



A SHORT HISTORY OF FREEFORM

BASED ON A LECTURE GIVEN AT MAFO – THE CONFERENCE
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In March 2011, Mark Mackenzie, of the international consultancy, Strategy with Vision (SWV) presented a History of FreeForm to the MAFO Conference, held prior to the start of MIDO 2011. This article is a summary of his presentation which covers not only the history or past, but also the present and the future of FreeForm.

By Mark Mackenzie

“To start my presentation today I’m going to give you some key dates. I think it is important to go back to the beginning and remind ourselves of recent events, especially for those in the audience who may have only recently joined the industry.”

THE HISTORY OF FREEFORM: 1970 - 1990

By the late 70s there was computer controlled spot polishing of large glass surfaces in astro physics and computer numerically controlled cutting (CNC) was being used in the aerospace and automobile industry.

However, it was not until 1985, when Roland Mandler (at present OptoTech Optikmaschinen GmbH, Germany) handed-in his notice to Loh, to start his own business, OptoTech, that this technology began to be used in optics. In 1986/7 Gunter Schneider (at present Schneider GmbH & Co. KG, Germany) started to use computer controlled processes in Feinoptik (precision optics), and from 1987 onwards CNC technology was used in the manufacture of devices, needing high precision lenses.

In 1991, Marc Savoie (at present Satisloh GmbH, Germany) gave up his job to set up IDC (Industrial Design Corporation) to test the feasibility of FreeForm. This company was later absorbed into Micro Optics.

By 1993, the management of Carl Zeiss suggested that Schneider Optical Machines should consider developing equipment that could cut ophthalmic lenses with complex surface geometry to prescription. Tests had shown, that using CNC polishing for the manufacture of glass moulds, led to much more precise surfaces.

In fact, Hoya was already using numerical control manufacturing to produce glass moulds, in the 1980s.

THE HISTORY OF FREEFORM: 1990 - 2000

By the early 90s, both Essilor and Rodenstock had also developed computer-controlled cutting/polishing systems to manufacture glass moulds.

At that time, developments were gradual and made step by step. This was not a race. Although I imagine there was someone in the marketing department or someone on the technical side saying “Hey, couldn’t we use this process to manufacture plastic lenses?”

The early 90s was a time when the industry was in transition. The optical market was moving away from mineral lenses. In 1990, 66% of all lenses sold in Germany, were mineral. Unbelievably today, the figures for 2010, show that the market for mineral lenses is now at 11%.

Some bright young man in the equipment industry also realized that data needed to generate complex progressive lens designs was ‘just a computer file’. He was right. It is indeed just instructions in a file about how to cut something.

It is important to keep developments in the market in mind when we look back at the development of FreeForm. Progressive lenses represented 12% of all lenses sold in Germany in 1990, and grew to 19% by 2000.

By 1995, Rodenstock had adapted their computer-controlled polishing process to the point, where they were able to make ophthalmic progressive lenses. Indeed, there is someone in this room today, who saw Hoya using these tools for single-point cutting, at that time.

1996 saw the launch of ‘Multigressiv’ (Rodenstock). There was a huge road show with demonstrations to 14,000 people. At the same time, Carl Zeiss launched ‘Gradal Top OSD’ (optimized surface design). Both products had aspheric/atoric back surfaces.

Was FreeForm purely a European/German development? I would argue, no. This was a process going on across the world - as very often happens in any technological breakthrough. Different people work on the same problem from different angles and for different reasons and at different speeds. Because by 1997, Seiko Epson had also developed a FreeForm production line, capable of making progressive lenses, where the progressive design plus sphere and cylinder were cut on the back surface of the lens. And in Japan, the Super P-I was launched under the brand name Seiko. At the time, the development was so secret that a senior person of Seiko on his first visit to headquarters said, that he was taken to a door in the production facility where he was told “behind this door is the FreeForm, but you are not allowed to see it”.

The developments weren’t only in Japan, they were also seen in North America - we tend to forget about this country in the development of FreeForm. Three North American companies were involved in the development of FreeForm equipment - IDC, Gerber Coburn and DAC International. Without them, Dan Katzman of Shamir Optical would not have been able to establish their FreeForm R&D test lab in 2000. However, there are fundamental differences in the production methods between the fine optic industry and the ophthalmic lens industry. And here I have to thank Mr. Schneider who explained this to me. Fine optics is about making short production runs of highly precise lenses. If they made a hundred the run was finished and then they went on to make 50 pieces of something else. This is contrary to the ophthalmic lens industry, where larger production runs are needed as well as precision. But this also meant that fast manufacture was necessary. If John Fried is in the auditorium, the late ‘90s was all about better as well as faster. You could not only be better, you also had to be fast.

At this point, a race was developing, because the potential of FreeForm had been recognized. Schneider developed their process and Rodenstock continued to develop their proprietary process. The development issues were those of getting the speed but also getting the control mechanisms (which actually control all the cutting and which can receive these very, very complex instructions) to work at a speed necessary for the ophthalmic lens industry. It was not long before these issues were indeed solved and by 1998, Schneider launched their first optical machines and displayed the HSC 100 at Silmo, and in January 2000 their first soft-tool polishing machine.

THE HISTORY OF FREEFORM: 2000 - 2010

And then we come to the most debated topic in the whole industry which is - who launched first? Was it Carl Zeiss or was it Rodenstock? I don’t think it’s important who launched first. What they did with their products is more important.

What we do know, is that on the 25th January 2000, a press conference was held by Rodenstock, in Frankfurt (Germany). The man

holding the press conference was Randolph Rodenstock and the reason for the press conference was to launch a new lens.

“THE ERA OF WIDESPREAD SUPPLY WITH SPECTACLES IS COMING TO AN END. IT WILL GIVE WAY TO AN ERA OF DIFFERENT USERS WITH VERY DIFFERENTIATED PRODUCTS.”
(RANDOLF RODENSTOCK, JANUARY 2000)

If you look at the launch material, which was supplied on that day, the actual name ‘Impression’ or ILT isn’t mentioned in the documents. On the same day, Carl Zeiss launched their own individualized progressive lens.

But what exactly did they launch? They made an announcement to the trade press and the public so the information was in the public domain. But in fact, both companies started with small-scale test programs in February 2000, before going nationwide in the summer of the same year.

Digital surfacing was not just about making individualized lenses with a whole lot of extra measurements. The use of digital surfacing allowed the optical industry to shorten product development time when creating a new design. No longer was it necessary to:

- | Slump glass moulds
- | Manufacture tools
- | Manufacture lenses

Theoretically, just a few lenses could be made to test a design and the speed to market was shortened, and the theory was that there would be an increase in innovation in this industry. (And I like the phrase that Karen Roberts (Carl Zeiss Vision International, Australia) used, when she was talking to me “Democratization of the product development process”. This was such a good phrase that I had to borrow it)

So what about the products that launched. SWV has written documentation from the optical trade shows, which dates back to Silmo 2001. And we reviewed our information and asked: What exactly is a new product launch? You can argue with me, and I have the list here - but it had to be something which was not previously known. We have split these new product launches between the top five (Carl Zeiss Vision, Essilor, Hoya Vision Care, Rodenstock, and

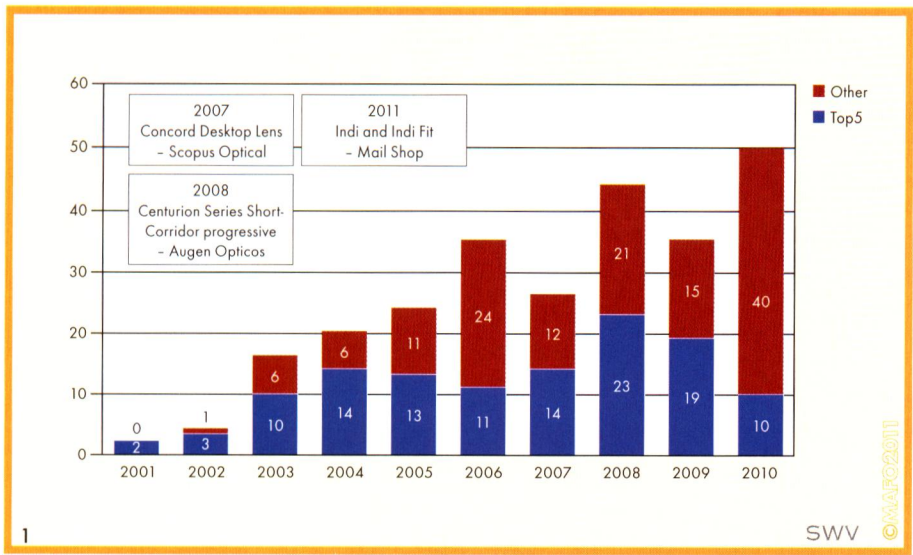


Fig. 1: Ophthalmic lens design launches

Seiko) and others – I am sorry but I cannot mention you all.

We asked who launched what and when? Were there more launches following the introduction of FreeForm? I would argue, that the answer to this is yes. There is an indication that there are more. The graph definitely goes up. Now it could be that we were sleeping in 2001 and did not pick up every single product launch. But there really didn't appear to be that many.

The area shaded blue on the graph are the launches from the top five companies. So you see a growth at around 2007 and 2008. But from 2006 onwards, just look about how many other companies launched new products. And that for me is democratization of the new launch process. Because it is much cheaper. Even a small company can take the risk.

THE DEVELOPMENT OF THE WORD FREEFORM

How did this strange word FreeForm come about? We tried to research it. We went back to our records and saw that Pentax launched a product at Mido in 2002. They used the terms 'FreeForm generating and custom-made'. It's a strange phrase 'FreeForm generating'. What does it mean?

Up until then, Carl Zeiss Vision and Rodenstock intended to use the words 'individualized, individual and custom progressive'. The equipment industry however had already been using the word FreeForm since the late 90s. Their marketing departments got the word. And then Shamir, registered the words 'FreeForm technology'.

So why did the people in the industry use the word FreeForm, when they were struggling to explain what they were doing? Never the less, it is quite a good word.

So, let's jump forward and ask what is happening today. Table 1 shows the words which have been used to describe FreeForm, during the last 18 month - and this is only in Europe.

The Americans are much better organized then we. So the Americans got together and developed a website explaining all the designs which are available in FreeForm. Here is the link to this website: www.totallyoptical.com.

SWV found 13 main manufacturers offering FreeForm progressives with a total of 80 different designs in 587 variations. The words used in the US to describe FreeForm, may be found in table 2.

I think you've got the point, that's an awful lot of words. And so it leads to my question to finish this part of the presentation: How do I not confuse the consumer?

Table 1: How has FreeFrom been described in the last 18 months?
An individualised progressive lens
A third generation individualised progressive
All FreeForm products are called high definition
Offering FreeForm capability
FreeForm technology
Digital eyewear
Super personalised FreeForm
Free-Form PAL
A private label FreeForm lens

FREEFORM TODAY

Last year, SWV did a study of the world lens demand. One of the questions asked in the analysis was about FreeForm progressives. It is difficult to quantify the exact figures for FreeForm because even now different laboratories have different perceptions about what FreeForm is. Is it a conventional progressive? Because the difficulty is, some people use digital surfacing machinery to cut a semi-finished progressive. Is this FreeForm? No, it isn't. So SWV believes it is somewhere between 18-20%. 18-20% of all progressive lenses sold worldwide are manufactured using digital surfacing technology.

SWV reckons that about 130-135 million progressives were sold, worldwide, in 2010. And if we take 18-20% of this figure, then we are talking somewhere in there area of 23 to 27 million digitally surfaced progressive lenses.

Western Europe and Japan have the highest penetration of progressive lenses manufactured, using designs which are digitally cut, and using instructions from a computer file. In addition, there are a small number of single vision lenses manufactured using this technology.

My understanding is, as of today there are eight firms supplying CNC-polishing machines in the market (table 3). (If I forgot one, I really apologize, I did try to do my homework)

From interviews with the main manufacturers of FreeForm lines, SWV estimates that over 1,100 FreeForm generators have been delivered to the market, since 1998. I am talking of generators, because generators are not always supplied with a polishing machine. I have not included in that figure Rodenstock equipment, because that is top secret information that they do not tell anyone. Moreover, I have not included Gerber Coburn,

Table 2: US Terminology
Back
Front and Back
PAL front, power back
Add split, Rx back surface
Full back side
Personalized dynamic split/behavioural
Integrated double surface
Aspheric/atoric design optimization

Tab. 1: Words which have been used to describe FreeForm
Tab. 2: US Terminology

Table 3: CNC-Polishing

Machine Manufacturer/Suppliers

- | Augen
- | Chemat Technology
- | CN Optical Equipment
- | Comes
- | Gerber Coburn
- | Optotech
- | SatisLoh
- | Schneider

Tab. 3: Eight firms supplying CNC-polishing machines

but there are a few machines in Europe. In other words, there are some other machines out there. It is believed that there are about 850 FreeForm capable lines in the world. Why have we made a deduction from 1,100? Because old machines have been decommissioned and are no longer used or are too slow for the FreeForm manufacturing process, or are now just used to make conventional progressives.

If you assume 850 lines (and I think I am conservative on this point) and you estimate a production of 35 lenses per hour for 13 hours a day – because you should be running your FreeForm equipment at least on a two shift basis – and if you take 290 working days per year (the Chinese would laugh and say that are 365 days in three shifts), then you get to the potential worldwide manufacturing capacity of 110 to 115 million lenses.

The next question is - what are we going to do with that manufacturing capacity? And the answer of course is - we need to fill it. So has this actually happened? World lens volumes are not growing very much. Table 4 shows the figures for the top five Western European markets (D, E, F, I, GB).

These markets are quite important because they accept and buy FreeForm progressives. But how do you grow the market? 136 million lenses in 2009, to 137 million lenses in 2011, is not a great increase.

In such a market, the development of segments, which previously may have been too small to concentrate on, become more important. What are these segments? Well, there may be the things you can do with FreeForm machinery which you can't do so well with conventional generators. For ophthalmic lenses these might be:

Year	Total	Monofocals	Bifocal	Progressives
	Million Lenses			
2009	136.1	96.3	6.1	33.7
2010	135.1	94.8	6.0	34.4
2011	137.1	95.9	5.8	35.4

Tab. 4: The top five Western European markets

- | Ophthalmic polarizing lenses
 - | Business and occupational lenses (a great growth segment)
 - | Wrapped ophthalmic lenses
- FreeForm is not just limited to our industry, it is being used by the contact lens industry to make multifocal contact lenses and one company has just released a silicon hydrogel base bonded to a moulded RGP front part.
- There are also intraocular lenses made using digital surfacing technology, and at the end of last year, multifocal intraocular lenses were launched in Berlin (Germany).
- In the future there are other areas where FreeForm technology may be used. E.g. shield design, special sports lens designs and special work environment/safety lenses.
- By allowing manufacturers to develop small segments more effectively, using digital surfacing to enable complex surfaces to be generated from software will mean that Rx laboratories can significantly reduce their inventory of semi-finished products.

THE FUTURE OF FREEFORM

I think in ten years' time, when I again stand here in front of MAFO, we will still be talking about single vision, bifocals and progressive lenses. I'm sorry, but FreeForm isn't really going to change that.

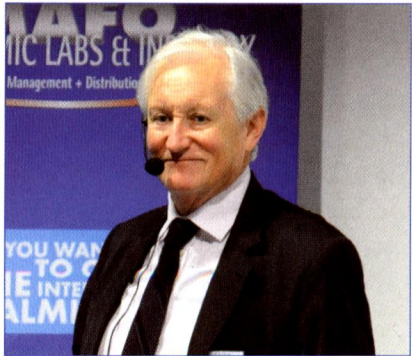
If we just think of FreeForm as a method to supply into niche markets, the optical industry will never achieve the volumes to fill the worldwide capacity. Even if, for example, the number of wrapped lenses in Germany were increased from 1.5% to 3%, that is we double the market, the volume increase will be relatively small.

And so that means we've got to try and grow the value of the lenses in the market. Because one thing that hasn't happened in the last few years is a growth in value. Other industries, such as the hearing aid industry, have been more successful in getting consumers to spend more money on

their products, than the optical industry.

At the moment everyone is moving to FreeForm. In Germany today, a branded product from any of the big five, is a FreeForm product. But is this actually what we really want to achieve? Did we just want to achieve a cost cutting exercise? Or do we want to grow values? I am arguing that growing values must be important in the future.

“THE WORD FREEFORM IS NOT A
GUARANTEE OF QUALITY.”
DOMINIQUE MESLIN, VARILUX
UNIVERSITY



Mark Mackenzie
Founder of Strategy with Vision

In 2001, Mark Mackenzie and his wife Ingeborg founded the company Strategy with Vision, a unique team of eyewear and eyecare consultants, conducting market research worldwide. The company had grown and developed with the establishment of an international team of consultants who bring added strength to eyewear and eyecare businesses and organisations.

Mark Mackenzie was formerly International Business Development Director for the ophthalmic business of Carl Zeiss. Before, he was European Regional Director of SOLA Inc. His experience in the ophthalmic industry followed a career in consumer goods marketing, including L'Oreal and Tarket.