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"Will They Ever Learn ?"

An analysis of three design failures with a warning for a fourth.

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1.0 Introduction

The design of mass produced products often goes unnoticed by the consumer. The modern marketplace is awash with products that promise to ease and improve the quality of our working and recreational lives. To say that the general public take the design and development of these products for granted is an understatement, most people remain happily ignorant of a products background and are content as long as it fulfils its function to their satisfaction.

Obviously there are many exceptions, designs which are celebrated as 'classics', the Volkswagen Beetle and the Coca-Cola bottle for example are products which are universally recognised and hold a special place in both design and cultural history.

The reasons why some products come to be regarded as classics and others remain largely anonymous are many, what is certain however, is that these products found acceptance with consumers world-wide, for a time-span far beyond that of most mass-produced products.

A point worth noting about the above examples and indeed many so-called 'design classics' is that they were in no way revolutionary. Neither was the result of a fundamental change in design thinking or was produced with the aid of radical new technology, they were, and still are, no more than a bottle and a car.
What differentiates them both from the vast majority of designed objects however, was the sheer scale of their commercial success.

Both products not only fulfilled their functions, but crucially, they had mass consumer appeal. They not only returned huge profits for their manufacturers, but they also became cultural symbols for an age.

Designers and manufactures can only dream of producing a product with the socio-cultural impact of the Coke bottle or the Beetle. Increasingly, financial reward is the driving force in today's capitalist society, and so it may be said that a product can only be considered a success if the result is profit for the manufacturer. This may sound harsh but the part played by designers in the development of a successful product is just that, a *part* of a package, a package that must be complete if the resulting product is to find acceptance among the consumer public.

Simply put, no matter how practical, elegant or innovative a product may be, whether it is the result of ground-breaking technology and huge sums invested in development costs, without public approval in the form of market sales, the product is destined to become a white elephant.

Design writer Penny Sparke maintains that over the last two centuries, the most powerful constraining factor on design has been its growing alliance with mass-production and mass-consumption (Sparke, 1986, p.156).

This being the case, professional designers have become an established part of the commercial world. Of course to what degree the designer wishes to become embroiled in 'market-led' design is a matter for the individual. Social concerns or environmental issues may be the driving forces behind some designers careers but for many others commercial success and its subsequent rewards are the main goals.

The designer F.H.K. Henrion argues that 'the designers place in the economy is of crucial importance but his place in society is no less so'
(In Whiteley, 1993, p.1)
Henrion clearly felt that designers should have a strong sense of social responsibility that is *at least* as important to them as commercial success.

This raises the question of the morality of consumer-led design and the ethical responsibility of the designer. In his book 'Design For Society' Nigel Whiteley maintains that "consumer-led design in a market economy goes far beyond the idea of meeting human needs: it seeks to create and stimulate human *desires*" (Whiteley, 1993, p. 3). The reasons why manufacturers and their designers attempt to stimulate these desires are generally speaking less than noble, the simple need to profit financially, rather than any attempt to improve the quality of the consumers lives.

There are of course exceptions, a notable example being the 'Freeplay' clockwork radio designed in England in 1995 [1]. The Freeplay was conceived as a solution to the problem of conveying healthcare information (particularly in relation to AIDS)to remote regions of the Third World. The poor availability and high prices of batteries in these regions made the idea of a clockwork radio a very attractive option. Once the product had been fully designed and developed a factory was set up in a South African township where people with slight mental or physical disabilities were employed to manufacture the radio.

The Freeplay radio is certainly an extreme example of what could be termed 'humanitarian design' but it does serve to illustrate that socially responsible, mass-produced design is possible.

The involvement of the design profession with consumer culture is of course nothing new, it emerged with the Industrial Revolution. Events such as the Crystal Palace Exhibition, held in London in 1851 were organised to improve the position of British manufactures in the international marketplace. In the following century organisations such as Britain's Design and industries Association (1914) and the Association of Arts and Industries in Chicago (1922) were formed for similar purposes. The intent of these efforts was to improve the quality of designed objects, on the one hand, but more important was the aim of using design to perpetuate prevailing economic values. Better designed goods would help expand national economies by being more appealing to consumers. They would also compete more favourably with foreign products at home and abroad.

This is reflected in the ever increasing use of design as a marketing and advertising tool. The design process within manufacturing industry has always been crucial, but its public profile has been heightened thanks to the advertisers assertion that 'design' confers added value to a product, and so a higher market position. Sparke continues, 'design simply becomes one of the forms of mass-communication in modern society inasmuch as it plays a fundamental role, both practical and psychological, within daily life' (Ibid, p.11).

These 'practical and psychological' roles as Sparke calls them are among the factors which dictate the success or otherwise of a new product.

'Since the Second World War, and particularly since the late 1950s, the criterion and manufacture of well designed products, across the whole spectrum of technical innovation, have become essential to the success of both individual companies and national economies' (Walsh,1992, p.4).

In the post-war period industrialised economies moved from a situation in which markets were often protected and there was relatively little choice of products, to one in which international competition has steadily grown and customers have a growing choice of products and suppliers. At the same time rapid technological and market changes have stimulated the flow of new and improved products, while greater affluence has increased the demand for well-designed goods of high quality and technical sophistication.

Launching a product has thus become a gamble with ever increasing odds. In this thesis I hope to illustrate, by way of three notable design failures, how any one of a number of factors can lead to the demise of a product and how sometimes, even very basic of errors of judgement can spell disaster for the chances of the product on the marketplace and indeed, for the companies producing them.

The vehicle designs I have chosen are as follows:

- The Sinclair *C5* - an electrically assisted tricycle, designed in England by Sinclair Vehicles in 1985.

- The *NSU Ro80* - a front engine five seater saloon, designed in Germany by NSU in 1967.

- The *Lambretta Vega* - a 75cc scooter, designed in Italy by Innocenti and styled by Giuseppe ("Nuccio") Bertone in 1967.

In Chapter 5 I will discuss a product that is at present in its final development stages the *BMW C1.* The C1 will be very closely related to the design of traditional sccoters i.e. small wheels, a small engine and a step-through frame. The BMW, however, will be a radical departure from the traditional scooter in that it will feature an protective roll-bar and integral windscreen. The intention is to produce a motorbike that will be legal to ride without wearing a crash helmet.

With possible reference to issues that will arise during the analysis of the three failed products, this chapter will be concerned with what I see as the possibility of the BMW C1 failing on the marketplace when it is due to be launched in the year 2000.

The fact that all of the four products that I will be discussing are modes of personal transport, is significant only in so far as that their end purpose, i.e. that of transporting people, is the same. The errors made in their design and development and the subsequent lessons to be learnt, can be applied to the design of any type of product and indeed the discipline of design in general.
These issues and others will be dealt with in the conclusion of this thesis.

2.0 Sinclair Research

The story of the Sinclair C5 cannot be fully understood without first explaining the background to its inception. By 1985, the year in which the C5 was launched in Britain, its designer, self-made millionaire, Clive Sinclair was a well known name in Britain.

Sinclair made his fortune and his reputation by designing award-winning and ground-breaking products that were possible due to his genius with micro-electronics and computers.

Born in Richmond, Surrey in 1940, Sinclair's childhood appears to have been typical of many children who grow up being labelled as 'gifted' and 'of above average intelligence'. If not quite a loner, as a young boy his unconventional approach to life kept him at a distance from his school-friends and he was always more comfortable in the company of adults. He hated sports and while his peers played football the young Clive would amuse himself by solving mathematical problems and reading voraciously. Mathematics had always interested him deeply, and he had barely become a teenager when he designed a calculating machine which could be programmed using punched cards. Because he wanted to make his adding machine as simple as possible he did it using just two digits, 0 and 1.

In Sinclair's own words:

> "I thought that was a great idea. I was really amazed to discover that this was a known system; the binary system. That discovery disappointed me deeply, I thought I'd make a fortune ..... but I was very pleased with the idea."

Sinclair's disappointment was certainly understandable as the binary system is the very foundation of computer technology and so his claim to have discovered it, completely independently, is akin to somebody putting a rod through the centre of a disk and proclaiming the invention of the wheel, only to realise that it had already been done.

As a teenager Clive Sinclair 'discovered' electronics, he whiled away his youth designing and building electronic circuits. As he became more expert, he began producing increasingly small and more refined circuitry. Soon he was supplying family and friends with radio receivers and amplifiers. These were not supplied free of charge however, the young Sinclair realised that his talents and expertise could provide him with an income, his entrepreneurial flair was beginning to show itself.

During school holidays Sinclair worked in various local electronic companies. It was while working for one such company, Solatron, that he first began to enquire of his mentors about the possibility of designing electrically-propelled vehicles. When one considers that it was now the late 1950s, it seems unsurprising that Sinclair's suggestion was rejected out of hand, indeed he was later to loose this job as a consequence of his penchant for theoretical precociousness.

And so Clive Sinclair had yet to reach twenty years of age when he began what was to become a lifelong preoccupation, the design and production of an electrically-powered personal vehicle. It was to be almost thirty years before he would realise his dream but while the world waited for his electrical revolution Sinclairs himself began a career that was to be by turns both dazzling and dismal in almost equal measure.

Having left school there was no reason why Sinclair would not have gone to university - except that he didn't want to. In their book 'Clive Sinclair and the Sunrise Technology', Adamson and Kennedy state that if Sinclair wanted to learn about something , he did so very readily, that he had an incredible facility for assimilating information' (Adamson and Kennedy, 1986, p.12). Apparently the converse was also true - Sinclair would invest very little of his time in subjects which did not interest him.

Sinclair decided that there was no point in going to university as he knew from experience that anything he wanted to learn he could find out for himself and that there was no point in wasting his time on things that did not interest him. This lofty attitude may be regarded as the arrogance of youth, and as such be worthy of praise, but I feel that this intellectual arrogance was a trait that would be at the root of many of Sinclair's future business failings.

Sinclair decided that he wanted to start his own business selling miniature electronic kits by mail-order to the hobby market. Before this could happen he needed to find a job that would finance his plans. By this time Sinclair had published a number of articles in a magazine called *Practical Wireless*. He was asked to come and write for the magazine, which he did, and when shortly afterwards the editor stepped down as a result of illness, he appointed the 18 year old Clive Sinclair to the post.

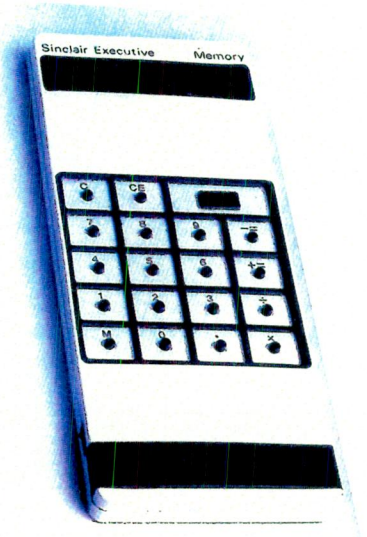
Never one to sit still for too long, Sinclair had soon moved on. He accepted an offer to run a publishing company called *Bernard's Publishing*. In the course of his four years with Bernard's Sinclair published thirteen hobby constructors' books, all of which were commercially sound (Ibid, p.49). All of these books contained clever and innovative circuits designed by Sinclair himself.

During this time publishing and writing Sinclair researched and experimented with transistors and semiconductor devices which were starting to come onto the market . Now that Sinclair had amassed sufficient capital and expertise, he was now in a position to set up his own business, Sinclair Radionics came into being in July 1961.

The first intimation the world had of Sinclair Radionics Ltd. was a half-page advertisement which appeared in the hobby magazines in November 1962. The ad was for the Sinclair Micro-amplifier, "the smallest of its type in the world" which it was claimed would "out-perform amplifiers twenty times as large." The ad illustrated the tiny size of the amplifier with a photograph of it sitting on a coin.

Sinclair rented a premises and assembled the small staff he needed to run his mail-order operation. Sinclair had previously been excited by the realisation that electronic components, which up until then he had bought in relatively small numbers, were massively cheaper when purchased in large batches. This led to Sinclair adopting the 'pile it high and sell it cheap' philosophy of sales. This led to a grossly over-crowded and chaotic working environment. An employee at that time, Rodney Dale who would later go on to write Sinclair's biography, commented that Sinclairs all or nothing approach led to a feeling among the staff that "He's either going to become a millionaire or go broke."(Dale, 1986, p.150)

From the first day on the market the Micro-amplifier sold exceptionally well. The company Clive Sinclair had always wanted to own was finally up and running. Over the course of the next nine years Sinclair Radionics produced a succession of smaller and more powerful radio receivers and amplifiers, devices Sinclair had been making since he was a child. 1972 was the year in which Sinclair Radionics branched out, away from the cosy world of amateur hi-fi, into the international market-place. The product was the '*Executive*', the worlds first pocket calculator [2] .



It was only a centimetre thick and twelve long, and was the first to be powered by a wafer thin battery, it was the most powerful calculator of its time (Dormer, p.41).

That the Executive was a technological marvel was never in doubt. His ingenious use of microelectronics enabled Sinclair to produce his design at a previously unimaginably small size. Miniaturisation had thus given the designer increased scope and flexibility when it came to designing the casing for the Executive. This asks the question; What should a calculator look like? The average user of the worlds first pocket calculator would of course have absolutely no idea how the device works. He or she may expect it to resemble a larger desk-bound machine, but why should it?

The press advertisement described the Executive as being 'as thick as a cigarette' .This curious way of suggesting the scale of the product came from Sinclair himself, it reflected his belief that "One must always bear a packet of cigarettes in mind as the ideal size."

The design of the Executive is credited to both Clive Sinclair and his younger brother Iain. It is unclear which brother was responsible for the various aspects of the design. As Clive was an electronics expert first and foremost it would appear to be a reasonable assumption that Iain Sinclair was responsible for its appearance and function. Whoever it was, they were responsible for a design which was highly influential, but also seriously flawed.

The Executive has a very simple, almost plain looking design. A white rectangular box with the keypad laid out in a grid. Everything needed to operate the calculator, 18 buttons and a sliding power on/off switch is accommodated within this grid. The black stripe created by the LED at the top of the calculator, is visually reflected by a similar strip of black plastic at the bottom of the calculator.

Whether consciously or not Sinclairs' design is heavily indebted to German Rationalism and particularly the *Ulm Hochschule fur Gestaltung.* The Ulm, a design school that replaced the Bauhaus, had an 'industrial, serious, through and purist' approach to design (McDermott p.198). Ergonomics, sociology, economics and psychology were all used to arrive at a systematic rather than inspirational approach to the design method.

Sinclair's Executive was both rational and functional in the extreme, no unnecessary buttons, knobs or lights, simple clean lines and apart from the strip of black plastic, no ornamentation.

This rational, modern aesthetic was much admired. The Executive went on display at the Museum Of Modern Art (MOMA) in New York, and Peter Dormer suggests that Sinclair's design had an important influence on Dieter Rams who five years later, designed the ET22 electronic calculator, a design that is now considered to have provided the definitive answer to what a calculator should look like (Dormer p.41).

The modern aesthetic established by the Executive, was used with considerable success on all later Sinclair products, however, the Executive also set many less desirable precedents that would be found in many subsequent Sinclair designs.

Although the Executive was a great success (earning Sinclair over £1.8m in profits), one aspect of its design was undoubtedly ill-conceived, this was the decision to use small rubber 'nipples' for the buttons on the keypad. Although the location of the buttons is clear, they had an unpleasant squidgy feel, the tactile feedback to the user was poor and it was difficult to hit them precisely. Dormer maintains that this was an ergonomic mistake, the likes of which a graduate of The Ulm, particularly Dieter Rams, would never have made (Ibid p.42).

Essentially with the design of the Executive, Sinclair came tantalisingly close to a near-perfect design for a pocket-sized electronic calculator, but his decision to utilise tiny soft rubber buttons instead of larger buttons with more tactile feedback, can only be described as an ergonomic disaster. Miniaturising products always presents ergonomic problems but this cannot be used as an excuse as the Executive was not so small that suitably sized buttons could not have been used.

When you consider than the Executive has only two areas of interface with its user; the LCD and the numeric keypad, the scale of Sinclair's error becomes apparent.

This crucial error in terms of the keypad ergonomics and alarmingly similar errors in his subsequent designs marked a fundamental flaw in Clive Sinclair's attitude towards design and the consumer market.

2.1 The Sinclair C5

The story of the Sinclair C5 [3] could be described as both a tragedy and a travesty of design. It chronicles the most depressing failure of a Sinclair vision. Ever since that summer in the late 1950s while working for the electronic company Solatron, Clive Sinclair had been obsessed with the idea of designing some kind of electrically powered vehicle. Exactly why he felt the need to design such a product is unclear. It is particularly strange when one considers the fact that every single product that Sinclair had designed thus far was based on the clever usage and miniaturisation of micro-technology. Why become involved in vehicular design? The scale of the risk involved is further heightened by the fact that the launch of the C5 took place barely a year after the farcical launch of the QL computer. For Clive Sinclair the sad truth is that his electric-powered dream came and went in ten short months.

Serious research into electric-powered vehicles began at Sinclair Research (there was a change of name from Sinclair Radionics in 1980) but limited research had been carried out as early as 1973. Even at this stage it seems the research was active mechanical testing rather than simply theoretical as basic prototypes were being produced. It would appear however that even from the very early stages of the project, Clive Sinclair was ploughing something of a lone furrow. Adamson and Kennedy point out that:

"Everyone is at pains to emphasise that the electric vehicle had always been Sinclair's personal dream rather than any kind of corporate endeavour. Uncharacteristically, Sinclair seems to have bowed to this consensus of doubt, and development of the C5 was postponed until it could be backed by his own burgeoning fortune" (Adamson and Kennedy, 1986, p.59) .

In early 1980 Clive Sinclair's mood was buoyant, The recently released ZX80 home computer was receiving very good press reports and more importantly it was also selling well. Development of the follow-up computer, the ZX8, was also well under way. While in lesser mortals such a period might prompt a sense of cautious optimism, the new decade found Sinclair in an expansive frame of mind. The time seemed ripe to re-evaluate the electric car concept.

With the benefit of hindsight it is easy to observe that at this point in time the prudent course of action for Sinclair Research would have been to grapple with the growing problem of the unexpectedly high order numbers which the ZX80 was generating. In effect Sinclair was being offered an opportunity to exploit the company's tangible success in a new line of consumer electronics thereby going some way towards smoothing the cracks in the company's somewhat fractured public image. But Sinclair had the wind in his sails once more and while ignoring the demands of the early home-computer enthusiasts his boundless self-confidence allowed him to indulge in his obsession.

Sinclair and a sometimes business partner of his, Tony Rogers proceeded with the preliminary investigation into a personal electric vehicle. In 'The Sinclair Story' Rodney Dale Sinclair's corporate biographer says that at this stage " the vehicle is assumed to carry one person (with a possible second person only by squeezing), and it is seen as a replacement for a moped and limited to urban use with a top speed of 30mph" (Dale, 1986, p.152)

Sinclair left Rogers with the responsibility of looking after the development of both the vehicle body and motor. Sinclair decided to concentrate on the issue of battery development, or as things transpired battery *choice.* Obviously when designing any type of electrically powered vehicle the source of the power is crucial, indeed it is fundamental to the operation of the vehicle. Adamson and Kennedy explain the problem:

> "..the creation of a reliable power source for electric vehicles is one of the major obstacles impeding their commercial development. The bottom line quandary that continues to plague battery-technology development centres around petrol's privileged relationship with energy.....to put the battery researcher's problem into perspective; a kilogram of petrol offers an energy potential of 13,000 watt-hours; the lead-acid equivalent holds a miserable 50 watt-hours of energy." (Adamson and Kennedy, 1986, p.63)

Sinclair decided to make do with existing battery technology. Typically the logic behind his decision was simple. He saw no reason why he should spend potentially massive amounts of his time and money on the development of a suitable efficient battery, he considered this to be the job of the battery manufacturers. Rodney Dale obviously agreed with Sinclair's stance:

> "Sinclairs very sound reasoning was that a successful electric vehicle would provide the necessary push to battery manufactures to pursue their own developments in the fullness of time: for him [Sinclair] to sponsor this work would be a misplacement of funds." (Dale, 1986, p.154)

I consider the above statement to be absolutely senseless, on what basis did Sinclair feel that his product could be a success if he knew that the existing battery technology was far from being ideal and yet he wan not prepared to tackle the problem himself. He had only just begun to design his vehicle, but I feel that with that decision, Sinclair had already severely hampered his chances of succeeding. Moreover where would the innovation come from now? The battery issue was the only real challenge, it was a problem that demanded genuine technical innovation.

The foundations of Sinclairs "completely new concept in personal transport" as he called it, were beginning to shake and yet Sinclair was determined to carry on seemingly happy to ignore a potentially crucial problem.

By the beginning of 1983, the development of the C5 had reached the point where serious investment was required if the product was ever to reach the marketplace. After a fruitless search to find investors, Sinclair elected to sell off a percentage of his holdings in the company. He used this money to finance the founding of a new company, Sinclair Vehicles. The new company's first product would of course be the C5. Sinclair's use of his own capital to fund the C5 project was a clear indication, if one were needed of Clive Sinclairs unshakeable self-belief. Adamson and Kennedy suggest that "there can be little doubt that the move would have been greeted with relief by the doubting hordes at research. From now on the parent company could continue to consolidate its success in splendid isolation, securely insulated from the economic consequences of a shaky vision."(Adamson and Kennedy, 1986, p.64)

Sinclair made some key appointments to his new company and the development of the C5 proceeded quite smoothly for a time. Sinclair himself managed to get the Welsh Development Agency (WDA) to act on his behalf in order to persuade the Hoover company that they could painlessly adapt its production line to handle the demands of electric-trike manufacture. It seems certain that both the WDA and Hoover Allowed themselves to be seduced by Sinclair's wildly optimistic production projections of 200,000 - 500,000 units per year.

By the end of 1984, the first batch of C5 trundled out and began their ill-fated quest for a non-existent market.

The Sinclair C5 was unveiled to the British public on 10th January 1985 priced at £399. The launch at Alexandra Palace was an unqualified disaster. It turned out that for one reason or another a large number of the demonstration machines simply didn't work, an ominous sign indeed. Sinclair gave a speech, in which he promised that Sinclair Vehicles were committed to developing a full range of electric cars, his optimism still clearly un-dented.

While the print media were perhaps predictably hard on the C5, it was left to the safety and consumer associations who really put paid to any chance the C5 might have had of gaining public acceptance.

Having conducted their own tests these are the conclusions of the AA regarding the C5's overall performance:

> "The C5 looks more comfortable and convenient than it really is - older cyclists looking for less pedal effort will be disappointed by the agility its layout demands. Although it is delightfully quite, performance, range and comfort do not compare with the better mopeds and costs are much closer than one might think when one allows for the inevitable battery replacement."(Ibid p.72)

Which?, the magazine of the British consumer association gave their overall verdict as: Of limited use in its present form; poor value for money.

Which? was particularly damming of the range the C5 is capable of . With a fully charged battery Sinclair claim a range of 20 miles, none of the Which? Testers managed more than 14.2 miles. Half of their testers had the motor cut out on them and were forced to wait up to 15 minutes before starting again. Nearly half ran the battery flat.

The Which? report also voiced concerns about C5 driver safety. Compared with a bicycle , the C5 has two major potential drawbacks, both of which are as a result of its low seating position. Firstly, the drivers body (rather than legs) is directly at bumper height, likely to increase the chance of severe injury in a collision. Secondly the C5 is easily hidden behind other vehicles making it more vulnerable in heavy traffic.

The NSU Ro80

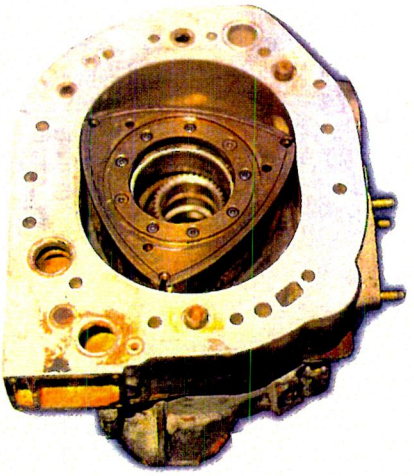
To many car enthusiasts the story of the *NSU Ro80* represents the classic example of what might have been. It was a car that promised so much and came tantalisingly close to delivering that promise, but fatally it couldn't [4].

In 1886 the NSU company began producing bicycles in Neckarsulm in Germany. The company began designing and manufacturing cars in 1905, but soon motorcycle production forged ahead, with cars playing second fiddle to the two-wheeled output. In 1929 due to financial difficulties, NSU sold their car plant to Fiat and for the next 28 years motorcycle and later scooters remained NSU's principal products. In 1957 the firm re-entered the car market with the 'Prinz', a 600cc, rear-engined two stroke [5]. The slightly more powerful Sport Prinz followed.(Lillywhite,1997, p.78)

Up until this point the technology that NSU were using in the design of their cars was no different from that of the other European car manufactures, with the notable exception of the French manufactures Citroen. Almost a decade earlier Citroen had unveiled the startling DS model. The DS featured a combination of radical styling and equally radical technology. Citroen had pioneered a hydraulic suspension system which would keep the car level on even the bumpiest of road surfaces. The result was a supremely smooth and comfortable ride.

There is no doubt that the DSs' advanced technology and futuristic image heightened Citroen's standing in the eyes of Europe's car buyers, maybe NSU had the success of Citroen in mind when they too decided to take the plunge and use innovative and radical technology.

In 1964 the NSU Spider (a derivative of the Sport Prinz) became the first production car in the world to be powered by a Wankel rotary engine. The Wankel engine is named after its inventor Felix Wankel, since he was a young man he was obsessed with his dream of building the perfect rotary engine, his concept featured triangular shaped rotors inside curved and waisted chambers [6] (Chapman,1996, p.123).



The resulting engine supplies power in an extremely smooth manner as there are no pistons reciprocating rapidly as there are in conventional engines.

The significant principal is that of replacing the piston, cylinder and crank assemblies with simple rotating disks, which have section removed to form firing chambers.

The reduction of weight and size is also significant. The rotary engine is smaller than conventional engines, thus have fewer moving parts; less wear, less friction and greater reliability.

The light weight of the rotary also results in a lower horsepower requirement to achieve the same speeds, this is because much of the power in a car has to be used to pull the engine itself.

Having introduced the Wankel motor in its Spider NSU was determined to prove its reliability and superiority over the conventional engine. An all new top-of-the-range saloon would make the company's mark and attract the appropriate prestige. So in 1967 the Ro80 was launched, conceived around the idiosyncrasies of its engine and brought into being with a healthy dose of forward thinking. The Ro80 looked stunning, its aerodynamic styling, while less radical than the Citroen DS, was no less impressive. "The long-travel all independent suspension and the interior equipment were also engineered to match the refinement of the rotary engine "(Lillywhite, 1996, p.77).

The Ro80 was voted 'Car of the Year' in 1967 and went on to be hailed by many as the car of the decade. It seemed that NSU had been successful in their efforts to showcase their revolutionary engine and the beautiful car they had built around it.

Sadly this was not to be the case. Indeed far from proving the superiority of their designs, within ten years, the Ro80 would bring NSU to its knees.

It would gradually transpire that the Ro80 was rotten at its core, the much lauded Wankel engine was the source of all the problems. While the car performed perfectly on the fast German Autobahn, it did not fare so well in heavy traffic where the engine was inclined to stall. It was at such times that the vital rotor tip seals suffered from excessive wear and they would then soon fail altogether.

The rotor tip seals in a rotary engine correspond to the piston rings in a conventional reciprocating engine. If they fail, all compression is lost and the engine can no longer operate. The reason the rotor tips failed was simple, the alloy with which they were made was not strong enough to cope with the high reving nature of the rotary engine.

This simple, yet fatal flaw led to the farcical situation where a brand new Wankel engine would expire after only 15 - 20,000 miles (Willson,1995, p.182). In an effort to salvage the situation NSU offered extremely generous warranty terms, with engines replaced free of charge. This was in effect a stalling tactic by NSU, as they attempted to solve their engine problems.

Another major drawback of the Wankel rotary engine was its insatiable thirst for fuel, a gallon lasted only 16 miles and as the rotor tips wore down this figure would reduce further. By the early 1970s NSU had made some advances with the engine life-span but now the worsening fuel crisis damaged any remaining chance the Ro80 might of had of surviving.

After almost ten years in production, during which time 37,204 Ro80s were built, NSU's commitment to the Wankel engine stretched the company to its limits. In 1969, just as NSU were on the verge of introducing a conventional-engined model, Volkswagen bought out the cash-starved company.

The Lambretta 'Vega'

The Lambretta Vega was produced in Italy by Innocenti in 1970 [7].The Vega was one of a range of lightweight small-engined scooters that formed the 'Luna' range. In Italian Luna means moon whilst Vega translates as 'brightest star. Two other models completed the range, these were the Cometa (comet) and the Lui (the small moon).

The Vega and Cometa were 75cc machines and the Lui had a 50cc engine. Styled by Bertone, the famous Italian car designer, the Luna range was very different from conventional scooters of the day. Lambretta returned to the open framed look of the very earliest Lambrettas, exposing the scooters' engine instead of covering it with side-panels which had become the norm in scooter design since the early '50s [8].

During the '60s,sales of Lambrettas had been in steady decline with Innocenti, the makers of Lambrettas steadily losing out to arch-rivals Piaggio, the manufactures of the Vespa brand. The pressure was on Innocenti, if they were to have any hope of clawing back some of the market share that they had lost during the previous decade, the Luna range would simply *have* to be a success. It was their last throw of the dice.

Bertone had worked for Innocenti before, styling the very successful Grand Prix range and so it can be assumed that he was familiar with the company's heritage. As a high-profile designer, his response to the Innocenti commission was eagerly awaited.

The launch of the Luna range took place amidst tremendous publicity. The modern, uncompromising styling of the scooters was reflected with an expansion of the lunar theme, with the new range being displayed with a backdrop of silver space-suited girls [9]. The overall shape of the scooters was quite new also, with increased ground clearance and raised handlebars, giving the bikes a tall, slim appearance, quite different to traditional Lambrettas which were lower and longer. The 'space-age' look was evident with the slots cut out of the cast aluminium handlebars and tail-light frame, the rectangular headlight too was a break from the normal round type. Finally the range of colours on offer was a huge departure from what scooter riders were used to, there was a choice of five standard colours - red, turquoise, lime green, yellow ochre and orange. A two-tone colour scheme using white and a primary colour was about as adventurous as manufactures had been up until this point.

The design and styling of the Vega was undoubtedly a brave gamble by Innocenti, and employing the talents of a designer of Bertone's stature ensured essential media interest even before the scooters were seen publicly.

So what went wrong? Despite strong public interest, initial sales were disappointing. Mike Webster, author of Classic Scooters feels that the design was just too different for many people to relate to (Webster, 1997, p.78). Sales eventually did begin to pick up, but by then it was too late. Innocenti did not get the quick sales they needed and two years after the Vega was launched the company was bought out by British Leyland.

The new owners had no interest in producing scooters and the old Lambretta factory was re-tooled in order to begin production of what would be called 'Innocenti Minis', wonderfully ironic as it was small cars such as the Mini and the Fiat 500 that caused the decline in scooter sales in the first instance.

The Vega was well received by the scootering press, as from a technical viewpoint it was a good machine, Mike Webster writes that "the 75cc motor delivers a performance that belies its small capacity. Its power is nearer to many 125cc machines of just a few years earlier." (Ibid, p.79)

And so is it fair to consider the Vega a failure at all. It performed well, it attracted a lot of favourable press for Innocenti.

The BMW C1

The BMW C1 is due to be launched on the Irish market in summer of the year 2000 [10]. As can be seen in the photograph this vehicle bears more than a passing resemblance to the shape and proportions of a traditional scooter. The generally accepted definition of a scooter is a bike that has small wheels, a small engine and a step-through frame. The BMW C1 clearly fits this description, what is equally clear however is that the C1 features a protective roll-bar which frames the windscreen.

The concept rendering [11] shows the seating arrangement more clearly. Unlike any other two wheeler, BMW hope that it will be perfectly legal to ride the C1 without wearing a helmet, the rider will of course be obliged to wear a seat-belt instead. The concept rendering was first shown at the 1986 Cologne Motorbike Show which obviously suggests that BMW have been considering this product for over 10 years. One wonders why the delay, I suspect that there may have been doubts raised about the concept, possibly in relation to safety, should BMW be encouraging the use of any type of motorbike without a helmet?.

Judging from the appearance of the man riding the C1it would appear that BMW are hoping to attract businessmen (note the metal briefcase on the back) who might be attracted to the idea of being able to cross the city in a hurry. But BMW are going to release the C1 in a choice of four different liveries, two of which have a very sporty 'boy-racer' look. Is that the image established BMW car drivers wish to be associated with? At present BMW have a firmly established wealthy, sophisticated image that is why I feel that with a product like C1 which is neither a scooter nor a motorbike they are at risk of hitting neither market properly. You only have to look at what happened to Clive Sinclair and his C5 to see what happens when you aim for a target that does not exist.

Conclusion

This thesis examined the cases of three vehicular designs that have been considered failures. As I stated in the introduction the fact that they were vehicles is unimportant. One common link that these products did share however, was a failing. They were all let down in the research stage before the first models were even built.

Whilst the failure of the C5 can be attributed to design deficiencies, such as low riding position, limited range and luggage capacity etc., there were also marketing deficiencies which contributed to its failure. Clive Sinclair relied on his conviction that a market existed, or could be created for a vehicle like the C5 and based the design specification of his own views of customer needs and preferences. Some market research was carried out but only after the basic design had been decided upon. Had Sinclair Research made some attempt to investigate the market systematically before the design and launch of the C5, they might have discovered that there was no real demand for an electrically assisted tricycle as a means of commuting.

The NSU Ro80 and the Lambretta Vega may both have been successful had more testing and market research been carried out respectively.

Market demands and user needs are unstable and constantly open to change. Consequently companies have to be aware of trends and shifts in consumer preferences and be able to design new products which fulfil new demands. Firms have to be able to anticipate changes in the market order to keep ahead of the competition.

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