Victorian Spatial Council

Proceedings of the VSC December 2006 Forum:

'Where to next for the Spatial Information Industry?'

The Victorian Spatial Council has been established under the Victorian Spatial Information Strategy 2004-07. The Victorian Spatial Information Strategy is a whole-of-Government strategy concerned with all aspects of Victoria's spatial information industry. It considers roles and requirements of the public and private sectors and academia in advancing Victoria's social, economic and environmental goals through the provision and application of spatial information.

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January 2007

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INTRODUCTION

Description of Forum

On 12 December 2006, the Victorian Spatial Council hosted a public forum entitled *'Where to next for the spatial industry in Victoria?'*

The way in which spatial information is being delivered and presented is rapidly developing and is changing the way it is being perceived in the community.

The likes of *Google Earth*, Microsoft's *Live Local* product, and, closer to home, the *Victorian Mapping and Address Service*, are opening up the potential of spatial information to the non specialist user, who is now able to access it without the need for any specialised hardware, software or training.

Similarly, it seems that almost anyone can create 'spatial applications', such as the so-called 'mash-ups', which are using freely provided API software to draw maps and update them in real time.

Victoria's strategic framework is supporting the push toward greater availability of spatial information by stating explicitly that development of applications should enable data to be accessible by anyone anywhere; cater for all users; and enable data exchange, regardless of technology and formats.

But what does the pace of this change mean for the traditional spatial industry – the data producers, vendors, and GIS experts in government, the professions, business and academia? Is our existing spatial information management framework capable of supporting it? And what are the strategic and policy directions needed to meet these challenges, as well as the ongoing need to guarantee the quality of spatial information, improve the way in which it is managed and maintained, and to find national solutions to environmental, economic and social issues?

In 2007, the Victorian industry will embark on developing the next Spatial Information Strategy that will set the course for the years 2008-2010.

The Victorian Spatial Council's December Forum will highlight some of the recent significant changes in the availability and delivery of spatial information and provide an opportunity for participants to begin to identify the key issues that should be considered in the next Victorian Spatial Information Strategy.

This document contains a detailed summary of the proceedings of the Forum.

Forum Program

Forum Overview	Olaf Hedberg Chair, Victorian Spatial Council
The spatial information environment and how the paradigm is changing – where we've been, where we are now and what is the future	Peter Woodgate CEO Cooperative Research Centre for Spatial Information
What might these changes mean for the spatial information industry in Victoria?	Mark Judd Director Geomatic Technologies
Demonstration of a current example of a new use for spatial information in meeting business needs	Alex Tao Chen Phd Candidate Department of Geomatics, University of Melbourne
Facilitated Discussion	Led by Peter Holland Victorian Spatial Council

Acknowledgements

Mark Judd would like to acknowledge his collaborators – Richelle Pearson, Jessica Davies and Ross Caldow.

Alex Tao Chen would like to acknowledge the fellow members of his research team – Dr Christian Stock, Professor Ian Bishop, and Alice O'Connor.

SUMMARY

Presentations

The number of satellites used for earth observation and positioning is increasing exponentially. The improvements in the technology are improving the amount and quality of data available, including resolution, and positioning accuracy.

The improvements in positional accuracy have all sorts of implications – the current datums, and a lot of our databases, will not be able to cope with people positioning themselves to 2cm accuracy in real time.

The challenge for the spatial information community will be to link the metrics incorporated in the three-dimensional topologically structured GIS to the two-dimensional data that has been collected over the past 30 years, and to analyse, use them and display them in three dimensions.

Users are literally demanding 'anywhere, wireless, mobile and in real time' information for decision making.

The key issues for consideration include:

- Recognition of user need
- The industry's preparedness to use and develop this next generation of information technologies.
- Where are the investments being made?
- Forecasting our ability to have the trained people ready to take advantage of the changes that are coming.
- The issues of immediate national significance include climate change, water, biosecurity, coastal vulnerability (the triple bottom line).
- What principles that will drive the strategic direction.

Spatial information is going to take off. However, we are not going to have much control of it.

SDIs have 4 levels – starting from the top: user interfaces; integrative services; access services; and data sources.

This should be the model for spatial information going forward where industry, government, and academia all have a role and an opportunity to participate at the different levels.

But each has to make a decision about where they are going to participate.

The availability of standards that allow free and open movement of data has grown. As a result, business is going to start to 'own' spatial information. The spatial industry will just be participating along with them.

Good spatial solutions support organisational growth, enable structured work flow, reduce dataset duplication, support access to accurate datasets.

Already the commodity players are coming in at the top layer of the SDI, so we're not going to be able to play there for very long. The spatial industry has to play in

the other spaces, but if we do so, we have to do it cost effectively.

A fluid, unrestrictive, and realistic collaboration between multiple people in a virtual environment has been the dream of many.

A Collaborative Virtual Geographic Environment features a multi-user, distributed, networked, sharing the same study area, and being task-oriented and interactive. An example is **SIEVE** (**S**patial **I**nformation **E**xploration and **V**isualisation **E**nvironment) built on a Torque Game Engine under CRC-SI Program 5.2.

Augmented Reality overlays synthetic elements onto the physical world to enrich and enhance the user's perception of his/her surroundings.

Using the SIEVE live link with ArcGIS, the user can switch GIS layers on/off, e.g. automated re-vegetating simulation; track viewer position or object edits in 3D view, avatar position synchronisation; and capture the virtual environment edits back to the GIS.

Discussion session

How do we integrate the potential multiple SDIs, and what's the role of an overarching strategy, such as VSIS, to bring them together?

Data – content and quality – will still be important elements of the forthcoming strategy. Users will be sceptical about the new applications unless the data that underpins them is of good quality, reliable and consistent.

Users do not always understand the limitation of the data they are using – whether the purpose for which it was created matches the use to which they want to put it.

We should be making data available – with all its limitations and 'imperfections', get it used by the maximum number of people, and from there be able to promote the message that further investment is required.

People still don't know what to look for. So access must be supported by 'awareness' and 'discovery'.

The industry needs to understand how the SDI hierarchy works to be able to know how it can participate in the ongoing development of spatial applications.

It will be the standards that underpin the SDI hierarchy and the links between the four levels.

The industry needs to understand the 'commodisation' of spatial information and what it means and what impact that will have.

Spatial information has to be utilised in a way that adds value and improves business outcomes, or government outcomes or community outcomes.

In lots of ways, users are only interested in getting what they want out of the applications/interfaces they access – they don't care about the spatial information and all that goes behind them as long at they get the results.

FORUM PRESENTATIONS

Chairman's Overview

Today' second VSC Forum for 2006 follows the highly successful July Forum on the Property Information Program, which addressed the need to guarantee the quality of the core spatial data to support an increasing range of activities by government and industry.

Today's forum will be considering the impacts on the spatial industry in Victoria of the rapidly growing accessibility and use of spatial information.

We are all aware of the plethora of stories in journals and magazines showcasing new developments that are putting spatial information in the hands of more and more users. If anything, they are highlighting that growth and change continues ever more rapidly.

Today's discussion is also timely as we embark on a year long project to develop Victoria's next spatial information strategy. The objective of the open discussion later in the afternoon is to begin to identify those themes that will form the basis for the way in which the Victorian industry will develop from 2008 to 2010.

Victoria has a solid framework for spatial information management and development that has been put in place over more than a decade and is being consolidated by the current strategy that runs until the end of 2007.

But as the infrastructure for delivering spatial information becomes more sophisticated and capable of placing more information in the hands of all kinds of users, we are seeing the creation of new ways of representing and applying it.

Some examples are

- Public mash ups becoming more widely used as a source of new applications.
- Interactive, networked approaches potentially opening up information management and maintenance to potentially thousands of data collectors and editors.
- The increasing use and future mainstreaming of Radio Frequency IDs, sensor networks, intelligent objects, and the spatial web.

So what do these changes and the pace at which they are occurring mean for the traditional spatial industry – that is, the data producers, vendors, and GIS experts in government, the professions, business and academia?

And what are the strategic and policy directions needed to meet these challenges?

The three speakers today will

- take us through the changing paradigm for delivering and presenting spatial information – where we have been, where we are now and what the future might hold,
- suggest how these might influence the spatial information industry in Victoria,

and

- demonstrate just one of the new uses for this information in responding to the environmental, social and economic challenges us that face us early in this 21st Century.

I invite you to listen to each of them, who have been asked to stimulate our thinking with their perspectives on these changes and the questions I posed above, and then join us during the open discussion in proposing key themes that should be considered in the next Victorian spatial information strategy.

The spatial information environment and how the paradigm is changing – where we've been, where we are now and what is the future.

This presentation stepped the audience through some of the most strategic things that are going to impact on the spatial information industry over the next three to five years in Australia, and particularly in Victoria – what's changing and what's coming.

Remote sensing

- NASA with its satellites and hundreds going up over the next few years.
- European Space Agency has also got many satellites that are going up.
- China over the next 10 years will be putting up 100 satellites – a good proportion of those will be earth observation. They are putting them up in combination with a range of other countries – Brazil, France, Algeria; they're even inviting Australia to become involved.
- A very substantial earth observation program is being developed by India. It is about to invest a hundred million dollars in launch facilities based on Indian territory.
- The World Meteorological Organisation has a very substantial number of satellites already up there and being proposed, given a lot of impetus by global climate change issues.

Over the next 5 to 10 years there is going to be a particularly large investment in radar satellites, ie satellites that are capable of active sensing across a range different frequencies and wavelengths.

Over the last 30 years there has been a more than exponential increase in the number of satellites. It's only a matter of time before the leveraged airborne investment sees us with a significant investment in hyperspectral satellites.

Positioning

Global navigation satellite systems are also developing. The familiar United States Global Positioning System constellation is being joined by the European Union's Galileo system; Japan is going to be putting up its own regional system; Russia has made its investment in Glonass; and both China and India have got regional systems.

Over Australia there are about 25 global positioning system satellites at the moment which we can read; within the next 5 years there will be 60. And that's going to drive a significant improvement in our ability to position ourselves.

The resolution of military satellites was around 5 cm in 1992. Extrapolate this forward and they're probably at around about 1 or 2 cm in spatial resolution, with a lag time of around about 10 or 15 years before that technology comes across to the civilian arena.

We can very confidently predict very high pixel resolutions in the next few years, probably in the life of this Strategy.

Australia is an enormous user of positioning systems and satellite earth observation systems. The point to be made about this is that the vast amounts of information which are going to be made available are going to be exponentially increased over the next 3 to 5 years.

In addition to that there are about 40 to 60 countries who own space infrastructure. While Australia is not one of them, it leverages very significantly off other people's investments.

In November 2006, the federal government funded a program called AuScope, which is part of the National Collaborative Research Infrastructure announced by the Minister for Science, Julie Bishop, earlier in that year - $500 million will be available over 7 years.

$40 million has been allocated to AuScope to strengthen our understanding of earth processes in Australia; $15.8 million of that will be specifically devoted to strengthening the CORES system in Australia, with the aim of achieving at least 2cm accuracy, x-y-z, some time in the next 5 to 10 years. A significant investment from the States as well as from the private sector will be part of the initiative.

That has all sorts of implications – the current datums, and a lot of our databases, will not be able to cope with people positioning themselves to that accuracy in real time. A lot of thought needs to go into how we're going to manage that.

Visualisation

Relatively unintelligent pictures can be turned into dynamic models using visualisation techniques to determine landscape and other changes.

For example, on-ground air photos can be augmented with real data – trees in the background, cut aways that create a scene below the ground showing salt hotspots; watertables, soils. These features drive a much more profound understanding of how the landscape works, particularly how the impacts of land use shape the landscape over a period of time – 20, 30, 40, 50 years. The user needs to have an understanding of the hydro-geological cycle, of the impact of weather and global climate change, the evapo-transpiration of trees, how the water moves from the landscape, and so on.

With current developments, this is becoming increasingly possible.

Within a year or two, three-dimensional, topologically structured GIS will be available. The challenge for the spatial information community will be to link the metrics incorporated in this GIS to the two-dimensional data that has been collected over the past 30 years, and to analyse, use them and display them in three dimensions. How are we going to make the most of these 3D systems as they come on to the market?

The Supranet

The Supranet is a vast mixture of information sources that is increasingly becoming available. Two examples are Radio Frequency Identification devices and Sensornets.

MEMS chips are capable not just of being passive in terms of their ability to collect information – when a transponder is passed over it, any information that has been tagged within a MEMS chip is ingested back. They also have their own energy source so they irradiate their information and that information can be pre-

programmed to supply information about the surface of the object that they're on – temperature, pressure, chemical constituents and so on. If there are enough chips in a network, they all talk to each other – if one chip drops out, provided they're not more than 100 metres apart, then the network will reform itself.

It is possible to conceive of the time in the not too distant future, maybe within the context of the next strategic plan in Victoria, maybe not, where these things become ubiquitously available.

200 billion of these chips were sold in 2005. Most of them are not going into PCs, they're going into microwaves and washing machines and so on. More and more of them are going onto the supermarket shelves.

A very substantial increase in growth in the number of these chips is projected through to 2008. They're still sitting at about $1 in price, but when they get down to a few cents or more, there's no reason why we can't conceive of them being in most hands.

So this supranet, in its broadest definition, will enable us literally to know, think and communicate – in 2D and in 3D, and, indeed as we model, in 4D.

This is an information revolution which is right on our doorstep now.

That last point about 'anywhere, wireless, mobile and in real time', is one that we need to underline as we service our end user community, because so many of our end users are literally demanding just that. They've got an impatience about their desire to have information for decision making. They're here and now, they're on the move, they've got their device, and they want the information right now.

An example where it's all starting to come together:

On 26 October, a NASA earth observing satellite was pre-programmed to detect a volcanic eruption anywhere in the world. It started to detect a smoke plume over the volcano of Talang in Indonesia, re-programmed itself to keep watching that particular volcanic eruption, and at the same time informed the ground authorities that it had detected a likely volcanic eruption – this was unusual because Talang hadn't erupted for centuries. The ground analysts are now re-programming the satellite so that it can receive infra-red signals from the modus satellite, which is capable of picking up infrared plumes to augment the ability of the earth observing satellite to pick up smoke so that it has an increased ability to detect the likelihood of a volcanic eruption. And also it's been linked to a sensor network on the ground – which is also programmed to detect earth tremors.

So for the first time, we have a satellite which is doing its own thinking and processing, in real time on board the satellite, linked to sensor systems on the ground, making decisions without being retasked by human intervention on the ground.

Forthcoming strategic initiatives

In early December 2006 the Prime Minister's Science, Engineering and Innovation Council met. It heard the results of a review of the next generation of data needs for science in Australia.

The presentation was heavily weighted to spatial information, because spatial information is going to have such a profound effect on decision making, in a way which we haven't seen at the highest levels of government over the previous

decade.

The results have yet to be communicated.

ANZLIC, ASIBA and the CRC-SI will undertake a study in the first half of next year to value the contribution of spatial information to the Australian economy (as was done in the UK in the late 1990s to value the contribution of Ordnance Survey data – which was valued at about £200-300 billion to GDP).

The National Collaborative Research Infrastructure Strategy, referred to earlier, is also funding an initiative called TERN – the Terrestrial Ecosystem Research Network – to the tune of $40-50 million.

This proposal is in its early stages, but it proposes to establish a complex network of ground based sensors to get a better understanding of our environment and the processes which drive land use.

That one won't be funded, or at least approved, until probably the middle of next year. So there's an opportunity for us to get involved in it.

Issues for consideration

First of all, recognition of the user need is going to be the fundamental driver over the next 3 to 5 years.

Second, what is our preparedness to use and develop this next generation of information technologies?

Thirdly, where are we making our investments? Are they consciously into competitive niches that are good for us? Have we not thought about it? Are we looking to harness public-private partnerships?

Fourthly, capacity building – we're well aware of our skill shortage, our people shortage. Our skill shortage will be compounded by these new technologies that we've just touched on – very few of us are trained in them. We've got to think about forecasting our ability to have the trained people ready to take advantage of the wave that's coming.

The issues of immediate national significance include climate change, water, biosecurity, coastal vulnerability (the triple bottom line).

Are we making a big enough contribution in these areas? Are there others? For example, the Commonwealth Government spends $90 billion a year on social security and welfare. What contribution is the spatial information industry, with its technologies and information sources, making to the improvement of that allocation? Have we had a look at it?

There are probably similar things at State level that we might be able to do as well.

Any strategic consideration needs to be driven by principles, such as the single point of truth; leveraging off the collection of information as many times as possible; ensuring that the information is fit for purpose. And there may well be other principles that should underpin the strategic plan.

A final consideration is our strategic international engagement – a number of the global issues were touched on earlier.

Together all these lead to the outcome – the subject of today's forum – the strategic road map for the future.

What might these changes mean for the spatial information industry in Victoria?

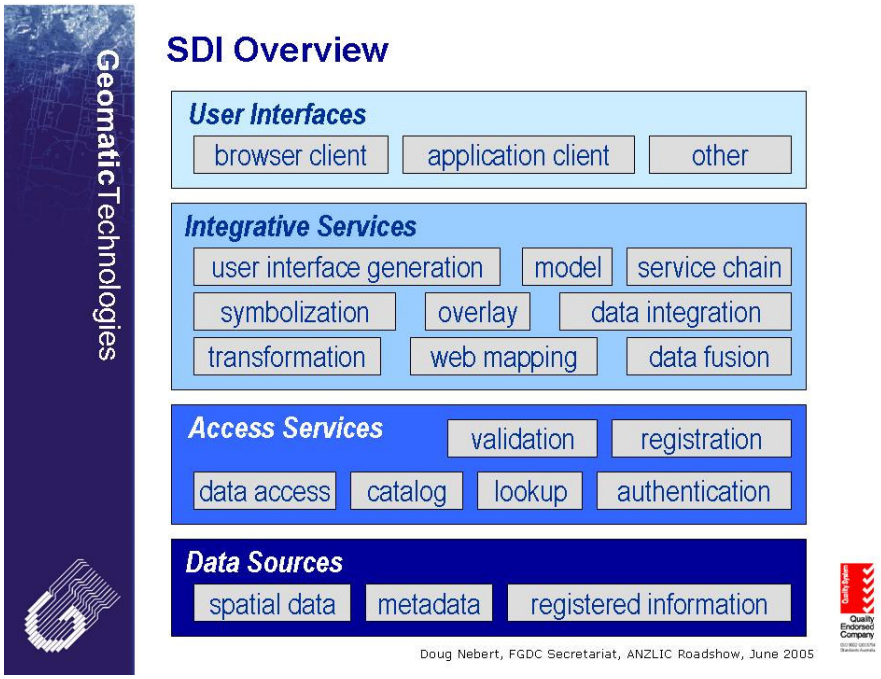
Spatial information is going to take off. This presentation aims to show why this is so.

However, we are not going to have much control of it so some serious thought needs to be put into how we're going to participate in it.

The spatial information industry is very much a niche industry, if you can define it as an industry at all. Up to now there haven't been many users of it and those who do use it have needed to be specialists. So while spatial information is a fantastic tool for making business decisions, the reality is 95% of the world hasn't had, and still doesn't have, access.

'Spatial Data Infrastructure', which in my view has up to now had little or no substance, has come along way. Governments have understood SDI for a long time, and have been very active in the access and data elements.

SDIs have 4 levels – starting from the top: user interfaces; integrative services; access services; and data sources.



This should be the model for spatial information going forward where industry, government, and academia all have a role and an opportunity to participate at the different levels.

But each has to make a decision about where they are going to participate.

It creates a massive opportunity, but there are some threats and you've got to be fast enough to cover your ground, because we're not going to be in control.

The top layer – user interfaces – and some of the other layers are going to become commodities.

I think government's in a good safe place because data is going to be the one thing that will be seen as something of fantastic value.

Standards

SDI as a concept didn't work because there weren't enough standards to allow free open movement of data. But they're here now – XML SOAP, open LS, GML, WMS, WFS GML. A user can plug into any of these layers and can talk to the other layers quite happily.

As a result, business is going to start to 'own' spatial information. The spatial industry will just be participating along with them.

Some food for thought: Microsoft has released Virtual Earth 3D, which they are combining with aerial photography and 3D modelling extraction. They are also generating a 3D visualisation tool and making it available both commercially and for free.

They and the other big companies are doing this because spatial information is a great business tool and it's an unbelievable commodity, and if they can make it easy for people to use and they can get to that 95% of the non-specialist users, it's a fantastic conduit for all sorts of other things, such as virtual billboards selling products within a spatial application – spatial information as a platform for selling cars…

What makes a good spatial solution?

The easy obvious things are cost effectiveness, answers business questions, solves business problems, supports timely data updates, supports known metadata.

But what it is really about is supporting organisational growth, enabling structured work flow, reducing dataset duplication, supporting access to accurate datasets. That's what we need to solve.

And for me, that's the solution.

Already the commodity players are coming in at the top layer, so we're not going to be able to play there for very long. The spatial industry has to play in the other spaces, but if we do so, we have to do it cost effectively. We're already starting to get a sense of how much cheaper it is to operate in this sort of a model… it's all about service oriented architecture – it's about being able to plug and play, putting bits and pieces together, creating another client, and another application.

A final thought – from Doug Nebert of the FGDC:

> When we think of SDIs we are generally seeking to establish a minimum environment that enables applications to flourish using compatible standards and policies, where practical.
>
> *The infrastructure, then, provides the bridge between data and applications.*

Demonstration of a current example of a new use for spatial information in meeting business needs

The title of the presentation is 'Prototyping an in-field collaborative virtual decision making environment by linking GIS with a game engine'.

The project incorporates 5 elements:

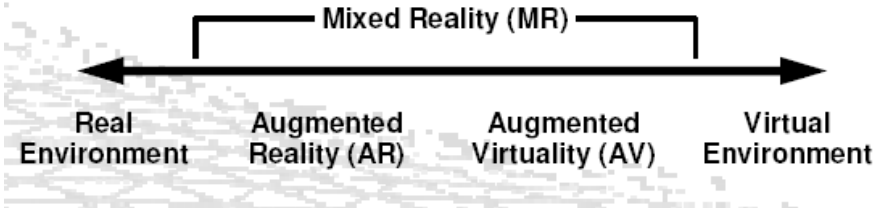
- Augmented Reality
- Location based technology; mobile computing
- Computer supported collaborative work

- Game Engine (visualisation tool)
- Spatial information database (geo-analysis)

A fluid, unrestrictive, and realistic collaboration between multiple people in a virtual environment has been the dream of many.

A Collaborative Virtual Geographic Environment features a multi-user, distributed, networked, sharing the same study area, and being task-oriented and interactive. An example is **SIEVE** (**S**patial **I**nformation **E**xploration and **V**isualisation **E**nvironment) built on a Torque Game Engine under CRC-SI Program 5.2.

Augmented Reality is part of a continuum of a so-called 'mixed reality' as illustrated below:



Augmented Reality overlays synthetic elements onto the physical world to enrich and enhance the user's perception of his/her surroundings. It has the following characteristics: it

- Combines real and virtual objects in one single display
- Runs interactively and in real time
- Registers real and virtual objects with each other

The objectives of the research project are to develop a prototype in-field collaborative decision system for geospatial visualisation to facilitate land decision support by linking the Torque Games Engine (TGE) and GIS in real time.

It involves

- Developing a visualisation tool that incorporates the real world and virtual entities and environmental models in context
- Implementing a real-time linkage mechanism between the visualisation tool (the TGE) and a GIS
- Investigating the effectiveness and efficiency of the presentation by using the established prototype system in the field
- Exploring the workability of the collaborative interface for multi-user decision making practices

The system works in the following way: data from the real world is input into the Torque Game Engine, which in turn is linked to a GIS via a network. The data is combined (layered) in the GIS in the Engine to deliver an augmented picture to the viewer.

An example relating to land and environment management:

- A local farmer reports a soil salinity problem and requires implementation of re-vegetation practices based on a current land-use schema saved in a GIS.

- The land planner examines the schema and prepares vegetation and other environmental models and their relevant properties.
- The land planner wears the HMD [device on his/her head] with system running on a lightweight laptop. He/she can see the synthesised scene and position objects based on the proposed schema onto the scene and instantly observe the result.
- The back-end GIS can be updated via the Live Linkage for the new land-use proposal.
- The land planner will report the result proposed based on the observation on the environmental model changes and on-site discussion with the farmers. Eventually, policy-makers will be able to suggest an updated land use policy and landscape feature cultivatiation plan on the basis of the report by the land planner

This can also be done by multiple users at the same time to support collaborative decision making. It can be done in the field or in the office.

Other applications for the system include: emergency response (eg bushfire management training), event planning, tourism, archaeological re-building.

Using the SIEVE live link with ArcGIS, the user can switch GIS layers on/off, e.g. automated re-vegetating simulation; track viewer position or object edits in 3D view, avatar position synchronisation; and capture the virtual environment edits back to the GIS.

The current focus and outlook for the project includes:

- Interface Google Maps, Google Earth and local on-line mapping services (e.g. VMAS) with SIEVE
- Integrate positioning and head orientation information into Torque Game Engine
- Develop built-in graphic user interfaces (GUI) for collaborative decision support practices
- Bring the system in-field and test the augmented feature alignment and registration
- Investigating the whole system through at least 2 case studies

DISCUSSION SESSION

The discussion session was moderated by Peter Holland, member of the Victorian Spatial Council.

Contributions to the discussion session were made by: Pat Beason (Geography Teacher), Duncan Brooks (DOI), Dianne Daniell (Maryborough Shire Council), Jacqui Denham (DSE), Rod Flynn (DSE), Clare Grosser (SKM), Milind Joshi (Dandenong City Council), Mark Judd, Robyn McCutcheon (Vicroads), Rob Morrison (DSE), Peter Mosley (DSE), Bruce Thompson (DSE), Yvonne Thompson (ESTA), Prof Ian Williamson (University of Melbourne), and Peter Woodgate.

The following pages summarise the key points made by the participants.

Multiple SDIs	Possibilities for more than one SDI. Crossover between spatial and environmental, spatial and infrastructure, spatial and transport. Sectors tend to want to create their own user interfaces and networks. They are bringing data together, integrating it and using it – thereby creating sectoral SDIs. We have potentially multiple SDIs. How do we integrate them, and what's the role of an overarching strategy, such as VSIS, to bring them together?
Data quality	Users will be sceptical about the new applications unless the data that underpins them is of good quality, reliable and consistent. Some part of the Strategy therefore is going to have to be about control of how the data is captured and how it's described and what are the levels of accuracy. But there is also a link with the way in which data is used and how it is combined with other (non-spatial) information to give a more comprehensive picture. The example of in-car navigation was cited in this case – the directional information being supported by information about road and weather conditions.
Use of the data driving demands for better quality	As more non-expert users start to use spatial information, this raises the issue of their understanding of data quality, integrity and completeness, and how they thus use the data for interpretation and analysis. On the other hand, it is from the greater use of the data that a lot of the industry's opportunities are going to come. The question is, do you protect those users or do you let them go and make mistakes? The user will take what they think is a commodity and find that it has limitations, and they will look for ways to overcome those limitations from the experts. This will drive the whole quality issue, and the participation issue.
Users understanding the limitations of the data	However, it is the lack of knowledge on the part of the users of the limitations of the data that causes the trouble. Users have unrealistic expectations and that is where the potential for bad decisions emerges. It's not that the data is 'bad', it is that the user doesn't have the necessary understanding of its limitations and may use it inappropriately.
Getting the data out there and being used	Still, we should make the data available, with all its limitations and 'imperfections', get it used by the maximum number of people, and from there be able to promote the message that further investment is required.
Finding and generating data	Until that happens, we will still see the creation of duplicate sources of data and commercial products. There is still a lot of work to do to secure some fundamental data, such as points of interest, but it's not happening quickly enough.

Awareness and discovery	Regardless of the talk about access to data, people still don't know what to look for. So access must be supported by 'awareness' and 'discovery' – not only don't they know what to look for, they don't know where to look, don't know how to look, don't have the right vocabulary to start looking.
Easier to access the data	The licensing and access regimes that are put in place should make the data easy to access – not just for users but also value adders. This does not necessarily mean it has to be free.
Future role of the spatial industry	Taking the SDI hierarchy – ie user interfaces ➔ integrative services ➔ access services ➔ data sources – where will the spatial information industry's role be? Is it going to become more limited as 'control' of spatial information delivery shifts to the Microsofts and Googles? The industry needs to understand how the hierarchy works to be able to know how it can participate. It needs to understand the way that the relationships between the users and the providers works and find the way to fill any gaps, whether it is in data or expertise in interpretation and analysis, or whatever.
Commoditisation	The industry needs to understand the 'commodisation' of spatial information and what it means and what impact that will have. Commoditisation means that almost anyone can create a 'spatial product' – just look at Microsoft Virtual Earth and Google Earth. New technology is developing rapidly and overtaking a whole range of traditional business areas. It's our challenge to understand where the interface will be. We are trying to look 3 to 5 years ahead based on our understanding of the past.
Taking the 's' out of SDI	Perhaps we have to drop the 'S' from SDI and adopt a much broader view (although there is still a huge amount of interest worldwide).
Standards	It will be the standards that underpin the SDI hierarchy and the links between the four levels. Standards enable the data provider to ensure that the correct meaning is transferred with the data and that put structure behind it. As a result both the data provider and user should have the same understanding about what has been supplied.
Improving business outcomes	RFIDs and MEMS have the potential to stimulate efficiencies and financial savings for users, and contribute to improving the accuracy of spatial data. If these benefits can be demonstrated, this will give more weight to arguments with senior management of organisations to invest in the data, technology and applications. The 'reality check' on all that has gone before is that spatial information has to be utilised in a way that adds value and improves business outcomes, or government outcomes or community outcomes.
Relevance of the application to users	In lots of ways, users are only interested in getting what they want out of the applications/interfaces they access – they don't care about the spatial information and all that goes behind them as long at they get the results. The need for the industry to 'market' itself better has been raised as an issue – but how relevant is it for the end user given the preceding statement?