Summary of the Two Day Workshop
20th and 21st august 2004 – Leicester

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The 7th ICA Commission on Map Generalisation and Multiple Representation was held jointly with EuroSDR at the University of Leicester on Friday 20th and Saturday 21st of August. The workshop was comprised of almost thirsty presentations based on reviewed papers, demonstrations and small discussion groups. As with previous workshops, the objectives were to disseminate and critique the most recent developments in this field, and to foster closer collaborations between mapping agencies, vendors and researchers, as well as encourage integration of new ideas and participants from cognate disciplines. Broadly speaking the workshop was in two parts – the morning of the first day was devoted to presentation of research and production requirements of some national mapping agencies and GIS vendors. The afternoon focused on the challenges of developing multiple representation databases and generalisation requirements. The second day continued this topic, showcasing research solutions in this field.

Friday 20 August

The first day began with a presentation on EuroSDR EuroSDR is a pan-European organisation, tasked with acting as the European research platform for National Mapping Agencies, Academic institutes, Private sector, Industry and User's groups on issues relating to provision and use of core spatial data. Peter Woodsford and Colin Bray presented an overview of the various activities and outreach programmes offered through the five commissions comprising EuroSDR. The central aim of EuroSDR is to act as a bridge between Geographic Information based organisations, National Mapping Agencies and research communities.

Generalisation Methodologies among National Mapping Agencies

The first session was a collection of papers painting a picture of generalisation activities taking place at National Mapping Agencies and collaborating bodies.
It began with a paper by Patrick Revell '**Building on Past Achievements: Generalising OS Master Map Rural Buildings to 1:50000'** [paper] [oral presentation] which presented some current research being undertaken at the Ordnance Survey in the generalisation of buildings –including constraints and algorithms - in anticipation of their display at 1 :50K based on LaserScan's Clarity technology. In particular his research attempts to model the distinction in behaviour between rural and urban buildings. The solution highlighted subtle differences in generalisation requirements among NMAs. Future ambitions are to extend the system to handle forests and hydrology. In discussion over the evaluation methodology, the observation was made that we are in danger of creating 'cartographic kitch' – anachronistic output too reliant on paper based perspectives.
The next paper was presented by Serdar Aslan from the Turkish NMA. Entitled **'Some intermediate results of KartoGen generalization project in HGK'** [paper] [oral presentation] he reported on a current project to generalise maps from reference data at 1:25K, to directly create maps at 1: 100K. The solution includes displacement, amalgamation and rotational operations built around a user centered approach. The project began in 2002 with the intention that the project be completed in early 2005. The human component remains central to the process. The project highlighted the need for sequencing strategies and the interest NMAs have in being able to directly derive small scale mapping from fine scale mapping.
The third paper was presented by Adam Iwaniak of the NMA of Poland on behalf of his co-authors. The paper entitled '**Generalization of the topographic database to the vector map level 2'** [paper] [oral presentation] provided an overview of the Polish strategy for mapping at different levels of detail – based on the DynaGen software from Intergraph. Adam reported on earlier work utilising rule based approaches emphasising the importance of data enrichment prior to generalisation as well as the

importance of quality control. Future plans were to migrate to Oracle (a common aim among NMAs), and to utilise expert system concepts in the automation process.

The final paper of this session was given by Jantien Stoter, a lecturer at ITC. Entitled **'Generalisation of Framework Data: A Research Agenda'** [paper] [oral presentation] the paper laid out plans for generalisation research in collaboration with TDN – the national mapping agency of the Netherlands. Taking a holistic perspective, it is intended to build a prototype capable of supporting derivation of multiple products from a single detailed database. The questions that followed highlighted the need for methods for semantically transforming data as part of the generalisation process (as opposed to geometric transformation).

Generalisation: Some Vendor Perspectives

The second session of the day was a series of presentations on vendor perspectives beginning with a paper by Dan Lee from *ESRI*. The paper entitled **'Geographic and cartographic contexts in generalization'** [paper] [oral presentation] presented an overview of challenges that remain in automated map generalisation and then went on to discuss tools available via the Arctoolbox, and the supporting role of the Geoprocessing methodology for creating generalisation flowlines now available in ESRI's software, with the ambition of including more generalisation tools in version 9.1.

This presentation was followed by Dieter Neuffer from *Laser-Scan,* who spoke on **'Integration of agent-based generalisation with mainstream technologies and other system components'** [paper] [oral presentation]. His presentation discussed issues of extensible architectures that conform to open standards. He also discussed issues of algorithm robustness – developing solutions that could handle the reality of 'dirty' data. He stressed the importance of validation techniques, and the challenges of designing interfaces that allow user to specify the generalisation task in a meaningful way. Attempts to automate the generalisation process were placing additional demands on NMAs to precisely specify the required solution.

The third presentation of this session was given by Vince Smith from *Intergraph*. His talk, **'**Interoperability of Agent based generalisation with open, geospatial clients' [paper] [oral presentation] presented an overview of the link up between Intergraph and Laser-Scan technologies. The link up stressed the importance of compliance with OGC interoperability philosophies in order to maximise interoperability between GIS components, deliverable over a broad range of devices and environments including Microsofts .NET technology. The paper highlighted communities of users for whom interaction in the generalisation process is very much required. In essence GeoMedia software will act as the client on the desktop – the user is oblivious to the face that Laser-Scan's Clarity generalisation engine sits beneath. The issue of interoperability raised the question of whether other vendor technology can be integrated into such a model.

Paul Hardy, currently working for *ESRI*, gave a presentation, **'Database driven cartography from a digital landscape model with multiple representations and overrides'** [paper] [oral presentation] that provided an overview of current cartographic functionality, as well as ESRI's vision for future generalisation technology. A demonstration of current cartographic capabilities was given – the emphasis being on a combination of both batch processing and user interaction capable of supporting case by case editing, and an environment that formally recorded edited changes as part of quality control.

Generalisation and Multiple Representation Databases

The third session of the day focused on multiple representational database issues, their design and implementation.

The first paper was by Christelle Vangenot, from the EPFL Database Laboratory in Switzerland (Lausanne) and entitled '**Multi-representation in spatial databases using the MADS conceptual model'** [paper] [oral presentation]. The presentation reflected work undertaken as part of the MurMur European project. The 'MADS' conceptual model forms the basis of a logical MRDB – and explores methods of representing explicitly the relationship between entities. The focus is on modelling consistency across scales and the questions that followed highlighted the challenges of modelling the changing relationships among entities over changes in scale.

Karl-Heinrich Anders from the Institute of Cartography and Geoinformatics presented the second paper of the session entitled **'MRDB Approach for Automatic Incremental Update'** [paper] [oral presentation] which reported on extensions to the ATKIS model that enabled automatic triggering of update processes. The system is based on MRDB concepts and implemented in ArcGIS and Oracle - one that incorporated an active data object (ADO) approach. The presentation discussed methods for identifying logical conflicts in the database and how generalisation 'transactions' can be defined in an MRDB.

The third paper was given by Hanna Stigmar, from NLS, the national mapping agency of Sweden (which is based in Gävle). Her paper '**Merging route data and cartographic data'** [paper] [oral presentation] outlined proposed research in the context of GiMoDig – a project exploring the representation of cartographic products over mobile devices– an important application being the delivery of routing information at a range of scales. In particular the requirement that routing information be combined with cartographic representation of street segments using integration techniques. The research will explore the role of generalisation in the integration of such datasets.

The fourth paper in this session was presented by Jenny Trevisan from COGIT laboratory - IGN Paris, and entitled '**From DLM to multi representation DCM - Modelling an application on buildings'** [paper] [oral presentation]. The work examined theoretical issues in MRDB, exploring the use of hierarchical structures to support the aggregation of objects (for generalisation, for data storage and for DCM updating from DLM). The topic raises the question of how much semantic information is implicitly tied up in the geometry of an object and how we can design schemas for small scale mapping that are populated by derived/generalised objects rather than data collected directly in the field.

Dariusz Gotlib from the Institute of Photogrammetry and Cartography at Warsaw University of Technology presented the final paper in this session entitled '**Investigating possibilities to develop the BDT in Poland as a MRDB type database'** [paper] [oral presentation]. The paper discussed the implementation of a topographic database (BDT) for Poland that took place in 2003. The approach was based on MRDB, the challenge being in the development of a system capable of supporting a broad range of data, in a variety of themes, from a single detailed database. This and other presentations from the NMAs drew attention to the idiosyncrasies that exist in the specification and requirements of generalisation algorithms.

Closing Sessions

In the penultimate session of the day, the Workshop held the first of one of two brainstorming sessions. This was broken into two groups – one focusing on current challenges for National Mapping Agencies, and the second, held in parallel, focused on the challenges of designing and building multiple representation databases [summary].

The final closing session of the day was given by Peter Woodsford and Colin Bray in which they outlined future events of EuroSDR commission – in particular their ambition to commission work that reviewed "current state of the art in map generalisation by a small set of carefully devised tests". Colin Bray went on to specifically seek proposals to undertake a review of the current state of the art of automated generalisation in production and research environments (for more information colin.bray@osi.ie).

Saturday 21 August

The day began with a presentation by Anne Ruas on the planned activities of the ICA Commission. Input and contributions were sought for the various tutorials, workshops and conferences that will take place over the next three years with a particular focus on the structure of the workshop and tutorial that will take place immediately prior to the ICA Conference in A Coruna in Spain in July 2005. The two day workshop will be organised by Sébastien Mustière and Cécile Duchêne, and the Tutorial will be organised by Anne Ruas and William Mackaness of which more details can be seen at http://ica.ign.fr

<u>Algorithmic Developments in Generalisation</u>
The first session of the second day focused on developments in generalisation algorithms beginning with a paper by <u>Jan-Henrik Haunert</u> from Institute of Cartography and Geoinformatics, University of Hanover, entitled **'Using the straight skeleton for generalisation in a multiple representation environment**' [paper] [oral presentation]. The objective of the research is to establish links between different datasets to support both complex analysis and automatic update with a MRDB environment. The paper presented an implementation based on skeletonisation – that preserve topological relationships and constraints and - that could be used to link cadastral and topographic datasets. Linking together in this way enables a richer user of the collective attributes in support of various update and spatial analysis tasks.

In the second paper of the session, <u>Cécile Duchêne</u> from IGN Paris, COGIT laboratory, presented a summary of her PhD thesis in a paper entitled '**The CartACom model: a generalisation model for taking relational constraints into account'** [paper] [oral presentation]. The focus of this work was to develop further the agent methodology by supporting higher levels of communication between agents, such that activated generalisation plans depend upon the relational constraints that exist among a group of agents. The results illustrated the 'conversations' that occur enabling the handling of internal and relational constraints between agents.

<u>Stefan Steiniger,</u> from Zurich University, presented the third paper of this session: '**Snakes: a technique for line smoothing and displacement in map generalisation'** [paper] [oral presentation]. The work is based on an energy minimising spline function borrowed from the graphics domain in image recognition. The method is comprised of two components – a features internal energy, and the variation in the external energy. The work is being extended to incorporate control using shape characteristics of the feature. The questions that followed highlighted the challenges of developing interfaces that allow a user to intuitively set generalisation parameters for methods that exhibit complex and subtle behaviours.

<u>Lars Harrie</u>, from The National Land Survey of Sweden at Lund University, presented the next paper entitled '**Using simultaenous graphic generalisation in a system for real time maps'** [paper] [oral presentation]. The work examines the simultaneous application of a subset of generalisation techniques to support real time delivery maps over mobile devices as part of the GiMoDig project. The emphasis of this project is on shortening processing times in the retrieval, structuring and generalisation of map data. The work highlighted the 'cost' of modelling topological relationships in the structuring time, as well as the challenges of developing common generalisation interfaces to different applications.

<u>Monika Sester</u> from the Institute of Cartography and Geoinformatics at the University of Hannover gave two demonstrations highlighting the use of generalisation algorithms in the representation of buildings at varying scales. The first was a demonstration of algorithms for generalising buildings at smaller scale using typification. The second demonstrated the idea of 'streaming generalisation' – progressively transmitting more and more details of spatial data when the zoom level is increased. Algorithms incorporating typification and polygon simplification were combined to render in real time building objects as the user zoomed in and out. Rendering the space in a way that made the generalisation process almost invisible to the user, even though the objects were being generalised in front of their eyes. There are ambitions to commercialise this work [paper] [oral presentation]

<u>Generalisation in 3D and for Mobile Location Based Services</u>
The sixth session of the workshop focused on research being undertaken in 3D modelling and Location based services and the role of generalisation in both these areas of research.

The first paper was to have been given by <u>Tiina Sarjakoski</u>, who was unable to attend the workshop. The paper, entitled '**A use case based mobile GI service with embedded map generalisation'** [paper] details the application of generalisation methodologies in the fast delivery of customised spatial data over mobile devices in support of mobile activities and was part of a number of papers reflecting the various elements of the GiMoDig project.

<u>Mark Hampe</u> from the Institute of Cartography and Geoinformatics at the University of Hannover presented his work in a paper entitled **'Generating and Using a Multi Resolution Database (MRDB) for Mobile Applications**' [paper] [oral presentation]. The focus is on the optimal linking of

maps at varying levels of detail within a multi dimensional database in order to deliver instantaneous results over mobile devices. Such a MRDB could support seamless presentation of information through the zoom, and alllow 'information drilling' in response to user interaction. The challenge is in preprocessing the data sufficient to enable instantaneous display on various devices.

Frank Thiemann from the Institute of Cartography and Geoinformatics at the University of Hannover presented the second paper entitled **'Segmentation of buildings for 3D generalisation'** [paper] [oral presentation]. The idea is to decompose a building into its partonomic forms and to create a hierarchical structure that enables rendering of the coarse form, with increasing detail as the user moves closer. A recursive segmentation process is used to build the tree of component parts. Such work can be used as a basis for visibility analysis as well as generalisation methodologies.

Andrea Forberg, from the Institute for Photogrammetry and Cartography at Bundeswehr University Munich, presented the third paper of the session, entitled '**Simplification of 3D Building Data**' [paper] [oral presentation]. The work extends further her research in the generalisation of 3D buildings. Simplifying anthropogenic forms comprising solids with protrusions, step and box structures. Previous work has explored the use of mathematical and curvature space but this work focuses on parallel space to define simpification of roofs and walls. The research has produced some very promising results which will form the core of her PhD thesis submission in January.

Dirk Burghardt from Zurich University presented the final paper in this session: '**Derivation of digital vector models - project DRIVE'** [paper] [oral presentation]. This is a collaborative project between a map publishing company, Axes System and the University of Zurich. The objective is to extend an existing cartographic production system to a higher level of automation by addition of an orchestration methodology that incorporates a constraint based approach and extension of the existing data model.

Database Enrichment

The seventh session of the workshop entitled 'Data Enrichment', focused on ways of making explicit the complex set of patterns that exist among map entities (both in their attribution and metric/topological qualities).

The first paper was by Julien Gaffuri from the IGN in Paris (cogit laboratory) and entitled '**Role of urban patterns for building generalisation: An application of AGENT**' [paper] [oral presentation]. The paper highlighted the importance of preservation of pattern and characteristic forms through scale change. It presented a enriched model to the agent data model that enable various qualities among groups of buildings to be measured and preserved during the generalisation process. It also examined the use of 'empty space' as well as 'consumed space' as a measure of the success with which it had reached a generalised state.

Moritz Neun from Zurich University, presented the second paper of this session entitled **'Data enrichment for adaptive generalisation'** [paper] [oral presentation]. The work highlighted the broad range of applications for MRDB. It emphasised the need to model 'vertical' and 'horizontal' relationships among and between classes of objects in support of map generalisation. These work incorporates ideas of hierarchical and partonomic relationships, with an emphasis on modelling changes in topology in tesselated surfaces. The ambition is to use these structures to enrich the database, with specific application to the generalisation of geological maps.

Bin Jiang then presented a paper entitled '**Spatial clustering for mining knowledge in support of generalization processes in GIS'** [paper] [oral presentation] which highlighted opportunities for applying data mining techniques to make explicit semantic information inherent among spatial data. Such information can feed into the enrichment process and thus be utilised in the application of map generalisation methods. The paper focused on application of multi dimensional clustering techniques to discern patterns among points and network structures. Having extracted such information, the challenge remains one of deciding which of that information is pertinent to subsequent generalisation.

The final paper in this session was presented by Qingnian Zhang. His paper entitled '**Modeling Structure and Patterns in Road Network Generalization'** [paper] [oral presentation] focused on the various patterns inherent among road networks (such as Manhattan space, hub space, and circular road patterns). These patterns can co-exist and manifest themselves at varying levels of detail or resolution.

The talk illustrated the challenges in generalisation in separating out and making explicit these pattern as a basis for the characterisation of the map.

<u>Discussion Group</u>
The discussion groups were broken into three groups, each group tasked with the challenge of discussing, summarising and presenting an overview to all the participants. The groups were entitled: Development of a **Research Agenda for Map Generalisation**, **Interoperability Issues in Map Generalisation**, and **The Impact of the Web on delivery and use of geographic information and its impact on map generalisation research** [summary].

The closing session, presented jointly by William Mackaness and Anne Ruas reviewed the aims and objectives of the meeting as well as highlighting future events. In particular they drew attention to deadline for abstracts for the **ICA Conference** that will be held in La Coruna in July of 2005 www.icc2005.org , and the **ISGI conference** to be held in 14-16 September 2005 in Berlin (more information soon)

As in previous years, the ICA Commission on Map Generalisation and Multiple Representations will run a **research workshop**, and for the first time, a **tutorial**, specifically aimed at encouraging new researchers to join this commission. The two day workshop will take place in A Coruna on the 7th and 8th July, and the Tutorial will be given on the 10th July. More details can be found at http://ica.ign.fr.

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