

Cyberspace—From Order to Chaos and Back

Cyberspace is much more than just web sites and discussion rooms. It will profoundly affect our business and social lives. Companies and other institutions will be decomposed and recomposed, with new power structures. The new order will be volatile. Empires will come and go with increasing regularity. Today's value chain will be barely recognisable in the future. Enabling the many lucrative opportunities will require a much faster network. Asynchronous digital subscriber line (ADSL) technology will not suffice for long. Also, company volatility will necessitate quick capitalisation before someone else with better insight or vision comes along. A much more efficient economy will come at the cost of us having to get used to very rapid change. Stability is historical.

Introduction

Many people mistake the Internet for cyberspace, whereas it is simply a network linking computers together. Cyberspace is actually that notional 'space' where transactions on the Internet take place. Cyberspace is a dynamic, developing concept. This article offers some introductory views of its current state and some indications of its future potential. Life experiences today are increasingly divided between the physical here and now and a 'someplace else' immanent in a virtual electronic space. The social, economic, and political lifelines of the world are now evolving almost exclusively within this electronic space. Here, for example, large corporate alliances busily coordinate their quest to balance efficiency, flexibility, and economies of scale. Here, data about consumer demand, production flows and finance is managed and shaped. Here is where our savings reside in bit form so that large banks and investment firms can fundamentally mould our lives. Here also is where the new activists reside, hidden from media view; in their invisible communities they plan and organise until their presence explodes into the physical world. This virtual world is thus a place in which we already live.

A telephone call can be thought of as simply a virtual meeting in cyberspace.

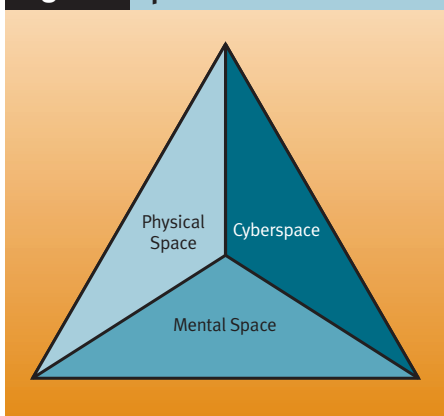
Likewise, virtual reality environments are commonly considered as cyberspace. But cyberspace is composed of far more than the much-hyped Internet or new virtual worlds. It is the total communications space that saturates our lives. It all adds up to an existential sprawl so vast and ubiquitous as to seem unmistakably 'real'. Cyberspace is the information space of modern society. It pulses with blasts from the sophisticated production studios, satellite uplinks, digital delivery systems, and receivers of the global media. It is the society of the spectacular. The irony, of course, is that the more 'wired' we become as a society, the more dependent we grow on the mediating technology. Despite the steady hyperbole about how networked virtual worlds will render the mental landscape of our electronic culture uniquely visible, the essential point about the Internet is precisely its growing invisibility.

But its roots go deeper. Cyberspace refers to the emulation of physical space in electronic environments. As the Internet continues to grow, electronically mediated environments will expand and 'physical place' will become less important. Mathematicians use the term 'space' to describe complex systems. In very complex systems, spaces acquire their own unique dynamics, as they require extremely high dimensions to be described. Many complexity theorists describe cyberspace as an emergent phenomenon whose properties transcend the sum of its component parts. Cyberspace is therefore a place outside physical space.

Part 1—An Introduction to Cyberspace

In the beginning there was the physical universe. When intelligent life originated with the capability to internalise a representation of the physical universe, mental space came into existence. When it became possible to electrically link together devices that were physically separated, cyberspace came into existence, the notional space where some kind of electronic transaction takes place (Figure 1). A telephone call is a meeting in cyberspace. Strict definitions might demand that some representation of the notional space must exist in the

Figure 1 Space domains



machines at either end, such as a virtual-reality environment, but this definition is unduly limiting when considering the potential of this new domain.

Much of the brain is dedicated to imaging the outside world, and then internalising the information from those images. Our thinking is dominated by visual analogies, so cyberspace can introduce us to new ways of thinking in a networked world. But we only explore the tip of the iceberg in applying spatial analogies to networked systems. We will find many more opportunities when we can think outside the box.

In the physical world, geography dominates. In cyberspace, time and connectivity dominate. Geography has little importance in cyberspace.

Physical space

Of these spaces, we only understand physical space very well. It is governed by laws of physics and is highly geographical or time constrained. Shops and distribution outlets rely for their existence on the geographical limitations in the physical world. The inconvenience of distance makes direct buying from manufacturers difficult and creates a wholesale industry. Similarly, the physics of displaying many diverse products, in easy-to-compare ways, creates a retailing industry.

Mental space

We understand our own mental space quite well, but there is much we do not understand since our attention is normally outwardly directed. Understanding and trying to manipulate the minds of other people has been addressed by billions of person-lifetimes of effort, still with limited success. However, there are of course many areas where we all agree. Human knowledge and culture are full of shared concepts. We agree on what to call a red ball, and share the concept of a filing cabinet. From time to time, a new concept is created by someone and spreads to other people's minds to become part of their mental space too. They take a lot of time to spread and often the original concepts are modified substantially as they spread, so that many people have slightly different views of the same space. This helps creativity and new ideas, in the same way as mutations spur on evolution, but interferes with, and degrades the quality of, communication.

Physical—mental mappings

Because of the significance of physical space, we each hold a mental picture of the geographic world, its various structures and behaviours. However, although our models need to be sufficiently similar to those of

other people to allow exchange of information, they do not have to be identical. I might not have noticed a building or feature that forms a central part of someone else's model of a particular street.

We also conceptualise fictional entities. We imagine structures, and make them. Mental space includes many imaginary items. We use shared mechanisms for storing abstract knowledge, and build on these abstractions to develop and share more abstractions, such as higher mathematics or works of art. The foundations for human mental space growth are thus being continuously laid, but still mostly based on geographic thinking. But there are other limitations to inventiveness. No one could have imagined most of today's technologies in the 10th century because even the basic building blocks for the concepts did not exist then. Mental space grows from existing seeds, from recombining or modifying existing concepts or transferring and applying concepts from one area in a different area. Since today's historic institutions are designed for the geographic world, and because our minds are designed to cope with it, we find it very hard indeed to think freely about a world where geography does not have the same significance.

Cyberspace

Today's cyberspace is founded on physical and mental spaces. We already have cyberspace emulations of the physical world: shopping arcades, chat rooms, tourism, virtual cities, libraries, banks, magazines, newspapers. We have complex virtual environments where we can meet others. Our web sites are our little patch or place in cyberspace. Some of it is very physically oriented. We do not care that this information is in Australia, this picture in Sweden, and this chat room in the US. But in our imaginary meeting areas, it is as if we were still limited by real-world physics. Spatial relationships are preserved and objects largely behave in everyday ways.

But the net also echoes our mental world. We see advertising, security and encryption, which have little physical world root. Also language translation, information processing, and a few abstract information representations or interfaces. But we are just beginning to scratch the surface. Just as we can have whole fields of human knowledge and culture that do not explicitly have any mapping onto the physical world, so we can have infinitely more in the cyberspace domain than mappings from physical space and from mental space.

Most of today's companies think the net means they just have to put up a decent web site, install an e-commerce capability

and then continue as they are. They do not appreciate its full potential for change. The infinite potential of cyberspace will mostly have to wait for us to catch up. Nonetheless, in due course, machine intelligence will invent many of its own concepts and execute those, sharing with us or keeping them within the machine world. This is already happening with computer-based design, evolving software, artificial life and so on, but this is just the beginning of the flood. For now, we mostly map existing concepts, hoping for occasional flashes of inspiration and cross-fertilisation from other fields. Computer-based intelligence and creativity is still too much in its infancy to contribute significantly. Cyber-creatures and other forms of computer-generated life will come later.

Until we start the cyberspace reconstruction of our world in earnest, it is in the mapping of existing physical and mental entities and processes that much of the rewards will lie. Since cyberspace is relatively new, this mapping process is still in its early stages, and it is requiring a great deal of experimentation to discover which mappings are worth making and in exactly which form.

Cyberspace is spatially and temporally disjointed.

Characteristics of cyberspace?

Cyberspace is not just the computer's 'mental space', although this is certainly a large component of it. Some parts of cyberspace can still exist when the computer is off. It is a higher-level construction, of which human and computer mental space are two important types of building blocks, but not the only ones.

Cyberspace is spatially and temporally disjointed. When someone plays in a virtual world on an isolated machine, that virtual world is certainly part of cyberspace, but is not connected to any other part. By contrast, no part of the physical universe is completely isolated. Some parts of cyberspace spring in and out of existence when machines are switched on and off, or programmes activated or closed down. Links in time can be backwards or forwards. Normal physical laws of causality need not be observed, and processes need not be played out in physical time.

It is asymmetric. When the network is reconnected to the above machine, that part may be connected to the rest of cyberspace either uni- or bidirectionally, so that the user may be able to see out with no one permitted to see in, or vice versa. Also, a

select group of people may be able to see in, perhaps to different degrees. This is no different conceptually from someone allowing a group of people a key to their front door, or being able to go outside while not permitting anyone entry.

Appearances are not fixed. While we all might agree that a ball is red, a cyberspace entity might present itself differently to different viewers, in different conditions, or at different times. A virtual shopping arcade might be a cosmic landscape with floating shops staffed by weird aliens to one user, while being a conventional 1980s mall to someone else. Both could buy the same products, though perhaps in very different ways.

Physics is optional and customisable. There are no God-given rules as to how things should behave or interact, and there is no absolute requirement for consistency of behaviour. Imagination and skill are the only limits and variability of behaviour may be a desirable option.

The roles of time and space are reversed relative to the physical world. While space and distance are dominant in the physical world, time and delay are dominant in cyberspace, while space is irrelevant.

Figure 2 shows the many degrees of freedom in cyberspace in many dimensions. Although this figure is by no means exhaustive, the numbers of permutations is already in the trillions. Most of these options will never be explored, even once, by anyone.

What use is it?

The main advantages of cyberspace are the absence of real-world restrictions such as time and space, its potentially infinite extent, and the resultant scope for facilitating physical and mental business, social and personal processes that would otherwise be impossible because of the constraints of these two domains.

Cyberspace allows people to share a meeting even though they are geographically dispersed. It allows a limited form of telepresence, where a user can see or do things as if he were in a remote location. The only real limitation is that of course it does not allow for direct manipulation or transfer of atoms so the user has to rely on signalling to persons or machines to do this.

The main advantages of cyberspace are the absence of real-world restrictions such as time and space

Figure 2 Cyberspace dimensions

World Real Rearranged Recorded Customised Sanitised Synthetic Representational Imaginary Mixed	Physics Real Textbook Customised Sanitised Synthetic Imaginary Variable Random Mixed	Presentation Universal Personal Group dependent Role dependent Position dependent Mixed	Time Consistency Stable Dynamic Cyclical Variable Random Mixed	Blend Pure Overlay Substitutional Mixed	Immersion Screen 2d Screen 3d Partial immersion Full immersion Full sensory immersion Mixed	
Navigation Fly to Paths Regional Free Guided Mixed	Access Closed Open Hierarchical One way Duplex Mixed	Control Read Write Modify Move Add/delete Mixed	Instance Whole self Role Multiple Lurker Viewer dependent Variable Mixed	Appearance Realistic Substitutional Cartoon Symbolic Invisible Multiple Viewer dependent Variable Mixed	Driver Self Proxy Agent Recorded Learned Mixed	Owner Presenter Viewer

It allows conceptual entities and processes to interact freely independent of their physical location or manifestation. This is tremendously important as it means we are unconstrained by today's business and social structures. Companies that have evolved in the physical world may have no reason to exist in a cyberspace dominant world, and certainly we should challenge every aspect of our familiar world to see if there is a better way of achieving our goals.

Cyberspace—physical feedback

Although cyberspace is not directly linked to physical geography or building design, the behavioural characteristics of cyberspace may often be affected by the delay in the physical world, which is linked at least in part to geography.

Parts of cyberspace that have a larger delay between them will generally have a reduced range of capability. The large part of the increase in computer power so far has come from decreasing component size, resulting in decreasing path length, hence faster clock rates and execution of instructions. Increasing distances between components of a process, however it is caused, will reduce performance again. Obviously, networks have to cover large distances and nothing can yet be done to reduce transmission delay below that given by the speed of light, but even this limits the range over which applications can be usefully implemented. For some applications, anything other than execution on the same chip will introduce a significant drop in performance, whereas others will remain tolerant of delays in the regions of seconds or even minutes.

Wherever we draw the line, there will be some markets to which we will not have access.

While there is much talk of increased teleworking for people, the latency problem may ensure that some processes remain in

the office, and offices remain in the city. For stock-market applications, information decreases in value extremely quickly, and just a microsecond difference will soon be significant. There would thus be a premium on gaining a site as close to the centre of information as possible. Possible approaches to this include charging for guaranteed rapid delivery, or charging for simultaneous delivery, or to own the best centre of information.

Part 2—Institutional Evolution in Cyberspace

So cyberspace is different to the geographic world, and need not be constrained by geographic-world thinking. Over the next decade or two we will see a massive deconstruction and reconstruction project as we make use of cyberspace to get the most out of our world. Existing companies put up web sites, and even today's entrepreneurs are often crippled by having been taught old-world thinking. Over the next few years, we will see a new generation leaving college with little prejudice about how systems should be organised. Having been brought up in an IT-dominated world, they will look first to IT-based solutions. They will be native cyberspace thinkers. They will have seen the turbulence caused by the Internet and will not assume that the best way to build a system is in any way related to today's. While today we mainly see ongoing automation and some disintermediation, tomorrow we will see very different structures.

So begins the decomposition phase of the Internet (Figure 3). If we look at most companies today, we see a mixture of functions. Some of these have to take place in a particular factory or building or place. These are the statics. They are fairly immune to the impact of the net, since they

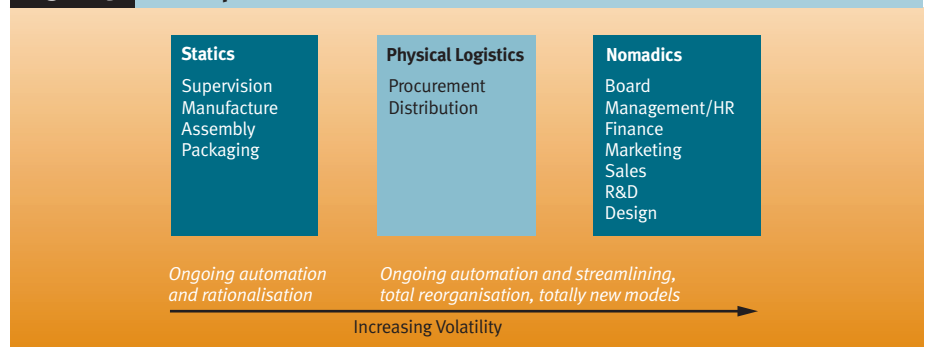
cannot easily be uprooted and moved elsewhere. They will change slowly, as they do today. The actual manufacturing processes in an industrial company is a good example. However, the organisation of this, right down to organising the date for the machine tools, is not static. If we look at other functions such as procurement and distribution, they certainly have a geographic element, but they can be organised from anywhere. A truck has to drive along a road, but might get its route information from anywhere. The other processes in a company such as finance, personnel management, sales, research and development (R&D) and so on, could be based anywhere. Decomposition will allow a complete disassembly of the functionality right across our business and society. From now on, there is no reason for all these processes to exist in the same location. Outsourcing was the beginning of this process. The net will allow processes to be combined in optimal ways regardless of historic business structures.

Decomposition is of course accompanied by recomposition (Figure 4). We will still need most of the functionality of today's systems; however, they will be organised differently. It is likely that statics will remain mainly as they are today, though we will of course see more of the ongoing processes of automation and collaborative manufacturing.

The logistics side of businesses will be revolutionised. With a mature and ubiquitous e-commerce/e-business infrastructure, organisational units and processes will mostly have standard interfaces. Super-efficient logistics companies will organise processes on a global scale for millions of businesses. They will be the best of class, and we will not need very many of them. Wholesaling and retailing exist today because most manufacturers do not have the means to organise delivery to the individual customer. In a cyberspace world, this will be organised by a remote logistics company. Customers will decide what they want and the logistics company will find or organise its manufacture, collection and delivery. This will rely on many physical distribution and storage providers, but their selection and coordination can reside anywhere.

But most of the departments in today's companies might just disappear into history, or change beyond recognition. Many of the administrators just are not needed in a cyberspace-dominated world with masses of machine intelligence in the background. E-commerce will produce easily traceable audit trails, and statistics by the database-load. It will be able to arrange and record most things automatically. We will need very few accountants or auditors, very few

Figure 3 Decomposition



managers and very few clerks. Almost all of their roles can be automated. Most sales will be arranged between agents, and the organisation of the system needs far fewer points of sale in any case. Managing personnel in such a world can be very lightweight too. Not because they will be any more pliant, but because most of us will work on short-term contracts on particular projects, freelance. People with appropriate skills will log them in e-commerce databases, and they will be contracted when an appropriate job needs to be done for which they are suited. Of course, their 'suitability' includes a host of factors. Even the board is not guaranteed survival. People will lend money on the net according to various parameters. Loss adjusters, risk assessors and so on will help this process. Virtual companies will spring up using this capital pool, and managers will be employed on the same virtual company basis as any other staff to implement or oversee the implementation of the system.

So the virtual company, or virtual cooperative has no need for a department of permanent accountants. If and when the virtual company needs some finance function that cannot be fulfilled automatically, an accountant will be contracted to provide it. We might of course have some companies that specialise in those particular skills, and they may link to many virtual companies. We could see specialist marketing companies, assimilators, interfacers and so on. Even functions such as R&D may be more

commonly arranged as separate entities than being full-time parts of a specific company. It is very rare indeed that the fruits of research are appropriate to only one company, and the net allows the results to be marketed for maximum reward.

But we might see an alternative structure—the *knowledge guild*. The guild simply guarantees the quality of the workmanship of its members. Members get work. These might evolve from today's guilds and professional institutions, but will be much more powerful, because they will be global, with all the advantages of a network community (see future power structures). Apart from the guilds, we will see a great many genuine individuals, whose specific skills or attributes guarantee them a privileged position in the new order. The guilds will be for the new middle classes, while the elite will be those with rare or unique skills.

Volatility

As we move from statics to nomadics, we see increasing volatility. The share prices we see today for many Internet companies are much too high because they are very volatile. Yahoo may be doing very well today, but if a trendier site appears tomorrow, they could lose market share very quickly indeed. Their company is probably worth a tiny fraction of its current valuation, and the same could be said of many others. They are only as good as their next front-end revamp. The real value is in creating an appropriate market image

Figure 4 Recomposition

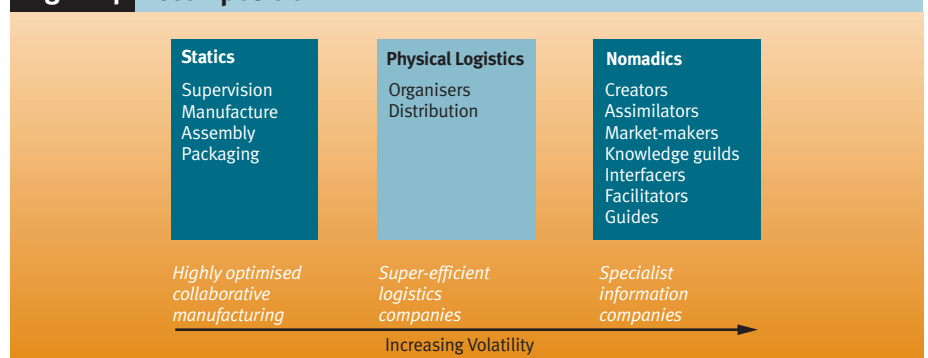
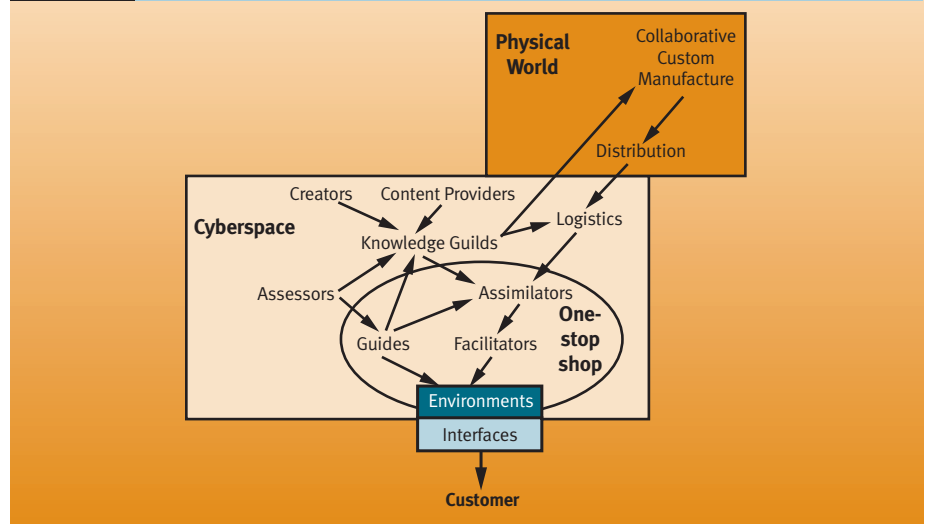


Figure 5 Cyberspace value chain



and keeping up with fashion. Their existence depends also on the nature of the browser. If it were replaced by a cyberspace browser with a 3D mall style interface, they might disappear into oblivion if they could not adapt fast enough. Their volatility is very high. The cyberspace world will be very dynamic. Empires will rise and fall with great regularity.

The value chain in cyberspace will evolve too (Figure 5). Customers will have a wide choice of interfaces through which they enter cyberspace—whether mobile communicator, three-dimensional booth, interactive TV or a computer screen or whatever. Providing a wide range of usable interfaces to cyberspace functionality will be big business. The interface will take the user into some sort of personal cyberspace environment, which could be anything from a simple list on a cellphone to a fully three-dimensional virtual-reality space. Translating a multiplicity of forms of Internet data into a wide variety of personalised interfaces will keep interfacers very busy indeed.

The Internet already has a huge amount of functionality and it is rarely obvious which is the best site to go to or the best product to pick. Guides will therefore play a very important role, as will facilitators, who will help users do what they want.

Assimilators will bring together the functionality that the user wants. Today we have portals that do some of this, but really, with increasing complexity in everyday life, users will want a one-stop shop that offers to unload from them all the hassle of organising their everyday lives. Quite simply, the one-stop shop will manage just about everything for the user—diary, appointments, social life, business life, home management, contacts, finance, shopping around, buying, booking, getting information, news and providing chat, entertainment, travel, hiring—the list goes on and on. This will be the future of the portals. But they will look nothing like portals or the personalised services we have today.

Outside of this customised personal cyberspace, knowledge creators, guilds and quality assessors will provide service to the one-stop shop. Logistics providers will organise acquisition of goods and services that the user buys, including of course collaborative custom manufacturing and its distribution.

What we won't need

It is clear that many of today's institutions are unnecessary in such a world, where an almost optimal system will provide our every need at minimum cost. Shops may become try-on outlets as people go there simply to try clothes on before buying direct from a customised

manufacturer in exactly their size. Even today's e-tailers are just old-world shops in new-world clothing, as are the vast majority of corporate web sites, trying to keep obsolete companies hanging on in a world that does not need them. Most will vanish as cyberspace thinking makes them redundant. We will not need banks, building societies or insurance companies, just the risk assessment and loss adjustment that they provide. With digitised cash that can be stored in secure databases enabled only by digital signatures, our computers can manage our cash easily, buying and selling it, calling in appropriate services as necessary.

And best of all, we will not need mountains of administration. With globally standardised processes and interfaces, and with all our data electronic, almost all of it will be automated.

Part 3—Personal Cyberspace

Most people will have their own little patch of cyberspace, even if it amounts to no more than an answerphone message. Usually, they will interface with the rest of the net via their own area. They may maintain many zones with a variety of privacy attributes, echoing the range of different roles that the personal plays. Some will be completely personal and secure, other shared with family or with close friends, others with business colleagues or members of a club. Users will be shielded from the cacophony of information noise by a multiplicity of smart filters and translators.

But people like to talk more than to listen and we can expect people to want to make their mark by transmitting into cyberspace as well as receiving from it. This ego-echo will challenge the assumption that lines to people's homes should be asymmetric with more data travelling to the home than from it. It may be the other way round! Their personal area would appear differently to other people depending on who they are, where they are, and when they are looking, as well as on that viewer's personal interface characteristics.

Personal cyberspaces will interact with each other and of course we will have group cyberspaces too.

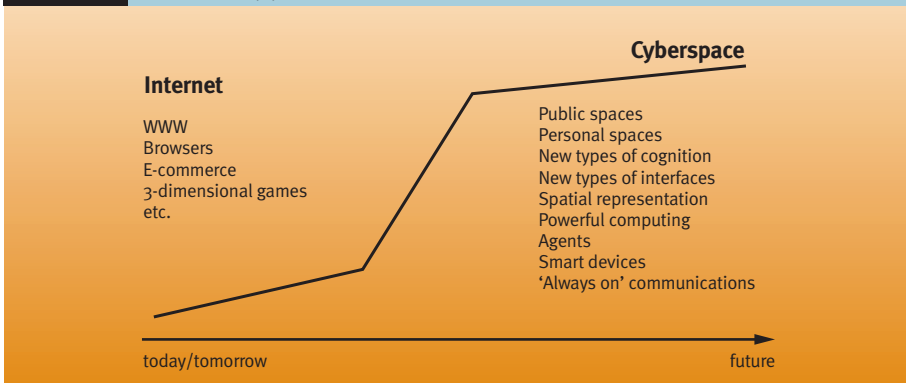
Remaining opportunities

In spite of the large number of Internet start-ups hitting the headlines every week, there are still many opportunities left (Figure 6). Here are just a few:

- Some of those identified above—the one-stop shop, guides, facilitators, organisers and assimilators are largely untapped today.
- Knowledge guilds exist but are using the wrong models so far
- Historic quality guarantors exist but are not well developed on the net, yet the net can never achieve its full potential as a reliable information source without them.
- Lifestyle management is completely green field today but will be an essential component of our lives in a decade.
- Competent proactive search engines have been on the horizon for years but still

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Figure 6 Evolving opportunities



have not happened. Push technology is a failed attempt in this direction.

- Providing interfaces that maximise what can be achieved through a thin medium such as portable communicators will be very lucrative.
- Building and renting visual cyberspace environments exists and is developing well. However, there are huge associated markets in tools and assistance.
- Putting customers in touch with the best customised manufacturers is an obvious application, but is almost invisible. Today's net models are still almost all minor adaptations of conventional retailing.
- Provision of standard business procedures and interfaces is developing but there is still no easy way of automatically linking existing resources and facilities together into virtual businesses. There will be.
- Supporting this will be huge resource databases, again almost non-existent today.
- Identifying niches could be done almost on the fly by the e-commerce environment. It would be fairly easy to spot areas where local distribution is a problem for instance.
- Telework centres, where people can work for virtual companies from a nearby hot desk instead of trying to work from home, barely exist, and the few that do often use the wrong models.
- Trust-based distribution is another opportunity—someone has to provide the function of delivering at a convenient time, instead of expecting householders to stay at home waiting for delivery.

Part 4—Engineering Cyberspace

The Internet is not a global superhighway. It is a machete-hacked footpath through the information rain forest. Table 1 explains part of the reason, based on a user with a high-end PC, using the highest-speed domestic access.

The bottom line clearly shows that computer performance is racing ahead of network capability, so the network is getting relatively worse. Although the technology to transmit tens of megabits per second to the

home over optical fibre has existed for a decade, the access network of tomorrow will be even more of a bottleneck than it is today. While we continue to delay the deployment of fibre to the home, with low cost and high bandwidth, cyberspace and its boundless potential will remain embryonic. Simple substitution arguments would suggest that not only is a high-speed fibre-based network economic, but would pay for itself in a very short time. Meanwhile, huge revenue opportunities remain unexploited.

Today, people access the net via an Internet service provider (ISP). Tomorrow, the network will be IP-based so any computer or communicator will be able to access the Internet directly. ISPs will have no reason to exist. Some may survive as portals or one-stop shops.

Asymmetry might be the reverse of the assumption underlying asynchronous digital subscriber line (ADSL). People running their own cyberspace presence from home may need more upstream bandwidth than downstream. The network will have to cope with this.

Privacy and security will be important factors. We cannot expect each individual to be an IT expert, so the infrastructure will need to provide simple means of guaranteeing these hygiene factors.

Finally, mobility will be important. Universal Mobile Telecommunications

System (UMTS) will allow people to access the Internet at relatively high rates within a few years. As people become accustomed to always being in touch with the Internet, they will depend more and more on it. Being in an area with a poor signal today is annoying, tomorrow it will be intolerable. Providing truly ubiquitous access will be an essential characteristic for mobile networks that wish to survive.

Colonising cyberspace—developing a new economy

In a companion paper in this issue¹ an economic view of the information economy was presented. In this section, a more speculative view is taken, which draws on biological metaphors. In contrast to mainstream economics, which sees the world essentially at equilibrium, biological metaphors see the economy as a system far from equilibrium and in constant change. A static view of economic and commercial systems is transformed into one which is characterised by evolution.

The two themes of this section are:

- Commercial change is driven by the interplay of new business opportunities with the physical, mental and cyber spaces.
- Cyberspace is relatively undeveloped compared with the physical and mental spaces, and can be pictured as a new territory to be colonised by new species.

The bottom line clearly shows that computer performance is racing ahead of network capability, so the network is getting relatively worse.

Table 1 Relative network bottleneck

	1981	1986	1991	1996	2001
RAM	32 k	500 k	8 M	64 M	640 M
Computer speed	0.1 MIPS	0.5 MIPS	8 MIPS	200 MIPS	3000 MIPS
Aggregate file volume	256k	2 M	80 M	2 G	100–200 G
Terminal access rate	–	10 Mbit/s	10 Mbit/s	10 Mbit/s	32 Mbit/s
File volume/LAN speed	–	1.6 s	64 s	0.44 h	13.9 h
Telco line rate	–	2.4 kbit/s	9.6 kbit/s	28.8 kbit/s	1 Mbit/s
File volume/access rate	–	1.8 h	18 h	154 h	444 h

At present it is empty; over time it will develop a rich 'ecology' of novel organisations and institutions which will interact to form a cybereconomy.

Commercial change

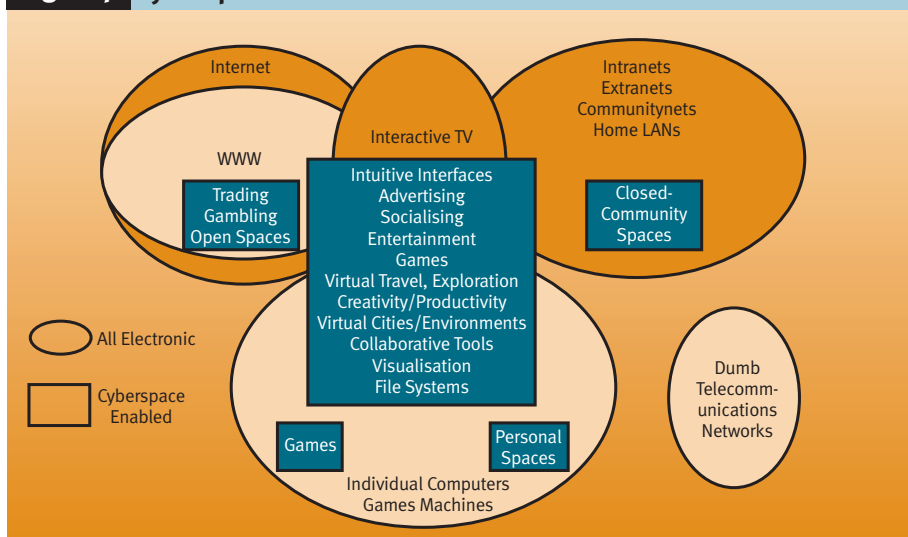
Although assumed almost a right, the causes of economic growth are far from understood. Growth in labour and capital are only responsible for a small fraction of total economic growth. Technological progress is a key factor, but is estimated to be responsible for only 20–50% of total growth. The economist Paul Romer suggests that 'Economic growth occurs whenever people take resources and rearrange them in ways that are more valuable'.⁷² He points out that the number of ways resources can be arranged are multiplicative, not additive. Thus, in a simple model where there are N resource, each of which may be used or not to form a new economic good, the number of possible combinations is 2^N . Of course, not all combinations will make commercial sense, and there is more to a product than simply 'mixing ingredients', but the message is clear: the more technology develops, the greater the number of goods which can be combined with existing goods to provide an explosion of new possibilities.

Marketeers emphasise the need to meet customer needs. But customer needs are not a constant. True, there are some basic needs: food, water, shelter etc. which must be met. But the vast majority of goods and services offered in the marketplace have little to do with meeting these basic needs. There is a constant interplay between the products and services which are created and marketed in the physical space and the needs they meet in the mental space. New products create new needs. For example, the Sony Walkman is a classic example of a new product which created an unrecognised (and probably non-existent) 'need'. In the future, Rolf Jensen has suggested we will live in a 'Dream Society' in which successful products are those which appeal to people's emotional needs and aspirations⁹.

We have, therefore, two spaces—physical and mental, in which products and wants are co-evolving. Cyberspace opens up a third space which can interact with the others. Cyberspace changes the way we interact with each other, and the way we

Technological progress is a key factor, but is estimated to be responsible for only 20–50% of total growth.

Figure 7 Cyberspace markets



can interact with the physical world. As new ideas are developed in cyberspace (Figure 7), they can create new consumer wants in the mental space, and also interact with the physical space to create a vast new range of possible hybrid products and services, which in turn create new needs in consumers and yet more product ideas. Because the possibilities are so vast, it is impossible to predict all the products which may be developed, or which will be successful. All we can be certain of is that the range of possibilities is increasing all the time.

In the long run, the stream of new product opportunities will ensure continuing economic growth. But cyberspace may also increase the rate of growth. Because there is no geography, a new product can be marketed world wide in seconds. Ideas spread more rapidly and as more people are connected to cyberspace, both the number of ideas for new products will increase, and the rate at which these are generated.

Developing the cybereconomy

Isolated volcanic islands, such as Hawaii or the Galapagos Island, started as barren rocks, yet they now support rich ecological systems, with many unique plants and animals. In the beginning, animals and plants arrived by chance from other, existing ecologies. But over time these species evolved in their own unique way, to form species found nowhere else.

Such a picture is an analogy to what is happening in cyberspace. At present, ideas and concepts are being migrated from our existing physical and mental spaces, to cyberspace. Many of the ideas being tried out in cyberspace are deliberately modelled on physical space equivalents. Thus we have seen cyberspace 'shopping malls' and electronic chat 'rooms'. Many of the new businesses developed on the Internet are exploiting the possibilities of cyberspace to

reduce transaction costs, in order to market and distribute goods in the physical world. In other words, the initial businesses in cyberspace are derived from and supported by the physical space or 'real' economy. Some parts of this economy have, in reality, already moved to cyberspace. Money is no longer a physical commodity (such as gold) but information stored in computers around the world. Similarly, the trade in stocks and shares is primarily one which occurs in cyberspace. And as more people become involved in cyberspace, so direct trading in these instruments ceases to be the preserve of specialists, but open to everyone.

At present, the activities which generate money are largely supported by activities in the physical world. By and large money flows through cyberspace, but is not generated in cyberspace. But as more cyber-businesses are created, then increasingly money will be generated by economic activity occurring solely within cyberspace. These businesses will explore more of the commercial possibilities offered by cyberspace. In addition, the development of these businesses will change people's desires and expectations. These changes will in turn alter the commercial environment of individual businesses. A new business will start and grow by serving a niche market. As it grows it will change its commercial environment: some firms will continue to do good business in a specific niche. Others will grow to dominate particular sectors, but many will decline and fail.

Change is characteristic of all life. But in the natural world, evolution does not occur at a constant rate. There are periods when the ecology is relatively stable, and evolutionary change is slow. At other times, evolution is very rapid, with many species developing and declining over a short period of time. In many cases, these burst of activity have occurred after a mass extinction event,

The emergence of cyberspace is a new business

world in which many new forms of business may evolve.

when many new niches suddenly become open and are waiting to be filled. The emergence of cyberspace is a new business world in which many new forms of business may evolve. Some, if not all of these, will also affect the way businesses in the physical world operate. Figure 8 shows Michael Porter's model of the strategic forces which can affect a company's growth and which have to be taken into account in developing a strategy. Underpinning this strategic approach is the assumption that the forces do not change too rapidly. If the substitute products arise, buyers needs and power change, or new entrants can emerge at a faster rate than strategies can be implemented, then strategic planning no longer has meaning. In cyberspace, the strategic landscape is changing all the time. New players and new business ideas will be emerging constantly. Rather than thinking of corporations planning for the future, it is better to think of new business ideas as a search mechanism, where the search is for a viable business niche. But because so many new ideas are being developed and will be developed in the near future, no company can be certain of its commercial environment, even in the short-term. If companies are to succeed in the long-term they will need to be constantly innovating. As the cybereconomy becomes larger, some areas will start to stabilise. At present, all cyberspace is frontier. But eventually, more permanent business forms will emerge and the frontier will move to new areas of human and business need. As the environment becomes more stable, the focus of companies will alter. Instead of a focus on change and constant innovation, there will be greater emphasis on efficiency and cost reduction.

However, change is always a threat. Even in the physical world the average life of a company is around 25 years. As Arie de Gues⁴ points out, those companies which have histories of a hundred years or more have survived by radically changing their core business over time. They often set up small subsidiaries in new business areas. Some will fail, some will be sold off, but one or two may grow to become the company's new core business. In cyberspace, change will always occur more rapidly, as there are no fixed assets which have to be depreciated or sold off. All businesses will have to develop structures which will not only enable and encourage innovation, but also nurture that innovation to the stage where it is a viable business.

Because there are no physical assets in cyberspace, it is easy and quick to set up new businesses. This fact, coupled with the primacy of innovation in maintaining competitive advantage, means there will a shift in power away from owners of physical capital, towards those who possess the intellectual capital. The trend, especially in the US, towards paying people by stock options may, at present, be driven by financial considerations but in the long term it is reflecting the reality that the true owners of a cyber-company are its employees.

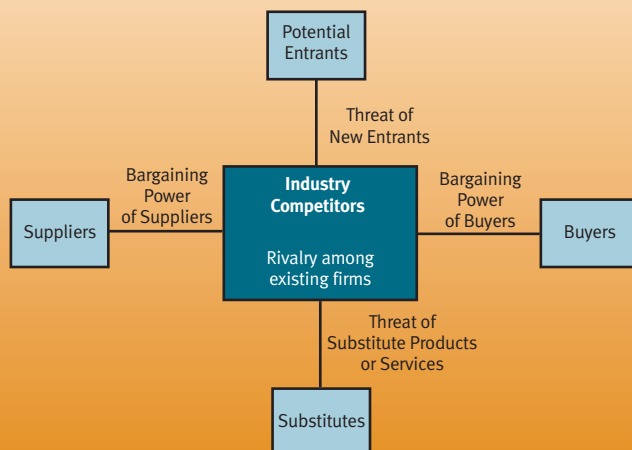
If one source of power is the intellectual capabilities of individuals, another source derives from the ability or inability of individuals to navigate through cyberspace. Although there is no geography in cyberspace, in the sense that there are no fixed relationships between entities, all who inhabit cyberspace will need to navigate within it, to access information, services and other inhabitants. Because there are no

fixed relationships, each inhabitant will develop his/her own geography. In one sense, this gives considerable freedom to individuals. Because there will be so many routes to any entity (piece of information, service, etc.) it will be impossible for a government, or even a single cyberspace authority, to control what is accessed. If it's in cyberspace, then anyone can access, duplicate and publish it.

However, if access is uncontrollable, search is not. The very size of cyberspace means that a considerable power will reside in the portals and search engines people will use to explore. Already, marketers are recognising that in the future, the key problem will not be getting their message across, but gaining enough attention from people to even tell them your message. And as more information is thrust at people, so they become more adept at ignoring that which does not grab their attention. For a new and struggling company, then, the most difficult problem will be highlighting your existence to your potential customers. Those who control the portals have the ability to determine whether or not most of your potential customers will ever know of your existence, and in the rapidly evolving cybereconomy 'word of mouth' will, in most cases, just be too slow. In this world, branding will also be important. A brand will not be a product, but an assurance of quality for a wide range of products and services (rather as Virgin is attempting to be). But brands may not just be owned by large corporations. Groups of small companies could group together under a common brand (rather like Best Western in the hotel industry). Such groupings would not just guarantee quality and possibly provide navigating/portal facilities to potential customers, but would also actively market their members and provide a route for new entrepreneurs, once they had satisfied the membership requirements, to enter into the cybereconomy. Here we have the economic equivalent of the herd.

As the cybereconomy develops, change will become ever faster. In this world, the way in which many present businesses currently work can only lead to failure. There will be no time for business cases. Businesses will be forced to recognise that the only advantage is first-mover advantage. They will constantly launch new products, and be forced to accept that only a few will succeed (rather like a film studio or publisher). Successful companies will be those who can manage the innovation process—exploiting the successful ideas, and controlling the costs of the failed projects. There will not be time to plan—since the world will change too rapidly. A company like 3M, which has a policy that

Figure 8 Porter five-forces model



Biographies

30% of its revenues should come from products less than four years old, will be the norm. Indeed, the four-year timescale will seem hopelessly pedestrian. Truly, in this world *'In delay there lies no plenty'*. Where only the innovative survive, companies will be forced to recognise that those who can develop and implement new ideas, or can sense what consumers will want next, are not just their most important assets, but their only assets.

At present, our pictures of cyberspace are heavily influenced by the physical world. However, as we spend more time in cyberspace, so will our mental constructs evolve and in time influence the way we think about our mental world and the physical world around us.

Conclusion

Unlike the natural world, humans devised cyberspace. Whereas nature is found, cyberspace and its properties are constructed for human use. Therefore we have to think in terms of 'engineering' cyberspace in the same way we engineer other complex human artefacts.

Until recently Cyberspace has been devoted to the relay of text, numerical information, graphics and simple video. But electronic spatial environments themselves will increasingly become subjects for design. A fundamental feature of cyberspace is its interdisciplinary nature. Cyberspace is particularly rich in artistic content and in many ways has more affinity with media subjects than engineering ones.

The development of portals serves as a good example of this feature. Portals may be conceptualised as environments within cyberspace. If portals were merely text-driven spaces then their popularity would be limited. They are, in fact, becoming multimedia-rich design zones. We have to rethink our design parameters for such environments and the ways in which we link them to the underlying software and communication architectures.

In cyberspace nothing is given. The spatial experience is a conscious choice and requires an investment of effort and resources. The strategies for these spaces require us to determine their content as well as their containing spaces in much the same way as architects are aware of the ergonomics of people and movement when designing terrestrial buildings.

Cyberspace offers designers no such certainties. Users may occupy several spaces simultaneously. Many alternatives are available to users of these spaces, and designers must anticipate each choice, constructing the experience for consistency and grace. Furthermore, this design must be

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coherent from one space to the next and from one state to another. This might require designers to think like the director of a film, unifying content, movement and transition through careful design. Similarly, the architecture of cyberspace is more like the space of our dreams, where our environment is complicit with us anticipating our actions and responding to our states of mind.

Conventional architecture of the physical world can only provide passive amenities. Architecture of cyberspace is a dynamic, changing environment that if well conceived attends us in everything we do. Cyberspace has to reflect the intrinsically human quality of space, its role in thought, communication and identity. Through its perceptual and cognitive realms cyberspace extends us beyond ourselves to others. This is the potential strength of cyberspace—that it will

allow us to integrate within a single architecture personal, social, economic and political considerations as well as technical ones.

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