

Picture Pathways: New Opportunities in Imaging

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Thank you, Dick, and good morning everyone.

I am very pleased to be here today to share some thoughts about imaging technology ... and the almost limitless growth possibilities that lay ahead for all of us in this industry.

We are in a time of dramatic progress along the entire length of the imaging chain -- as new ways of capturing, manipulating and sharing images are being offered to customers around the world. It is indeed an exciting time to be in our profession.

The reality for our business future is this:

As we make it easier and more convenient for our customers to use and enjoy pictures ...

As we multiply the ways people can capture, manipulate and share images ...

As we offer innovative and exciting technology for communication and information management ...

our markets will grow exponentially ... whether those markets serve consumers, professional photo-graphers, health care, publishing, entertainment and all the rest.

The bottom line: More pictures mean more business.

The competitiveness of silver halide and digital technology has been a major theme for imaging in recent years. And from my background, I see digital technologies as a powerful enabler -- versus a competitive threat -- for the future of imaging as we take advantage of the opportunities in many markets.

Indeed, the dynamic mix of digital, chemical and other technologies presents a new picture of the imaging business. This picture -- which has been taking shape over the last two decades -- is now coming into sharp focus as we stand on the threshold of the third millennium.

So today I want to talk to you about my optimism ... and the many new possibilities that lie before us.

I want to talk about...

Picture Pathways: New Opportunities in Imaging

(Lights down, Slides begin)

As I see it, the new picture of our industry has four defining characteristics:

- First, there is a large, expanding worldwide market for imaging products and services. I want to show you why I think this market can reach a half a trillion dollars in the next few years.
- Second, there are many new participants across a global marketplace who provide both traditional and digital imaging solutions. We can show you why we welcome these new players as positive contributors to growth in imaging.
- Third, growth in the new millennium will feature new business models in imaging. These emphasize winning partnerships, alliances, horizontal structures and joint ventures to deliver the products and services imaging customers are coming to expect.
- Fourth and finally, there are many new opportunity pathways for our customers to use and enjoy pictures. These new pathways are enabled by new technologies. They will offer greatly expanded means of delivering value to our customers ... resulting in exponential growth in the ways to use and enjoy pictures. The picture is changing dramatically in our industry. But it is positive change that is creating a sure foundation for solid growth.

Let me begin with a brief view of the size and scope of the new market opportunity. I've used a 1996 base in this illustration.

The imaging market comprised of these elements might look like this:

- Consumer imaging -- which includes both traditional and digital capture, output and storage products and technologies -- totaled about \$160 billion dollars. Soft copy output includes television and products such as DVD and VCRs. Hard Copy includes photofinishing

and ink jet. Capture includes digital and film cameras along with the film itself.

- Commercial applications -- which involve imaging products for printing and publishing, professional imaging excluding broadcast equipment, office applications and others -- adds another \$109 billion
- Add another 29 billion dollars for Health and Entertainment applications and the total imaging market is nearly 300 billion dollars ... even excluding video games and the like.

Beyond the well-defined bubbles are which are yet to be defined.

We can expect this total market to reach a half a trillion dollars by 2002 ... and the following will provide the basis for this.

That brings me to the second industry characteristic: the new industry participants who are enabling the growth in imaging.

In today's world, there are many new players who now consider themselves as part of the imaging business. These new players are providing the impetus for novel imaging solutions -- and growth for the industry by bringing new customers into the market mix.

Computer companies, consumer electronics giants and telecommunications networks are now major factors in a market once dominated by traditional photographic companies. They serve customers with imaging applications ranging from home imaging ... to printing and publishing ... and on to commercial applications such as medical diagnostics.

Consumer electronics companies like Sony -- which built its brand on radio and television products -- now offer digital cameras. Adobe, a printer software company, offers tools to manage the color and content of images. Network services like America Online help computer users store and transmit pictures electronically. And H-P and Epson have moved output technology well beyond text output to offer consumers new capability to print photos in the home.

These companies will bring a lot of assets into the new market. Not just new capital and new technology, but a tremendous amount of intellectual and business energy as well.

Customers ... capital ... technology ... and energy. All of these are enablers of strong growth for our industry. In fact, we are already feeling the presence of these forces in our midst. And it is good news for our industry.

One of the influences of these new participants is the set of new business models being adopted in the industry -- the third foundation point.

The computer companies in particular have been successful at changing to new business models for growth and innovation.

Initially, companies like IBM were largely vertically integrated. The company designed the applications software operating system ... as well as disk drives, processor and other hardware.

I've picked IBM as an example here. But this same model was used by many other companies, including film manufacturers which designed, manufactured and marketed products from end-to-end ... from capture to output to delivery to the customer.

The introduction of personal computer technology into the computer industry changed all of that. It emerged and grew as a horizontal business model.

In the process, industry leadership changed from companies that do everything themselves to companies that do a few things very well -- and partner or link with others to deliver what customers want.

So now, for example, you may have a PC from Compaq or Dell equipped with a microprocessor from Intel inside. The operating system may be Windows 98, and the modem from 3Com.

Indeed, when customers receive their Kodak PictureCD from Qualex, it comes not only with the Kodak logo but the Intel Imaging logo as well.

Much like the evolution from vertical integration to horizontal relationships in the computer industry, there is a new business model incorporated in this venture to leverage the strengths of the two companies.

Kodak's alliance with Intel enables us to digitize a large fraction of all the photographs shot each year. We are then rapidly extending the menu of digital options for customers.

Intel architecture-based equipment is being linked with Kodak scanning technology and Kodak's Qualex laboratories to produce a series of easily accessed digitization products throughout the U.S. These include PictureCD and Kodak Picture Disk.

Beyond this Kodak has linked photofinishing services to AOL's "You've Got Pictures" services. Furthermore, PictureVision retail services has been added to this network, enabling with archives and additional digital services.

So you can see in this instance how Kodak and others have adapted their business models to ones that leverage the strengths of other companies.

That brings me to the fourth enabling principle: the new opportunity pathways are truly coming of age as we stand at the doorway of the new millennium.

Let's look at the major pathway categories on which we can drive to growth.

The imaging chain components: capture, store, process, communicate and output are familiar categories and allow us to see the expanded opportunities.

In the traditional imaging chain, opportunities are limited. Movement along this pathway travels from capture to process to output.

You capture your picture on film. The latent image has extremely high content quality, but it requires a chemical process to reveal the content.

So the exposed film is delivered to a retailer for processing.

You receive back from the retailer your prints or slides.

You may order a few reprints and mail them to family or friends via the U.S. Postal Service.

And if you're organized, you may even sort out the best images and put them in a photo album.

But if you are like most people, your prints and negatives end up in a shoe box ... or a closet ... or even in the closet!

In this world, there is essentially one picture pathway from capture to output, and very few alternate routes once you have your prints.

The new consumer opportunity pathway is built on the same elements of the chain, but the opportunities are supported by new technologies. The pathway is far more flexible and creates significant new opportunities in imaging.

So let's examine why I'm so optimistic about enabling these new pathways by examining some of the technologies in the imaging chain categories.

The first category is capture.

Traditional film capture continues to improve in terms of quality and affordability. In the APS system, magnetic coating on the film enables digital data to be stored on the film ... which can be used by the photofinishing equipment and other applications.

In the first instance, lighting, scene, date and time data are recorded along with the picture-taker's preferences among three picture formats. Then this information -- or "metadata" as we call it -- is available to the finishing equipment which adjusts itself for best quality output.

One can put even more data onto the film to improve not only picture quality but customer features as well.

Digital image capture is growing in capability and affordability.

Lower pricing trends for digital capture products are equally aggressive, as this chart shows.

Average camcorder prices have dropped from about \$1,500 per unit in 1985 to a little more than \$500 last year. About 30 percent of U.S. households own a camcorder.

Lower resolution ... or VGA 640 by 480 pixel ... digital still cameras over the last decade have dropped sharply from more than \$10,000 to under the \$500 price point.

And 1.3 megapixel resolution still cameras follow along a parallel path to price points well under \$1,000. This year, 2 megapixel still cameras will be priced below the one thousand dollar threshold.

CCD costs for digital cameras have been declining 21 percent annually since 1980.

At the high end of the market, digital cameras have progressed significantly in image capture capabilities ... and are especially attractive in applications such as newspapers and commercial photography where quality, speed and convenience are a premium.

Let's look at one example.

The Kodak Professional DCS 620 camera has two-megapixel resolution and a flexible ISO range of 200 to 1600. It has a burst rate of 3.5 frames per second for up to 12 images. It adjusts color to match the light source and it has 36-bit color for capturing color and detail in shadows and highlights.

An on-board histogram lets the photographer verify exposure accuracy on the spot ... along with a color LCD display to evaluate image composition.

The camera also features an audio notebook which allows the photographer to document specific shots by voice.

Digital still camera shipments from all manufacturers this year are forecast to reach 5.5 million units. By 2002, digital still camera shipments are projected to be 13.3 million units worldwide. That assumes an annual growth rate of 55 percent. Between 1996 and 2002, the digital still camera will grow from \$1 billion to an estimated \$4.3 billion. As a reference, film and camera sales were \$24 billion dollars in 1996. And there are more than six hundred million traditional cameras in use today.

(Pause)

In commercial applications, there are a series of special-purpose capture devices. An example of the "very high end" is a remote sensing satellite to be launched tomorrow by Space Imaging Corporation of Colorado.

Aboard will be a special telescope camera designed and developed by Kodak. It can resolve earth objects less than one meter square from hundreds of miles in space. In other words, it will be powerful enough to distinguish between a car and a truck from 400 miles in space.

The camera system comprises an optical telescope, panchromatic and multispectral imaging sensor arrays and processing electronics.

The telescope has the equivalent resolving power of a 10,000 mm telephoto lens. The five mirrors are polished to atomic level accuracy.

The camera's focal plane unit contains separate CCD sensor arrays for simultaneous capture of black and white and color imagery. The panchromatic sensor array contains thousands of 12-micron-sized. To capture red, green and blue and near-infrared light, the multispectral array is coated with special filters.

(PAUSE)

Storing and retrieving digital large digital image files is another category. Images are driving demand for high density storage, as we know. The following produces some brief data on the major storage technologies and their growth categories.

Film remains the premier storage medium for archival purposes whether in microfilm business systems or for consumer images. A 40-exposure cassette of Kodak Advantix film holds the equivalent of 422 floppy disks, or a 590-megabyte hard drive.

The Optoelectronics Industry Development Association estimates that the optical storage market will grow from \$6 billion today to \$50 billion by the end of 2010. This growth will be driven mostly by video and computer-related products.

CD's hold 650 megabytes and are proven image storage media for digital images. DVD technology is moving ahead rapidly as the next generation of this style of storage. The follow-on variants to DVD will surely extend this very cost-effective storage technology,

The magnetics industry has been impressive as well. The areal density of its hard drives has improved by 60 percent per year since 1991. They have crossed an amazing threshold – storing 10 gigabits per square inch!

The 21st Century may see new technologies such as the class of 3-D volumetric storage modules.

As many of you know, DARPA is now investigating optical storage readout technology (called FROST) which is intended to overcome limitations through novel 3-dimensional, highly parallel readout approaches with speeds measured in Gigabits per second.

This advanced technology are likely to have initial applications in multimedia, virtual reality, medical imaging, digital movie editing, video and others requiring cost-effective, high-capacity, random-access image data storage.

A major technical challenge will be to process all this information efficiently and reliably.

New technology is also transforming the traditional photofinishing operation.

Not only are wholesale photofinishers such as Qualex getting digital pathways, minilab operators, too, are participating in digitization services. At PMA in February, Noritsu and Kodak announced digitization capabilities in a new Noritsu digital lab system.

A digital transition has started in this tier of the photofinishing industry. Multi-purpose digital photofinishing systems gives photo retailers a complete system for processing traditional photofinishing orders while adding new digital printing, enhancing and previewing capabilities.

The operating system software handles 50X zoom, red-eye reduction, enlargements up to 12 x 18 inches, under exposure correction, automatic contrast and image sharpening adjustments, and much more.

Special applications software is available for finishers to allow customer to preview rolls in the store and select only the pictures they want to print -- including zoom and crop requests. For customers who desire highest quality, there is automatic dust, dirt and scratch removal software available.

Picture processing is also defined as manipulation, information extraction, and transformation of images. And this is done more frequently today by microprocessors.

The cost of raw computing power – defined as cost of instruction set per second – has been tracking downward at more than 25 percent per year since 1975.

This chart shows that in terms if the cost of one million instruction sets per second on an IBM mainframe in 1975 was one hundred dollars. By 1995, a Pentium PC chip could do the same job for one cent. In the decade between 1985 and 1995 costs improved an order of magnitude ... and since then we have broken the “penny barrier.”

As the cost of digital technology drops ... and as capabilities expand ... the new opportunities for pictures grow more positive.

Personal computers in the home offer an interesting example.

Today's PC penetration in the U.S. home is about 40 percent. It's estimated that this will double to 80 percent by 2020. A lot of this is a function of price, which is on a steep downward slope in some cases.

The average price of a PC today is \$947, according to PC Data. That's 17 percent less than a year ago.

Earlier this year, MicroWorkz Company offered a 300 megahertz computer – without monitor – for \$299 and a year's free use of the Internet. Features included 32 megabytes of memory and a 3.2 gigabyte hard drive.

Newspapers reported that the company's web site was “brought to its knees” by 7.2 million bargain hunters who logged on to the site after the announcement. They must have survived because the offer still stands three months later.

While the growth in computer households in the U.S. accelerates, the worldwide market has continuing potential. SRI roughly estimates that only 25 percent of households will have a personal computer in 2010.

Of course, that could change as the cost barriers to computer ownership continue to decline. Furthermore, alternate devices such as TV set top boxes may offer the needed interface in some countries.

This increased use of home PCs to access the Internet is putting increasing pressure on worldwide telecommunication service providers.

The fourth class of pathway – communication and sharing – is being driven by the expanding power of enablers such as computers and network technology.

The Internet is obviously one of the critical enablers to drive the expansion of picture usage.

Last year the top five internet service providers served almost 20 million customers in the U.S. Sixteen million of those use American Online as their ISP.

SRI Consulting estimates that -- worldwide -- 70 million households will be online by the end of the year 2000. It estimates that this will grow to one billion households by 2050.

The number of adult Internet users will reach 500 million in another decade, according to SRI.

With this growth, we can look for more and more creative ways to get people connected to the Internet. The Web appliance is one example.

Appliances will begin to complement the traditional PC as a means to access the Internet. The Wall Street Journal reports that AOL is getting ready to announce a device “about the size of a dictionary” to enable members to quickly access e-mail or Web pages. Called a “screen phones,” it would contain a small screen and a keyboard. It's a safe bet that pictures will be included in that e-mail.

At another level, look at the nearly 20,000 Kodak PictureMaker “appliances” placed in retail outlets around the world. These kiosks allow customers to access an image file on the Internet and download the images they want and print them on high-quality thermal paper.

Or they scan prints and upload them to a file at PhotoNet Online to share with friends or family. This is

just one of the many ways people will be able to enjoy and share images without owning a computer.

The ultimate “appliance” may be under development at Frigidaire, according to ABC News Dot Com. The product is a refrigerator with a 233 MHz processor, 32 megabytes of ram and Internet connectivity for shopping at your favorite web grocer.

As new and innovative applications for images are developed, so will the demand for improved transmission rates.

John Sidgmore, vice president of MCI WorldCom, spoke recently at a Fortune communication conference. He pointed out that Internet bandwidth demand is doubling every three to four months, or 10X annually.

The bandwidth of “the last mile” to the home connection is an important enabler for growth. Simple modem and telephone lines are cost-effective yet struggling to deliver 56 Kbs. Movement to multi-megabit transmissions is now starting to grow.

There are three technologies now being deployed that can and will enable images communicated to the home in a timely fashion:

- Wireless
- DSL
- Cable modems

All three technologies are being developed around the world. Regardless of the technology used in your home, pictures will be easily communicated.

Ease of use is critical to enable growth. Multiple higher-level initiatives have been work to help solve these connectivity issues.

Microsoft’s Universal Plug and Play and Sun Microsystem’s Jini offer great potential for making images available in an open hardware and software environment.

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New pathways to output are being enabled by new printing technologies also.

The output print technologies are steadily improving, along with cost effectiveness. Laser and optical silver halide printing continues to dominate the photofinishing needs of consumers.

Decentralized photo-grade images are being produced with dye-thermal sublimation printers. Consumers are enjoying excellent pictures via this gray scale technology in the numerous kiosks and personal printers being used around the world.

Technical advances in small particle toner, transfer subsystems, media and the like are enabling steady performance improvement in electrophotography.

Electrophotography is also moving ahead in capability for very high-quality color output. It has been growing at a 23 percent annual rate since 1997 and will be \$6.2 billion market by the end of the year.

Ink jet is growing even more rapidly and enabling new picture-capable equipment.

Not that long ago, computer output was not taken seriously as high-quality competition for silver halide photographs. Today we are using ink jet printers for critical x-ray imaging!

Technology advances include sub 10 picoliter drops, 1000 plus per pixel inch addressability, 15 kilohertz plus drop frequencies and half-inch print heads.

This year, some 40 million ink jet printers will be sold worldwide.

(PAUSE)

As I hope my message is clear by now.

The imaging marketplace is large, yet still has very large growth potential. This is what we can expect it too look like in a few short years ... 2002.

The new participants bring customers, capital, technology, and energy to our industry.

The new business models are bringing new solutions for customers.

And finally, technology advances in the major categories of the imaging chain are enabling and explosion of growth in the number of new pathways for imaging.

By the time we gather for PICS 2002, I’m convinced our industry will have grown to beyond the \$500 billion dollar level ... and it will continue to excite and challenge all of us who are determined to keep it growing well into the new millennium.

Thank you.