

Visualising Ballarat - past, present, future

A collaborative research proposal to develop
online tools to support Ballarat's Historic
Urban Landscape program.

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Status: Discussion Paper

Version: 2

Date: 22/07/2014

Executive summary

In recognising the role that urban heritage plays as a social, cultural and economic asset in the development of cities, Ballarat was the first Australian city to join an international pilot program to implement UNESCO's Recommendation on the Historic Urban Landscape (HUL) in September 2013. The HUL program vision is to help Ballarat grow without compromising its heritage; by providing a road map on how to address change without losing Ballarat's character. At the core of the HUL approach are the community's values, which are the starting point for city management. Hence, there is a need to map these values effectively and have all of Council referencing them as a starting point to city development.

This discussion paper outlines a collaborative research approach that aims to develop state-of-the-art knowledge management and planning tools that are required to understand the urban landscape, recognise cultural significance, and assess and monitor change. We propose a staged approach to a long-term research project that will result in web-based spatial information systems, which include 3-dimensional and 4-dimensional visualisations together with augmented reality experiences of past, present and future Ballarat city landscapes. The information systems will have a much broader appeal than HUL, extending through a full range of uses - from the utilitarian, such as locating old mine workings and landfill sites - to the esoteric, such as immersive augmented reality experiences of historical places or events. The key component is to provide the community, practitioners, researchers and industry with place-based information on demand, and hence encourage a deeper understanding, consideration and appreciation of the city's historic urban landscape values.

As a starting point, we propose to utilise Federation University Australia's eResearch and digital innovation capability to federate HUL information, data and databases, enabling the Ballarat community, practitioners, researchers and industry to easily find and access historic urban landscape information and share in the vision of the HUL program. The proposed web-based portal will provide easy access to authoritative and credible heritage information for city managers, developers, planners, researchers, communities of interest, groups and agencies wishing to engage in HUL program activities. It will promote the sharing of knowledge and information through the internet, allowing people to gain insights, present ideas, advice and information in a friendly and easy-to-use format, available at people's convenience. It allows the City of Ballarat citizens to grow their knowledge and share their thoughts and enthusiasm for their city's historic urban landscape. In that sense the website is deliberately aimed in part at supporting ratepayers, citizens and community groups feel connected and supported in their heritage interests.

The longer-term intention is to encourage the generation of research ideas and projects with other collaborators, locally to globally. This discussion paper outlines a collaborative approach which can be regarded as a blueprint for research that will assist the City of Ballarat and Federation University Australia in achieving their shared goals. The proposed research is founded on the 144-year old relationship between the organisations that has resulted in a substantial repository of regional knowledge. Online liberation of this information, together with that held in the other knowledge repositories of long-standing Ballarat institutions, has the potential to provide new insights into the urban landscapes of this historic city.

Introduction

The objective of City of Ballarat's Historic Urban Landscape (HUL) program is the participatory management of change. By engaging with stakeholders, the aim is to provide a deeper understanding of values in the historic urban landscape and guide decisions to manage change. (CoB 2013). This discussion paper proposes a collaborative research approach to developing knowledge management and planning tools that will support Ballarat's HUL program. It is envisaged that the tools will use leading edge technology in web-based spatial information systems, including 3-dimensional and 4-dimensional visualisations together with augmented reality experiences of past, present and future urban landscapes.

The HUL program proposes that new urban management tools be developed, including:

- Civic engagement tools designed to empower people to identify key values in their urban areas, articulate their aspirations and visions, set goals and agree on actions to safeguard their heritage and promote sustainable development, and
- Knowledge and planning tools to enable understanding of the urban landscape, recognition of cultural significance, and provide for the assessment and monitoring of change.

Both are central to this discussion paper, which outlines a collaborative approach which can be regarded as a blueprint for research that will assist the City of Ballarat and Federation University Australia (FedUni) in achieving their shared goals. The proposed research is founded on the 144-year old relationship between the organisations that has resulted in a substantial repository of regional knowledge. Online liberation of this information, together with that held in the other knowledge repositories of long-standing Ballarat institutions, has the potential to provide new insights into the urban landscapes of this historic city.

Research context

The New Digital Age (Schmidt and Cohen 2013) provides unprecedented opportunities for a deeper understanding and appreciation of our environments, including urban environments. These opportunities largely arise through ubiquitous access to information, particularly when that information is delivered on demand via high speed broadband to mobile tablet devices or wearable visualisation technologies such as Google glass (e.g. Apple 2014; Google 2014). These technologies have created a society that is spatially enabled and aware. Big business and citizens increasingly expect to be able to access past and current information about any location of interest, to find answers to their spatial queries. Deeper appreciation and understanding comes from the sheer volume of information that can be amassed about any particular place in the landscape, and how that information can be dynamically synthesised to provide the most definitive answer to the user's question.

The use of spatial technologies for the deeper understanding of historic urban landscapes is an emerging area of research. Recent examples in the international scientific literature include the use of traditional GIS tools (e.g. Li and Song 2009; Apollonio et al. 2012; Myers et al. 2012); the use of web-GIS with interoperable Open Geospatial Consortium (OGC) standards, such as CityGML (e.g. Groger and Plumer 2012; Prieto et al. 2012; Costamagna and Spano 2013); and modelling past, current and future urban spaces and buildings to assess development impacts (e.g. Short 2007; Vanegas et al. 2010). Experiments with 3D, 4D and augmented reality visualisations, usually at iconic heritage sites, have also been published (e.g. Guhathakurta et al. 2009; Norris et al. 2014; Petty et al. 2014). Similarly, the

use of gaming technology has been trialled as a means to assist in the appreciation of cultural heritage (Mortara et al. 2014).

Nationally, the Australian Urban Research Infrastructure Network (AURIN) is a \$20 million initiative tasked with developing a portal providing access to federated data, modelling and visualisation tools to assist improved urban design and management, by linking the physical and social aspects of the built environment (Stimson 2011; Pettit et al. 2012; AURIN 2014). Although not specifically aimed at historic urban landscapes, much of the technology developed in the AURIN research project is transferrable.

At FedUni, research has focussed on the development of interoperable spatial knowledge systems with dynamic modelling and visualisation capabilities, which have been developed to assist natural resource management, socioeconomic research and municipal planning (e.g. Dahlhaus et al. 2011; 2012; MacLeod et al. 2013; Thompson et al. 2014). These systems typically have the following features:

- The data resides with the data managers (ensuring currency and validity)
- They are intuitive to use (similar to Google Earth)
- All forms of data are included - vector, raster, text and multimedia
- Data downloads are allowed (subject to data manager's consent)
- Spatial data links to original source documents and images
- Spatial data links to real time data (data loggers, webcams)
- They are capable of analysing the interoperable data on the fly
- Interactive 3D visualisations can be created for user-selected scenes
- Users can add, edit or update data (subject to QA/QC)
- The spatial data and models are credible to the user

A relevant example for this project is the FedUni Geoffrey Blainey Research Centre interactive historical maps website spatial.federation.edu.au/eureka/eureka.php. This site was constructed as an experimental tool to assist researchers at the centre to visualise how the past mapped landscapes of urban Ballarat fit with the current mapped landscapes. Similar methods have been used in other international research projects (e.g. San-Antonio-Gomez et al. 2014) and also used to develop freely accessible websites for the delivery of global historic maps online (e.g. University of Portsmouth 2014a; 2014b). At some sites, Ballarat regional maps can be interactively viewed in 3D (e.g. British Library 2014).

Current access of historic urban data for Ballarat

The present access to historic urban landscape information and data for the City of Ballarat is highly varied and uncoordinated. In general, data custodians may be:

- Federal, State and local government organisations and agencies;
- regional museums, libraries, galleries, institutions and authorities;
- community history, heritage and cultural groups and practitioners;
- universities and research organisations;
- local industries and businesses; and
- citizens and stakeholders

The information and datasets have limited spatial and temporal coverage, are held in a variety of formats and database schemas and are on disparate information systems. Information and data is distributed via dozens of web-portals, web-based GIS tools,

password protected portals, cloud storage, portable storage devices; hardcopy maps, atlases, theses, reports, newspapers, documents, images; museum art, artefacts and heritage objects; and oral histories and social stories. The search for relevant and current data, and its collection and collation is a substantial component of any HUL research project, which often results in days, weeks, months or years spent trying to assemble research-ready data for a project. As larger data sets, such as high-resolution remotely sensed data, on-ground sensor data, time-series monitoring data and digital archives are becoming more readily available, the task has become exponentially more time-consuming.

Outside of the research community, this impressive resource of HUL data is largely ignored simply because most people do not have the knowledge, capability or desire to deal with the data deluge. Many people feel increasingly time-poor and most would just like to get an authoritative, definitive, answer to their questions, preferably via Google, or an App on a mobile device. Even though most people may realise that there is a plethora of data available, there is little opportunity or desire to undertake the research required to answer the question.

Consequently, city management decisions may be based on partial information, the selection of which may be subjectively biased by the argument for or against a specific development, or to influence a decision outcome. While it is unlikely that objectivism is possible in history (Munslow 2002) the ready availability of information and data will result in less subjectivity. This is particularly true if the information can be geographically visualised, to aid comprehension of the place in a landscape (Seddon 1997).

The Vision

The HUL program vision is to help Ballarat grow without compromising its heritage; by providing a road map on how to address change without losing Ballarat's character (CoB 2013). At the core of the HUL approach are the community's values, which are the starting point for city management. Hence, there is a need to map these values effectively and have all of Council referencing them as a starting point to city development.

The HUL approach proposes that four new urban management tools be developed: 1) civic engagement tools; 2) knowledge management and planning tools; 3) regulatory systems; and 4) financial tools (CoB 2013). This research project focuses on the development of civic engagement, knowledge management and planning tools, but includes components that link the outcomes to the remaining 2 tools.

We propose a staged approach to a long-term research project that will result in state-of-the-art web-based spatial information systems, which include 3-dimensional and 4-dimensional visualisations together with augmented reality experiences of past, present and future Ballarat urban landscapes. The information systems will have a much broader appeal than HUL, extending through a full range of uses - from the utilitarian, such as locating old mine workings and landfill sites - to the esoteric, such as immersive augmented reality experiences of historical places or events. The key component is to provide the community, practitioners, researchers and industry with place-based information on demand, and hence encourage a deeper understanding, consideration and appreciation of the city's historic urban landscape values.

An initial project

With the dawn of high capacity broadband, mobile devices and interoperable technologies, the federation of datasets into a single virtual online database has become a reality. This is evidenced by the research projects already completed or being completed by FedUni, such as Visualising Victoria's Groundwater (www.vvg.org.au). As a starting point, we propose that the capability of these research tools be extended to federate HUL information, data and databases, enabling the Ballarat community and other stakeholders to easily find and access historic urban landscape information and share in the vision of what may be possible.

The key component of this vision is that the broader community are empowered with the capability to share their data in the same virtual space without losing custodianship of their data or ownership of the data value. The research tools will federate all or parts of historic urban landscape databases with disparate schemas and stored on disparate systems, subject to the custodian's consent. The tool will have the capability to display old maps and plans, draped on a high-resolution terrain model, in interactive pseudo 3D perspectives. Points of interest can be added by the community, with a pop-up template to record basic historic urban landscape value information about that site, and photos, documents or videos can be uploaded to support the values. The ability to overlay historic photographs on contemporary street scenes may be possible, similar to the What Was There website (www.whatwasthere.com/browse.aspx). A few selected interactive landscape visualisations similar to those on the Victoria Resources Online website (vro.depi.vic.gov.au/dpi/vro/vrosite.nsf/pages/landscape-visualisations) or the Panoramic Earth website (www.panoramicearth.com) could be included. These may include iconic Ballarat panoramas, such as the view from the lookouts at Black Hill and Sovereign Hill.

The primary intention of the initial project is to inspire and encourage community participation in the HUL program and provide a platform for proactive holistic planning, by demonstrating what may be possible. The website will:

1. Provide easy access to authoritative and credible heritage information for city managers, developers, planners, communities of interest, groups and agencies wishing to engage in HUL program activities. The online portal will enable the user to identify HUL priorities using all the current and relevant data that is publically available, spatially locate and examine proposed development plans and develop guidelines for the consideration of tangible and intangible urban heritage. The access to data is almost limitless, with thousands of datasets already available, spanning across a variety of topics from social, economic, demographic, environmental, historic, landscape and climate change. Providing pseudo-3D views on demand will assist with exploring viewlines, viewsheds, sitelines and skylines, which are critically important in historic urban landscape planning.
2. Promote the sharing of knowledge and information through the internet, allowing people to gain insights, present ideas, advice and information in a friendly and easy-to-use format, available at people's convenience. It allows the City of Ballarat citizens to grow their knowledge and share their thoughts and enthusiasm for their city's historic urban landscapes. As a starting point, perhaps the extensive Ballarat Imagine community conversation data that has been collated through the Ballarat Strategy may be made available. The Strategy uses HUL methods and has captured many values that can be spatially depicted. This would make the data available for use by the community, stakeholders and researchers.

3. Be a cultural mapping and engagement tool, encouraging 'citizen-based heritage values' by allowing data to be added by the user for the benefit of all users. As the network develops and the portal contains more information, the relevance of the tool to the City of Ballarat and HUL stakeholders increases. Importantly, the portal could act as a one-stop store with links to other cultural mapping projects, especially community-led projects that may be active. Engagement tools could be embedded into other stakeholder's websites enabling interoperable sharing of data. In that sense the website is deliberately aimed in part at supporting ratepayers, citizens and community groups feel connected and supported in their historic urban landscape interests.

The strength of this initial research project is that it leverages value from the investment in the web-based research already completed or being completed by FedUni. This includes the hardware and software technologies, data sets and intellectual expertise.

Longer term vision

It is envisaged that the initial project will inspire other researchers and bring a greater understanding of the power of eResearch and digital innovation in HUL research projects. The intention is to encourage the generation of research ideas and projects with other collaborators, locally to globally. Examples abound, but at a minimum it is expected to generate interest and excitement through the existing FedUni research collaborations, such as the Collaborative Research Centre in Australian History (federation.edu.au/research-and-innovation/research-areas/research-centres-and-networks/craah) and the Centre for Informatics and Applied Optimization (federation.edu.au/faculties-and-schools/faculty-of-science/school-of-science-and-technology/research/ciao). In addition, it is likely that other HUL stakeholders in Ballarat, such as Sovereign Hill, Ballarat Art Gallery and the Mechanic's Institute, may also be inspired to join into the eResearch opportunities. Globally, it may initiate interest from other cities in the HUL pilot program and UNESCO.

There are many research directions opportunities that can be envisaged, such as:

1. The technology research involved in creating the tools and methods, particularly using data interoperability and 3D visualisation standards.
2. The social research in understanding how the use of technology can capture intangible heritage values and show connection and disconnection to places, perhaps through cultural mapping, empowering citizens and mapping values. Enabling citizens to participate in decision making may empower them to express their heritage and change a broader range of attitudes, including city managers.
3. The urban planning and municipal management research in the utilitarian adoption of the tools to pragmatic solutions for city management.
4. The cultural research into how best to incorporate aboriginal and migrant needs in revealing their own cultural understandings. Getting this right would enable proactive inclusion in urban management.
5. The economic research around mapping economic values and aligning these to the citizen's desires to maintain employment and growth while respecting heritage.
6. The sustainability research in projecting the past towards the future, taking into account changing climates, population growth and urban conservation.
7. The history research around the new discoveries and interpretations that will be possible when all of the data can be assembled and spatially compared.
8. The environmental research around the changes in city landscapes, hydrology and ecology throughout its past and future development.

9. The education research in the use of technology to augment the teaching of history, culture, media studies and information technology.
10. The health research using the information to bring understanding to the value of heritage on the well-being of the community.

In fact, the potential is limited only by the imagination.

The connecting thread is the use of eResearch technology to enhance the traditional research opportunities. These stretch the spectrum from web-GIS and electronic libraries, through 3-dimensional and 4-dimensional visualisations, to augmented and virtual reality and 3d printing. For example, being able to zoom to a location and overlay the historic goldfields maps on the modern-day landscapes will provide a relatively accurate location of mine shafts and tunnels, which may be of use to urban planners and engineers. With 3d visualisation, it may be possible to see the extent of the mine workings under the city landscape, and with virtual reality, take a tour along the mine workings, enhanced with historical photographs of miners at work in a particular mine or tunnel. As an educational tool, this could bring Ballarat's heritage alive. Organisations may even be encouraged to install visualisation rooms, such as those at Queensland University of Technology www.thecube.qut.edu.au and Curtin University research.humanities.curtin.edu.au/projects/hive/facilities.cfm.

Similarly, reconstructing historic landscapes would be possible through the technology that produces a digital terrain model from stereo aerial photographs. This in turn would provide a map of Ballarat's landscape changes, including cut-and-fill areas and landfill areas (perhaps of use to planners and engineers), as well as give historians an accurate picture of landscapes at least as far back as 1934, when the first aerial photos were flown. Perhaps 3d printing of the reconstructed goldfields landscapes will enhance the understanding of historic events.

Arguably the most challenging research will be in using technology to reveal the cultural meanings of places. Cultural understanding of a landscape evolves through many forms, from the traditional maps to mindscapes, soundscapes and other sensory landscapes (touch, smell, taste). It may have been interpreted through relating places to each other (e.g. name places such as Grampians), explorers' experiences (e.g. Mt Misery), historical events (e.g. Eureka Street), or observations through European eyes (e.g. Greenhill) (Carter 1988; 1996) and be quite different to aboriginal or migrant understanding (Seddon 1997).

Research benefits

These research proposals have clear benefits to the City of Ballarat and FedUni, such as:

- raising the organisations' profiles by engaging with the broader community as the authoritative one-stop solution for Ballarat HUL data, that makes people feel connected and supported in their interests.
- offering people a common repository that includes their own historic urban landscape data, information and knowledge, and thereby ensuring that their personal or communal investment has been properly recorded and their efforts acknowledged. This improves access to research data and enlightens the city managers with more information.
- ensuring that supported individuals or groups are working with the same access to data and knowledge for city management plans, thereby improving the opportunity for integrated HUL management and research.

- educating the community with the breadth of regional historic urban landscape information, ranging across economic, social and environmental, thereby building capacity and resilience within the region.
- ensuring that public and private investment is more usefully used to build with respect for the community's heritage values.

For the City of Ballarat, the collaboration with FedUni also brings benefits. These projects benefit from the spatial information services stack (SISS) research infrastructure that has been installed by CSIRO at the university, as well as leverage the research collaborations FedUni has with international, national and state research agencies such as: Natural Resources Canada, the European Commission, GNS Science (NZ), CSIRO, Bureau of Meteorology (BoM), Grains Research and Development Corporation (GRDC), Queensland University of Technology (QUT), the Victorian Department of Environment and Primary Industries (DEPI) and Department of State Development, Business and Innovation (DSDBI), to name a few.

The key principles of the FedUni spatial knowledge systems include:

- Use of open-source and standards compliant software wherever possible.
- Building upon existing collaborative software initiatives and contributing enhancements/tools back to the community.
- Ensuring the flexibility of the developed system to consume data from a variety of sources so as not to interfere with existing provider work practices.
- Ensuring end-user tools and applications are fast, intuitive and easy-to-use.
- Software based in the cloud: no end-user requirement for software, updates, computation power or plug-ins

The project's research community has expertise in geoinformatics, environmental science, social research, economic research, history, data collection and management, database design and formats, information systems, high speed computation and data distribution, data modelling and visualisation, and integrated catchment management and modelling. This research collaboration is rapidly establishing a track record of innovative approaches which are enabled by new technologies and this has inspired and encouraged other organisations to share their data, especially catchment management data sets.

For FedUni, these eResearch projects provide opportunities to collaborate with the lead agencies working in international standards for data distribution, data visualisation and high capacity broadband technology, further developing the university's capacity and capability to become leaders in interoperable data exchange and visualisation. The learning is transferred to the lecture theatres, graduate and postgraduate research, scientific papers, collaborative research, environmental management and business opportunities.

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Acknowledgement

The authors acknowledge the contributions of Ms Susan Fayad, Coordinator Heritage Strategy, City of Ballarat, in the development of this discussion paper.

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