

# THE ROAD AHEAD

## How the Emerging Technologies of the Digital Age Will Transform Everyone's Lives

BILL GATES

### MAIN IDEA

The emerging technologies of the information highway have the ability to transform the life of every person on the planet - by improving their quality of life through providing access to cost-effective information and by eliminating middle-men who add no value to the products or services they represent.

Once the information-based economy becomes fully established within the next decade or so, technology will forever change the way everybody does business, works, learns and communicates with other people.

### **1. A REVOLUTION BEGINS**

Worldwide, many thousands of companies and governments are committed to the same vision - of being able to interconnect every home and office to a high-speed network which can access vast amounts of information. Many individuals and companies are basing their futures on making that vision a reality.

The free exchange of information around the world on a high-speed high-capacity network will completely restructure the established order of global commercial enterprise and business.

### **2. THE BEGINNING OF THE INFORMATION AGE**

The information age will be noted for the development of high-speed, low-cost machines which can process and transmit information to any place on the planet. The genesis of the information age began when computers were developed.

### **3. LESSONS FROM THE COMPUTER INDUSTRY**

Companies investing in building the infrastructure of the information economy will be in a position to avoid many of the mistakes which were made in the formative years of the microcomputer industry.

### **4. APPLICATIONS AND APPLIANCES**

One of the key benefits of the information economy is that communication will become asynchronous - that is, any piece of information (or entertainment) will be available to be accessed by any person at a time that suits that person rather than at a time when it has been scheduled for transmission. The implications of just this one simple concept are profound.

### **5. PATHS TO THE HIGHWAY**

Today's Internet will eventually evolve into the full-scale information highway. It is a precursor to the developments which will soon follow. The growing popularity of the Internet with all its technical bottle-necks does suggest that information highway applications will become extremely popular very quickly and justify large capital expenditure once they become definitively established.

### **6. THE CONTENT REVOLUTION**

With the establishment of the information superhighway, communication will become exceptionally cheap. Under those conditions, people will have an entirely new way to express ideas and to format entertainment packages. The information highway will open new formats of artistic and scientific content that will impact directly on the quality of life for almost every person on the face of the planet - and unleash new and exciting creative opportunities for emerging generations of geniuses.

### **7. IMPLICATIONS FOR BUSINESS**

Within the next 10 years, there will be substantial shifts in how and where people work, the companies they work for and where they choose to live. Technology will become so flexible and efficient that physical location will become virtually irrelevant.

### **8. FRICTION-FREE CAPITALISM**

The availability of a global information network will impact on every industry profoundly. For the first time in history, highly efficient markets, free from the distorting effects of middlemen who add no value, will exist. These markets will be accessible by every producer of goods and services and every consumer in the world. Society, as a whole, will move forward as never before.

### **9. EDUCATION: THE BEST INVESTMENT**

Education has historically been institution-based - if you go to the right school, you are taught by the best teachers and move in influential circles which can later help boost your career. The advent of the information highway will change the emphasis from the institution to the individual.

Under those circumstances, education will become more a lifetime experience than simply something you do to earn a degree or some other qualification. Every student who is connected to the information highway will have access to a lifetime's worth of learning on every subject that is of interest.

### **10. PLUGGED IN AT HOME**

Although the information highway will offer endless hours of personal study, man is still a social animal. The establishment of the information highway will not diminish man's social activities - we'll still want to go out to the big social occasions, participate in community events and even go to movie theatres to be entertained.

### **11. RACE FOR THE GOLD**

From the headlines that regularly appear in business newspapers, you may be under the impression that the race to build the information highway has already been won by one company or another. In reality, nobody has even reached the starting line yet.

The construction of the information highway will be a huge project with vast fortunes to be won by the companies which make the correct choices, but nobody knows for certain exactly what the general public will want from the highway yet. The public doesn't know because it doesn't have enough experience in the options that are available at this point.

### **12. CRITICAL ISSUES**

This is an interesting stage in the development of the information highway because we are watching the foundations being laid down. The decisions consumers make within the next decade will have a huge impact on the balance of human history. We are literally part of the dawn of the information age.

## 1. A REVOLUTION BEGINS

### Main Idea

Worldwide, many thousands of companies and governments are committed to the same vision - of being able to interconnect every home and office to a high-speed network which can access vast amounts of information. Many individuals and companies are basing their futures on making that vision a reality.

The free exchange of information around the world on a high-speed high-capacity network will completely restructure the established order of global commercial enterprise and business.

### Supporting Ideas

The term "*information superhighway*" which has been popularized extensively by the media was first promoted by Senator Al Gore (prior to his becoming Vice-President of the United States of America).

The problem with using a highway for a metaphor for the ready access to all types of information is that it emphasizes the infrastructure rather than the benefits. In the final analysis, however, the mechanism for delivering information takes is far less important than considering the changes which will take place when every person on the planet has ready access to vast amounts of information.

A more accurate metaphor for the coming information age would be to visualize the world's largest department store or a vast stock exchange, many times larger than the New York Stock Exchange. The global information market will combine in one place a limitless number of means of exchanging goods, services and ideas. Information stored in a digital format will become the most widely accepted medium of exchange.

On a practical level, the global information market will impact on every human activity, giving people much broader choices in everything they do.

Just as the development of the printing press by Johann Gutenberg in 1450 changed Western culture forever, the coming information age will transform the culture of every country in the world just as dramatically. This transition will not happen overnight - it will take decades for the information infrastructure to develop and reach the mass market.

Bill Gates and Paul Allen managed to build Microsoft from a two-man shoestring operation to a company with 17,000 employees and \$6 billion in revenues mainly by having the vision to ask: "*What if computing were nearly free?*" In that situation, software becomes vitally important, and Microsoft always worked on the business premise that software is the difference.

At the present time, the relevant question to be considering is: "*What if communicating was almost free?*" The person or company who can best answer this question at present stands a very good chance of being able to best position themselves for commercial success as the global information economy evolves and matures.

### Key Thoughts

*"Little by little, the machine will become a part of humanity."*  
- Antoine de Saint-Exupery

## 2. THE BEGINNING OF THE INFORMATION AGE

### Main Idea

The information age will be noted for the development of high-speed, low-cost machines which can process and transmit information to any place on the planet. The genesis of the information age began when computers were developed.

### Supporting Ideas

Periods of history (such as the Bronze Age and the Iron Age) were named for the emergence of new materials used in tools and weapons. Yet, the concept of an Information Age seems vague simply because information isn't as tangible and measurable as the materials which have previously been used.

Already information is becoming vitally important - even as the cost of possessing and transmitting usable information continues to drop. In the present economy, the possession of information at a critical time can completely dictate the economic fortunes of a person, a company or even an entire country.

Most of the information currently being produced is being stored electronically. It may be printed on paper for ease of distribution at the present time, but most of it is now stored in computer databases. Information stored that way can be recalled, compared and re-fashioned at will.

Some of the key milestones in the development of computers which laid the foundation for the information economy are:

1642 The 19-year old French scientist Blaise Pascal invents the mechanical calculator.

1830s British mathematician Charles Babbage develops the "Analytical Engine" - a steam powered calculating machine.

1940s Alan Turing, Claude Shannon and John von Neumann develop the first electronic computer as a secret war time project. Turing contributed the concept of general purpose use, Shannon the binary system and von Neumann the concept of computer memory.

ENIAC (Electronic Numerical integrator And Calculator) was developed at the University of Pennsylvania to speed up calculations for artillery-aiming tables.

1960s The transistor was developed replacing unreliable vacuum tubes, and the concept of placing multiple transistor circuits onto silicon chips was pioneered.

1965 Bob Moore who was one of the co-founders of Intel predicted the capacity of a computer chip would double every year. His prediction has held true since that time. This has led to an exponential growth in the power of computers.

If Moore's Law holds true for another 20 years, a computation that today takes a day will be completed in fewer than 10 seconds. With that kind of raw computer power available, many of the technical problems now faced by mankind will be within reach.

Today, we stand on the verge of the digital information age - when communications technology will become completely digital. When that happens, communications will become subject to the same exponential growth which has characterized the computer industry.

## 11. RACE FOR THE GOLD

### Main Idea

From the headlines that regularly appear in business newspapers, you may be under the impression that the race to build the information highway has already been won. In reality, nobody has even reached the starting line yet.

The construction of the information highway will be a huge project with vast fortunes to be won by the companies which make the correct choices, but nobody knows for certain exactly what the general public will want from the highway yet. The public doesn't know because it doesn't have enough experience in the options that are available at this point.

### Supporting Ideas

Many companies are currently making huge investments in products and services that are designed to be used by the information highway. The only trouble is that in this field, as for anything which is still emerging, the public doesn't yet know exactly what it expects from the highway because it doesn't yet have a broad enough experience base from which to choose.

Therefore, at the present time, any investment in the information highway is at best an informed guess and at worst the result of hype and speculation. The only thing the business community knows for sure is that the companies which develop successful consumer products for such a vast emerging market stand to generate significant future revenues.

Rapid innovation is occurring on a number of different fronts to establish the style and content format of the information highway. Numerous companies are conducting small scale trials of various aspects of the future network, but most of these trials will simply identify other problems.

Using the personal computer industry as a model, most success came from small start-up companies run by people who were open to new possibilities the major companies ignored. The development and introduction of the broad information highway looks set to be market-driven, with numerous approaches being tried until one emerges as the de facto standard.

The concept that a government can design or dictate the development of the information highway runs counter to the experience gathered from the personal computer industry. At the present time, the information highway has generated zero revenue for any company in the world. It is, therefore, very difficult to invest in a product which does not yet exist.

Building the information highway will be a learning experience, with many failed ventures and false turns before the mass market emerges. Most success will come from small start-up companies which can either be a huge success or fail without repercussions.

By letting the marketplace evolve from this figurative melee, many different approaches can be tried simultaneously. About the only thing any government can actually do to help the development of the information highway is to deregulate its telecommunication industry and let market forces move the country forward. Any other approach is destined for failure.

### Key Thoughts

*"When hundreds of companies try different risk-taking approaches to discover the level of demand, society gets to the right solution a lot faster than it would with any form of central planning. The range of uncertainties about the information highway is very large, but the marketplace will design an appropriate system."*

– Bill Gates

## 12. CRITICAL ISSUES

### Main Idea

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### Supporting Ideas

The thought of the coming information based economy generally brings out the following questions for most people:

1. *How will everybody fit into the evolving information economy?*

The concept of evolving jobs and industries to most people means unemployment. The thing is that from the perspective of decades, the economy is always in an upheaval. There are always jobs being lost in one sector and created in another.

There are not a finite number of jobs in an economy. When the standard of living increases within an economy, more high quality jobs tend to be created and there are less low quality jobs. There is no reason to suggest the emergence of the information economy won't have the same effect again.

2. *What if the machines driving the information age become so smart they can do away with the humans?*

For more than two decades, scientists have been trying to create a machine based artificial intelligence - that is, a computer which has human understanding and simple common sense. It has proven to be totally impossible to achieve.

Rather, computers have proven to be an excellent tool for magnifying and leveraging the human mind rather than replacing it entirely.

3. *How will people be able to afford to participate in the information economy?*

By definition, the information economy must be within the financial reach of the mass market or it cannot exist. It will simply be a redistribution of the money people currently spend on the same goods and services in other forms.

Instead of buying compact music disks or seeing movies, everything will be redirected through information appliances that will deliver those products to you in exactly the format you prefer.

4. *How can you put a definitive price on information, on intellectual property?*

It can't be done using any established pricing framework. This is one of many interesting decisions that will need to be made by society at large as the information economy emerges.

Perhaps a system will be possible in which people with more assets pay more than people without. Or perhaps the price will vary from country to country. The options are numerous.

5. *What if people become so caught up in entertaining themselves nobody wants to do anything productive?*

Perhaps the system can have built in timing routines which allow you to limit the number of hours spent in entertainment areas each day. Or perhaps we can trust simple human nature which has always been that people derive a lot of pride from their career achievements.

6. *What if people around the world become highly dependent on the information network and a computer failure takes the system down?*

Computer systems can have a high degree of redundancy built in, so if one part of the system fails, another part will automatically take its place.

In terms of security of information stored on the system, computers have a good track record thus far. Most mistakes uncovered until now have been caused by human error rather than a failure of the computer security system. The key concept is to make any computer based system flexible so if it is breached, it can easily be changed to something more secure.

7. *What about privacy issues?*

This is definitely one area that will have to be worked out while the information economy is emerging. It will be among a number of judgment decisions that society as a whole will be required to make.

The information highway may also impact on the way political decisions like that are reached. Two way communication will be effortless, and direct voting will be instantaneous. Perhaps a direct democracy without the need for elected representatives will emerge. It will be possible.

#### Key Thoughts

*"I'm optimistic about the impact of the new technology. It will enhance leisure time and enrich culture by expanding the distribution of information. It will help relieve pressures on urban areas by enabling individuals to work from home and remote-site offices. It will relieve pressure on natural resources because increasing numbers of products will be able to take the form of bits rather than of manufactured goods. It will give us more control over our lives and allow experiences and products to be custom tailored to our interests. Citizens of the information society will enjoy new opportunities for productivity, learning and entertainment. Countries that move boldly and in concert with each other will enjoy economic rewards. Whole new markets will emerge, and a myriad new opportunities for employment will be created."*

– Bill Gates

*"Human history becomes more and more a race between education and catastrophe."*

– H.G. Wells

*"We are watching something historic happen, and it will affect the world seismically, rocking us the same way the discovery of the scientific method, the invention of printing, and the arrival of the Industrial Age did. The information highway won't solve every problem, but it will be a positive force in many areas."*

– Bill Gates

*"Big changes used to take generations or centuries. This one won't happen overnight, but it will move much faster. The first manifestations of the information highway will be apparent in the United States by the millennium. Within a decade there will be widespread effects."*

*You'll know the information highway has become a part of your life when you begin to resent it if information is not available via the network."*

– Bill Gates

*"Transport of the mails, transport of the human voice, transport of flickering pictures - in this century as in others our highest accomplishments still have the single aim of bringing men together. Do our dreamers hold that the invention of writing, of printing, of the sailing ship, degraded the human spirit."*

– Antoine de Saint-Exupery

*"When measured by decades, the economy is always in upheaval. For the past few hundred years, every generation has found more efficient ways of getting work done, and the cumulative benefits have been enormous. The average person today enjoys a much better life than the nobility did a few centuries ago."*

*Henry Ford, in the first part of the twentieth century, was the automotive industry, but your car is superior to anything he ever drove. It's safer, more reliable and surely has a better sound system. This pattern of improvement isn't going to change. Advancing productivity propels societies forward, and it is only a matter of time before the average person in a developed country will be "richer" in many ways than anyone is today."*

– Bill Gates

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