BIOGRAPHICAL INFORMATION

Dennis F. Beck
President and CEO
Spatial Business Systems, Inc.

Specific Responsibilities

Dennis F. Beck is President and CEO of Spatial Business Systems, Inc, responsible for overall company operations, corporate business development activities and executive consulting in the advanced use of geospatial technologies.

Past Experience

Prior to forming Spatial Business Systems Mr. Beck was the Vice President of Global Business Development for GE Network Solutions. In this role Mr. Beck was responsible for managing acquisition activity and expanding the use of GE Smallworld technologies to government and transportation markets. Mr. Beck also oversaw the technical delivery of geospatial technologies to customers in the utility and telecommunications market segments.

Prior to his role at GE and Smallworld Systems, Mr. Beck was the product manager for IBM's GFIS suite of geospatial products. Mr. Beck has a BS in Engineering from Purdue University and a Master's Degree from the University of Texas at Austin. Mr. Beck also possesses US government security clearances.

Educational Information

Professional Memberships

GITA

THE NEW ECONOMICS OF GIS INTEROPERABILITY

Technology trends in the geospatial technology industry are causing a number of important changes that dramatically affect the traditional economics and adoption of GIS. Some of these key trends include:

- Continuing reductions in hardware price points,
- Reductions in geospatial software and database software prices,
- Support for mainstream development languages in geospatial platform products,
- Product-level support for GIS interoperability,
- A movement towards product-level geospatial application products and,
- Widespread availability of low-cost spatial data sources.

The author will present an interesting look at technology trends based on Chris Anderson's "Crash Course in Innovation" and how pricing, critical mass and timing impact the widespread adoption of new innovations. This model will then be applied to recent trends and innovations in the geospatial technology industry. A focus case will be developed that evaluates the adoption of GIS interoperability technologies and the impact it is having on the reduction in overall system procurement, application development and long-term maintenance costs.

INTRODUCTION TO INNOVATION ECONOMICS

As the information technology field has matured a lot of analysis has been done on how technologies move from going from the invention stage, onto the niche stage and ultimately to become a ubiquitous, breakthrough technology. In my third decade as GIS professional I have heard the question asked, "When will GIS become a ubiquitous technology?" in many different forms over the last 15 years. GIS is actually quite ubiquitous but it is taking forms that are much different than what one might expect.

Significant research has been done in this area both in academia and industry but one of the most interesting and easy-to-understand analyses I've seen has been from Chris Anderson, the Editor-in-Chief of Wired Magazine. His brief article, from the May 2004 issue, "A Crash Course in Innovation" describes several interesting phenomenon that occur in technology trends. Anderson refers to these as "collisions". These collisions are critical price, critical mass, displacement of other technologies and what I will call "ubiquitous pricing" for lack of a better term.

These different collisions and how they impact technology adoption are explained below.

The first collision Anderson refers to is critical price. When technologies drop to a certain level it is now possible to appeal to a much larger market. Some thresholds are psychological in nature. For example, a drop below $1000 makes technology more likely to be purchased for home use. A price below $400 typically opens up that product for mainstream consumption from early adopters. PDAs are a good example. I picked my PalmIII in September 1998 where there was a special offer that dropped the units below

$400. It made complete sense to me at the time, but I wouldn't even think of owning one before then. My personal preference however is that of a buy-and-hold buyer, rather than an early adopter. Some of my associates had already bought one or more Palm devices several years earlier and were already moving on to more current technology.

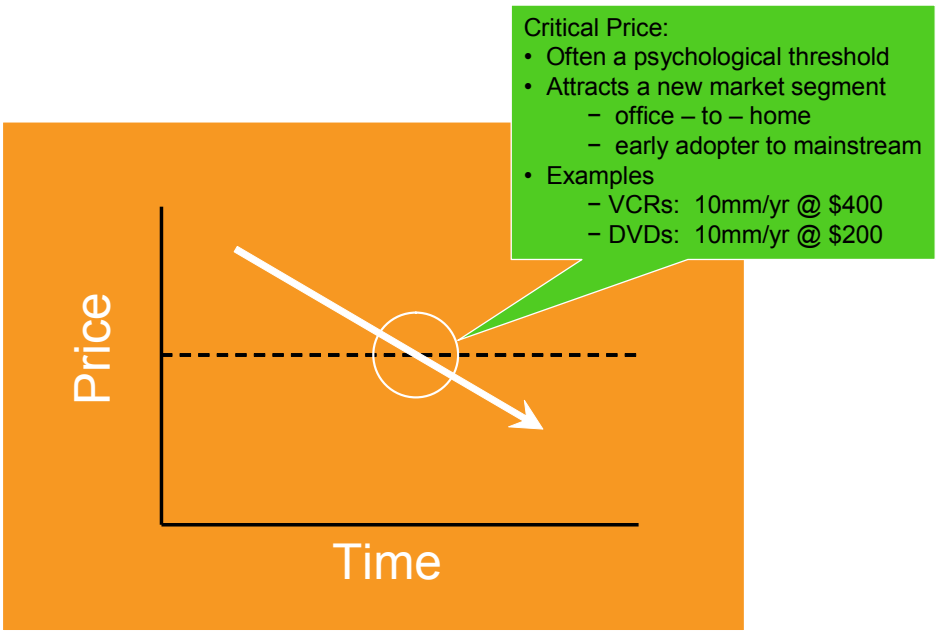

Figure 1. – Critical Price

The next collision is critical mass. Critical mass occurs when the technology becomes generally prevalent, rather than as a unique trendy item. PCs, VCRs and DVD players all reached critical mass a long time ago but some devices, such as the TIVO DVR are still coming up in market penetration. There are guidelines as to when critical mass is reached, perhaps 15% to 20% market penetration, but it is oftentimes more of an attitude that the technology is mainstream and ready for general consumption. This can be evidenced by comments heard on TV or slick demonstrations you may see from friends or co-workers.

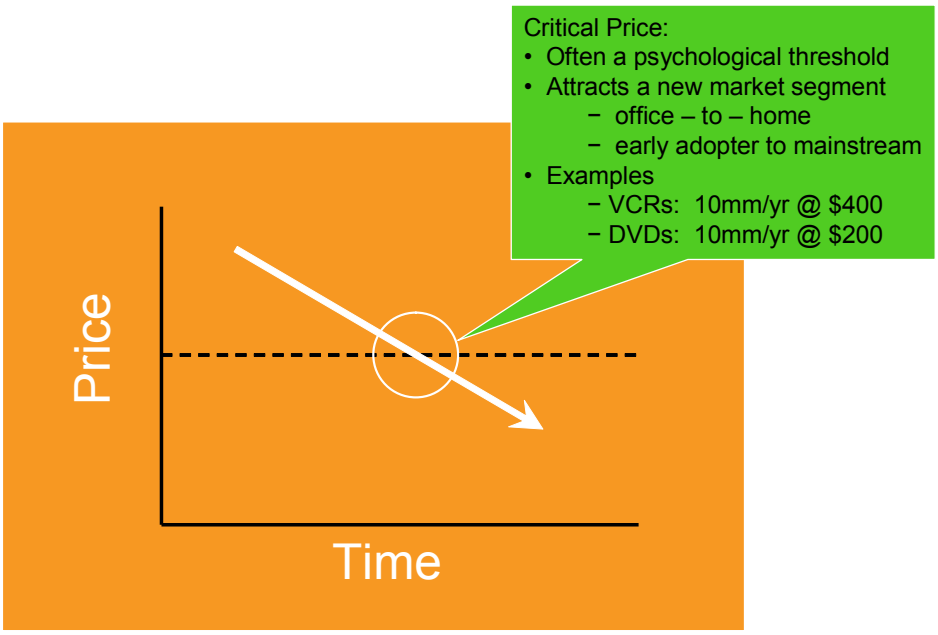

Figure 2. – Critical Mass

The third collision is referred to by Anderson as displacement. This occurs when an established technology begins to be replaced by a newer one. Displacement is sometimes referred to as disruptive technology as coined by Clayton Christensen of Harvard Business School. The replacement of VCRs by DVDs is one example, but the effects of disruptive technologies have been around for a long time and include replacing manuscripts with the printing press or canals with railroads.

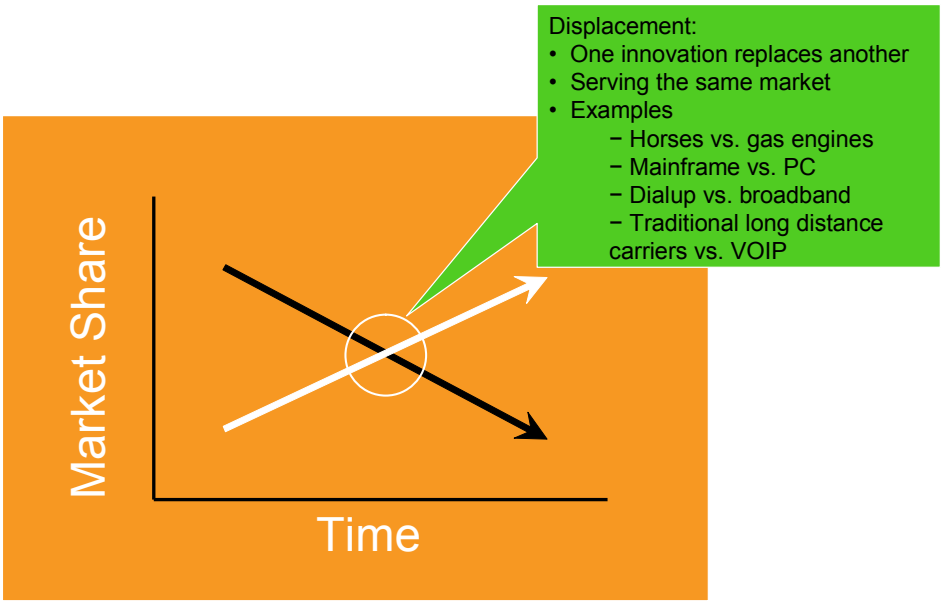

Figure 3. – Displacement

The fourth, and perhaps most though-inspiring collision, is zero. As technologies become very well-established the price begins to approach zero. The best example of this is disk storage. I remember paying about $250 to buy a 42 MB hard drive for my first home PC. I had to give up floppy drive but I was gaining more storage than I ever expected to use! I recently was at a trade show where they were giving away storage sticks as part of their promotion efforts. That $250 worth of storage was now a marketing giveaway. This kind of tremendous drop in price opens the way to all kinds of innovation that can really change the way businesses operate.

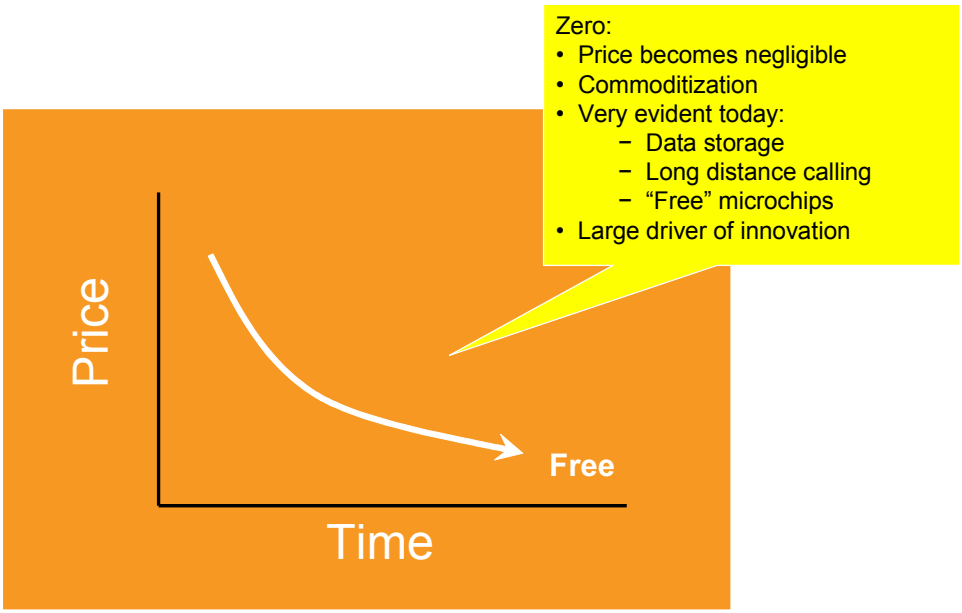

Figure 4. – Zero

There are many examples of how these technology collisions occur to move new innovation into the mainstream. The shift to DVD players from the VCR has changed the way that videos can be distributed. Many of you may be familiar with Netflix, which is a video-by-mail service that charges a monthly subscription fee to its users. Subscribers are allowed to rent out 3 DVDs at a time and they are conveniently sent to and from the customer via the US Post which practically speaking, is nearly a free distribution vehicle. In major cities such as Denver, where I live, the turnaround period is just about 3 days between the time that you mail in a disk and get the next one in your queue. One particularly nice feature is the fact that there are no late fees. The centralized nature of this also allows Netflix to keep a much larger inventory.

Another disruption has occurred with the dramatic change in the cost of bandwidth and its impact on the cost of international phone calls. The capabilities of the thousands of well educated, English speaking workers from India, the Philippines and other lower cost countries can now be exploited for just a fraction of the price. All of this is possible because the price of the phone calls is rapidly approaching zero, relative to the wages of US call center workers.

THE GIS INNOVATION CYCLE

The GIS technology marketplace presents an interesting sandbox with which to apply the innovation model. There are many dynamics that will cause big changes to the industry over the next 5 to 10 years. I must preface these remarks by saying that the use of geospatial technologies is very diverse in terms of market segments. A GIS environment that supports restoration of electrical outages is different from an in-car navigation system. At the same time there are also very interesting links that exist between all the different GIS segments. That said, this analysis is high-level and simplified to get you to think about where things are going in various aspects of geospatial industry.

Collision 1 - Price reductions in geospatial technologies

Geospatial technologies have experienced extensive price reductions over the last 20 years, but different components of the overall price of implementing GIS are varying at different rates. It's important to look at the pricing components of GIS separately to see how they have changed. I have given the different components following report card style ratings in how they have been able to reduce costs.

Component	Grade
Hardware	A+
Software	B
Services	C+
Data	D
Network bandwidth	A

Hardware
Hardware continues to become more and more commoditized. A powerful GIS product can run on hardware purchased from a local department store for under $1000. It is interesting to note that 15 to 20 years ago when I first started in the GIS business the use of GIS was much more driven by hardware vendors than software vendors. A GIS workstation set up would cost $125,000 per seat, which explains their great interest. Both these examples of software and hardware support the fact that the critical price collision has already occurred.

Software
GIS software is changing from being a high-end specialty priced offering to now being much more mass marketed. Ten years ago GIS software was selling for anywhere from 12 to 25k for a full seat. This same level of functionality can now be purchased, with data, for as low as $500 per seat if one wants to use desktop software. This is a dramatic change that is making it more prevalent, but there is a bigger change that needs to happen – that is the ability to reduce the overall costs associated with the data conversion effort for infrastructure driven organizations. In some ways, this software cost becomes almost negligible compared to the other longer-term costs.

Services
Services get the "C+" grade. In spite of great improvements they have not been changing too dramatically in overall price relative to hardware and software. The use of foreign developers from lower-cost countries is not uncommon, but it is still a here-and-there phenomenon. Software also continues to drive the services component down on a couple of fronts. First off, products are being developed that require less customization, which reduces the services component; perhaps more important is the continued move to de facto standard application development environments from custom programming. The use of standard development environments is not a cure-all as it doesn't solve the problems associated with geospatial expertise required to drive a successful project but it certainly lowers the cost of entry with regard to prerequisite skill sets and learning curve.

Data
I have given data an "D" grade for several reasons. First, it is still by far the most expensive component of any GIS implementation, particularly for any infrastructure driven organization, such as public utilities and local governments. The commercial data providers, while consolidating, are still difficult to deal with due to licensing issues. The quality of the products continues to improve, but it's just not there yet. The same goes for commercial imagery products, which have been seen as a promise for many, many years, but they are just not in any position to become main stream. The data problem continues to relegate GIS to a niche market, but it continues to change and evolve.

One of the most exciting drivers that could make this change is the rapid acceptance of low cost GIS products such as Microsoft MapPoint.

Network
Network technologies, while not necessarily a component of a given GIS implementation are an exciting enabling technology that is, and will continue to change GIS as we know it. In GIS, as in the rest of the technology world, the Internet truly changes everything.

Collision 2 – Critical Mass

There are sub-segments of the GIS market where critical mass is close to being reached, there are others where the technology remains very niche oriented. In the area of low-cost GIS supporting location based technologies, I believe critical mass has not been reached and it will likely be a while. For example, MapPoint is not included as a part of the Microsoft Office Suite. (It would be interesting to see what impact this would have on future sales of their upgraded product suites if this were to be offered.) On the other hand, I don't know of too many Internet users who don't use either MapQuest.com or MapPoint.com to find out where they are going. High-end GIS applications such as those used in utilities that commonly attend this conference are still in the niche position but it gets interesting to see how the applications that are approaching critical mass can be melded into the high-end systems.

Collision 3 – Displacement

Displacement has been happening for over 10 years now in various forms. Mainframe systems, such as IBM's GFIS or mini-computer based systems such as Intergraph FRAMME or Synercom started to decline and in the early 90s as workstation based systems proliferated. These are displacements in one sense, but they can also just be considered to be technology upgrades – doing the same thing with newer software. The big question that we need to ask is what will be the next displacing technology? I believe that displacements will not be occurring like they did in the 1990s. The focus will now shift to integration.

Collision 4 - Zero

Zero is here, but only in some applications. Routing and address location via MapQuest and MapPoint is here now and it is really quite effective. Several things make zero possible:

- The availability of low-cost data sets
- Low-cost bandwidth
- Wide spread appeal of application (just about everyone needs to know how to get somewhere) and,
- Advertising to subsidize operating costs

Zero is just one way that something nearly free can generate tremendous business benefits which are oftentimes much greater than the original objectives of a corporate GIS implementation.

FOCUS CASE - INTEROPERABILITY DRIVES INNOVATION

The remainder of this paper will focus on an example case of how interoperability and integration can drive the future of GIS innovation. Interoperability is not unique to GIS but it has received quite a bit of attention in our industry over the last 10 years. This has been manifest by standards organizations such as the Open GIS Consortium (OGC) and the emergence of de facto standards for geospatial data exchange from vendors such as Safe Software, which has a well-established universal data translator called FME and the defacto acceptance of data formats from various vendors (e.g. shapefile, DXF & DGN formats). These formats do not have the richest set of exchange features but their prevalence in the industry has created collision two, critical mass, which means that it is accepted and more widely adopted than richer formats that exist.

The GIS implementation used for this example is intended to be typical of the enterprise GIS installations that were taking place in the mid to late 1990s. These systems often have been successful to an extent their key strengths are typically highly integrated with corporate systems, have high data currency, a significant, well trained user base and are typically achieving solid benefits for the organization. The weaknesses of the system are centered on the fact that the high level of integration and complexity of the system software makes additional application development costly. Often these systems required

specialized development environments which can lead to a larger base of custom software that needs to be maintained throughout the life of the system.

The new capabilities offered by open integration solutions can address many of these concerns. When these original systems were designed they were focused on managing assets and integrating key business processes that either maintained the database or supported business needs. These include work management, outage management and network analysis, amongst others. While these applications have been foundational to the very nature of utility business many significant business benefits have been "left on the table". One example is routing of mobile crews. This application is highly spatial in nature but organizations that developed, or looked into developing custom routing applications for their mobile workers quickly realized that this was a very complex application and even though they had a rich land base with extensive roadway data they were missing things such as street directions, turn restrictions, alternate names, rich geocoding and other requirements that make a routing application effective.

In a utility with 1,000,000 customers a powerful routing application can improve productivity by a few percentage points which may not seem like much, but can save many millions of dollars per year. There are many other examples of applications that can be integrated into a corporate GIS, but hopefully this will give the reader an idea of how existing GIS implementations can be "supercharged" by the use of sensible integration of open technologies and well proven mainstream applications.

Another example is reporting. The generation of reports is considered a rather mundane piece of information but it can have a much more dramatic effect when a geospatial representation has been added. The open integration of a corporate GIS with lightweight client software can add a whole new component for an organizations executive team. The entrance of products like MapPoint 2004 and others opens the door for this kind of reporting capability.

These two examples may seem very modest, but when one looks at the cost benefit of the solution it becomes quite dramatic to look at what interoperability has to offer. In the case of reduced routing costs the millions of dollars that can be saved within a year are supported with minimal costs. The hardware can be standard off-the-shelf devices that cost a few hundred dollars or less. The software costs are negligible and the data is provided by the routing application. The payback can be achieved the first time a work crew is able to avoid getting lost for a job or stuck in a traffic jam. The reporting application opens the door to take a strategic look at a business in ways that were typically available to executives.

CONCLUSION

The concepts of innovation and breakthrough technology are interesting to look at in other industries and can be used as tools to expand our look into the future of GIS. There are many exciting developments that will be taking place in this market as the traditional custom systems have matured and new, lower-cost applications take hold in the market place.

This raises the question, where is GIS going in the utility industry and other organizations that rely heavily on networked infrastructure? I believe the future is driving towards integration of existing applications and that there will not be nearly as many major system implementations and migrations from different platforms. There are several reasons for this:

- There are not major drivers for changing – operating systems have undergone tremendous standardization with the movement to Windows-based platforms over the last 10 years. There are not the drivers of Y2K or obsolete hardware/software environments. Problems identified with proprietary development and data management environments can be addressed via other means such as outsourcing of skills and supplementing future developments with more mainstream developments.
- Integration is where things are going. The addition of mainstream tools, such as routing, that have been tested on millions of users into a specialty corporate environment offers a way to exploit the big investments that are being made in location-based tools.
- Things will continue to be fun and exciting and ripe for new innovation. The continued progress made in areas such as commercial imagery and web services will continue to generate huge opportunities for generating real benefits.