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Potential Applications of Geospatial Information Systems for Planning and Managing Aged Care services in Australia.

[1]Sunil Bhaskaran [2]Jeffrey Soar

[1]Lecturer: Faculty of Engineering and Surveying
Tel: +61-07-46312549
Fax: +61-07-46312526

[2]Associate Professor
Department of Information Systems
University of Southern Queensland
Toowoomba, 4350, QLD, Australia
Email: Bhaskar@usq.edu.au

Abstract

This paper discusses the potential applications of Geospatial Information Technology (GITs) to assist in planning and managing aged care programs in Australia. Aged care is complex due to the numbers of participants at all levels of including planning of services, investing in capacity, funding, providing services, auditing, monitoring quality, and in accessing and using facilities and services. There is a vast array of data spread across the entities that are joined to aged care. The decision-making process for investment in capacity and service provision might be aided by technology including GIT. This is also expected to assist in managing and analysing the vast amount of demographic, geographic, socio-economic and behavioral data that might indicate current and future demand for services the aged and frail-aged population.

Mapping spatio-temporal changes in near real time can assist in the successful planning and management of aged care programs. Accurate information on the location of aged care services centres and mapping the special needs of clients and their service needs may assist in monitoring access to services and assist in identifying areas where there are logistic challenges for accessing services to meet needs. GIT can also identifying migrations of aged people and of the cohorts of the population who are likely to be the next wave of clients for aged care services.

GITs include remote sensing, geographic information systems (GIS) and global positioning systems (GPS) technologies, which can be used to develop a user friendly digital system for monitoring, evaluating and planning aged care and community care in Australia. Whilst remote sensing data can provide current spatiotemporal inventory of features such as locations of carer services, infrastructure, on a consistent and continuous coordinate system, a GIS can assist in storing, cross analysing, modeling and mapping of spatial data pertaining to the needs of the older people. GITs can assist in the development of a single one-stop digital database which will prove a better model for managing aged care in Australia. GIT will also be a component of technologies such as activity monitors to provide

tracking functionality. This will assist in tracking dementia sufferers who may be prone to wandering and be exposed to risk.

Introduction: Planning and managing aged care programs is a complex operation due to the vast array of data created by this program and the variations presented by demographic, geographic and socio-economic composition of aged person population. Furthermore, aged care services are located in different parts of the country and each one of them is different in terms of road network, accessibility to resources, environment. At the same time efficient mechanisms to monitor aged care programs are very important in order to determine the quality of service delivery and for addressing issues which may emerge at certain carer service locations. Therefore monitoring and coordinating the different care programs at the national and state government levels can be a very complex process that needs careful monitoring at all stages. GITs can contribute to decision support systems that enable visualisation, manipulation of large-scale data storage (about aged care programs ranging from the determination of clients, demographic characteristics, physical and social environment) in a digital form, permit cross analyses, and most importantly provide current information on a consistent an continuous coordinate system (Bhaskaran, 2000). In the context of developing such systems the use of GIS has to be underlined since almost all of the processes have some link to geographic space and therefore can be spatially referenced.

A GIS is a computer based tool that organises and displays data. In the health organisation, GIS provides powerful tools for geographic and spatial analysis. It allows visualisation of data that might have otherwise been overlooked in spreadsheets, charts and other reports (ESRI, 2004). A GIS mainly uses three components: spatial, aspatial attributes. Whilst the spatial feature enables visualisation of the location, the aspatial features give out details about the location. A GIS is mapping software that links information about where things are with information about what things are like. Unlike with a paper map, where "what you see is what you get," a GIS map can combine many layers of information. For example, a GIS can integrate various types of data such as a) Market data: births, death, disease, population demographics, b) Infrastructure: buildings, roads, floor plans, nursing units, c) Internal data: product Lines, Patients, Utilisation, Revenues, d) Facilities: hospitals, physician offices, retail health outlets, employer locations, e) Administrative Boundaries: service regions, referral areas, planning areas, post-code, census region) Environmental: topographic, bio-hazards, toxic sites, infectious disease, air and water quality testing sites. The location or spatial reference is a “main key” in the transformation of data and for linking and integrating different datasets covering same and contiguous locations (ESRI, 2004).

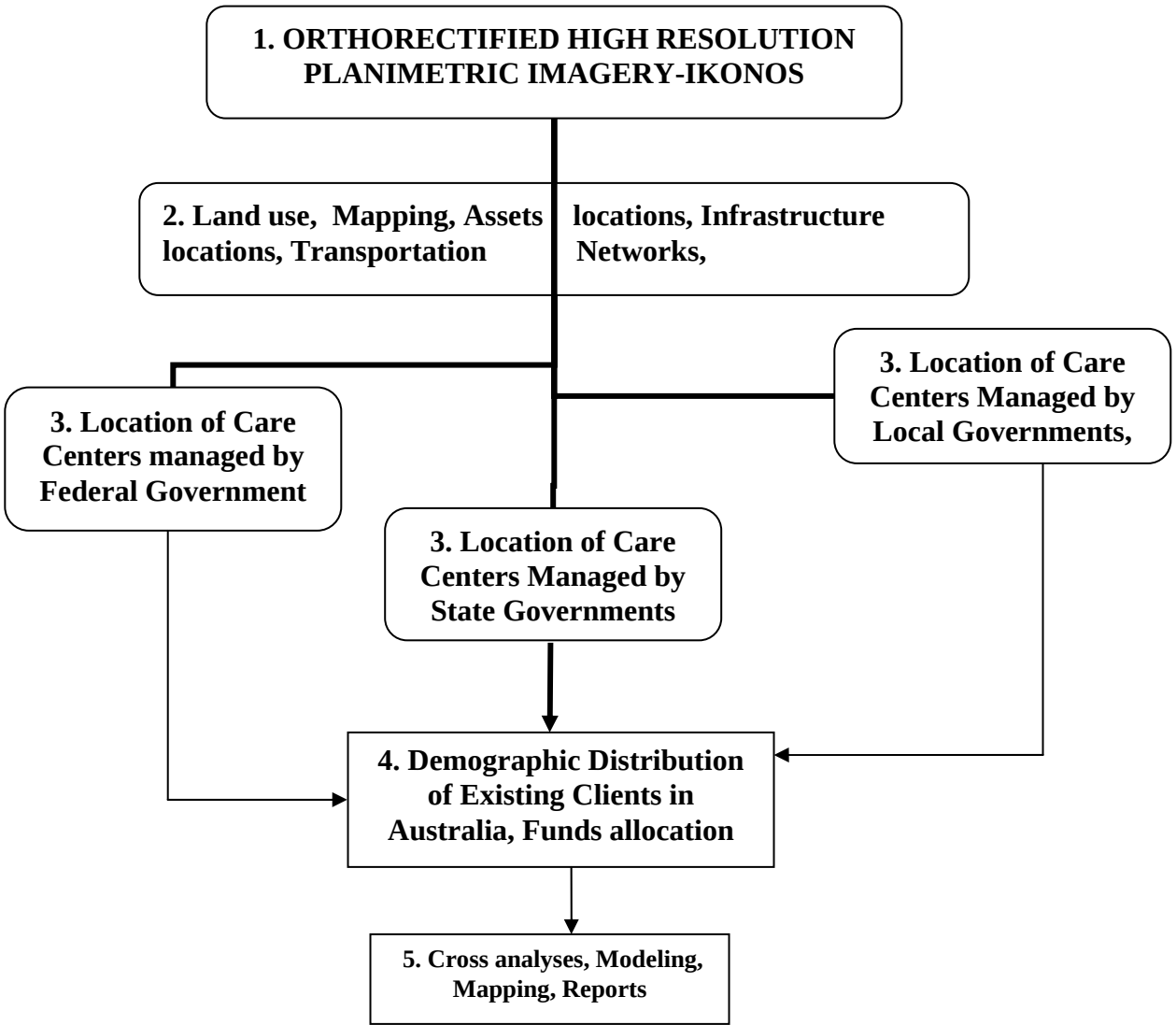
GIS is defined as “computer systems for the input, storage, maintenance, management, retrieval, analysis, synthesis, and output of geographic or location based information (Sunil put the reference here to - US Federal Geographic Data Committee) and list in References). The potential application of GITs has been underlined in many studies that have integrated remote sensing with GIS data bases to build decision-support-systems (Arambulo and Astudillo, 1991, De Lepper, 1995, Beck et al, 1994, 1997, Brooker and Michael, 2000, Curran et al, 2000, Higgs and Gould, 2001, ESRI, 2004, Noonan, 2003, Bhaskaran et al, 2004). A geographic information system (GIS) can be used for simulating the entire network of various processes that characterises delivery and management of care programs. One of the areas where GIS have debatably made less impact is that of measuring and monitoring aged care programs. A number of aspects about aged care could be monitored and measured such as locations of aged care service delivery networks and their client populations. GIT can be used to model the expected rising demand for aged care on the basis of population projections.

The main objective of this study is to describe the potential of GIT applications for planning and managing aged and community care service investment and service delivery in Australia. Specific objectives are to

- **Develop** a database that shows the locations of existing carer service centres by type of service, client dependency level, funding source and accountability; and to link databases on different types of services provided at each care service.
- **Map** the spatial distribution, demographics, remoteness of existing and potential clients serviced under the aged care program by using existing databases.

Data base: A challenge will be in accessing data. Census data while comprehensive has the limitation that it is only as current as the most recent census data collection. Other datasets will be reviewed for their currency, relevance and completeness. As the time of writing discussions are underway to access primary care data which is expected to be more up-to-date than some other sources. IKONOS imagery or high resolution aerial photo-images will be orthgorectified and used for locating all care services which will be located on an orthorectified image (IKONOS). The ABS data will be useful for mapping the spatial and temporal distribution of aged care clients – both existing and future. The Accessibility Remoteness Index of Australia (ARIA) will be used to measure access to transport, and other service indicators of existing clients. This uses GIS technology to combine road distance to population centers of various sizes, as a measure of service access, to develop a standard measure of remoteness that is suitable for a broad range of applications.

Methodology and Analyses: The methodology will focus on developing a database using an orthorectified remote sensing image (IKONOS) and other attribute information. This high resolution base image would enable detection of individual features to which other attribute information related to



aged care and health issues will be linked by using a GIS. Layers of data that will correspond to the different levels of government involved in administering, funding or delivery of aged care programs would be created within a GIS environment. All data processes that take place at these levels and between these levels would be linked systematically by process of geocoding where the attributes are linked according to their address fields. A database model showing the hierarchical arrangement of three governments (Australian, State and Local) and data flow between them will be created. The services funded by different levels of governments will be located by using a GPS on the ortho-rectified imagery by different color codes. The respective attribute details for each carer center will be updated to the locations of centers and organised as separate layers by using a GIS. This layer will show the different departments and staff profiles that are responsible for the various activities related to the aged care programs (Figure No 1). The attribute data will be linked to an ortho-rectified image by using location as the integral data component. Data from the Census, health care assessment professionals, health care networks, GIS data providers, and other reliable sources will be used to map the distribution of existing clients (older and frail people) and infrastructure.

Figure No 1. Simplified illustration showing layers of GIS data and potential of GITs for monitoring the aged care program in Australia.

Attribute information that may be linked to this data model is shown as Layer1. Ortho-rectified high resolution base image will provide a current and consistent surface to map locations of carer service centers. Layer 2. Infrastructure mapping, Location of important assets (home care services, nursing homes) and infrastructure (street network) derived from imagery or other available digital data sets will constitute this layer. Layer3. Location of care services managed by different levels of governments will be shown on the orthorectified image by using a GPS. The funding source and type of service will be linked to the respective care service center on the image along with the number and type of clients being serviced. This information will be mainly derived from their original assessment done by aged care assessment teams (ACATs). Each care service will therefore store different demographic and social, physical needs of their clients. These details will be stored on layer No4, which will show the spatio-temporal distribution on demographic characteristics of the clients. By exposing the regions again at regular intervals and updating the attribute information a consistent and continuous mapping database will be created that may be managed as a service to the aged care community.

Results and Discussions: By using an ortho-rectified image all the major locations (facilities, carer, and other agencies involved) can be mapped over Australia, resulting in a seamless and consistent data surface. After linking the attribute information this integrated data model can be used for mapping changes in the attribute information. For instance, a new service may be added to the existing data set by just locating them on the image. Facilities provided by the carer service can also be linked to its location on the image by creating many data layers. Ortho-rectified images can be used for analysing accessibility, perform shortest path analyses for emergency situations. Key assets from the study perspective such as location of services along with infrastructure (road network, railway lines, assets, locations of hospitals, and emergency services) can be mapped and updated at regular intervals. A major effort is required to initiate a process for listing data bases along with their custodians and finally securing them by mutual collaborations or other reliable mechanisms. All available datasets from various organisations must be centralised and a metadata for each datasets must be created which will assist in the use of these datasets and estimation of accuracy.

By using GITs the entire network of processes from the different levels of government to the various carer services can be stored in an organised manner, spatially referenced and cross analysed. This will provide a one stop digital database which will assist the management of aged care across the country.

Disparate datasets can be merged using GITs and modeled for making informed decisions mainly pertaining to managing aged care services. All relevant databases will be linked to the ortho-rectified image by using location as the integral data component. Cross analyses may be performed by using the data wherever required to determine the reasons for quality deterioration or for monitoring of aged care facilities.

References

1. Aged Care Report, (2003), [online] Available from http://www.ageing.health.gov.au/about/agedaust/agedcare803.pdf [Accessed 10th June, 2004]
2. Arambulo, P.V., and V. Astudillo. 1991. Perspectives on the application of remote sensing and geographic information system to disease control and health management. *Prev. Vet. Med*. **11**:345-352.
3. Beck, L.R., M.H. Rodríguez, S.W. Dister, A.D. Rodríguez, E. Rejmánková, A. Ulloa, R.A. Meza, D.R. Roberts, J.F. Paris, M.A. Spanner, R.K. Washino, C. Hacker, and L.J. Legters, (1994), Remote sensing as a landscape epidemiologic tool to identify villages at high risk for malaria transmission. *Am. J. Trop. Med. Hyg.* **51**:271-280.
4. Beck, L.R., M.H. Rodríguez, S.W. Dister, A.D. Rodríguez, R.K. Washino, D.R. Roberts, and M.A. Spanner, (1997), Assessment of a remote sensing based model for predicting malaria transmission risk in villages of Chiapas, Mexico. *Am. J. Trop. Med. Hyg.* **56**(1):99-106.
5. Bhaskaran., Datt,B., Forster., Neal., Brown, (2004), Integrating imaging spectroscopy (445-2543 nm) and geographic information systems for post-disaster management: a case of hailstorm damage in Sydney, International Journal of Remote Sensing, **Volume:** 25 **Number:** 13, pp**:** 2625 – 2639
6. Brooker, S., and E. Michael. 2000. The potential of geographical information systems and remote sensing in the epidemiology and control of human helminth infections. Book chapter: *Remote Sensing and GIS in Public Health*. *Advances in Parasitol.*, vol. 47 [S. Hay, D. Rogers, S. Randolph, eds.]. Academic Press. pp. 245-288.
7. Curran, P.J., P.M. Atkinson, G.M. Foody, and E.J. Milton. 2000. Linking remote sensing, land cover, and disease. Book chapter: *Remote Sensing and GIS in Public Health*. *Advances in Parasitol.*, vol. 47 [S. Hay, D. Rogers, S. Randolph, eds.]. Academic Press. pp. 38-80.
8. De Lepper, M., H. Scholten, and R. Stern (eds). 1995. *The Added Value of Geographical Information Systems in Public and Environmental Health*. Kluwer Academic Publishers, Dordrecht, The Netherlands. 355 p.
9. ESRI, 2004, [Online], Available from http://www.esri.com/industries/health/business/hospitals.html [Accessed on 17th June, 2004]
10. ESRI, GIS Solutions for Health Sciences and the Business of Health Care, (2004) [Online] [Available from] http://www.soi.city.ac.uk/~dk708/res/heathbro.pdf. [Accessed on 18th June, 2004.
11. Noonan, G.R. 2003. GIS technology: A powerful tool for epidemiologists. *Insight. A Milwaukee Public Museum Series in Natural History* **1**:1-98. Available online at http://www.mpm.edu/cr/insight/Papers/Noonan%20GIS%20review.pdf.
12. Higgs G, Gould M, (2001), Is there a role for GIS in the new NHS? Health Place, 2001, 7 (3): 247-59