict the racing cycle to the conventional riding position (Fehlau 2003 p.13 and passim). Seated position bicycles, with the cranks ahead of the saddle and the rider sat as in a regular car driving position had been designed and built in various forms since the earliest cycle construction. The most prolific ground for these variants in riding positions was in tricycle construction or in association with cycles aimed at the female rider for whom the launching ascent and perched position of a high-wheel bicycle would be deemed inappropriate if not impossible in full skirts (McGurn 1999 Ch.4). Recognised as providing superior comfort, such designs were dropped in the rush towards the safety bicycle in the 1890s, offering as it did significant advantages in simplicity of construction and manufacture (Herlihey 2005 ch.4). In the early 1930s Charles Mochet designed and built recumbent position (feet-first) bicycles (Velo-Velocars) for general use as an offshoot of his manufacture of velocars – enclosed body, four-wheeled, pedal-powered cars designed for urban use (Bruning 2000). Francis Faure set a new Hour Record on July 7th 1933 on a version of Mochet's velo-velocar, demonstrating the gains to be had by adopting a more aerodynamically efficient position, even without streamlined fairings. Although this record was originally ratified by the UCI, the governing body decided retroactively to withdraw sanction of this record.

Although apparently an insignificant chapter in cycle sport, the effect of this ban was considerable. Since the UCI governs all cycle sport, therefore any cycling achievement made outside of the regulations allowed by the governing body effectively are null and void. For a cycling record to stand, it must be recognised. Although Charles' son George, who took over the running of the family firm on his father's death in June 1934, continued to construct practical velocars there was little incentive to develop the possibilities of seated position cycles. A few other manufacturers brought out recumbent cycles in 1934 to exploit the attention the possibilities offered by a new approach to cycle design, these were quickly discontinued within a couple of years of the decision to outlaw recumbent cycles from sporting competition. From the time of the ban until the formation of a new governing body - the International Human Powered Vehicle Association (IHPVA) in 1978 - independent of the UCI, design and manufacture of recumbent cycles was limited to the realm of the individual designer³. Even today, however, recumbent cycles continue to exist completely outside the mainstream of sporting activity, since the UCI does not recognise the existence of the IHPVA and its right to maintain legitimate records for cycles that fall outside of the regulations of the UCI. Being unrecognised as a sports body by the 'sole organiser' of cycle sport, the IHPVA therefore occupies a role as much as a technology development association with record-keeping functions, rather than as an active organising body of cycle sports events (functions which are carried out by a network of national organisations affiliated to the IHPVA).

Similar UCI retrospective bans on successful technological developments outlawed the 'ski tuck' riding position pioneered in the early 1990s by Graham Obree, and the 'superman' stretched riding position used the following year (Obree 2003). Using these rider positions Obree, Miguel Indurain and Chris Boardman set world hour records. Both positions were outlawed and new regulations were instituted with stricter definitions on the frame shape and dimensions. Boardman's record of 56.375km is now recognised as the 'best hour

³ Details of the IHPVA are to be found at <http://www.ihpva.org/>

performance', but not as the 'record', which stands at 49.700km (set in 2005 by Ondrej Sosenka of the Czech Republic) using a bicycle conforming to a strict set of regulations. Even Boardman's distance pales when set against the current human powered vehicle record of 84.22km set by Sam Whittingham (2004) utilising the advantages of streamlining and a recumbent seating position. These restrictions at professional level also affect riders at domestic level, even in non competitive events. Cycling Time Trails (CTT) is the governing body of time trialling in the UK and their rules explicitly forbid participation by recumbent cycles in any competition, even private trials, organised under CTT rules⁴. The net result is that no direct performance comparisons can be made to demonstrate the differing capacities of varying designs.

Despite the elevation of professional sporting cyclists to the heights of acclaim as representatives of the ultimate possible cycling achievement, the performances of these athletes are limited by the strict rules governing the equipment used. If cycle sport remained marginal to the public image and promotion of the bicycle, then these limitations would be of trivial effect and be rendered irrelevant to non-sporting cycle users. However, the relationship between cycle sport and cycling in broader society is tangled and complex. The UCI, whilst it claims sole representation of cycle sport, also declares in its Mission Statement adopted in 1994, to have 'an interest in helping to nurture all other forms of cycling' (Verbruggen 1999). In order to do this, it depicts cycling activity as a pyramid comprising 5 layers. At the apex is Sport, divided into 1) Elite class racing and 2) Masters and Sport racing. Below this comes Recreation divided between 3) Cycle Touring and 4) Leisure cycling. The final base layer is Utility, with the sole category of 5) Cycling for transport. According to its president in 1999 "The UCI must share the responsibility of feeding the roots to ensure that the whole tree flourishes."

However, this mission is at odds with the principles of cycle sport laid down in the UCI's Lugano Charter (8th October 1996) which was drawn up specifically to constrain technical development of the bicycle.

The features which have contributed to the world-wide development and spread of the bicycle are its extraordinary simplicity, cost-effectiveness and ease of use. From a sociological point of view, as a utilitarian and recreational means of transport, the bicycle has given its users a sense of freedom and helped create a movement which has led to the considerable renown and popular success which cycle sport enjoys. The bicycle serves to express the effort of the cyclist, but there is more to it than that. The bicycle is also a historical phenomenon, and it is this history which underpins the whole culture behind the technical object.

If we forget that the technology used is subordinate to the project itself, and not the reverse, we cross the line beyond which technology takes hold of the system and seeks to impose its own logic. That is the situation facing us today. New prototypes can be developed because they do not have to take into account constraints such as safety, a comfortable riding position, accessibility of the controls, manoeuvrability of the machine, etc. The bicycle is losing its "user-friendliness" and distancing itself from a reality which can be grasped and understood. Priority is increasingly given to form. The performance achieved depends more on the form of the man-machine ensemble than the physical qualities of the rider, and this goes against the very meaning of cycle sport.

Whilst such principles may be eminently suitable for the governance of professional sports competition, they have little place outside of cycle sport and are positively damaging when applied to any other form of cycling. A comparison of the comfort and accessibility of controls

⁴ See <http://www.cyclingtimetrials.org.uk/> for details

between a UCI compliant racing bicycle and an example of the contemporary urban semi-recumbent would render the UCI compliant machine as the on lacking 'user friendliness'. At the cutting edge of utility cycle design and promotion Shimano Europe have concluded that new riders creating a modal traffic shift "will demand better products and solution, changing the mobility industries dramatically, both what they offer and how it's developed" (van Vliet 2005). Whilst Shimano have an interest in promoting their high technology solutions, simpler interventions can also be of major benefit. The use of front fairings for any type of cycle can both increase average speeds (or decrease the amount of energy required for a journey) and offer a considerable degree of weather protection.

Professional cycle sport, presenting itself as the apex of all cycling activity, and with global access to the media and public presentation of cycling, is therefore explicitly set against the encouragement of technological innovation except within carefully defined parameters. The UCI has historically taken a stance against innovation, and continues to do so, whilst simultaneously claiming to speak on behalf of, and represent the ultimate form of, all cycling. The enshrining of a particular design of bicycle as the sole option for cycle sport, the limited freedom granted to innovation in Mountain Bike design notwithstanding, has 'knock-on' effects throughout the cycle industry. In sociological terms it creates a normative pattern from which all variants are seen as in some way deviant and needing justification. The elevation of the traditional diamond frame also suggests that the racing diamond frame cycle is the most efficient possible form of cycle - despite the clear empirical data to the contrary. We are left then, with a situation in which the UCI's own mission is explained as a "duty ... to participate, ever more actively, in the development of programmes and initiatives based on enhancing the value of the bicycle as a healthy and environmentally-friendly means of transport and leisure" simultaneously denying opportunity of participation for those who design and construct bicycles and tricycles outside the UCI's own definition of a bicycle (Verburggen 2000: 77).

Implications Beyond Cycle Sport

One of the problems in trying to build new markets for cycling in order to promote modal shift within industrial nations is the public perception of the bicycle as a second class and obsolete technology. The employment of innovative materials technologies such as the widespread use of carbon fibre – associated with aviation and motor racing industries can be a useful sales tool to overcome this perception. But even the majority of the current use of carbon fibre to build tubular structures mimicking diamond frames (or 'monocoque' facsimiles thereof) ignores the structural capabilities of the material to produce new forms.

There nevertheless remains a 'Catch-22' situation for those seeking to engineer bicycles more appropriately designed for everyday transport use. The closer they approximate in form and material to the cycles visible from professional cycle sport, the more desirable an image they create. Yet simultaneously, the forms appropriate for sports use are not those best suited for general purpose transport use. The mundane realities of everyday use require integral luggage carrying capacity, mechanical reliability and durability and, in most situations, the provision of adequate lighting and mudguards as a minimum. If the cycle is already burdened with an image as a second class means of urban mobility, then the hegemony of cycle sport means that designs departing from the norm are oft regarded as second class bicycles. Cycles purposely designed for transport risk being doubly marginalised by the dominant claims of sporting images as the 'ultimate'.

This is not to deny the existence and important contributions of innovatory engineers and designers working in the cycle industry. However, it is pertinent to examine the response of both sporting bodies and the wider cycle industry to key innovations in the past 50 years. Borrowing styling from Italian motor scooters Alex Moulton re-engineered his bicycle to incorporate small wheels and suspension (Hadland 1981, 1994). Smaller wheels enabled

luggage to be carried on the centre line, directly supported on the frame itself (rather than on bolt-on racks) increasing both capacity and stability under load⁵. Suspension allowed the use of high pressure, low rolling resistance tyres so there was no loss of performance. The step-through frame design enabled greater ease of mounting and dismounting and a single frame size was able to accommodate a full range of adult riders of varying heights, thus lowering manufacturing cost. Though none of these features was without precedent, the Moulton was the first cycle to bring them all together in a single mass produced package. The Moulton Bicycle Company was only founded when the design failed to attract the interest of major manufacturers and the resulting bicycle was successful enough to result in a turnaround in the fortunes of the entire UK bicycle manufacturing industry in the 1960s.

In response, Raleigh (the UK's largest manufacturer) launched their biggest ever sales campaign in the mid 1960s to regain the market share lost to Moulton, and launched their own considerably inferior (from an engineering perspective) small wheeler, which missed the point of many of the innovatory features such as the integral suspension and frame mounted luggage carrying capacity. They took over production of Moulton bicycles in 1967 and by 1971 had discontinued production altogether, although continuing with their own small wheeled cycles. Thus the small wheeled cycle became synonymous in the popular imagination with second rate performance and handling whilst offering few advantages. Alex Moulton bicycles started production again with an improved version (the AM) in 1982/3 and continue to the present with a number of models, all subject to continual development. However, these high performance multipurpose vehicles remain in limited hand-crafted production with prices to match.

So the cycle industry itself can also contribute to the marginalisation of innovation. It is notable how many recent innovatory products actually arise, like the Moulton Bicycle, outside of mainstream cycle production. One of the earliest and still most compact and groundbreaking folding bicycles is the now classic Brompton, first produced in 1975. Although a proven and successful design from the initial construction of early prototypes and limited production the move to series production was almost impossible. Indeed the Brompton spent 4 years out of production whilst venture capital was sought of finance the tooling necessary for a move to series production. In the end this came via enthusiastic owners, not from the normal sources of from within the industry⁶. Across the whole spectrum of folding bicycle manufacture, the most innovatory designs can all be seen to be the product of independent companies working outside of the mass market e.g. Bike Friday, Riese und Muller (producers of the Birdy), Airnimal. Similarly, at present all recumbent bicycle manufacture is currently undertaken by relatively small scale, specialist manufacturers. One can make the same claim for the production of specialist cycles for disabilities. One may argue that this is the nature of specialist products, but it might equally suggest the inherent conservatism of the larger manufacturers.

Small scale production might be a suitable approach for the manufacture and distribution of specialist products, but it also ensures that such products remain limited in visibility: few are afforded the opportunity to garner sufficient publicity to have an opportunity to create new markets. Remaining a small scale manufacturer also creates its own problems. Frequently undercapitalised, small manufacturers struggle to afford sufficient access to major trade shows and therefore their products remain at low levels of visibility. If we are assuming a completely free-market model this may be adequate, but the very suggestion that modal shift needs to be encouraged suggests that we are trying to shape consumer choice. At some stage, therefore in order to expand and *create* demand there needs to be some measure of intervention into the market. Creation of new markets for modal shifts requires changing

⁵ <http://www.alexmoulton.co.uk/> carries numerous illustrated pages depicting both the history and the engineering justifications for these designs.

⁶ <http://www.bromptonbicycle.co.uk/index.cfm?fuseaction=thecompany.history>

existing public perceptions and practices: in the terms employed in of Shimano's 2005 *Cycling a Smart Way of Moving* campaign, confronting and modifying the existing mindset surrounding cycling and transportation (Shimano 2005). The few forays of major manufacturers into recumbent production (e.g. Trek with the R200) have been unsuccessful largely because of a failure to engage with education of both of the retailers and customers to the radically difference these cycles represent⁷.

The popularity of the annual SPEZI cycle show in Germany, organised by a small family manufacturer (Hase), and exclusively for manufactures of 'specialist' non-mainstream cycle products shows that a growing market can be created with co-ordination, but that to grow such a market requires education of the prospective customers. A vital part of SPEZI is an arena where different products can be test ridden and compared. Conventionally, the cycle industry has assumed that children learn to ride as part of 'normal' life skills. Customer education in riding skills is not (nor should it necessarily be) part of the purview of cycle retail, but customer education, even if in challenging some of the widespread preconceptions about cycle design, appropriateness and usage may be an important part of the creation of new markets. Immature markets – those in most need of greater modal shift – have insufficient base interest to sustain an endeavour such as SPEZI. In these cases, suitable intervention might be found in subsidies or collective space allocation for innovative and specialised products within major trade shows, perhaps bringing user, activist and interest groups in as well.

Whilst innovative products remain the exclusive province of small scale manufactures, they also remain within the business cycle of high cost and low volume. To shift from this to a mass market operation requires radical transformation of business methods, through production and distribution. Those who do seek to expand can fail spectacularly as growth and demand temporarily cease to match. The point of greatest vulnerability for any business is when major expansion is required that means abandoning the individualised control that the product enjoyed whilst production is small scale and in-house. Moving to mass market also means that the manufacturer has to rely on a network of retailers, rather than direct customer contact where ongoing product development in relation with a network of users can be a normal and vital part of the developmental and innovative process.

Cycle retail provides another potential inhibitor to innovation. In the UK at least, the cycle retail business is still largely dominated by its history of independently owned business, rather than large multiples or franchises. Independent retailers build trade discounts through loyalty to particular suppliers and gain discount according to volume sold. With relatively low margins in the business there is little financial incentive to stock non mainline products. Independent retailers can benefit from corporate advertising either by manufacturers or from wholesale distributors who are responsible for the bulk of cycle press advertisements. These in turn reflect product ranges driven by the lead of professional cycle sports. Stocking specialist products that may require specialist knowledge is simply not a viable option. Although they may have some benefit in terms of novelty value in attracting initial customer enquiries, low volume, high value products represent an unjustifiable financial risk for most retailers. Successful marketing of recumbent cycles, for example, succeeds where customers can be given extensive opportunity to try before purchase. Test rides or familiarisation sessions mimic the conventions of sales techniques in the motor industry rather than in cycle shops which assume extensive product knowledge prior to purchase. Operating in this manner require a fundamentally different business plan and maybe even different business premises from those normal in the cycle retail trade.

⁷ It is for this reason that Alex Moulton rejected the recumbent seating position when he set out to build a better bicycle. He thought that this would be a change too far for most users in the 1960s.

Where the market is currently immature, the safest option for retailers is to sell products most familiar, feeding the cycle of supply and demand favouring the already dominant. Evidence for this trend is clear in the current production of specialist urban bicycles produced to utilise the latest computer controlled 'cyber nexus' systems from Shimano launched in 2004. Even when backed by the might of Shimano, cycles equipped with these components are currently only available in Germany and the Netherlands, where urban utility cycling is already firmly established. Paradoxically in a market like the UK, where such products are perhaps needed most, and might be employed to create new markets, the fears of the existing cycle trade dictate that 'there is no market for these kinds of products'. The lack of a prior market becomes a self-justifying process. It is left to the enthusiasm of user groups and specialist interest campaigners to promote cycle innovation. The importation of trailers and trailerbikes into the UK was pioneered by Neatwork, an independent importer and activist campaigning group in the 1990s.⁸ Only when Neatwork had demonstrated that it was possible to create a market for these products did they become available in 'conventional' cycle sales outlets. The dilemma for any would be pioneer is that, if successful, acceptance of any product range by high street retailers also means the loss of your own unique sales line – so success in campaigning terms can mean ruin in financial terms. In this manner, the retail trade effectively farms out its innovation risk to small scale specialists, supported by user groups.

Possible solutions

There are numerous institutional and structural barriers to innovation in cycling. These should not be taken to amount to any form of conspiracy theory; all have perfectly logical and reasonable individual justifications and rationales. The collective and cumulative effect, however is to create a dominant frame through which public understanding of the possibilities and realities of cycling is viewed. Cycles available in the high street and through regular outlets represent a very narrow range of options for the potential transport customer. A number of conclusions can be drawn in order to open up possibilities.

A first step might be for the UCI to recognise the IHPVA as a legitimate body governing various forms of human powered vehicle endeavour not currently covered by the UCI. Being properly representative the UCI could then legitimately act to lobby governments at a supra national level on behalf of the interests of all forms of cycling, rather than as a potentially factional and divisive organisation. Bringing together the various interests of sport, health, transport, leisure and other forms of cycling means acknowledging the legitimacy of these forms and their existing forms of organisation that are not currently covered by the UCI's organised forms of competition. Thus when the UCI creates a new category of public mass participation event such as its Golden Bike series in order to express its support of cycling in its wider forms, these events should be open to all regardless of the cycle design used as long as they fulfil the legal safety requirements. At present the UCI makes no ruling who should be allowed to participate, leaving this to the decision of the organiser, a decision which in practice can vary from event to event. This would be no more than to realise the UCI's own Articles of Constitution.

Another possibility would be that trade fairs organised under the auspices of national cycle trade or industry bodies might seek to set aside provision to include presentations and representation for innovations and experiments. Trade associations should not be satisfied with declarations that there is no market for a particular genre of product. Successful modal shift is about creating new markets, challenging stereotypes, not just serving the existing ones. Space and representation might also be given to voluntary organisations and user groups, or for collective space for low-volume specialist and craft manufacturers for whom

⁸ The same group also produced the *New Cyclist* magazine during this period, through whose pages much of the history can be traced.

normal commercial space is not justifiable. Small manufacturers may avoid existing trade shows not simply because the cost appears prohibitive but because it is not cost effective in that they do not expect their own customers and potential customers to be in the same client group expected to attend such shows. For the wider public however, the unfortunate consequence of this economic rationale is that the specialist products do not get general public recognition and the dominance of existing norms is once more reinforced.

As was stated at the beginning, a healthy culture is one that exhibits and maintains as wide a degree of diversity as possible. Moves to support this in any way should be applauded.

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