open source

as a

disruptive technology

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Last year, I had the pleasure of hosting a conference about open source GIS software in my home town. And my favorite conference story, is from a couple guys who were having a beer in the pub shortly after getting to town, and the server asked them "what brings you to Victoria"? And they answered "we're here for a conference about open source".
“who would want to go to a conference about open sores?”

To which she replied, "open sores? who would want to go to a conference about open sores?" Which seems like a pretty fair question!
Itchy, painful, and a source of infection.

Actually, if you've been listening to Steve Balmer, the CEO of Microsoft over the past few years, you'll have heard him make at least the last of these claims.
“Linux is a cancer that attaches itself in an intellectual property sense to everything it touches.”

He has said,
"Linux is a cancer
that attaches itself
in an intellectual property sense
to everything it touches"
A cancer!
Come on, Steve, don't soft-pedal it,
tell us what you really think! :)

Steve Ballmer
CEO Microsoft
“Open source is an intellectual-property destroyer... I can't imagine something that could be worse than this for the software business and the intellectual-property business...”

Jim Allchin
VP Microsoft

Or perhaps you heard the former head of the Microsoft operating system division, Jim Alchin, "Open source is an intellectual-property destroyer... I can't imagine something that could be worse than this for the software business and the intellectual-property business..." Ouch.
Normally, you only encounter this kind of overheated rhetoric in a war, or an election campaign. But something about open source really has Microsoft riled up.
And what it is, is, they see something of themselves in the rise of open source. Microsoft rode to prominence on the back of a disruptive technology, the PC, which tore down the previous mainframe and mini-computing edifices. And they fear that open source is a disruptive technology that might do them in, in turn.
I came to this topic in a roundabout way.

About six months ago,

I had lunch with friend of mine,
Steve Myhill Jones,
who is an avid reader of business books.
He runs the Latitude Geographic Group,
which is in Victoria, where I live.
And over lunch he said
"you have to read this great book,
the 'Innovators Dilemma',
by Clayton Christensen
I'll loan it to you!"
So I took it home, and put it on the back of my toilet,
and over the course of several, er, "study sessions" worked my way through it.
innovator’s dilemma

So, what is this "innovators dilemma" referred to in the title?
“blindly following the maxim that good managers should keep close to their customers can sometimes be a fatal mistake”

Christensen boils the "innovators dilemma" down to this warning to managers.

"Blindly following the maxim that good managers should keep close to their customers can sometimes be a fatal mistake."

Hmmm, OK.
But,
Where's the dilemma?
A dilemma is a choice between two paths,
both equally unpleasant.
Hence the term
"on the horns of a dilemma".

Pick a horn, any horn.
lose to more responsive competitor

Horn #1: if you fail to pay attention to your customers' current and future needs, you'll lose them to a competitor who does a better job of listening.
Horn #2: if you *do* pay attention to your customers current and future needs, your organization will be vulnerable to destruction by a "disruptive technology"
Uh,

Wait a minute, says the manager, that second one doesn't sound so dangerous. What's a "disruptive technology" and why should I be afraid of it?

Fair question.
First of all,

this is not lightweight,
class-room style "disruption",
like Johnny used to make
back in fourth grade.
This is full-on Klingon disruptor beam style disruption.

This is the kind of thing that rearranges every molecule in your body and leaves behind nothing but a pink mist.
The example of disruptive technology Christensen hangs much of his analysis on is the lowly hard-drive. He chooses hard-drives because the pace of change in the hard drive market has been so intense that several cycles of disruption have played out in just 30 years.
[ 1953 ]

random access method for accounting and control (RAMAC)

Hard drives have actually been around for a long time, they were invented in 1953 by IBM.

The "Random Access Method for Accounting and Control" (RAMAC) had 50 24" platters and could store ... wait for it ... 5MB.
Just enough to store an MP3, if the song isn't too long.

Of course, in 1953, there wasn't a computer powerful enough to decode the MP3 in real time, so moot point.

Anyhow...
The market for hard drives grew along with the market for computers, which at the time were mainframes, made by IBM and a handful of competitors.
In the hard-drive space, "plug compatible" companies grew up who made drives that could be plugged into IBM computers, but sold for a much lower price than IBM storage systems.

They also began supplying drives compatible with other manufacturers, so that by 1976 there was a stand-alone hard-drive market that was selling about $1B a year of mostly 14" drives, like this IBM unit.
There were 17 firms in the drive industry in 1976. By 1995, every one except IBM had gone out of business or been taken over.

Over the same 30 year period there was tremendous innovation and market upheaval, 129 new firms sprang up. But only 20 of them still survived at the end of the period.
So, what happened?

We didn’t stop using hard-drives between 1976 and 1995. In fact, the market grew from $1B to $18B.

Then, what killed off the 16 profitable firms, who owned the marketplace in 1976, with experience in manufacturing and selling storage devices.
The quick and easy answer is "technological change", the drive industry has endured insane rates of change, in technology and volume of production. Price per megabyte has gone down 5% per quarter, for more than twenty years.
But just saying "technological change" is too broad brush. Christensen proposes two kinds of technological innovations, "sustaining innovations" and "disruptive innovations".

Sustaining innovations are "more of the same, only better". It’s the kind of innovation that *existing* customers demand.
For example, Boeing transitioned from open planes to pressurized planes to jet planes, to jumbo planes, to composite planes. Each of these changes was technologically difficult and very expensive, but each was needed by Boeing's existing customers. Boeing didn't go out of business, it navigated 50 years of massive technological change easily, building on existing engineering skills and sales channels over time.
The disk drive industry went through similar core technology changes between 1975 and 1995.

Each of these changes to ferrite-oxide, thin film, and magneto-resistive heads, required hundreds of millions of dollars in R&D, and re-tooling of product lines.

And in each of these changes, the established firms led the way.

Even though these changes were technologically huge, taking years to complete, they were "sustaining". They improved products in ways that made them more desirable to the existing customer base.
"Disruptive change" is different.

It does not address the needs of the existing customer base.
Disruptive change is what happened to the 14” drive makers who dominated the market in 1976.
The 14" drive firms sold to customers who used or made mainframes. The mainframe customers required drives of about 300-400Mb. They had already invested millions and millions of dollars in their computers, and they could afford to pay top dollar for storage.

So the 14" firms had nice lists of customers willing to buy high margin products, who were all asking for more storage, faster storage, in the same basic form factor, something the size of a washing machine, like this IBM 2311.
But, around 1978, a group of new companies sprang up, [Shugart, Micropolis, Priam, Quantum and others.] making drives with 8" platters. The 8" drives introduced by these companies offered capacities of just 10Mb-40Mb.

Mainframe users did not want them, they had too little capacity.

However, the 8" drives were physically smaller, and they were cheaper, so they fit nicely with the emerging market for minicomputers, like the beloved PDP series from Digital Equipment Corporation.
Digression...
The PDP-11 shows up in old stories of UNIX and free software quite often.

Ken Thompson developed the original UNIX as a Multics hack for the PDP.

Richard Stallman came up with the concept of free software while wrestling with a proprietary PDP-11 printer driver in the MIT computer lab.

Bill Joy built the first BSD Unix distribution on a PDP-11 at Berkeley, before he went on to Sun Microsystems to write SunOS (now open source Solaris).
anyhow...
The minicomputer market was small, and the cheaper components had lower profit margins, so the incumbent 14" drive makers had no interest in the market. They stayed up at the top of the market, where the volumes were large and the margins high.

At first.

But by the early 1980s, the 8" drives had increased their storage so much that they were useful for mainframes. They also had a larger unit volume, from selling to the rapidly growing minicomputer market, so the 8" makers had economies of scale that the old firms couldn't match when they introduced their own 8" models.
But here's the really strange thing...
even with the knowledge of their own history,
the 8" drive makers had the same thing happen to them a few years later.
minicomputer makers on 5¼” Drive:

“not enough capacity”
“not reliable enough”

The initial capacities 5.25” drives were 5-10Mb, too small for minicomputers. And data centers needed reliability.

Who would want these crappy 5.25” drives?
pc makers on 5¼” Drive:
“capacity is acceptable”
“reliability is acceptable”
and...
“it fits on a desk”
“it’s cheap”

The early PC market was small, but they didn’t see the same drawbacks as the minicomputer makers and they valued two attributes of the 5.25” drive that the 8” drive lacked, small size and low price.
So, despite the lessons of their own history, only half of the 8" makers introduced 5.25" drives.

Of the top four 8" firms, only one survived as a top maker of 5.25" drives.

And then, it happened again with 3.5" drives, which found an initial market with portable computers.

And it's happening again with 1.5" drives, which have found an initial market in digital music players.
It also happened in computers.

Each computing generation was initially defined within a niche use, then expanded into general use.

Minicomputers were for scientists and engineers, then they were for everything.

PC’s were for spreadsheets, then they were for everything.

Notepooks were for road warriors, then they were for everything.

Netbooks are for college students. iPhones are for hipster doofusses. How long until they become people's primary computing platform?
Because it can be a music and video player, Internet access device, e-mail and instant messaging platform, camera and many other things, the iPhone gives cash-strapped consumers more for their money than do single-purpose products, and because it can be used on the go, it can help people make better use of their time.

http://www.itworld.com/personal-tech/57039/low-income-users-latch-iphone

Not long, perhaps, here's a quote from IT World magazine, on the uptake of the iPhone amongst "low income" people:

"Because it can be a music and video player, Internet access device, e-mail and instant-messaging platform, camera and many other things, the iPhone gives cash-strapped consumers more for their money than do single-purpose products, And because it can be used on the go, it can help people make better use of their time."

Is the iPhone a disruptive technology? May be...
Each disruptive transition brings a host of new companies into the market, and unseats many of the incumbents, as the disruptive technology moves out of its niche and into general use.
So,

What is wrong with these established companies?
Why can't they protect their old market
*and* enter into a new one?

Can't they do two things at once?
No. Not well.
First of all, the incumbent companies are "held captive by their customers". "The customer is always right" is a great business maxim, but it does limit the options of managers planning for the future.
what is your bidding, sire?
faster!
more storage!
Also, financially, expanding your share of a large market makes more sense than
scrapping for a share of a
tiny market.

So, the need to maintain
market share,
and follow the signals
provided by the
existing market,
means that
customers dictate what technologies
"make sense" to pursue.
Second,
Well managed companies make
good decisions about resource allocation.

What projects should I put my
dollars and
engineering effort into?
<table>
<thead>
<tr>
<th>Sustaining Research</th>
<th>Disruptive Research</th>
</tr>
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<tbody>
<tr>
<td>Known market</td>
<td>Unknown market</td>
</tr>
<tr>
<td>Well-defined goal</td>
<td>Poorly-defined goal</td>
</tr>
<tr>
<td>Improve profitability in short term</td>
<td>Lower profitability in short term</td>
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Sustaining technologies have a known market, an existing customer base, they are well defined, because the customers are providing requirements, and they will immediately be sellable, to a large pool of high-margin customers.

Disruptive technologies are the opposite, they have an unknown market, which means poorly defined requirements, and low profitability in the short term.
But, but, in the long term, the
disruptive technology could put you out of business!
So these established organizations should be focussing on disruptive threats! Right?

No, wrong.
An established organization that is focussed on a low margin emerging market will be ignoring and
losing market share in a high margin established market. That can make the difference between profit and loss,
success and failure.
The ability to concentrate on small, potentially disruptive markets, is a matter of scale...

Small organizations can afford to focus their resources on small markets, and can survive on the thin margins available in emerging technology.

Big organizations have to operate at a scale sufficient to meet their daily revenue needs.
Operating at large scale provides efficiency, but at the expense of flexibility.

Your size dictates who your customers are, and who your customers are dictates your corporate direction.
So, to recap,

*disruptive technologies*

*start crappy and get better*

*enter new markets and then move into existing markets*

*are not profitable enough to sustain existing enterprises (at first)*

they don't enter existing markets,
they gain a foothold in a
new market that
doesn't mind their crappyness and
likes some of their
other attributes, and

they are not
initially profitable
enough to sustain
existing enterprises,
this leads to
new small enterprises springing up,
that eventually
supplant the existing enterprises,
So, is open source a disruptive technology?

Should these guys be worried?
We don't *really* know yet, but we can evaluate the character of open source in the marketplace.
open source

• is very cheap
  ($0)

• is infinitely replicable
  (cost of N units = N * $0 = $0)

• is highly re-purposeable
  (take the bits you like, change the bits you don’t)

It has three properties
that really
differentiate it from
proprietary software in the
marketplace:

it's very cheap
($0)

it's infinitely replicable
(cost for N units = $0)

it's high re-purposable
(take the bits you like, change the bits you don't)
existing vendors

- sell software for $N
  ($0 looks like bad price)

- are used to high margins
  (Microsoft corporate profit = 25%)

The incumbent vendors don't want any part of open source, because the margins are terrible, and they are structured to operate on very high software sales margins. For example,
Everything Else Microsoft Does

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<table>
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<tbody>
<tr>
<td>Microsoft Office + Windows</td>
<td>$28 BILLION</td>
</tr>
<tr>
<td>Everything Else Microsoft Does</td>
<td>-$3 BILLION</td>
</tr>
<tr>
<td>Total Corporate Profit</td>
<td>$25 BILLION</td>
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The whole of Microsoft earned $22B.

So, all the other things Microsoft does (MSN, Search, Ads, SQL Server, Visual Studio, XBox, Mice, Keyboards) lost $3B.
existing customers

- have long feature lists
- do not like the cost of change

The incumbent customers generally don't want any part of open source either, because the feature list is usually shorter, and because of organizational inertia.

Change is expensive.
But history is a funny thing.

Sometimes, things can change and quite quickly. In fact, we have already seen one marketplace flip to open source, over about 10 years, and that's UNIX servers.
In 1995, UNIX servers were made by Sun, HP, DEC, SGI, IBM. They used expensive RISC chips and SCSI disks. They ran proprietary versions of UNIX, like Solaris, HP/UX, OSF, IRIX, AIX.
They could handle big tasks, like running databases and data processing (and GIS workstation software!) and could run network services, like web servers and mail servers. Linux was used by hobbyists and people (like me) learning to use UNIX at home.
But, over time,

Linux got good enough to run
web services and mail services.
Internet service providers
started to use it
for their infrastructure.

The incumbent vendors
could not lower their prices
enough to compete for the ISP business.
(Which was high volume,
but low margin: ISPs were cheap.)
But they still had
lots of business selling to
Fortune 500 clients who
wouldn't touch Linux.
Linux got better, the proprietary UNIXes got better.

New Linux companies added things like support and training to the Linux value chain, and the quality difference between the two got smaller.
And then Oracle ported their database to Linux.

Now Fortune 500 companies could migrate to Linux without being forced to change their database at the same time. Many did. And the proprietary UNIXes retrenched up-market yet again, to the realm of very expensive multi-way servers.
• “unix on x86 is a toy”
• “try Solaris x/86 if you want unix on x86”
• “we’re open sourcing java!”
• “we’re open sourcing everything!!”
• “we’ve bought MySQL!!!”
• “help, help!!!!”

Here's how Sun Microsystems reacted to the encroachment of Linux.

First they tried to laugh it off.

Then they tried to staunch the bleeding by putting a direct competitor to Linux in the field, but they couldn't compete on price, and they never provided the same level of engineering support as Solaris on Sparc got. Why? Because Solaris on Sparc had lots of high margin customers... rationally resources were better spent there, than on the x86 line.

Finally, Sun tried to coopt the open source spirit in Java.

Then, in their whole software line.

Then they started thrashing about.

And here we are now.
Despite seeing the Linux/x86 train coming, Sun has been driven upmarket to the point where its remaining high margin business is selling servers like these, ultra-parallel, huge memory monsters for high-end databases.
And what happened to the other UNIX server makers?

Compaq bought DEC and killed the Alpha chip and OSF, they were then bought by HP in turn.

SGI left the UNIX business early on, as PC workstations gained enough power to do 3D visualizations.

IBM and Sun have both retreated to the high end. HP also retreated, and is now selling HP/UX with Intel Itanium servers that nobody seems to want.

Some went out of business, some shrunk their market, all of them basically ceded their relevance to this
800lb gorilla.
Er, penguin.

OK fine, so open source has taken over UNIX servers,
What about desktop Linux?

Like nuclear fusion and universal health care, the "Linux desktop" has been "just a few years away" for the last 10 years, ironically, the same years in which Linux has eaten and fully digested the UNIX server market.
Why so little success?

First there has been no uncontested market niche to carve out a lead.

Which means there has been no place where a large capital investment in Linux desktop technology can land,

Which means the pace of development has been slow.

(As an aside, if Linux were proprietary, the pace of development in a low investment environment wouldn't have been slow, it would have been zero.
The "unkillable", "upstoppable" nature of open source makes it that much more threatening to existing vendors.)
So, what would a Linux desktop niche look like?

It would be a place where the Linux desktop is relevant to a wide base of users.

It would play to the open source strengths, of cheapness, replicability and customizability.
The niche may have arrived, with introduction of the netbook computer, and the resurgence of Apple as a viable competitor in the notebook and desktop computer market.

Netbooks retail for only a couple hundred dollars, and they have technical specifications that play to Linux’s strengths. Most importantly, the margins on selling operating systems for netbooks might just be low enough that Microsoft won’t enter the market.
Microsoft has traditionally treated Windows as a cash cow, directing profits from the operating system monopoly into strategic investments aimed at fending off disruptive change.

The return of Apple, and the failure of Vista has put Microsoft on the defensive in their core business for the first time in 15 years.

The fact that early models of netbooks shipped with Linux operating systems, that they were generally described as "good enough", and readily accepted by the student target market could be bad news for Microsoft.
Ironically, Apple may find a similar dynamic at work in the smart phone business.

I assume everyone knows about the iPhone already.

Google Android is not a phone, it's a phone operating system. Google developed it, then open sourced it. Phone makers will supply their own hardware, and customize Android to supply the software interface for their hardware.

The iPhone OS is a superior product, but with a price premium and a closed development process -- what apple wants, apple gets.

The Android OS is not as good as the iPhone, but it's "good enough", and it will be ubiquitous and free to any phone manufacturer.

So, who would you bet on?
Bear in mind,

the last time a superior
Apple product met an adequate but
more open solution
in the marketplace,

the result wasn't pretty.
anyhow...
“When will there be an open source replacement for ArcMap?”

So,

let's address an incredibly common question I get when talking about open source to geospatial audiences:

"When will there be an open source replacement for ArcMap?"
I think the "when" is a particularly nice touch.

Not for a while.
3.5" drives didn't replace 5.25" drives right away. They found a side market and eventually were good enough.

Linux servers didn't drop from the sky running Oracle, ready to handle the data center, it took a decade. And on the desktop, things seem to work the slowest. Linux only now starting to crack new niche markets for desktop software.
Disruptive change is like storming a castle.

You don't want to rush the gate because you have to cross a kill zone, where you'll be subjected to a withering cross-fire, from the arrow slits, and your reward when you reach the gate will be getting trapped behind a portcullis and drenched in boiling oil.
What you want to do,
is find a safe place,
far from the walls,

and quietly dig a tunnel.
Undermine the walls,
over a course of several weeks,
and eventually they will tip over naturally,
of their own accord.
"The stone age didn’t end for lack of stones."
The Saudi oil minister liked to use this phrase in the 1970s when asked about future oil supplies, which I think was mighty cheeky of him. But it is true of all kinds of things.
The mainframe age didn't end for lack of mainframes. In fact, you can still buy a mainframe from IBM, if you want one. What did end was the relevance of mainframe technology to the larger computing marketplace. The mainframe was driven from the mainstream into a niche.
“What is IBM’s next move?”

1970
“Tell me, I must know!”

2008
*yawn*

In 1970, the question everyone in IT wanted the answer to was "what is IBM's next move?" If was a question with great strategic value.

If you knew what IBM was going to do, you knew what IT would look like in the future.

Now we don't care.
anyhow...

What were we talking about again?

Ah right!
“When will there be an open source replacement for ArcMap?!?”

Ah right!

The age of ESRI dominance of GIS won't end with ESRI going into Chapter 11,
“What is ESRI going to do?”

it will end when
"what is ESRI going to do"
ceases to be a question of import
when discussing the future of GIS.
where is the cutting edge of GIS?

In some ways, the age of ESRI is already over.

The growth of internet mapping, and the entrance of huge firms not named ESRI has already changed the market dynamic incredibly.
The places where ESRI has built an insurmountable lead in technology and processes the traditional GIS operations of capture, analysis and printed map making, are not the places where our field is going to be growing for the next decade, the mass market of consumer applications delivered over the web to new devices in real time.
You can already see this trend in the new non-traditional GIS marketplace. The people building the next-generation of consumer facing apps are using open source tools, and tools from Google and Microsoft.

Here's a bunch of brand new companies, many venture funded, with very spatial centric businesses, and the technologies they are using.

(I know PostGIS, so there's a PostGIS-centric bent to this list.)
Zonar Systems builds their own fleet tracking GPS devices and manages all the data streamed back in PostGIS, with Google Maps and Mapserver as other components of their application.
RedFin, a real estate data startup, (yeah, bad timing) manages all their data in PostGIS and uses Virtual Earth for the UI.
WeoGeo, a map sharing site, manages their data in PostGIS
GeoCommons, a data sharing site, manages their data in PostGIS, and uses Google Maps for their UI.
Google itself, uses PostGIS to manage the metadata associated with their vast holdings of raw imagery.
WhereYouGonnaBe, a spatial add-on for FaceBook, founded by Peter Batty, the former CTO of *InterGraph* uses PostGIS for their data.
GlobeXplorer uses PostGIS to store image metadata, and vector data, and Mapserver to render vector data. They were purchased by DigitalGlobe three years ago.
Everyblock, a "hyperlocal news services" stores their data in PostGIS, uses Mapserver to render their map tiles and uses OpenLayers for their UI.
Outside.in, Another "hyperlocal news service", also stores their data in PostGIS.
The Urban Spoon, which I recently saw featured in this Apple television commercial, uses MySQL to drive their "shake'n'eat" iPhone application,
All these folks have in common that they built their infrastructures recently and therefore evaluated their technical options recently.
open source is good enough

and it’s a heck of a lot cheaper

And for building a web-based multi-user service, most evaluations are going to come to the same conclusions:

"open source is good enough"
"and it's a heck of a lot cheaper"
Does this formulation sound familiar at all?

How about...
the minicomputer is good enough and cheaper than the mainframe
the PC is good enough

and I don’t have to beg IT for system time
this laptop is
good enough

and I can take it
with me when I travel too

it's the disruptive technology
soundtrack, this is what you hear
this [option] is good enough [for the default need] and [has some extra compelling attribute]

as a disruptive technology moves upwards into the space previously held by an incumbent technology.

We are just beginning to see open source poke its head into the geospatial world.

But it's not going away.
It's a disruptive technology.

And it's going to change the way we think about GIS software forever.
Thanks!
Do we have
Time for questions?