Fundamental Factors Underlying Recent Technological Innovation

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What are the fundamental underlying "secret" forces that are driving recent technological developments? How can you apply these fundamental factors to your own product designs? Or at the very least, allow you to become enough aware that you can avoid getting done in by them?

Here's my choices of the biggies. Some are subtle and some obvious…

Factor #1 — Decoupling

Many of the stunning hardware developments of the past few decades can be directly traced to **decoupling**, or simply **separating inputs from outputs**.

Really wonderful things happened to electric typewriters when the keyboard output was **disconnected** from the printer input. For you could now **store and intercept** keystrokes and do all sorts of wonderful things with them. Not the least of which were fixing errors, sharing information, keeping copies, and saving previous work.

On copiers, decoupling the scanning function from the imaging function has eliminated the outrageous weight and sizes and unreliability of huge precision optics. Especially if size changing zoom or other features were needed. But copiers themselves have largely been obsoleted by stand alone scanners and printers. The ultimate in decoupling is thus to break the problem down into **two** separate systems. And allow extensive manipulation and modification between the two.

On monitors, expensive and unreliable front panel controls are now replaced by a **decoupled rotary wheel**. Same for washing machines and other appliances. On prepress, you no longer needed separate paths for text and graphics. Because the decoupled and captured intermediates were simply data files.

On oscilloscopes and test equipment, going to **menu driven buttons** eliminated the need for costly and bandwidth limiting switching in tight front panel spaces. Decoupling by **going digital** replaced expensive CRT's with cheap monitors.

Just about everything electronic benefited from the decoupling of power supplies **no longer doing their conversion at 60 Hertz**. By going to DC first and then to a

much higher frequency, switch mode power supplies dramatically slashed the size and weight of most capacitors, inductors, and transformers. And got much cheaper, much cleaner, and more efficient as well.

Music, of course, used to have these silly acoustical physics rules that everybody had to comply with that determined the size, volume, tonality, and the skill complexity needed. Usually combined with ludicrous ergonometrics. But by newly **decoupling the tone generation from any physical embodiment**, electronic music (and synthesizers in particular) removed most all of the physical barriers.

Stunning improvements have happened in decoupling content from the physical media forms that it used to demand. Obvious examples are email over actual letters, music and video downloads, and replacement of trade journals and manufacturer's reps with instant online sales. More on **disembodiment** shortly.

Google, of course, has totally decoupled information gathering from the traditional librarian gatekeepers and the now ludicrous demand that the information provider, the recipient, and the information itself all had to be in the same place during totally restricted times.

In telephony, we have decoupled the ability to talk remotely from the need for one fixed monopoly to provide wire-only service to your home or business. Obvious alternatives are cellphones, VOIP, cable, wireless, satellite, and great heaping bunches more yet to evolve.

The lowly computer mouse has long decoupled itself from the reliability problems of direct mechanical rollers and cords. Through optic sensing and wireless comm.

The next generation of vehicles will almost certainly be **drive by wire**. And again decoupling the driver inputs from what those inputs are supposed to accomplish.

...with this impact...

One of the more profound consequences of decoupling is that **many institutions and infrastructures are now not only utterly useless**, but are clearly a drag on society. Music producers and record companies are rather obvious examples of entities that clearly no longer serve any useful purpose whatsoever.

Or, what exactly is it that the first class mail part of the post office does, and why is it still of **any** use or need whatsoever? Or is this like the British Sailing Ship naval bureaucracy whose size and costs peaked **many decades** after the last sailing ship was removed from active service?

Similar examples obviously involve book publishers from whom the majority of their services are no longer either needed or relevant. Same goes for magazines and, especially, trade journal publishers.

Nobody felt sorry when the litho camera folks or the printed circuit tape and dots people went out of business.

Dozens of other examples come to mind. Which additional decoupling examples can you think of? What still can be separated?

Factor #2 — Accurate Replication

With accurate replication, the end user gains the ability to make copies of items or IP that are **as good or better** than those from traditional sources.

People once went to a commercial printer because they could not produce their own copies that were as good or as cheap by themselves. Authors once used book publishers because typesetting and artwork creation were unbearably difficult, time consuming, and second rate using previously available tools.

Musicians once used music companies because today's cheap but superb quality mixing and editing was once impossibly expensive. And that distribution required a physical media presence.

"Perfect" copies of video or music by either the creator or the end user are now trivial and clearly eliminate the surface noise, hiss, distortion, flutter, wow, and most bandwidth limitations of previous music delivery systems. Generation loss is now completely gone. **Digital now trumps Analog.** Nearly always.

One obvious consequence of cheap and fast perfect copies is that **anyone who is overcharging for their product will cause new copies to be made instead by the end user**. Thus, the price gougers all loudly scream "piracy". Rather than realizing that **additional copies would likely not be paid for anyway** and probably would **increase** the product awareness and demand.

Traditional copyright and IP protection has thus largely become totally useless.

Factor #3 — Elimination of the gatekeepers

Also known as **disintermediation**.

A **gatekeeper** was a profit stealing and time wasting obstructionist between you and something you needed or wanted. The internet has not only eliminated gatekeepers, but also the gate itself and the fence the gate was at one time supposed to go into.

Obvious examples are used car dealers, manufacturer's representatives, book publishers, music companies, scholarly journal houses, and, (sadly) librarians.

Anyone reasonably swift can now use the online **Blue Book** to find exact vehicle values. And can buy or sell the cars themselves via **Craig's List**, **eBay**, or any of a number of online **Auto Trader** publications. To the point of which it is clearly fundamentally insane to buy off a used car lot.

I consider manufacturer's representatives to have been the vilest of the vile. Several evolutionary steps below, say, lawyers. These epsilon minuses made it

virtually impossible to find out how much something actually cost. Or to get hassle free technical info in a timely manner. Replaced, of course, by **24/7 online stores** and totally free instant technical information.

At one time book publishers offered extensive services not available elsewhere. Such as art departments, type setting, competent editing, or economics of scale. With the possible exception of promotion and marketing, there is nothing a modern book publisher does that you cannot do faster, cheaper, and better by yourself. Or by cash-and-carry **targeted web alternatives**.

And **their competitors**.

Similarly, the only purpose I can see for record companies is to steal royalties off their talent. They accomplish absolutely nothing useful otherwise and clearly no longer serve any worthwhile societal purpose. Anybody that wants to can now pick up their own superb quality recording studio for pocket change.

Publishers of scientific journals are a good example of **gatekeepers in the process of self destruction**. An individual today has the choice of paying a journal many hundreds of dollars to publish their paper after a long delay and then making the issues so expensive that their own school library cannot afford a copy. Or of instantly and freely web publishing to a worldwide audience. To survive, the journal publishers must realize that **copies of every paper more than three years out of date should be available free and without ANY restrictions**.

Librarians were classic gatekeepers. Many of whom were control freaks. But the notions that the gatekeeper, the infoseeker, and the infosource had to be in the same place at the same time, or that the info somehow had to be "returned", or that access was restricted to anything less than 24/7 are clearly ludicrous today. As to online access, **Burger King** (and similar WiFi locations) offer **better** service and **more info access convenience** than do most libraries.

With far fewer food and drink restrictions.

Factor #4 — Computing power insanely beyond awesome

Back in the olden days, adding one vacuum tube to a system involved a major upheaval in size, cost, and power consumption. But these days, adding another half million transistors to say, an electric can opener, is no big deal at all. Chances are they are already sitting underused in the microprocessor of choice.

Engineering and other math analysis at one time had to be super efficient because of the value of the user's time. But **throwing another ten million calculations at something is now often trivial**.

Thus, many **brute force solution** methods now become eminently practical. And newly driven by the utterly unbelieveable and unprecedented drop in the cost of memory and the availability of raw computing power.

Two examples of brute force math techniques that have only recently become feasible include our **Magic Sinewaves** and our **Fun With Fields** tutorials.

Factor #5 — Nonlinearizing the tyranny of time

"The moving finger writes, and having writ, moves on." ain't necessarily so any more. At one time, type was painstakingly set one line at a time. Typewriters worked with one character at a time. Movies were real time edited by cutting and splicing with scissors and glue above the cutting room floor. Video similarly was A-B roll edited only in real time.

In book publishing, it was an absolute no-no for an author to try and tell the publisher how the text and words were to be arranged. And woe be to the author who dared try to — gasp — **change even one word** after typesetting. For it was outrageously expensive and time consuming to do so.

These days, of course, we routinely **typeset first and edit last**. With zero cost penalties and great heaping bunches of benefits. Because we can now easily do **nonlinear editing**.

The original breakthrough in this ability happened when word processors became **screen oriented** rather than line oriented. You could now edit and change anything you could see. Such techniques as cut-and-paste and spell checking and advance outlining became routine.

And a whole new level of capabilities got added when the layout programs became **document oriented** rather than screen oriented.

Missed a paragraph? No problem. Just let it ripple on through the whole story. Regardless of how many pages are impacted. Reposition a figure so its text is relevant? No biggie. Trivial, even.

The similar breakthrough in video and movies came about with the **Video Toaster** and related software. That let you store your entire movie or show in an **instantly accessible** form. You could now easily combine old and new material in any order regardless of its time sequence. And, of course, CGI and sound synchronization manipulated it in previously undreamt of ways.

Thus shattering the tyranny of time.

Factor #6 — Teeny Nano New Nu

Things are getting smaller.

Many electronic components are now so small you can't even see them and don't dare sneeze. Which is bad for individual experimenters and students, but otherwise has greatly reduced the size, weight, and cost of new electronics.

While dramatically expanding their capabilities.

One early example was the **Newtek Calibar**. This pen sized device completely replaced an entire television studio full of test gear. While providing cleaner and better waveforms to boot.

But you have to draw a distinction between "small" and "really small." The latter also being called **nanotechnology**. Great heaping bunches of very interesting things happen when sizes approach the molecular level.

Relative surface area goes up as volume goes down. And all the rules of friction, stiction, and attraction/repulsion dramatically change. For instance, the horsepower per pound of a nanoturbine is ridiculously higher than that of its full size brethren.

By going to nano pore sizes in **Super capacitors**, their **energy density** can be significantly increased. A new technology called **Quantum Dots** promises to lead to pv solar panels that may someday become true **net energy sources** that are both renewable and sustainable.

Many unusual chemical and electronic and medical properties emerge with strange shapes at the nano level. Most notable of which are **Buckyballs** and the **hexagonal carbon tubes**.

And **quantum computing** itself on the nanoscale promises to do complex things in interesting ways. Chemists and biochemists in particular are excited about building entire instruments at integrated circuit scale. For chromatography, DNA analysis, and even direct neural interconnects.

Factor #7 — Instant gratification via time compression

The industrial trade journals that are in the process of self-destructing give us a classic example here. The "standard" way of selling an industrial product used to be to take out a $15,000 ad in a trade journal, wait a few weeks for it to be published, wait a few more weeks for a bingo card recipient lead list, wait a few more weeks to mail our printed literature or alert your reps, and then wait a few more weeks for an order or two to dribble in.

These days, any more aware industrial supplier has an online 24/7 store. One that, of course, **welcomes single and small quantity orders**. From anybody, anyplace, anytime. And **makes all of their pricing conspicuously obvious**.

They also have full product info available, free downloads of any software needed to run their systems, and totally free repair and service manuals. Including continuing full support on older and obsolete products. All created at the tiniest fraction of traditional data books and print service costs. And with zero waste.

At least this is true of roughly half of the industrial suppliers online today. The rest will either quickly follow suit or will shortly render themselves into noncompetitive nonentities. The outcome is not the least in doubt.

Meanwhile, there are new **industrial data agglomerators** who gather in industry wide data for your instant and fully objective availability. One major example of which is the **Data Sheet Archive**.

Topo Maps are another obvious example. A complete collection of any larger area was outrageously expensive, easily harmed, and hard to maintain. For just a hiking trip, a visit to an outdoors store might have been needed.

Today, you might go to **Topozone** and print out the latest info on exactly the size and scale you need. Without any infuriating borders or page crossings, even. But chances are you'll be attracted to such newer and more flexible services that combine map info with aerial photography and other services. Such as **Google Maps**, **Google Earth**, or **TerraServer**.

email is perhaps the most dramatic example of 24/7 instant gratification.

A **Google Search**, of course, is another nearly perfect example. What used to be a frustrating trip to a library and a possible six week wait for a no longer available **Interlibrary Loan** (that might or might not happen) can now usually be resolved in a very few seconds. Even at 2 AM on a Sunday morning.

Factor #8 — Programmability

With **programmability**, a general purpose device is "taught" to meet the needs of a specific user while minimizing or eliminating entirely the need for specialized, low volume, dedicated hardware.

While laptops and PC's are obvious examples, smaller embedded microprocessors such as the **PIC** overwhelmingly dominate in the number of units sold and their extensive use range.

One secret of programmability is often to repeatably combine very simple steps of moving, adding, testing, and performing fundamental logic operations. Many individual steps repeated one at a time can go into a programmable **algorithm** that gets a larger job done.

One key concept that makes a programmable computer a computer is its **ability to test**. And then, based on the results of that test, **alter its future course of action**. A test might view a single bit **flag** and do nothing if cleared or branch somewhere else if set. Typical flags are based on a zero result, a negative number, or a set carry.

Another key concept of many programmable devices is the ability of something external to **interrupt** the normal action and temporarily go on to perform a special task. A programmable device that can do many things at once is said to be capable of multitasking. Which often is nothing but the creative use of interrupts.

Small programmable modules called **subroutines** greatly simplify and organize the program code. At the same time, they allow their own reuse at many different

points in the program sequence. A fancier type of subroutine with well defined inputs and outputs might be called an **object**.

My own very favorite programming tool is called **table lookup**. In which you simply find a previously known answer instead of going to a lot of trouble to calculate it. My **Magic Sinewaves** extensively use table lookups.

Some programmable devices combine their instructions and data into one area, while others keep the two as separate as possible. Leading to differing **Harvard** and **Princeton** computer architectures. Each with its own proponents and unique capabilities.

While programming can be done at the individual bit level, fancy tools have evolved using **assembly language** and various **higher level languages**. Two differing routes toward programmability involve **interpreted code** where everything gets done as it comes up in sequence. Or **compiled code** that does whole tasks faster on repeated reuse. But is more complex to initially create.

More examples on programming **here**.

Factor #9 — Disembodied virtualosity

It used to be that ideas, instruction, entertainment, and escape were **rigidly attached** to their physical distribution media. We had these funny pagey things made out of dead trees we called "books". Songs were molded into plastic disks with groves or pits in them called "records" or "CD's".

Movies arrived on long pieces of tape called "VHS" or on plastic disks with smaller pits called "DVD's". More timely info or escape were on floppier and even funnier pagey things we called "magazines" Or once (once very long ago and far away) "Newspapers".

And messages, of course, were ink placed on paper and stuffed into envelopes. You then paid the federal government to **delay the delivery** of your message for up to a week or two.

 The focus was usually on **acquiring the physical media** rather than its actual content. Naturally, when and where possible, manufacturers would obsolete one media format and come out with a new one. Requiring all previously purchased content to be bought anew. Thus eight track no longer reins supreme.

At the same time, an elaborate "priesthood" developed around physical media creation and distribution. With the result that the original creative sources (authors, composers, scholars, etc…) of the IP intellectual property only received the **tiniest fraction** of the final selling price of the physical media being distributed. And even that tiniest fraction was often stolen outright through contractual ripoffs and similar corporate games.

In each case, **the content was physically locked to its distribution medium**.

These days, though, most information is simply disembodied bits floating around in cyberspace. And **deliverable at most any speed in most any format**, and freely accessible **without** any physical "container" restrictions.

And, most importantly, **readily convertible into any chosen temporary physical format**. Present or future. High or low resolution.

There is no particular difference between the cyberspace bits used to convey a movie or a song or a math textbook or a power bill or a crawling-on- the-grass gothic novel. And no particular reason to relegate any wanted combination of bits to any specific "hard copy" distribution media or format.

Established media houses who feel that "business as usual" can in any way, shape, or form continue are awaiting a rude awakening. Especially if they feel that suing their best customers is a viable policy. Or feel that IP sources do not deserve or **must receive the lion's share of the final selling price**.

A related concept are the **virtual sets** now common in tv and movie production. In which live actors can be dropped into any imagined environment. And done so from any camera angle or zoom. Going far beyond traditional blue screen or green screen video source switching.

Such movies as **Toy Story**, **Robots**, or **Cars** even got shot completely **on location** in cyberspace. And bits and pieces of CGI virtual animation show up everywhere.

Yet another virtual concept involves exactly how and where and by whom things are going to get designed.

At one time, electronic circuits were first checked out by **breadboarding** and mechanical assemblies by actual physical **prototyping**. Current practice now uses **virtual emulation, simulation, and modeling** instead.

And a reasonable prediction would be that the next big things along these lines would be the widespread use and the dramatic price reductions of new **rapid prototyping systems** or **Santa Claus Machines**.

Factor #10 — Devaluation

In 1968, the price of one bit of core memory was a nickel. Today, the equivalent memory costs as little as a **tiny fraction of a microcent**. The price of memory has been dropping by something like **a factor of ten each decade**. And shows no sign of abating.

As memory drops precipitously in value, it becomes **the** critical ingredient or **the** enabling technology to open the doors towards as yet undreamt of cyberspace and electronic wonderments.

But at the same time, **this devaluation ruthlessly destroys whole industries and entire product groups**.

Obvious examples are slide rules, typewriters, mechanical calculators, copiers, printed circuit tape and dots, litho cameras, local fiber optics, smaller offset printing presses, artwaxers, newspapers, record players, 8-tracks and cassettes, books, slopping-in-the-slush photography, trade journals, VHS video, etc…

In many instances, **many of the purveyors of the status quo simply could not cope and have vanished without a trace**.

Winning products that do succeed are quickly taken offshore where all of their manufacturing costs plummet and cutthroat pricing reigns supreme. Very often, **the individual component parts for an electronic project often cost ridiculously more** than a comparable item in Aisle 13 of **Walmart**.

We can shortly expect someone working at home to produce the entertainment equivalent of a blockbuster movie for a total of less than $75 in expenses. **Thus leading to a 1,000,000:1 reduction in the costs of moviemaking**. As we've seen, superb home recording studios can be bought for pocket change.

It is ludicrous to assume that the price of movies and videos and songs are not about to drop preciptously. And the movie theaters who have steadfastly refused to install digital projection have signed their own death warrant. For low cost and high resolution home theater should soon reign supreme.

The situation is even bleaker in cyberspace. Where devaluation has made most all intellectual property take a major hit. **People expect stuff to be free or nearly so**. And if it is not, it **will** either be stolen or else a free substitute found.

Factor #11 — Unexpected value added

Products that replace older ones not only must be better in what the original did, but also must provide for **new** and **unexpected** features. If they are to be winners.

Thus, DVD's were better than VHS tapes because they provided cleaner and higher resolution pictures. Plus improved sound. They also were cheaper to manufacture and record. And, being contactless, did not normally degrade with repeated playings. At least with reasonable care.

But at the same time, they also eliminated any need for rewinding hassles. And provided for random access of episodes and scenes. And often had enough room left over for director's comments, alternate endings, snippets from the cutting room floor, gaffs or gags, and bunches more.

Less noted but in ways far more significant, **a DVD was much cheaper to mail**. Leading to the entire **Netflix** phenomena and utterly demolishing local video rental stores. Not to mention staking **Blockbuster** to an anthill. Or completely eliminating time slot competition.

A similar case can be made for cell phones. Yes, they were more portable and convenient than land lines. But, my oh my, all of the things they do that were

previously unthunk of with conventional phones. Like telling time to eliminate the need for a wristwatch. Or providing a LED flashlight. Or a stopwatch. Or instant messaging. Or GPS navigation reception. Or music and videos. Or having finally surmounted decades of Picturephone fiascos. Or let you record news events on the spot. Or instant reporting of accidents and fires.

And the next generation of phones should even be able to report their location if lost or stolen.

The future products that succeed will not only be much better than what they are replacing, but will offer quantum performance leaps in totally unexpected ways.

Factor #12 — Indirect payback.

It used to be that you could write a magazine article, a short story, or a book and people would pay you fairly well for it. Or could put together assembled or kit electronic devices that would sell for much more than their component costs. Sadly, those days are long gone.

In terms of real dollars, many authors today receive **less than one tenth** the payments they did a few decades back. Despite offering much higher quality in a more timely manner.

It is one thing to offer a definitive killer website with fairly priced useful products. And another entirely to show a worthwhile positive cash flow. One possible solution involves **indirect payback**.

With indirect payback, **you essentially give much of your stuff away for free**. And then make up the difference through such things as **banner ads**, clickthru programs, referrals, **cash and carry consulting**, an online 24/7 store, your **auction sales through eBay**, tech illustration services, associate programs, and similar ploys.

Any one of which may not be that big a deal, but taken together can easily make your whole venture worthwhile.

Factor #13 — Hybridization

With hybridization, **two or more normally separate approaches can be combined into a single solution**. Often leading to very surprising consequences.

The obvious biggie here is combining an ICE internal combustion engine with onboard electrics and batteries. Since each now needs to provide only half the total peak load, both can be smaller. The battery side never strands you empty, while the ICE side gets to run at an optimal load and optimal speed.

Curiously, your city mileage now **exceeds** your highway mileage. Such new features as regenerative braking and electronic all wheel drive and automatic restart are easily added. And, as batteries improve, the ratio of ICE to electrics can quickly adapt to new economics.

The efficiency of many alternate energy systems can sometimes be dramatically improved by **capturing** any waste heat and putting it to good use. Examples include **cogeneration**, **bottom cycling**, **process heat recovery**, or even **hot water production**. Similarly, we might expect exhaust gas heat energy recovery or reformation systems to eventually improve ICE efficiency.

Instead of offering only street maps, or only topographic maps, or only aerial photography, the three are now easily combined into one hybrid web service. To which we can eventually expect full stereo viewing, panned horizontal and zoomable views, controllable additional geographic overlays, and selectable multispectral coverage extending both into the ultraviolet and infrared. Stereo and infrared combined should be most useful for discovering new **caves**.

An obvious computing example of hybridization is combining a scanner, fax, printer, and copier into a single paper processing peripheral.

It is now often routine for a DVD movie to offer 16:9 widescreen on one platter side and conventional 4:3 on the other.

Electronic meters sometimes offer **both** digital (for accuracy) and analog (for viewing changes or monitoring) outputs. Similarly, digital oscilloscopes now have new features that fake the best of analog scopes, especially for viewing glitches or rarely repeating data. At the same time, their new capabilities often include the spectrum analysis, power measurement, and data acquisition that once required individual stand-alone instruments.

Computing systems traditionally gave you a choice of dense and cheap hard disk memory or fast, compact, and low power flash memory. By hybridizing and combining the two, most routine transfers can be done in flash. With the main electromechanical disk only needing powered for brief transfers.

For the best of both worlds.

Which is better for product photography, a digital camera or a scanner? The best solutions might use **both at once** for surprising depth-of-field results and other stunning benefits. Per **this example**. Or the **additional tutorials here**.

Factor #14 — Increasing competitiveness

A recent count showed something like **100 million websites** registered and about half that many currently being live and providing more or less useful content. Like it or not, **you've now got competition**. Great heaping bunches of it. And some of which will be better funded with better products, a better presentation, higher energy, tighter cost controls, cheaper suppliers, and more popularity.

Fortunately, **nobody knows you are a dog** on the internet. Individuals and small scale startups have definite and major advantages over large scale corporations **if** their web presence is good enough and **if** their focus is tight enough and **if** their reaction time is quick enough.

Defenses against competitors might include **giving a lot away to sell a little**, **maximizing your personal value added**, **offering highly unique content**, making **daily upgrades and improvements**. Plus **continuing lifelong self-study**. While **tirelessly promoting your website**, carefully **monitoring your web logs**, and **improving your links and search engine ratings**.

And, above all, **of becoming a "must view" definitive resource** for your area of interest and expertise.

Factor #15 — Form no Longer Follows Function

If you were designing a telephone a few years back, you started with a big and klutzy bell and an equally klutzy hybrid transformer. To which you added a fairly complex mechanical dial assembly. This defined a box too heavy to comfortably lift that had to go onto a table or shelf. A handset had to be separate and its distance from receiver to transmitter set by human heads.

These days, all of those limitations are gone and **a telephone can be any shape or size** and include an astonishingly wide array of additional features as well.

If you were designing a 35mm camera a few years back, you had to have two vertical cylindrical film cassettes separated by flat film plane. In front of which you placed the bottom of a Coke Bottle or similar fancier chunks of glass.

These days, all of those limitations are gone and **a camera can now be any shape or size**. Even the lens can now be replaced by a small drop of oil. As before, anstonishing wide array of additional features can easily be added.

If you were designing a light bulb a few decades back, you started with an intense point source and placed a controlled environment bulb around it. Virtually all of today's incandescent light fixtures are based on accomodating this specific form follows function shape.

LED lighting sources now offer efficiencies that are ridiculously higher than incandescents. But **the basic shape of an intense point source is a big no-no**. Because of heat management problems. LED lighting systems are best based on many dispersed emitters rather than a single concentrated point source.

And thus should shortly and totally revolutionize what a "lamp" is or what it should look like.

Factor #16 — Complexity Beyond Comprehension

Back in the days of an Apple IIe, any reasonably swift individual could understand exactly what all 128,000 bytes of memory were up to at all times. But these days, **nobody but nobody has the faintest clue what even a tiny fraction of memory in, say, a Pentium with XP is up to**.

And that is **before** the malware and trojans take over.

Similarly, at one time a reasonably swift individual could build up all aspects of a new product by creating their own printed circuit board and attaching obvious and easily understood components to it. With common tools and ordinary skills.

Not so any more. Sneeze and all your parts vanish without a trace.

The points being that **much of what was exactly and precisely known in past development now has to be taken on faith**.

And that no single individual is likely to completely understand any new product development. Teams and groupwork are now apparently a must.

Factor #17 — The Rules Have All Changed

What was a level playing field can often turn into a bottomless pit. One where new competitors can clearly be noncompetitive. Thus running away with all the marbles. **Because they can completely ignore the way things were**.

Some examples: **Craig's List** is totally blowing away newspaper classified ads because it is free. It is instantly delivered, exceptionally convenient, and can be trivially searched.

Music studio time currently goes for around $850 per hour. But you can build your own music studio for around $849 total. And often produce a much better product. Since there will now be zillons of new songs per year, **the value of any delivered song to an end user will clearly plummet**.

The belief that a classic website will continue to increase in popularity and demand can be flawed. Owing to the **eyeball siphoning** caused by other newly emerging things for people to do online. Such as personal networking, YouTube videos, online tv downloads, and countless emerging new stuff yet unthunk of.

Producing **books on demand** makes the **fatally flawed assumption that people will still value books**. The online distribution of info content with its near-zero delivery cost, its timeliness, its searchability, its instant access, its ease of updating, its total lack of waste and returns, its infinite forever backlists, and countless other advantages totally trashes this assumption.

The utter and total demise of the book is imminent. Because of their inherent and unavoidable flaws. It is just not yet too clear whether this will happen by way of new **eBook readers** or by the use of improving laptops, handhelds and any evolving ipods and such. But happen it will.

Quantum leaps in product features are routinely occuring. You cannot even give a CRT monitor or tv away, owing to flat panel LCD demand. **LED lighting** is coming on like gangbusters, owing to its flexibility and extreme efficiency.

And new approaches to solar panels involving **CIGS** and **Quantum Dots** promise to eventually be capable of delivering net energy. Something that conventional silicon PV will **never** be able to do.

The bottom line is that **projecting the value, price, and demand of any current products into the future is fraught with peril**. Because things simply ain't gonna be done that way any more.

Factor #18 — Immediacy

People want things to happen 24/7 aka NOW. **Stuff can now easily be bought and sold online at any time of day**.

Digital cameras are an obvious example. At one time you took your pictures, sent them out for development, and then, possibly weeks later, made your final prints. Now it is click and publish. Not to mention the hidden benefits of full color, easy **postproc**, reuse, and preserved quality.

The demise of the trade journal is being directly caused by their obsene ad turnaround times. You'd create and submit your ad and it would not appear in print for weeks or months later. More weeks and months for some bingo card results to dribble in. More weeks and months for them to even respond to your mailings and ad followups. And then maybe — just maybe — a sale or two.

The new **video sites** coming online are yet another example. These now deliver thousands of movies and tv episodes whenever you want to start them with full pause, fast forward, and rewind. And are now utterly and completely blowing away on-the-air and cable tv services in the process. Besides block busting Blockbuster.

The upcoming ebook readers or similar appliances can shortly be expected to do the same thing to print and publishing. A reasonable authors royalty rate is now 90 percent, and publishing turnaround time from submission to publication should be less than fifteen minutes max. Acceptance of your material is, of course, a certainty.

CGI and similar techniques have revolutionized moviemaking. We can shortly expect someone working at home to come up with an experience comparable to a major motion picture at a total cost of $67.73 and a total time involvement of three weeks. Thus leading to a one million to one reduction in the cost of watchable entertainment.

Factor #19 — The End of Scarcity

Many businesses and services were once based on picking up a pile of arcane equipment or expertise and being the sole local source for the product offered.

Innovative new solutions now give most anybody the ability to knock out a better product. Faster, simpler, and cheaper. Where competitors were once few and far between, there are now hundreds of thousands or even millions of them.

 Some examples of stuff already shot out of the saddle...

PRINT SHOPS— At one time, you had to buy a fancy printing press and zillions of support items like litho cameras, artwaxers, platemakers, joggers, punches, binders, green eyeshades, etc. These days, **anybody with an inkjet or laser printer can instantly produce whatever they need whenever they need it.**

PHOTO FINISHING— Here you once had to have an enlarger and a darkroom, along with all of the "slopping in the slush" accessories. Now, you can use **Imageview32**, PhotoShop, or any of hundreds of free computer programs to do much more image **postproc** much better. And do so ridiculously faster.

TRAVEL AGENCIES— Specialized contacts and insider info clearly have been replaced by online services newly available to anyone 24/7.

RESEACH SERVICES— At one time, profitable **consulting** could be based on knowning which libraries to use when, agressive subscription to trade journals and industrial shows and such. Because accurate and useful info was scarce. Now **just about anybody can do an instant Google Search to come up with more and better information.**

FONTS— Long ago and far away, adding a new font capability to what you were doing was a gut wrenching experience The fonts, of course, were one size and one weight at a time. Today, thousands of fonts are available free, and hundreds of them are included in standard publication software.

CREATIVE WRITING— Magazines typically had "room" for a small stable of regular authors. At least some of whom quickly established reps as **sought out resources**. The explosive onscene arrival of those **blogs** now means that **there are hundreds of thousands or even many millions of new info and entertainment sources**. Like it or not, some of them are better than you. At the very least, there are now thousands of highly competitive clones.

SPECIALTY STORES— It used to be that if you needed, say, some candles, that you would go to a brick and mortar specialty store. But today there are great heaping bunche of candles available 24/7 found on **eBay**, **Craig's List**, or **Kiji**.

The scarcity of sources is clearly gone. There's bunches of obvious stuff that is about to get unscarce.…

Books about to blown out of the water by eBook readers. Newspapers whose economics are now absurd. Over the air and cable tv laugingly obsoleted by web delivery. Outrageously expensive, slow, and hard to obtain peer reviewed scholarly pubs shot out of the saddle by instant web distribution.

Trade journals, again due to ludicrous economics. And, of course, music delivered from tens of thousands of sources that are much more cheaply produced that the cost of one hour of traditional studio time.

The bottom line is that **there are no more reject slips**. Nor any valid reason to limit the selection and availability of most any product.

Factor #20 — Fewer Mechanical Parts

The breaker points in an automobile were by far the least reliable and highest repair item. By new electronic switching, **most service needs were eliminated**. At the same time, timing and dwell became ridiculously more flexible. Besides less obvious benefits, such as spark plugs now lasting forever.

A piano might have thousands of mechanical parts in it. By switching to electronic synthesis, the number of moving piano parts got dramatically reduced and vastly simplified. And one instrument can now sound like any size or shape piano. Or, for that matter, any other instrument. Real or imaginary.

Mechanical adding machines were horribly complex and hard to maintain. Not to mention that even such simple math functions as multiplication or division added horribly to the system cost. Solid state calculator chips blew these away completely.

A VHS tape cassette had dozens of parts in it, and the VCR load/unload mechanism was quite elaborate. A DVD replaced the cassette with one round piece of plastic. And the player mechanics reduced to a moving shelf, a rotating spindle, and a linear positioner.

The DVD itself is in the process of getting blown out of the water by direct web distribution. With zero moving parts and incredible flexibility.

Ultra precision rotating disk drives are now being replaced by thumb drives and similar solid state flash memory. With dramatic reliability, speed, and power improvements.

Turning to stuff not yet here yet, compressor based cooling is an obvious candidate for solid state substitution. With possibly higher efficiencies, less noise, reduced environmental impact, and far less maint.

Automobiles can use fewer parts by going to electric valves. Similar gains are to be made by changing to electric power steering and electric variable rate cooling. Or even no ICE parts at all by going to fuel cells.

Factors #21 thru #26 — ... and some "also rans"...

There are several "second tier" factors that I felt did not quite make the cut for our above list…

Communities without borders — Should you chose to do so, you can easily access national and international markets for your products and services. Collaborators on any project need not ever meet each other, let alone be working for the same company or group or organization. While I personally have no international sales or support because I have found them to present far more problems than they solve, whole communities and product groups aggressively seek out worldwide support. Obvious examples are the **Linux** and **Open Source** folks.

WYSIWIG — People apparently **demand** solutions whose screen views closely approximate the service they are providing. While generally a good idea, the downside is that WYSIWIG ruthlessly destroys many **older and better** routes to getting useful results. One sad example is how the infinitely superior **text adventures** got completely blown away by their graphic imitators. In other cases, more controllable and more powerful solutions get substituted by a pretty screen. Or will otherwise generate little popular interest. Two examples include my **PostScript as a General Purpose Computing Language** and my **Gonzo Layout Utilities**.

Seamless pan and zoom — Most printed topo maps had to end up the same size and shape. Which meant that you sometimes needed four of them for a simple hike that wandered off near some northwest corner. Web replacements such as **Topozone** or **Google Maps** largely ignored the original paper page boundaries and map scales. Letting you move around at will with minimum distractions. The concept of taking and using a small portion of a major data base and **allowing that portion to freely move or expand without boundaries** goes far beyond topo maps. And represents a major and profound improvement in exactly how and where data, information, or entertainment can be attractively and usefully presented.

Gross incompetence — About a decade ago, many community colleges completely dropped their electronics programs. Some did so because the football team needed the money. High school courses quickly followed suit. **Heathkit** went belly up, and ham radio became a ludicrous geriatric parody of its one time greatness. While **Popular Electronics** and most other hobby level magazines flat out died.

The electronic kit market vanishing with them. Only **Circuit Cellar** and **Make** remain today. Meanwhile, electronics itself got so small and so precise and so demanding of costly gear that opportunities for entry level homebrew experimentation became truly challenging.

The bottom line being that **there is now zero interest or motivation whatsoever in the USA today for beginners and students to become**

technically competent. Or, even worse, **few computers today are sold that include ANY programming language, let alone a decent beginner's one**. One side effect of which was a community college student we just hired who did not know what the name of the direction was to the left when facing north. The consequences of which are (A) **It is virtually impossible to get competent tech help if you are an individual or a small scale startup**, and (B) Foreign solutions are now nearly certain to eat you alive.

Freebies are the norm — The popular expectation today is that all IP intellectual property offered on the web is to be either "free" or extremely low in price. Which means that **you have to give a lot away to sell a little**. As we've seen before, the old rules no longer apply.

Poisoned channels — While you could buy a bad book at a chosen bookstore, you were unlikely to buy one that would **destroy** your entire library. The web is endemic with library destroyers such as viri, spam, malware, trojans, misreprentations, and outright scams. Not to mention lesser nuisances, offensive content, and time wasters. All of which clearly will demand **eternal vigilance**. In the form of firewalls, filters, and, above all, plain old common sense.

History demands a web champion — If magazine articles, technical papers, journal reprints, or equipment service info is to survive, they **MUST** be freely available on the web. **Otherwise, history is history**.

Unfinished kaizen — A fairly accurate translation of the Japanese term **Kai-Zen** is "continuing small improvements". Such as a version 3.17 upgrade. Done when and where needed in **exactly** the size and shape required. Unlike like, say, most magazines that had a repeated and fixed "drop dead" deadlines at which time everything had to be finished, had to be exactly the right size, and had to precisely "fit" its carefully allotted space. One of the great liberating features of the web and the culture it has created is **the elimination of the "one size fits all" mentality**. And the need for most fixed or repeating deadlines.

For More Help

I have a hollow feeling that I may have missed one or two biggies in our above analysis of fundamental factors driving today's tech innovation. If you feel that something needs added, please **email me** with your suggestions.

Custom consulting services are offered **here**, while new opportunities in energy efficiency can be found **here**. Many more product design and development ideas have appeared in our older **Blatant Opportunist** columns that once appeared in **Midnight Engineering** magazine. These eventually morphed into this current **GuruGram** series better suited for web presentation and distribution.