From the Points of Inflection beyond the Limits of Convergence

An Unprecedented Transformation of

This month's interviewee Geoff Zeiss is a man of broad geospatial and IT knowledge with a great talent to transform it into clear and inspiring thoughts. Being a chief technology guru at Autodesk his thoughts and ideas reach far beyond the limits of his company. In the interview we discussed about several critical trends, thus enabling you to get an excellent first hand insight in the present and future developments in the geospatial industry.

By Joc Triglav

Geoff Zeiss

The developments of the last few years show that spatial is not so special any more as it used to be. Are we finally reaching the long expected point of entering the mainstream?

In the last two years the geospatial industry has undergone an unprecedented transformation. I see this as a point of inflection for several reasons, one of which is the widespread recognition that geospatial is no longer special because geospatial has joined the IT mainstream. What this means in reality is that geospatial has become one of the core enabling technologies that is available to everyone in IT, not just to GIS specialists. An important example is relational database management systems (RDBMSs). RDBMSs used to be restricted to numeric and text data types. Now virtually every RDBMS including Oracle support spatial data types. This trend also applies to architectural and engineering design, where the trend is toward designing buildings and infrastructure in their geographic environment. A number that has been bandied about in the geospatial industry for many years is that 80% of IT applications could benefit from spatial enabling. I think the mass market geospatial phenomenon has confirmed the geospatial industry's 80% estimate and illustrated the tremendous benefits of integrating spatial data and functionality with general IT.

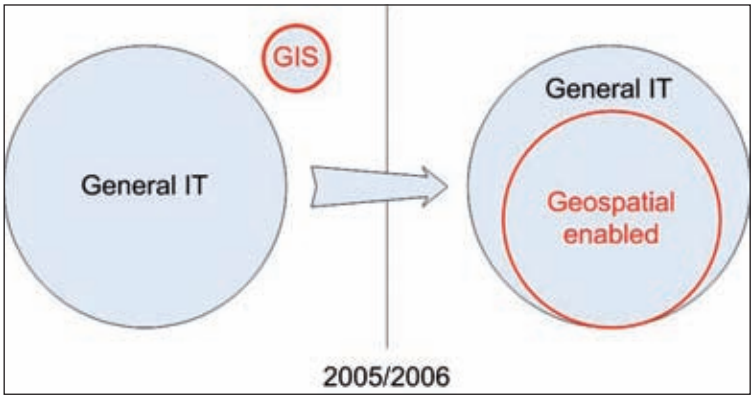
How does the so called mass market geospatial technology, like Google Maps/Earth, Microsoft Virtual Earth and others, influence Autodesk's behaviour and visions in the geospatial business? Do you see this technology more as a competition or as some kind of a booster of Autodesk's development or as something else?

Many more people are using spatial data and software in their day to day life than ever before in history, though most of these people wouldn't recognize what the letters GIS stand for. Well-known examples include MapQuest, Google Earth and Maps, Yahoo Maps, and Microsoft Virtual Earth. Google Earth has had 200 million downloads, an incredible statistic.

What this means in the design world is that there is much greater demand for design data incorporating location. In other words, you can't design buildings, highways and roads, and other infrastructure any longer in isolation from their location. Since Autodesk's products are used for creating most of the world's building, roads, and facilities design data, the requirement for location is one dimension of the trend to converged design applications. For the past decade Autodesk has been investing in the technologies enabling this fundamental business transformation, such as 3D, model-driven design, geospatial, and 3D visualization and gaming which I am convinced is going to change how architects, engineers, utility and telecommunications, local government, urban planners, emergency responders and others model and design our urban worlds.

Which are the strategic and operational strengths of Autodesk in the field of geospatial convergence? Where does Autodesk fit in convergence completely with its product line already and which are the main steps that still have to be made?

Several years ago the National Institute of Standards and Technology (NIST) commissioned a study to attempt to quantify the efficiency losses in the U.S. capital facilities industry resulting from inadequate interoperability including design, engineering, facilities management, business processes, software systems and redundant paper records management across the entire facility life-cycle. NIST estimated that poor interoperability cost the capital facilities industry $15.8 billion in 2002



Geospatial-enabling and GIS

Geospatial Industry

Burj Dubai 120 floors (by Calajava, Flickr.com)

Traditionally disciplines such as architecture, engineering, and construction, civil engineering, and GIS have been classic information silos. Each has maintained its own island of design applications and data. To break down these barriers many people see convergence as a key part of the solution. Another dimension of convergence is to be able to experience a building, road, or facility before building it. 3D visualization is a critical component of converged solutions.

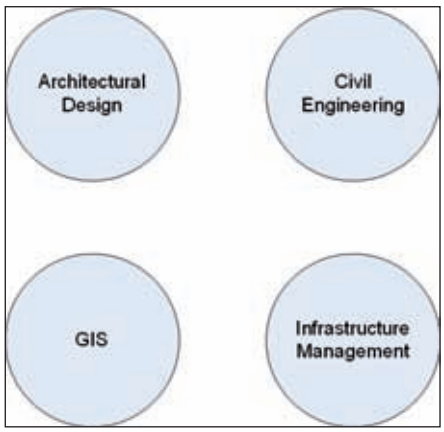
An implication of convergence for emergency responders and urban planners is that will have access to comprehensive data about the facility inside, outside, and under. For example, when a first responder enters a building he or she will have his or her fingertips seamless access to all of the existing architectural, engineering, infrastructure and geospatial data including structural, h/v, plumbing, underground cables and pipes, aerial photography, and roads and highways for that structure.

Autodesk is uniquely positioned to lead this transformation of the construction industry for several reasons. We provide design tools in all of the major design disciplines, including architectural, mechanical, and civil. Secondly, spatial technology is a well developed platform technology at Autodesk. Thirdly, we made the decision a decade ago to begin investing in 3D technologies and model-driven design. In the area of architectural design Building Information Modeling (BIM) is a model-driven design technology that was introduced by Autodesk. In the area of mechanical design Inventor has been a leader in solid modeling, and in civil engineering Civil3D has introduced the concepts of model-driven design and 3D. Thirdly, Autodesk's Media and Entertainment Division is a major player in the gaming and special effects market for films and television. For example, 3ds MAX is a de facto industry standard gaming engine. Because Autodesk has access to these technologies in-house including architectural and engineering design, geospatial, and gaming and 3D visualization, we are uniquely positioned to provide the desktop and web-based design and digital prototyping tools that will be required in a converged world.

With Autodesk's strong position in the architectural, engineering, and construction (AEC) and 3D geospatial business, is it reasonable to expect that Building Information Modelling/Management (BIM) solutions are one of the Autodesk's key paths of development?

The annual spend of the world's construction industry construction worldwide is estimated to be US$ 2.3 trillion. The construction industry is highly competitive, and firms must continually improve their productivity to remain competitive. This challenge of continual productivity improvement has reached crisis proportions in the US where statistics published by US Bureau of Labor Statistics show that the productivity of the construction industry has actually declined in the last 40 years while non-farm productivity has increased by over 200% in the same period. To improve productivity we need to change how we design and construct buildings. In addition we have to address the challenges of global climate change, more efficient use of energy, and minimizing environmental impact.

Traditional CAD is used to produce pieces of paper, often called construction drawings or



Islands of Information

blueprints. Traditional CAD drawings are not very intelligent because they lack a model or intelligent simulation of real world objects. Models make it possible to do intelligent things like a downstream trace from a failed transformer to determine the customers affected, changing the footprint of a 50 story building without having to redesign every floor, or designing an engine that can be animated it to visualize the moving parts. In the context of architectural design this is called a Building Information Model or BIM, and many people in the industry believe that BIMs not only reduce the costs of design and construction for new structures, but also significantly reduce the downstream costs associated with operation and maintenance. In a nutshell the business drivers for this transformative technology advance are productivity and efficiency in the construction and facilities management industry by improving the performance of facilities over their full life-cycle. Because these are key business drivers for our customers, Autodesk has been at the forefront in introducing building information modeling into the AEC market.

Is the fast growing field of building cadastres in many European countries influencing your technology development plans? The right product in this field, functionally exploiting the AEC, geospatial, BIM and database synergies, is still missing on the market. Based on the huge 3D knowledge base at your company do you feel that Autodesk will grab the opportunity and fill the gap?

I see automating the management of cadastres and land registry as an important priority for Autodesk, especially in Eastern Europe because of the legacy of a political system where land was state owned, South America, and Asia. For example, Budapest is a city of approximately two million people. It occupies 52,000 hectares and there are 230,000 separate land parcels registered in the city in addition to 750,000 other types of properties, such as condominiums, for which the Budapest District Land Office maintains data and legal registry information. The Land Office has just completed a pilot in three districts of Budapest using Autodesk Topobase. Among the features of Topobase that attracted the Land Office was that all data is stored in Oracle Spatial, a vendor neutral, spatially-enabled relational database management system, so that Budapest's cadastre and land registry is not locked into a single vendor and is open and accessible to other applications. Secondly, Topobase was also attractive because its desktop client is based on AutoCAD, which is the de facto industry standard precision data creation desktop. The Land Office was already familiar with AutoCAD, so this minimized the training was required. The combination of the de facto industry standards, Oracle Spatial and AutoCAD, simplifies automating a cadastre and land registry system. In the future I also see increased interest in 3D cadastres especially in the Asia Pacific region, and Autodesk's investment in 3D technologies such as Building Information Modeling (BIM) provides a foundation for creating and maintaining this new form of cadastre.

Which are the necessary near future geospatial developments in the world of network infrastructure, like the power lines, telecommunications, water, waste water and other public utilities?

Throughout the world utilities and telecommunications firms manage infrastructure in basically the same way and are facing similar challenges. If you look at the information flow in these organizations, the most obvious thing that strikes you is the problem of silos or islands of information. The second thing is that the information flow in these organizations is for the most part based on paper. For example, the Engineering group uses CAD tools, the Records or Network Documentation group uses GIS tools, and the flow of information between these two groups is paper. The result is redundant processes and backlogs. In addition the aging of the work force exacerbates what is already a critical problem because there is no effective mechanism for transferring the knowledge in the heads of experienced workers to the facilities database where it can be accessed by younger, less experienced workers.

The challenge for IT is how to help organizations make progress in solving these business problems. Most IT people would agree that technology is no longer the excuse. From a technical perspective the critical components required to address the problems that I've outlined are a spatially-enabled relational database management system (RDBMS), CAD/GIS integration, and Web 2.0 technology to enable field force participation. I see Web 2.0 as a key enabling technology, because it enables remote field staff to participate directly in the maintenance of spatial facilities data. The result is greater productivity and improved data quality, which will make it more feasible for utilities and telecommunications firms to employ younger and less experienced field staff to replace more experienced staff as they retire. MapGuide Open Source and FDO provide a Web 2.0 platform enabling participation of the field force in maintaining and improving the quality of facilities data.

Which further developments can we expect in the field of geospatial intellectual property rights? What do you think of GeoCommons, a recently announced repository for geodata available for mashups, with regard to the Web 2.0 world of mapping and Creative Commons licensing?

First of all I would like to clarify an important point and that is that intellectual property rights (copyright and licensing) and price are separate issues and that what I will discuss here is IP, copyrighting and licensing of spatial data, which is getting a lot attention recently. In the UK where spatial data collected by the Ordnance Survey, which in the UK is called a trading fund and is expected to generate a financial return for the Government, is copyrighted, access to public sector information is perceived to be so restrictive financially that there is an initiative Free Our Data supported by The Guardian (freeourdata.org.uk).

I was recently in Tasmania where I heard a very interesting presentation by two members of the Government of the State of Queensland, a Crown lawyer and a statistician. Their objective is to develop a standard set of licenses for the Government of Queensland to be used for digital spatial data. What is being recommended in Queensland is that all

3D technologies

Building Information Modeling (BIM) is a model-driven design technology that was introduced by Autodesk.

government spatial data would be available under Creative Commons (CC) licenses. This is possible in Australia because copyright is automatic and because government data is covered by Crown copyright. I believe this is also the case in Canada. In the US, in contrast, data emanating from the Federal Government is not covered by copyright.

I think that their ground-breaking research and recommendations will get a lot of attention nationally in Australia and even more attention worldwide. There are several sites that offer data collected voluntarily by participants including OpenStreetMaps (www.openstreetmap.org) and GeoCommons (www.geocommons.org) under a Creative Commons share alike with attribution license (creativecommons.org). Another interesting site is www.malsingmaps.com, where you will find street maps of Singapore and Malaysia, which are collected voluntarily but which are also copyrighted, and which can be freely downloaded for personal use.

What is your opinion on geospatial standards? We are lost without standards and we need them simple, effective and efficient, but why do they seem increasingly diversified and complicated to the geospatial layman and professional as well?

A famous saying we've all heard is that the best thing about standards is that there are so many to choose from. In the context of the geospatial industry, I believe that over the past two years we have seen a strong trend toward recognizing the importance of standards and standards bodies such as the Open Geospatial Consortium (OGC) and ISO, and toward adopting geospatial standards. I would suggest that the Simple Feature Specification for SQL(SFS) has had a tremendous and positive impact in opening up access to spatial data. Most of the world's relational databases (RDBMSs) have implemented the SFS in some form and all of the major geospatial vendors support one or more spatial RDBMSs. Another spatial standard that has been widely adopted is the OGC's open web services (OWS), for example, WMS and WFS. Again both of these are supported by all major geospatial vendors. So there has been tremendous progress.

There are two kinds of standards, de iure or open standards and de facto standards. Geographic Markup Langauge (GML) is an example of the former, and Google Earth's KML of the latter. Many people believe that for standards to be widely adopted, they must not only address real world problems, but they must be simple. The 80:20 rule is relevant here. The consumer market has made clear that KML has the right level of complexity to address 80% of the world's spatial problems. The good news is that KML has already been adopted as an OGC Best Practices and appears to be well on its way to becoming an OGC standard.

In various parts of the world an interest in commercial opportunities using open source geospatial technology is growing substantially. In your opinion, what should one consider most, be it benefits or dangers, when entering the open source community?

Before February of last year, open source geospatial was a "quiet reality". Most people were surprised by how extensive and widespread the use of open source geospatial software had become. The formation of the Open Source Geospatial Foundation (www.osgeo.org) with the support of Autodesk reflects the maturity of open source geospatial software and is contributing to bringing open source geospatial software into markets where it has had limited penetration in the past. There are two key requirements for successful open source projects, a grass roots developer community and a thriving business sector which relies on the technology. Both of these conditions have been realized in the open source geospatial community.

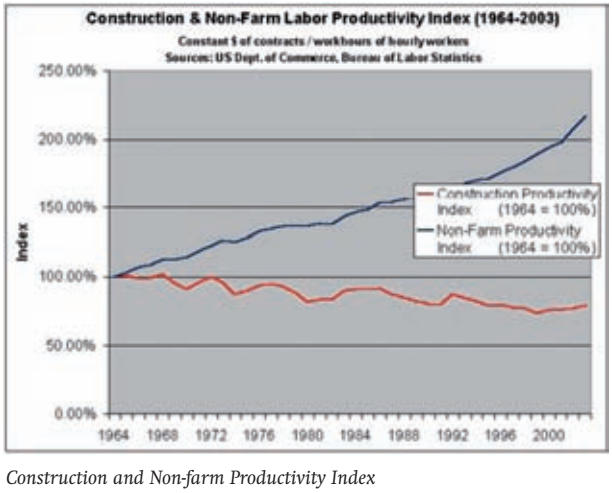
A common misconception about open source software is that open source software is the opposite of commercial software. The reality is that there are two types of commercial software, open source and closed source (often called proprietary). Many commercial companies such as Red Hat base their business entirely around open source software.

As a rule of thumb, open source does better in areas where software is being commoditized, where the opportunity for different vendors to differentiate their software is limited. Well-known examples are operating systems (Linux), web servers (Apache), relational database management systems (MySQL), and scripting languages (PHP, Perl, and Python). Another rule of thumb is that where you find well-developed standards, such as POSIX, SQL, HTTP, HTML, POP, and SMTP, you will often find commoditization. For example, MapServer has been among the leaders in supporting Open Geospatial Consortium (OGC) open web services standards (OWS) such as WMS and WFS.

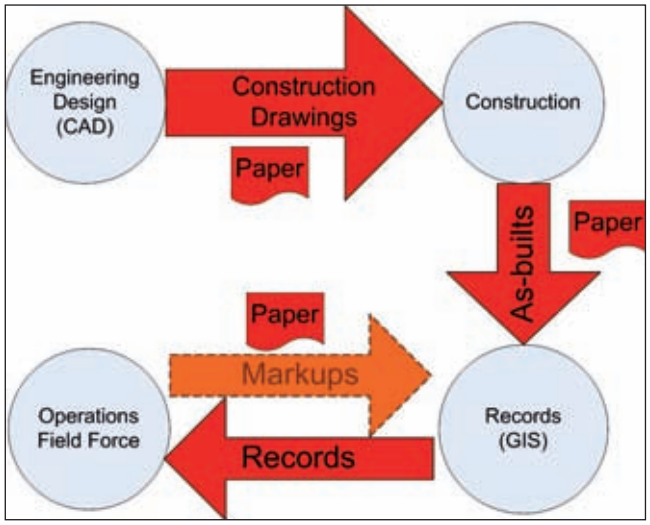
Another common misconception is that you're left to your own devices when it comes to support. The reality is that there are many companies that provide support for open source software. Perhaps the best known is Red Hat whose primary business is providing support for Linux. The last time we checked Red Hat's market capitalization was $4.3B. Similarly in the geospatial arena firms such as DMSolutions and Orkney are providing support for open source geospatial products.

Which are Autodesk's experiences so far with the open source technologies? Will the company expand its open source initiatives and if, in which directions or products?

I see an analogy between the current situation in web mapping and the early days of the web when the initial web servers were being developed. In the mid 90's eight core contributors supporting the NCSA HTTP Server got together for the purpose of coordinating their fixes and "patches" to the HTTP Server and formed the original Apache Group, which was little more than a shared mailing list. The industry, including major IT players like IBM, Sun, HP and others, had to decide whether to develop and support their own proprietary web servers and compete in this arena. In 1999, with IBM encouragement, the members of the Apache



Construction and Non-farm Productivity Index



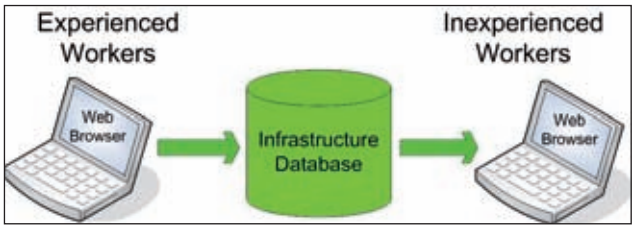
Infrastructure Management Lifecycle Paper

Group formed the Apache Software Foundation, a legal entity, to provide organizational, legal, and financial support for the Apache web server. Since then the Apache Web Server has been adopted by IBM and others and is running over 70% of the world's web servers. I foresee that the future of open source web mapping will be similar to what happened with web servers. In the short period since MapGuide was donated to the OSGEO, we have seen over 25,000 downloads of MapGuide Open Source and over 4,000 of the Feature Data Object (FDO) API. We are also seeing non-Autodesk developers actively contributing to both projects. For example, most of the FDO data providers currently available were developed by non-Autodesk developers.

At the end, please share with us your vision on the grand picture of the global geospatial market in five or ten years from now?

The single most important trend that I see in the future is convergence, breaking down islands of information based on traditional disciplines or professional categories and those created by the traditional organization of the construction, transportation, and utility and telecommunications industries. This is going to create points of inflection in the construction industry, the utility and telecommunications industries, urban planning, and the emergency response and disaster management sectors. For example, I foresee the replacement of much of our existing infrastructure, which in the US is in dire condition (www.asce.org/reportcard/2005/index.cfm) requiring trillions of dollars of investment, by more environmentally friendly, more energy efficient, and more efficiently maintainable infrastructure. I expect it will be exciting times especially for the much more digitally savvy younger generation, because I am convinced that gaming technology is going to be a critical technology in enabling the new converged world. We are going to realize what Roger Tomlinson, often referred to as the Father of GIS, foresaw in 1975, being able to simulate » a model of the earth on a computer that functions like the earth, including all people, places, things and processes...we've got a tool that allows us describe the world with much greater facility than we ever have before. And, by definition, that's going to what we understand about it«. In other words, SIMCity(tm) but with real data.

Secondly, I remember attending the last European Oracle Open World conference in London several years ago and listening to Lars Wahlstrom's, head of Oracle's EMEA Telecommunications Industry Group, presentation on the impact of IT in telecommunications. He said that compared to the banking industry (ATM's replacing tellers), the low cost airline industry segment (like Ryanair and Southwest), and the automobile industry (SAP), the telecommunications industry hadn't even begun to scratch the surface in applying IT to streamline its business processes. I also remember a very experienced director of operations at a major US telecommunications company who was convinced that by breaking down islands of information and streamlining the lifecycle involved in maintaining facilities data, he could reduce costs by 70-90 %, make his company much more agile in deploying new services, keep the regulator happy, and be much more responsive to his customers. In the intervening five years or so since, compared to what is achievable, the progress has been slow. But the aging workforce issue, the difficulty that utilities and telecommunications companies are having in finding planners, field staff, and others to replace staff who are retiring and the aging of the infrastructure itself are coming to a head, and I foresee that utilities and telecommunications companies and local governments are going to be forced to address the fundamental issue of having to do a lot more with less. I foresee utilities, telecommunications firms and others investing in IT like the banking industry, low cost airline industry, and German automobile industry did years ago. In the immediate future I see Tim O'Reilly's concept of Web 2.0, harnessing the collective intelligence, as a key technology enabling participation of the field force in maintaining infrastructure data as a key to addressing the aging work force challenge.



Experienced Workers Database

Thirdly, I foresee that government regulation and legislation is going to force the capture of a lot more digital data about infrastructure including buildings, roads and highways, and other critical infrastructure. The Traffic Management Act in the UK is a harbinger of what is to come. I also foresee that homeland security and global warming, human population trends, and the cost of energy will force the »digital earth« (www.isde5.org). There is a history of utilities, telecommunications, and local government having to be nudged by government legislation or regulation, but realizing tremendous business value from digitalizing their business processes after the initial nudge from government. Legislation will force standards like INSPIRE in the EU and standardized data models like the FGDC's Geospatial Data Model (www.fgdc.gov/dhsgdm) in the US.

Finally, I believe that the semantic web, which has been championed by Tim Berners-Lee and others, is going to start delivering real business value. In the building, highways and roads, and utilities and telecommunications sectors, I foresee that the semantic web will help these organizations reduce the cost of maintaining their infrastructure and to optimize the build out of new infrastructure and new technologies. The economic driver for this is clear because as a rule of thumb 90% of the cost of facilities whether buildings, highways and roads, or network infrastructure like telecommunications, power, gas, water, and waste and storm water is incurred in the operating and maintenance phase, and we are going to have to increasingly design infrastructure to reduce operating and maintenance costs, both in terms of dollars and environmental impact.

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