CONVERGING TECHNOLOGIES IN PREPRESS FROM 1980 TO 2003

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ABSTRACT

The author suggests that there has been three paradigm shifts during the 20th century. The first shift was at the turn of the 19th and 20th century, when the first modern typesetting technology was introduced. The new technology, the first major step since the invention of loose types by Gutenberg in the 16th century, became the most important contribution to mass market circulation of newspapers, magazine, textbooks, books and other publications during the years to come. This paper presents the major shifts in prepress technology during the last 30 years and in particular what happened during the last decade. The line casting technology was more or less unchanged during the first half of the 20th century, and only a few technical changes, such as the introduction of punched paper tapes after WW II, improved the productivity of the technology.

A major step forward came when the first affordable computers were introduced on the market, such as the PDP-8 from Digital Equipment Corporation (DEC) in 1965. But there were many forces who wanted to suppress the new technology. Despite strong union opposition, however, the second paradigm shift became a reality when computerized front-end systems for newspaper and other publications were introduced in the end of 1970s.

At the end of the 1980s, publishers were looking for cheaper and more efficient production methods, and the third paradigm shift happened with the introduction of DTP (desk top publishing), which soon became the only possible front-end technology. To-day, the Apple Mac is still the most popular technology in the publishing market, but Adobe Systems Inc. – the inventor of PostScript and PDF-technology – is the new giant.

Previously, many customers were complaining about the lack of competition and industry standards in the front-end market. Now, Adobe has created a de facto world standard with the PDF-process, which is also backed by the ISO. A new monopoly in the front-end technology has been created by default. Never before has one single company been in a similar position in the graphic art industry. For this industry it is like falling from the frying pan into the fire!

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1. INTRODUCTION

The author suggests that there are three paradigm shifts during the 20th century. The first paradigm shift was the invention and patenting of the first line casting machine by Otto Mergenthaler in 1884 (Fuchs, 2001). His invention had a slow start but made a significant change to the industry. When later the first large customer – The New York Tribune editor-in-chief saw the machine he exclaimed: "you just cast 'A line of type' " which later became one of the most well-known trade-marks in the printing industry. Its impact on the mass media production at the turn of the century should not underestimate. The invention made typesetting less a craft for a few skilled craftsmen and more of an industrial process producing text for the graphic art, and it was the single most important invention since the loose types were introduced by Gutenberg in the 16th century. With the Linotype machine the output of composed text increased by a factor of ten.

The second paradigm shift started with the emergence of computer technology in the industry in general in the beginning of the 1960's. The technical convergence started going from analogue to digital processing, but up to this point there were no straight lines of development. All production processes in the printing business were entirely analogue. Letterpress technology still dominated; and more than 50% of all printed matters were produced by this technology. Soon industry leaders were looking for new technologies, in particular in the composing area, as faster, more productive and cheaper methods for text production were needed. Another important factor was the need for better quality of images – both b/w and colour – hence the demand for more modern printing technology was growing. The industry was looking for new technologies, in particular phototypesetting, as higher production capacity for text production was needed as well as the need for more advanced printing methods than just letterpress. These new methods needed photographic based originals rather than lead, and new typesetting methods were invented to respond to the demands. Some inventive Americans realised that the newly invented computer technology could also be used in the composing area.

Up to this point the most limiting factor for the productivity of composing was the input of either keying in characters manually or using punched tapes (including formatting instructions) controlling the typesetters. The first applications emulated the old technology (line casting) and were used only for very complicated text (tables etc). The latter could increase the speed by a factor of 1.5-2 at a maximum – still emulating the old line casting technology. Many new composing systems were developed using the newly marketed mini-computers, such as the PDP8 from Digital Equipment (DEC) and others. These computers could process raw text input and produce hyphenated and formatted text for the phototypesetters. Without the need for manually formatting composing instructions, the speed could now be more than doubled, but basically these could only produce galleys of text. More important, however, the use of typeset text for other purposes, such as directories

and price lists being manipulated by computers, was now viable and economically possible.

The third paradigm shift started in 1985, when the Apple Macintosh was introduced to the graphic art market. The information flow was already to a great extent digital even if film was still the preferred media as an intermediary process to produce plates or gravure cylinders. In the middle of 1980's, when large newspapers started to produce many more colour pages, the demand for systems which could integrated both colour and text, became urgent. The reason was mainly the growing markets in colour TV and hence colour advertisements, to which publishers had to respond. New press capacity was added and the colour content increased quickly. Some publishers invested in high-end colour system, but they soon found out there was a lack of integration between the editorial text systems and the colour systems. They started to investigate other and cheaper solutions.

What Apple and Adobe could offer the publishing world at the end of the 1980's was not entirely clear to most contemporary industry leaders. What they overlooked was that the main emphasis for the newcomers was not the very top of the professional graphic art market, but the major part of the publishing markets as well as the consumer and industrial markets. This single factor made the development of this new technology a completely different business, and contrary to what most other competitors in the graphic art industry were used to. Suddenly these key suppliers to the graphic art market did not have only a few hundred customers, but they could be counted almost in the millions. With these vast markets in sight companies like Aldus, Adobe, Quark and others began to improve the quality of their product line, and they grew fast. Within less than a decade these companies were dominating prepress market and most of the traditional graphic art suppliers were defeated and gone. The converging technology was here!

2. PARADIGM SHIFT IN THE EARLY 80'S – ANALOGUE VS. DIGITAL TECHNOLOGY

ANALOGUE FILM VS. DIGITAL TECHNOLOGY– DIVERGING TECHNOLOGIES

The invention of the line casting machine made a great impact on the industry. It made it possible to produce the real mass communication media – newspapers, magazines, books and textbooks etc. – for several decades at reasonable cost and speed. The technology and indeed the fonts (types) produced by Linotype (Linotype Library, 2005) made a virtual standard and per se monopoly. The production output in comparison to the previous manual method was increased by a factor of ten, and tens of thousand of units were sold world-wide in a few years.

Among a few competitors were Monotype (basically for headlines and more advanced composition) and Intertype, which essentially was a copy of the Linotype unit ("invented" after the patent protection ran out). All these used, of course lead (or more accurately a blend of lead, antimony and tin), or hot

metal composing which became the correct expression. Both Linotype and Monotype could still earn much more money because the matrixes which formed the types in the composition processes wore out after a certain time and needed to be replaced. Servicing and maintaining hot metal typesetters became an industry of its one. Sometimes new type faces were introduced which also added to the investments in the industry.

Some concerns about the occupational health of the workers sitting close to hot metal fumes of heavy metals (lead is very dangerous to the health) in the composing rooms were raised with increased awareness in the early 1950's. The high costs of service and maintenance of the typesetters added to the efforts to break the monopoly of Linotype. Hence, the second paradigm shift came about with the growing use of computer technology in the beginning of the 1960's for industrial purposes. The graphic art industry was slowly coming into the digital age – using digital data instead of previous analogue working methods – which was a necessity for the convergence of the present technology.

Would phototypesetting be the answer to these problems? Many leaders in the industry were looking for new technologies, in particular phototypesetting, as higher production capacity for text production was needed as well as the need for more advanced printing methods than just letterpress. Letterpress was still the dominating process, and more than 50% of all printed production was produced by this technology. Nevertheless, the quality of images and indeed the speed which could be managed by letterpress technology were very limited. Simultaneously, the fast growing TV industry challenged the traditional publishers of printed media, and the need to improve the printing processes became a very important factor. They were competing fiercely in the mass media markets both in Europe and overseas.

The first attempts to produce a phototypesetting device were made by companies like Lumitype (later Photon), Linotron and others (May, Wrightson, 1986). These responded to two demands – to increase the possible output by a factor of ten or more, and more importantly to break the monopoly of Linotype. A third fact was the growth of other printing processes than letterpress such as offset and gravure, in particular web fed production, for the emerging mass circulation markets for magazines and catalogues. These two processes both demanded photographic film as output.

The productivity of the phototypesetting was limited by the input of either manual direct keying in the individual characters or the speed of punched tapes (including formatting instructions) into the systems. The first attempts emulated the old technology (line casting) and was used only for very complicated composing. The latter could increase the current speed by a factor of three or more when formatting instructions were stored in the computer. Of even greater importance was the fact that customers could now use information stored by computers, such as directories and price lists, input directly and typeset without manual intervention or work (Linotype Library, 2005).

Suddenly, there were many companies working in this area in the end of the 1960's and early 1970's. Hyphenation and formatting the input of raw text to instructions which could be understood by the system in question were marketed, and several companies – in Scandinavia and in the US – were established. The Nordic and in particular the Finnish language were among the most difficult to hyphenate, because these languages have more characters than in English, which made phototypesetting more complicated in those languages. Industrial acceptance was achieved about a decade later when more advanced computers were available and spread quickly in the industrial world.

During the 1970's many system developers discovered the new vast markets for text processing systems for newspaper, publishers, books and textbooks and others. Some technical universities in Scandinavia – in Helsinki and Trondheim – are the founding fathers of companies in this particular area – Typlan in Finland and Comtec in Trondheim. Comtec started using the PDP-8 mini processor (Jones, 2005) but was later bought by Norsk Data in 1980 (Oddene, 2005) and they preferred of course their own hardware first used in the training kit for the F16 fighters. Typlan was founded in 1970 and was one of the first developed text processing systems for the Scandinavian newspapers. Typlan was later taken over by Nokia and finally by ICL in the UK. Most newspapers and book publishers quickly adopted the new technology. Some of the more popular fonts were adapted for the new technology, but there were some legal struggles in the US concerning copyright and immaterial rights of the font library of Linotype and Monotype. These legal issues were later solved by cross licensing agreements between the parties concerned.

The software companies in Scandinavia were somewhat restricted in the development of new editorial software, as their potential customers could not come to terms with certain union activities, in particular the graphic union members, on how to rationalise the new prepress production workflow. These union problems, however, were very severe the UK. Not until 1984 a new labour legislation was introduced by the Thatcher government, and the new technology could then be introduced in the British newspapers. The new legislation, however, was the result of the miners' strike a couple of years earlier.

The largest system integrators, however, were founded in the US with its large market of newspapers. Companies like Atex, Hendrix (later Hastech), CSI and other quickly became dominant players in the US and in Europe. In the US, labour legislation was less strict, which made the US newspapers very early adopters of new technology – front-end systems – in the newsroom. This gave these companies a head start in the international competition. Soon some consolidation started in the industry, and in 1986 Crosfield Electronics acquired both Hastech and CSI and formed the Publishing Systems Division. Later also Muirhead – manufacturer of telephoto and facsimile transmission equipment – was bought and became part of this division.

The single vendor (One stop shopping) concept was born, but the concept never became a commercial success, at least not in Europe.

Simultaneously, the processing of high quality images was very important for many publishers and advertisers. The growing TV industry in the beginning of the 1950's created a demand for new and faster technologies for image processing than the old manual fashion cliché technology. The first attempts were made by a mechanical engraver – the Vario-Klischograph (Fuchs, Onnasch, 2004), and it became widespread in letterpress production.

But the demand for using film rather than hot metal in modern printing technology spurred numerous inventors. When more advanced computers (using the Neugebauers's equations for colour separations – first published in 1937) were available at the end of the 1960's, a number of electronic colour scanners came to the market, among them the Time-Life PDI scanner manufactured in the US. These scanners were in principle all analogue and used either transparencies and/or reflection copies as original, and all of them produced sets of same size negatives or positives depending on the printing process used.

The first real digital scanner was the Crosfield Electronics Magnascan 450 which was first shown at the GEC exhibition in Milan in 1969. This model could use transparency or reflection copy input, and output, either sets of continuous tone separations in positive or negative mode and later, with the use of contact screens, halftone separations for offset printing. The main expansion of colour scanners came some years later with the introduction of the laser generated dot scanner by Dr Hell in 1974 (Fuchs, Onnasch, 2004). With the laser dot, the DC 300 scanner was able to produce halftone separations directly either on positive or negative films without the use of expensive contact screens. There were many scientific problems to solve in colour scanning and many patents were held by either Crosfield or Dr Hell companies. Through cross licensing agreements between the parties the most advanced technology could be used by both companies, to the benefit of the users. (At the time a colour scanner was an investment of about US$ 175 – 225 000 – not to mention a change of a faltering laser exposure unit, which was in the magnitude of US$ 10-15 000).

During the 1970's the colour drum scanner slowly saturated the market used by companies with high volumes and/or high quality demands. The scanner operators needed to be very well trained – in general the training period lasted for several weeks. Colour scanners were used by high quality magazine publishers, advertising agencies or in mail order production. But the normal output was still less than one set of separation per hour and in order to increase the output and avoid manual planning (=montage) of several images on one page – in particular in the mail order business – the use of colour duplicates became very popular. Advanced photographic equipment was developed and the operator could enlarge a single colour original and superimpose several of those onto one photo duplicate (a second original copy) – hence the duplicate was used as input on the colour scanner. The

output was a set of separations with all the images on the page in the right position and in perfect register (which not always was the case when manual planning was involved). Second originals were also used to distribute colour originals for advertising purposes to all magazine publishers in a particular market. This was the ideal material input for the electronic scanner, but the process was quite expensive, slow and the integration of text and line works was also technically very limited.

Many craftsmen in the printing industry during the 1980's maintained the opinion that manual photographic techniques were superior in quality to electronic scanning, and those photographic techniques were still in some use. Colour separations by electronic scanners were still thought to be too expensive and sometimes not good enough quality. But, that opinion was about to be changed, because the digital revolution was not to be stopped. New and more advance electronic scanners offered many more options to the users, such as batch scanning and improved operator control of the colour adjustments.

There were two remaining problems of page make up of colour separations, i.e. the manual planning of all elements of a page after scanning, and the process of producing second originals. On the occasion of the Print 80 exhibition in Chicago in 1980 an Israeli based company – Scitex Corp. – showed the first colour page make up system for the graphic art market called the Response System. The system attracted immediate attention in the market. The company came from the textile industry (hence the name Scientific Textiles) and had successfully computerised pattern/colour rendering technology for the textile industry. Then Scitex quickly adapted their system to the needs of the prepress area of the graphic art industry. Under the management of Efi Arazi, founder and CEO of Scitex, the company quickly established themselves as the preferred vendor of colour page make up systems or CEPS (Colour Electronic Page Make up Systems). (Mr Efi Arazi, who was educated in computer science at MIT in Boston, left Scitex in 1989. Soon thereafter he started Electronics for Imaging (EFI); now a public company which is very successful in the colour server market).

The success of Scitex did not leave the main competitors – Dr Hell of Germany and Crosfield Electronics of the UK – idle. They were both major manufacturers of colour scanners, and could not leave Scitex alone on the colour system market. Two years later at the 1982 Drupa Exhibition in Düsseldorf, both companies launched their colour systems, called Chromacom and Studio Systems respectively. Whilst Scitex used Hewlett-Packard hardware, Crosfield preferred Digital Equipment (DEC) and Dr Hell used Siemens hardware (Dr Hell was at that time part of the Siemens Group in Germany).

In 1983 Scitex became famous for the first large installation of a networked solution at Gutenberghus (now called Egmont); the first truly integrated filmless system, called EMROC, outputting digital data to the Helioklischograph, the engraving system from Dr Hell, used by gravure printers. Guten-

berghus was using the Scitex system downtown Copenhagen, whilst the engraving and printing was done in Skovlunde, a suburb to Copenhagen. However, the transfer of data was carried out by couriers, not electronically because, at the time, it was too expensive.

In the end of the 1980's there was a large number of typesetters available on the market – ranging from Linotype, Monotype, and Compugraphic to the high-end Digiset from Dr Hell. The burden for systems engineers to write driver software all the various typesetters was immense and very time consuming. I can remember the price book concerning drivers for one of the more popular display ad systems – it was immense and became never complete enough to cover all versions of the available devices.

The demand for integrating colour and text became urgent when large newspaper in the end of 1980's started to produce many more colour pages. The reason was the fast growing markets of colour TV and hence colour advertisements, to which the publishers had to respond. New press capacity was added and the colour content increased quickly. Some publishers invested in high-end colour systems but soon found out there was a lack of integration between the editorial text systems and the colour systems.

3. PARADIGM SHIFT IN THE LATE 80'S THE INTRODUCTION OF ADOBE POSTSCRIPT 1

One of major obstacles in the 1980's was the lack of the integration between different text processing systems and colour page make up systems. Several attempts were made by the major vendors to integrate the contemporary text processing systems but none was very successful. The limitations in the current technology became indeed obvious, and the use of proprietary hard- and software made life very difficult for systems integrators. Many attempts were made by different companies, Atex front-end to integrate with Scitex Response, various attempts by Crosfield integrating the Studio systems with their own text editing systems. Nevertheless, newspaper publishers – except a few large ones – were reluctant to invest large sums in new proprietary systems, which only could be operated by very skilled operators – nota bene, graphic union members. Such a step would be a return to recent years when union shop stewards kept management on their toes.

Newspaper publishers began to look elsewhere for new systems to suit their needs. A few years earlier at the very end of the 1980's some new players decided to join the attractive colour market. A new concept and slogan had just been coined – Good enough quality – which made perfect sense for newspapers and other media in the lower quality colour market (lower in the sense that printing on newsprint or similar substrates limited the possible colour gamut). The use of the expensive high end colour systems became quite impossible, as the true potential of high colour quality of the system was never utilised!

With the slogan “Good enough quality” and a completely new marketing concept, the Apple Macintosh made a head start in the end of 1980. However, the prime target for its marketing efforts was not the top end of the graphic art market, even if this market was reasonable large, but the lower end of the prepress market, as well as the industrial and consumer markets. These markets are huge, and with the right price, the volume of sales and the profits, even with modest margins, would be of a quite different magnitude as compared with a “normal” supplier to the printing industry. With this in mind Apple started its crusade into the world market of graphic art. But they would never have succeeded, if some other important developments were not simultaneously in place. Apple first agreed with the newcomer Adobe to license its Postscript technology to the Apple LaserWriter – the first affordable laser writer with the engine from Canon. Remember that one of the limiting factors in the early days of phototypesetting was the struggle of digital typefaces – fonts. But together they managed to strike a cross license agreement with Linotype in 1985, giving them full access to the digitized font library (Fryd, 2005) of Linotype, and Linotype licensed the Postscript technology driving their Lino 100 and 300 high resolution phototypesetters, which turned them into the newly coined expression - Imagesetters. Another piece of very important software was the Aldus PageMaker, which made page make up not only possible but really cheap, now from the desk top (Aldus 2005). Cut and Paste were the new commands, and the experienced user could now output composed and neatly typeset pages directly from the desktop, either to the LaserWriter or to the more advanced Lino units.

Already in 1985 Adobe published the first specifications of PostScript in the Redbook (“The PostScript Language Reference Manual"), which gave software developers all over the world the possibility to license and build their own applications. With these huge volumes the extensive work of third party systems integrators, programmers etc made business sense, offering off the shelf products – shrink wrapped in a box– available to all potential consumers at a reasonable price.

This agreement with Linotype was the first of a series of very important agreements, and with the backing of Linotype and its profound ties and good name in the industry, the new technology was quickly accepted by the graphic art industry (Pfiffner, 2002). The Apple Mac with its new graphic user interface with its intuitive set of commands was very appealing to the news editors, who were used to proprietary terminals with an unlimited number of special commands. Remember that in 1986 Linotype would celebrate the 100th Anniversary of the Mergenthaler patent, and as a consequence of the new technology they stopped manufacturing the old typesetters only a few years later.

As mentioned earlier the Macintosh quickly became the preferred working tool for the editorial departments as well as in the academic world. The management of Apple also quickly realised – before many others – that another key to success factor in the corporate market was networking. The AppleTalk network was not very sophisticated, but it worked. The network

connectors/interfaces were built in, and the only thing to worry about was the cabling, which was done by normal telephone cables – easy and cheap. But there was more to come:

Apple and Adobe soon had another idea, which was unheard of in the industry. They started to openly publish the programming specifications of the Macintosh and how to interface third party applications. It is not easy building a critical mass market alone, and by opening up specifications and encouraging other system integrators, it would do the trick. Soon enough there were a number of important software packages such as PageMaker, FreeHand from Aldus and Adobe Illustrator available for the customers. Third party applications were made to enhance the number of different approaches for the customers and by doing so, the customer almost always found something he was looking for. The customer acceptance grew quickly as well as the volumes, and the concept became quickly very appealing to the customer

These new software packages on the Apple Mac gave the operator full control in the sense that you could "see" what you were getting before output - the WYSIWYG concept. – "What you see is what you get!" (Not always quite true in the beginning of the evolution of new technology on the market). The DTP – the desk top revolution – was born. Already in the beginning of 1990 the number of licensees to third party vendors exceeded 100 – going from the ordinary laser printers to high resolution Imagesetters.

All these developments led to the third paradigm shift in less than a century. The printing world would never look the same after this profound shift – and it will never be the same again. Of course, the supervening necessity was simply that affordable systems were suddenly available. The fact what made them affordable was the numbers. The buyers were not a few large and highly sophisticated companies, but there were hundred o f thousands of consumers. By these numbers the soft- and hardware solutions became affordable and cheap, but needed new marketing tools. But it was a not a swift shift, because the graphic art industry is quite a conservative industry. Nevertheless it took less than a couple of years until the new systems had proved their level of quality and productivity. The Law of Suppression of Radical Potential (Winston, 1998) was indeed in place for some years.

Apple made everything right at the time, but with one exception. One of the ironies of its time was that Apple never published or licensed their own hardware technology to third party manufacturers. This strategy, not giving the manufacturing rights to third parties, has severely limited the impact of the concept in the world market. Apple management felt that it would limit its financial success and progress, but the policy almost led to a financial crises and bankruptcy. Unfortunately this policy is still in place, and it is one of the reasons why Apple still has a total market share of not more than 5-6%.

4. THE STRUGGLE FOR DOMINANCE OF THE MARKET IN THE EARLY 90'S – ADOBE POSTSCRIPT VS. ROW

In 1989 Aldus proposed and succeeded in convincing the major vendors to support the OPI format (Open Prepress Interface), which defined how to handle low and high resolution images. The technique described how to use low resolution images on the desktop, while the high resolution images were stored on the server. This meant an enormous benefit to the desktop user, and allowed system integrators to interface and use the Ethernet protocol between networked servers and clients (Porter, 1999). By using the OPI technology it was now possible to create high quality colour pages with desktop solutions on the Apple Macintosh. Late in 1989 there were several competing packages, like Ready Set Go from Letraset (then owned by Esselte of Sweden), Lightspeed from Crosfield Electronics, the original Aldus PageMaker, Scitex DTP software and finally Quark Xpress from the newcomer Quark Inc.

During the Drupa Exhibition 1990 these companies all demonstrated the virtues of desktop publishing and with those programs customer could create high quality colour pages on the desktop, which up to this point was only possible with the high end solutions. The implications were severe, and in 1992 there were virtually very little sign of the high end systems at the very important prepress exhibition, Imprinta in Düsseldorf. Those who have survived ported their software to common workstation hardware platforms like Sun, SGI (Silicon Graphics) and others. The development of proprietary hardware was too expensive, and the sales volumes (and manufacturing costs) could never match the common servers available on the computer market. During the exhibition Postscript Level 2 was launched, and then an entire new digital world to the printing industry was introduced. Until then the major vendors would have had time to come to a joint agreement about a common data file format for the graphic art industry. But they failed miserably.

Both the managements of Crosfield, Scitex and Esselte failed to exploit the virtues of the desktop publishing software they had at hand during these years. Although there were several installations of those packages, the sales never really took off. Marketing was slack, and not enough development power was available. The management of Crosfield Electronics was afraid of the impact on its high end colour systems! I had my own experience of the first installation in Sweden. It was Grafiskt Forum – the magazine for the Swedish Federation of Printers - who used the software for several years until the lack of support and product development made it impossible to continue. Instead, Quark Inc. (About Quark, 2005) embarked on the same route as Apple and allowed third party developers to create and sell plug-ins to the Quark package. A year later, by 1993, Quark was more or less alone on the desktop market for editorial applications, in particular at the news desks.

In the end of the 1990's the number of Quark Xpress users could be counted in millions. These were volumes never before heard of in the colour page make up market. Quark has lately had some miserably years because the company developed a "fat cat" mentality to their customer – in particular in the newspaper market. (Not until almost a decennium later was Quark challenged by Adobe. Aldus were taken over by Adobe already in 1994, and Adobe InDesign, as the new Xpress killer application, was created on the Aldus PageMaker basis).

5. THE INTRODUCTION OF POSTSCRIPT LEVEL 2
MARKET DOMINANCE IS IMMINENT
TECHNOLOGY IS STARTING TO CONVERGE

By 1991 Adobe had managed to sell its license to more than 100 commercially available printers and typesetters, and more than 4 000 different applications were outputting to PostScript units. PostScript Level 2 was launched the preceding year and became the answer to all those who wanted four colour printing with reasonable quality and cost, in particular the newspaper industry and other media with medium to low quality expectations. Equipped with Postscript Level 2 typesetter manufacturers renamed their units to Imagesetters, because now the customers could integrate text and colour images on the desktop, and output finished and composed pages in four colours (=separations).

Adobe quickly licensed their technology to all who wanted to implement it – software developers and various manufacturers of Imagesetters. The company had recently developed a new software package, Photoshop, and colour image manipulations could now be done on the desktop. Previously such retouching and image manipulations could only be done on the high end systems, but now Photoshop enabled the user to produce manipulated and retouched colour separations with a reasonable quality using the OPI interface for storing the high resolution colour images on the server.

In 1992 Photoshop 2.5.1 version coincided with Postscript level 2, and Photoshop software soon became an industry standard per se. Again Adobe had an open view and gave their specifications to third party developers and quickly a series of plug-ins and filters to various scanners were available on the market. This made the software extremely popular. In reality Postscript Level 2 was launched by Adobe much earlier than it was really ready. One reason was that some of the licensees, such as Harlequin, Agfa, Hyphen Inc. and others, were quicker and more agile than Adobe, and managed to ship and install the new software before Adobe had finished their work. But the customer benefited on their actions, to some embarrassment to Adobe and other competitors. Somewhat later Adobe published the second edition of its Redbook on Postscript, and with the new version of the software Adobe had addressed some of the more serious problems with the earlier version related to colour separations and colour printing.

Some of the high quality aspects of colour printing were not quite solved in the Level 2 software. Some examples were the lack of trapping (expanding colours when printing negative text), suppression of moiré and some colour banding/colour shifts. Despite these shortcomings Level 2 attracted more and more users, because these systems were affordable. Slowly but surely, these systems started to outperform the high end systems in particular in those markets where Good Enough Quality was really good enough, such as newspapers, flyers, low end DM products and business forms. Many older union members were unable to retrain or were less adaptable to desktop publishing. The old skills were not asked for and most of them went out work during the first years of 1990's. Then number of union members dropped quickly during the Desk Top revolution.

Some of technical problems with Level 2 were addressed by third party suppliers. One obvious problem for newspaper in tabloid or broadsheet formats was the page files became very large, and hence slow and cumbersome to RIP (RIP = raster imaging processor, which converts the page image files to the Postscript format in order to output on Imagesetters). Sometimes the RIP would even crash. Another common problem was that the low resolution images were not properly replaced by the high resolution versions at output, which created very fuzzy and jagged images in the printed copy. The fast growing and highly competitive computer industry added to this development, and hardware became faster and cheaper day by day. Many corporations started to move away from mainframe computer to the client-server technology, and companies like Novell and Sun grow quickly. Later Microsoft (with its NT Server technology) made things easier and indeed cheaper for all customers. Moore's law really helped the development of desktop publishing. (Moore's law suggests that the chip capacity is doubled every 18 months). As new general industry standards became available, the technology became more affordable for more and more users. Simultaneously, international cooperation in digital networking decided that Ethernet-technology should be the new international standard for networks, stating first the standard for 10 Mbit/s on standard copper cables, but soon even100 Mbit/s with optical fibres. Hubs and switches for the rapidly growing telecommunication industry strongly supported the graphic art industry and overcame many of the previous bottlenecks. The graphic art industry was in no way different.

Adobe Photoshop became the poor man's image manipulation and correction tool. Although most of the high end scanners would through the OPI-concept interface with the desktop, many newly developed desktop scanners emerged on the market. Some were still using the drum technology, but most of the new scanners were flatbed using CCD (charge coupled devices) technology. Most scanners manufacturers would develop interfaces directly to the software – so called plug-ins – and Adobe – true to its policy – openly published the links to their programmes. Although the Good Enough Quality was the answer to most complaints, some of the separation algorithms in the earlier versions of Photoshop were quite awful – in particular in the richer tones of the magenta separation where detail definition completely

disappeared. But, the price and performance did match the expectations of most customers, and the sales volumes of the Photoshop package grew quickly.

The introduction of Level 2 was very successful even with very modest expectations. The supervening necessity was based on economy of scale, and for other suppliers in the market there were no other choice than to bite the bullet. Earlier versions of Postscript had limited success as the Law of Suppression of Radical Potential meant that quality and productivity were important issues, which gave some room for the conventional high end systems in the market. But, with Postscript Level 2, this was no longer true. Those of the high end manufacturers, who were still in the market, started concentrating on developing OPI-servers and RIP solutions, and quickly licensed PostScript-technology from Adobe. With their knowledge and experience from earlier installations, they added important elements to the PostScript technology.

These solutions to known problems addressed some of the more obvious quality problems in Level 2. The customers could now migrate from the high end to lower cost solutions without sacrificing the quality level. Among these solutions were:

- New advanced screening algorithms improved print quality
- Trapping problems were solved
- Other minor quality issues were improved
- Better control of ripping process
- Earlier version of pre-flight control were introduced - preproofing of digital data prior to output
- Last but not least – control of the process and output/productivity was greatly enhanced

Suddenly, the new technology was embraced by everybody, which had a profound impact on the graphic art market. In a very short time many suppliers in the prepress area disappeared, when they not fast enough embraced the new technology. Other merged and a few new players entered the market. By adding the last component to the prepress puzzle – the imposition of pages - the last piece of the puzzle was laid. Imposition means that all the individual pages were laid out in correct order for output on film (later plate), colour by colour. Imposition is quite complicated, and it took developers quite some time to exploit all aspects of imposition to the benefit of the users.

The Level 2 version became soon an unprecedented success, and it became the leading software for process control and output and with an abundance of extensions and/or plug ins it became the obvious choice. Slowly the owners of the high end suppliers were forced to change strategy:

- Crosfield Electronics was bought by DuPont and Fuji Film in 1989, but already 1994 only the latter remained as owner and the Crosfield name disappeared
- Dr Hell was bought by Linotype in 1991. Linotype was taken over by Heidelberg 1995, and the name disappeared
- Scitex made a joint venture with Creo Inc in 1998 divesting the prepress, and in 2002 the name disappeared, when Scitex sold the remaining shares

The new owners concentrated their efforts on client-server technology and more enhanced PostScript solutions. For many, the disappearance of the names Crosfield and Dr Hell was quite sad. Both companies were founded after the war (the inventors were both engaged during WW II in inventing electronic devices and anti-devices in the submarine war in the North Atlantic), and were among some of the very early developers of electronic scanning and phototypesetting. Together they dominated the electronic scanning and image manipulation market for more than 25 years! Scitex embraced the new technology somewhat faster and managed to survive longer. The company sold its last holding in Creo Inc. (the Canadian manufacturer of workflow software and CTP equipment - computer to plate) some time ago. Scitex Corporation Ltd. is now concentrating their efforts in financial holdings in companies producing inkjet systems. Nevertheless, last year they sold back to Kodak Scitex Digital Printing in the US.

Finally there was no important supplier in the market, who did not rely on products which one way or another were licensed from Adobe. The convergence of prepress technology was indeed here.

But Adobe never rested on their laurels. Already in 1990 Mr Warnock, one of the co-founders of Adobe stated that Postscript had a very strong support as the new standard for output devices. This was the turning point for Adobe. What Mr Warnock for some time had realised, was that the corporate world needed a new universal way of communicating documents across a wide variety of machine and devices and communication networks. The fax concept which had a strong growth during the 1980's could not be the answer, because they were slow, with low quality and needed dedicated phone lines (Warnock, 1991).

With a new technology any document should be viewable on any display terminal and/or be printed on any modern printers attached to the terminal. This concept would fundamentally change the way people would work, alone or in a network. PostScript was developed as a device independent page description language, and in 1991 there were more than 100 commercially available printer products and 4 000 different applications. Later the same year the Adobe Acrobat program and the PDF-file format were launched (Acrobat is a kind of subset of Postscript and requires a rather simple interpreter).

PDF, Portable Document Format, is a file format for representing documents in a manner that is independent of the original application software, hardware and operating system in use creating those documents. Such a file can describe documents containing any combination of text, graphics and images in a device independent and resolution independent format. There were several advantages to the PDF-format, such as there is only a single small file to transfer and the font-substitution technique ensures that the document will be readable even if the end-user does not have the "proper" fonts installed on his computer. First, not only did the only PDF creation tools cost money, but so did also the software to view and print. Hence, the new technology was slow to catch on.

After some time and internal struggle Adobe made a drastic change of their strategy. The management of Adobe realised that the Internet and the use of electronic mail over the Internet would soon be the new communication strategies for most of corporate and indeed also the home users. Soon the PDF-technology was integrated with the most popular Internet-browser programs, such as Netscape and eventually Explorer. The Acrobat Reader was to be distributed free of charge. Competing formats eventually died out, and PDF became a well-accepted "standard". To-day, the Adobe Reader is the single programme most used in the world with more than a billion users.

Soon after, a license agreement was struck with Microsoft integrating the Acrobat technology into MS Office software offerings. Now, every user of the popular Word, Excel or PowerPoint applications could create PDF-files for easy distribution by e-mail or through internal networks.

6. The introduction of Postscript 3 and Adobe Acrobat technology

Almost seven years after Postscript Level 2 was introduced, the Postscript 3 became available. With the new version Adobe addressed some of the more obvious flaws of the Level 2 version, and among some of the more important features were support of more than 256 graylevels which was needed to avoid some quality issues, and improved support for in-rip separations. The in-rip means that the RIP can handle composite Postscript files (RGB composite) and RIP on the fly. Further, new and enhanced screening algorithms allowed higher and more consistent colour quality of the output. But more importantly, PostScript 3 could also handle and rip PDF-files, which was the first step in a PDF-based workflow.

Many printers (Braswell, 2001) had realised that creating PDF-files and submitting those files (=pages) to the customer for approval, would save both time and cost. In particular, this would be useful in a distributed networking area, such as the distribution of ready made advertising material. New standards for submitting pages to the newspaper industry are based on PDF technology, lately PDF 1.5 based on the latest version of Adobe Acrobat. Hence all products, which are going to be printed, can use PDF technology. Most service bureaus will handle such files, impose them, pre-flight and send to the RIP for output. All manufacturers selling workflow and/or

output solutions must be able to handle a PDF workflow. Some actually convert all jobs (=files) to PDF prior to printing. This may allow them to see errors in a file before wasting paper, film or plates. A PDF file contains not only all information about fonts, images, printing instructions, keywords for indexing etc. which is necessary for the job, but also contains a job tickets in the newly developed JDF format – Job Definition Format. JDF is supported by all manufacturers in production chain and will ultimately assist in making the workflow smarter and faster. For example, a JDF-file contains information how to automatically set the ink keys in the press and other important make ready features.

We can now conclude that there is no other important company in the area of converging prepress technology than Adobe. Apple started the desk top revolution about 20 years ago, but over time Apple is no longer controlling the technology as it used to do. It is quite ironic, however, that the founder of Apple – Steve Jobs – actually helped Adobe with considerable funding in the start, in order to develop the Postscript technology. Otherwise it is questionable whether there would have been an Adobe and a desk top revolution at all.

What we have to-day is a new set of rules –no official standards – which all are controlled by only one company. After its initial success with Postscript and the large volumes of the Apple LaserWriter, already in1986 Adobe went public with its first public offering (IPO) with a revenue of 12 million $US and less than a score of staff. Today Adobe Systems Inc. is a huge company with revenues of close to 2 billion $US and some 3 500 employees. During the last decade about two score of competing and supporting companies were acquired, and through Adobe Venture seed capital for new emerging technologies is available. There are some interesting acquisitions during this period such as Aldus Corp. (as previously mentioned), the core of Hyphen (printer software) and last but not least Accelio (former Jetform), the leading provider of electronic business form solutions. With this acquisition Adobe will soon integrate electronic business forms into the Acrobat family of software. Soon Adobe will be the only and dominant player on this enormous corporate and government market. Adobe and Microsoft have quite close ties, as the PC market is by volume the most important one with over 90% market share. Hence, all DTP applications have been available in a PC version for long period of time.

Previously with a number of players in the prepress area, there was stiff competition, but no “standards” for the integration between different vendors. To-day we have only one supplier! We – the users –may have been happy with lower costs and less demanding capital investments, but on the other hand the graphic art industry now depends on one single company. One last observation which may have been lost! The technology now is quite “easy” and comprehensible – which means that thousands of jobs have been lost in the graphic art industry. All of these jobs, which previously were done by trained graphic art craftsmen, are now done by the customer. Not always, but mostly without any formal training in typography, lay-out

or any sense of colour manipulation. This is really Good Enough Quality! Was this really what the customer of the 1980's wanted?

7. ADOBE PDF TECHNOLOGY AND THE FUTURE (JDF ETC)

Adobe has stated that the PDF –technology is one of the most important of its future direction. More than a billion copies of the Reader (previously called Acrobat Reader – now Adobe Reader) have been downloaded from the Internet, and the Reader has made the company visible and well-known world-wide. In 2002 The International Organization for Standardization (ISO) announced that it has formally approved the first of a series of PDF/X standards for digital data exchange, based upon Adobe PDF, for the exchange of digital data in the graphic art industry. Yet, the ISO made a virtue of a de facto standard in the industry. This standard is based on PDF 1.3 and one might expect that in due course the future standard will be migrating to future versions.

Concerning the PDF-technology one might also expect, that it will replace the Postscript programming language. Rather, I would think that future versions of these programmes will be developed even tighter together to enhance future prepress workflows. Recently Adobe Inc. announced that the PostScript 3, version 3016 was now available to their partners who are building high performance printing systems and print workflow solutions. This version is supposed to be the only interpreter that supports the latest version of PDF 1.5 as well as the PDF/X standard. Adobe stated that they have pushed the technology close to the limits.
CIP4 – computer integration of prepress, press and finishing units – is the latest developments in the industry. The CIP4 consortium is a joint venture in the industry embracing almost all suppliers in order to automate future work flow in the industry – from the prepress area to the final finishing stage. The consortium has chosen the JDF-file format as the common platform for communication between all units in a given workflow. One might expect that the use of JDF-technology will be used extensively and may be the only alternative in the next few years. JDF as a job-ticket device is based on the new dynamic the mark-up language XML and is of course controlled by Adobe.

8. CONCLUSIONS

Fifteen years ago many industrial leaders in the graphic art complained that there were only too few companies on the market and no standards for the exchange of digital data were available. With the developments during the last decade the industry has got a new standard – even embraced by the ISO – but this standard is the immaterial property owned by only one company – Adobe Systems Inc.

Adobe Systems Inc. has a very solid position in the graphic art industry, and it is very difficult to envisage a competing technology replacing the present

Postscript and PDF-technologies. The only alternative would be, if Adobe themselves, for some reason, would come across something better. In my opinion it would be highly unlikely; as a public company, management would rather protect its present technology they possess, than enter into something new and uncertain; in particular with a market share of 100% in the prepress market. Management normally tries to avoid financial risks! Hence, the technical convergence has come to an end with the present technologies from Adobe.

To-day the corporate and government markets for documents and electronic forms are probably much more important for Adobe than the graphic art industry. One might only hope that they will not misuse its dominant position, and continue to support the poorer cousin. The graphic art industry needs new innovations and cost efficient solutions for more automated workflows.

A new monopoly in the front-end technology has been created by default. One may say that the convergence of technology in the prepress has come to an extreme! The technology has been converging to one single supplier! Never before has one single company been in a similar position in the graphic art industry. This is like falling from the frying pan into the fire!

Finally, some says that the Internet is the first paradigm shift in the 21st century. The web may have a great impact on the graphic art industry, but this has yet to be proven.

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