








Multi-scale Mapping by Automated Generalisation & Active Representation

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What is Laser-Scan?

	<h3>What is Laser-Scan ?</h3>	
	<ul style="list-style-type: none"> • British company, based in Cambridge <ul style="list-style-type: none"> – Founded 1969, digital mapping since 1975 • Customers government & commercial <ul style="list-style-type: none"> – National Mapping Agencies - OSGB, UKHO, NOAA, NIMA, LINZ, INEGI, IGN, KMS, + AA, Philips... • Now a member of the Yeoman Group <ul style="list-style-type: none"> – British Group listed on AIM Market – Specialists in mobile navigation - sea and land – First commercial turn-by turn car navigation service to the mobile phone - VoxNav 	
		

	<h3>Laser-Scan company focus: Spatial data engineering</h3>	
	<ul style="list-style-type: none"> • Generalisation and derived products (KMS, IGN) • Spatial Data re-engineering <ul style="list-style-type: none"> – OS MasterMap, NIMA DNC • Rich object data models (S57 / DNC) • Big continuous mapping (EDINA, NLIS) • Multi-scale, multi-product object database (AIDU) • Location-based services (VoxNav) • Database server spatial enhancer (ASPE) <ul style="list-style-type: none"> – adds topology awareness to Oracle 	

Problem and Goal

	<h3>Scenario and Problems</h3>	
	<ul style="list-style-type: none"> • Many mapping organisations have spent years capturing sheets of data at one detailed scale, but customers want something different <ul style="list-style-type: none"> – mapping at smaller scale (covering bigger area per sheet) – mapping for any area on-demand – map data with explicit structure – mapping to suit current purpose, with clutter removed – map data with explicit structure for further analysis • Other organisations currently capture and maintain several map series at different scales <ul style="list-style-type: none"> – very costly – often out of date 	


	<h3>Goal</h3>	
	<ul style="list-style-type: none"> • Ideally, we would capture the data once at the most detailed scale required, then derive all the other products from that, whenever we wanted <ul style="list-style-type: none"> – Previously impossible – Now becoming feasible – In near future will become much easier and economic 	

Technologies available to provide solution

<ul style="list-style-type: none"> • Generalisation, using objects and agents • Active representation • Continuous datasets (no sheet edges) • Process sequences for bulk processing
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<ul style="list-style-type: none"> • On-demand mapping • Explicit dynamic topology (adjacency, connectivity, sharing) • Spatial data re-engineering
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Generalisation



Generalisation

- Is deriving appropriate mapping for current purpose
 - It is a bad name (Specialisation?)
- Its about lying, not truth
 - exaggerate the important
 - subdue or remove irrelevant detail
- For traditional paper mapping, but also for data products and screen displays such as web mapping
- Uses simplification, displacement, typification, aggregation, reclassification, refinement, collapsing
- Needs pattern recognition
 - task that humans find hard, while computers find harder!

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Solutions to generalisation


- Human cartographer with graphics tools
 - slow and expensive
- First generation GIS tools
 - a feature at a time - no context
 - same algorithm on all features, so poor results
- Active object tools (e.g. LAMPS2 Generaliser)
 - still one at a time, but with some context, so can choose better
- Agent tools (new)
 - each object chooses best algorithms for its needs
 - meso agents can coordinate to provide global context

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Agents for generalisation



The AGENT Project - Partners



Institut Geographique National (leader)


University of Edinburgh

Institut National Polytechnique de Grenoble


Laser-Scan Ltd.

University of Zurich

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Need each district to think and coordinate the buildings within

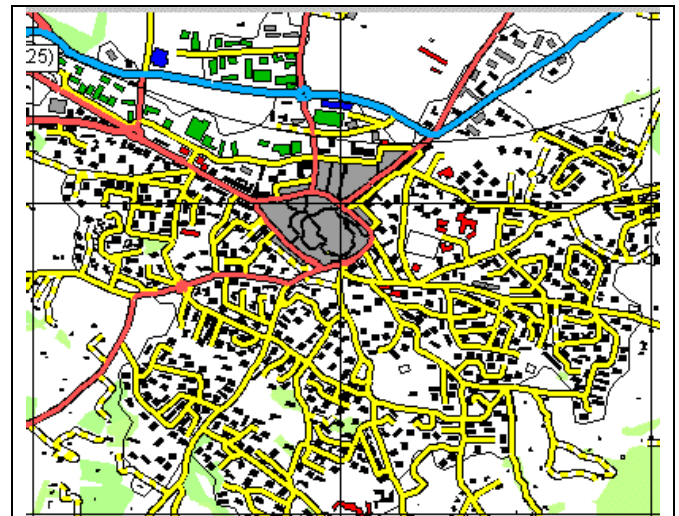
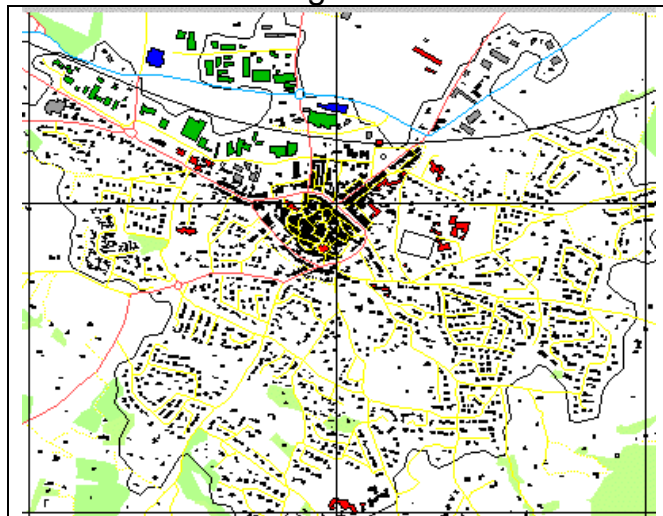


What is an Agent?


1. Autonomous piece of software
 - A thing that thinks for itself

2. The buildings and roads on the map
 - Aware of surroundings
 - Aware of goals, constraints
 - Trying to improve their own 'happiness'

Before and After Agent

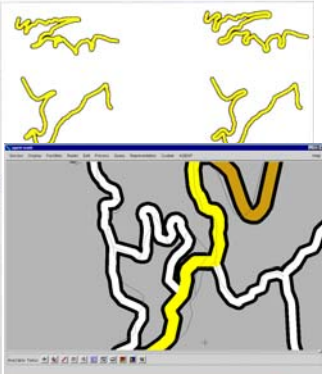



Road Generalisation



Remove conflicts in exaggerated roads

- Roads are drawn much wider than reality (2mm=200m@1:100K)
- Leads to conflicts
 - External (other roads)
 - Internal (within this road)
- Need to use different algorithms on different sections of road
- Need context to handle external conflicts

New algorithms being added - Displacement using 'Beams'

Before After

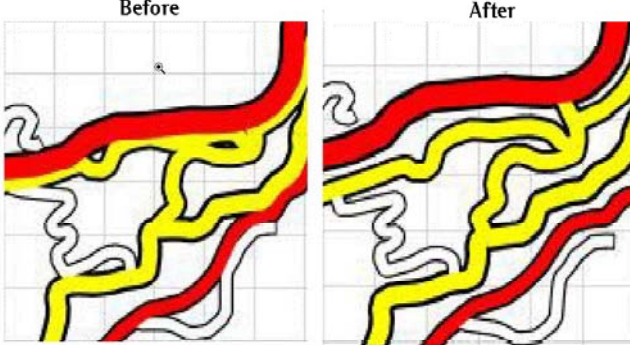
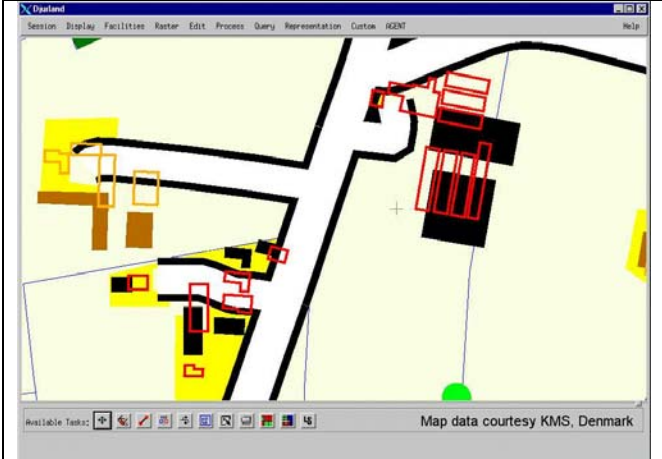


Illustration courtesy Mats Bader, University of Zurich

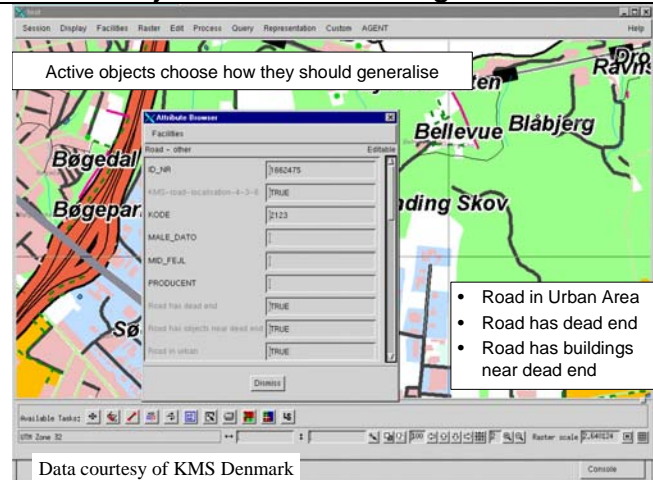
KMS Denmark

- Have captured 1:10K dataset
- But military want 1:50K mapping
 - up to date and accurate
- Competitive trial in 1999
 - chose LSL to work with to build solution
- Built flowline using mixture of software
 - Using LSL O-O generalisation processes
 - plus Agent techniques for buildings

Figure shows agent-based generalisation of farms, with displacement and aggregation



Active object selection and generalisation



Active objects choose how they should generalise

Attributes Browser

Facilities	
Road - other	
ID_NBR	3882475
KMS-road-locationalion-4-3-1	TRUE
KODE	2123
MALE_DATO	
MO_FEA	
PRODUCENT	
Road has dead end	TRUE
Road has objects near dead end	TRUE
Road is urban	TRUE

- Road in Urban Area
- Road has dead end
- Road has buildings near dead end

Data courtesy of KMS Denmark



IGN Belgium

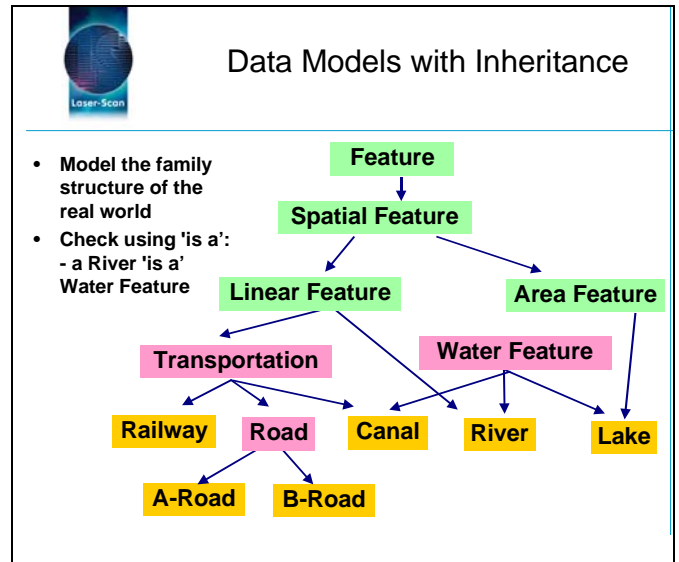
Original 1:10000 Generalised 1:50000



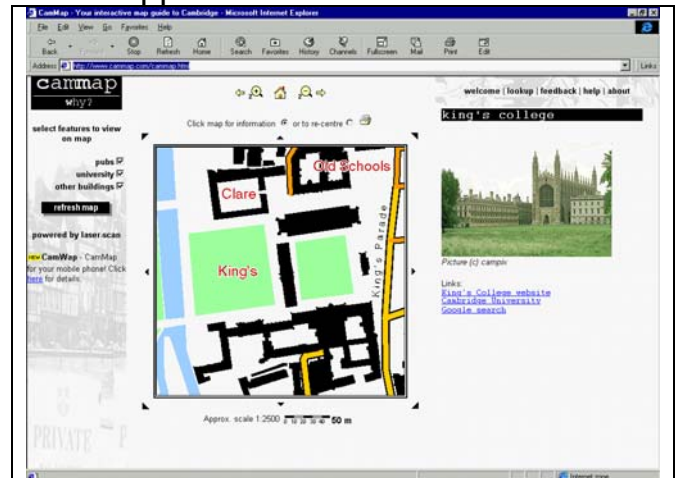
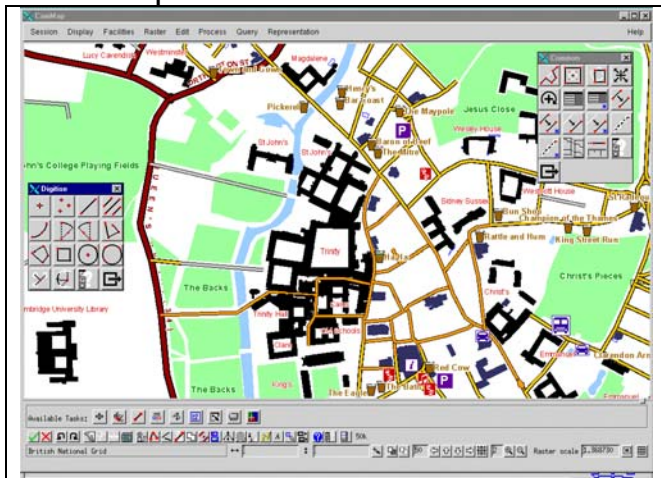
Data courtesy of IGN Belgium

Active object data models

- Message to objects - 'please draw yourself'
- Object display method can then:
 - decide not to draw
 - choose one of a rich set of styles
 - change type according to scale (area to point)
 - use different geometry with less detail
 - draw itself differently several times (casings)
 - move into clear space - avoid edge or collisions
 - modify representation according to surrounds
 - shorten text label to match road length



Active representation in LAMPS2 and Gothic Web Mapper



On-the-fly generalisation in web mapping

CamMap www.CamMap.com

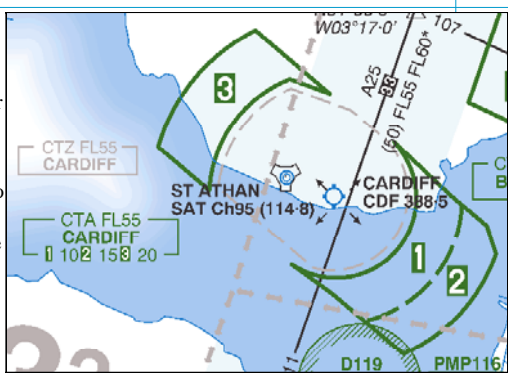
- Building generalisation as zoom
 - Switch to pre-prepared alternative
 - Simplified outlines of buildings

CamMap - Text Labels

- Shorten names
- Drop road numbers
- Intelligent positioning
 - avoid edge
 - avoid conflicts
- Done at draw time
 - Good for this request

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Multiple products at AIDU from single database



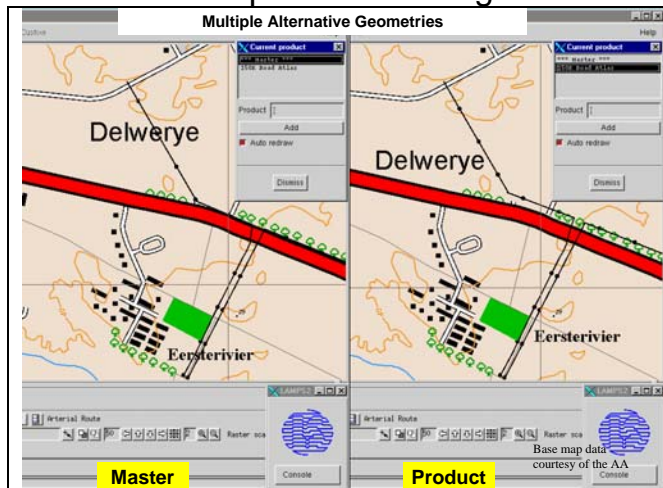
AIDU (RAF air charting)

World-wide air charting from LAMPS1

Now moving to LAMPS2 to derive multiple products from single dataset

- AIDU - Complex Aeronautical graphics
- Object database to drive production of
 - Paper charts (tight time - 28 day cycle)
 - Notices to airmen via web portal
- Single master dataset covering whole world
 - Including data spanning poles and date line (challenging!)
- Philosophy of update once, use many times
 - Relies on active representation (display methods)
 - Same object may draw differently on different charts

Relies on multiple alternative geometries and on continuous mapping



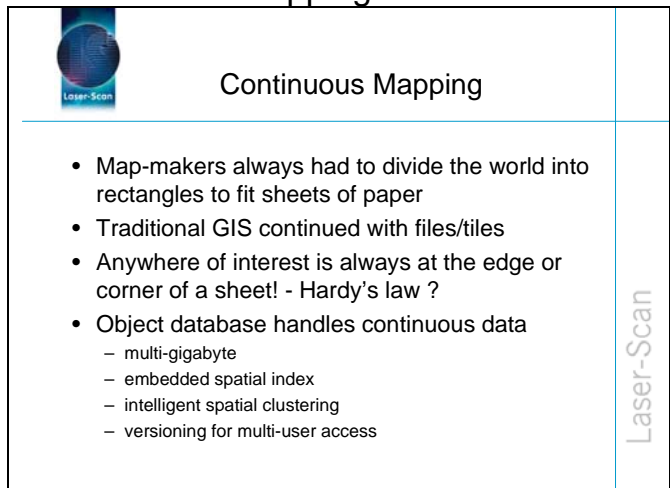
Multiple Alternative Geometries

Delwerye

Eersterivier

Master

Product

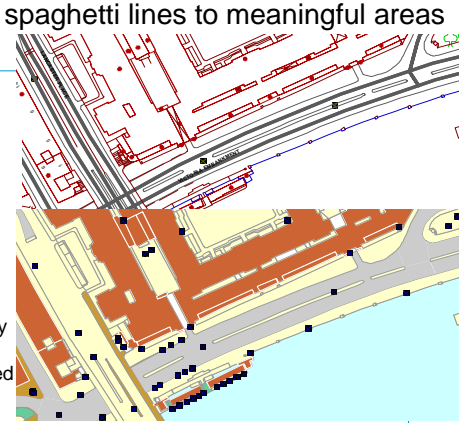


Continuous Mapping

- Map-makers always had to divide the world into rectangles to fit sheets of paper
- Traditional GIS continued with files/tiles
- Anywhere of interest is always at the edge or corner of a sheet! - Hardy's law ?
- Object database handles continuous data
 - multi-gigabyte
 - embedded spatial index
 - intelligent spatial clustering
 - versioning for multi-user access

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Spatial Data Re-engineering

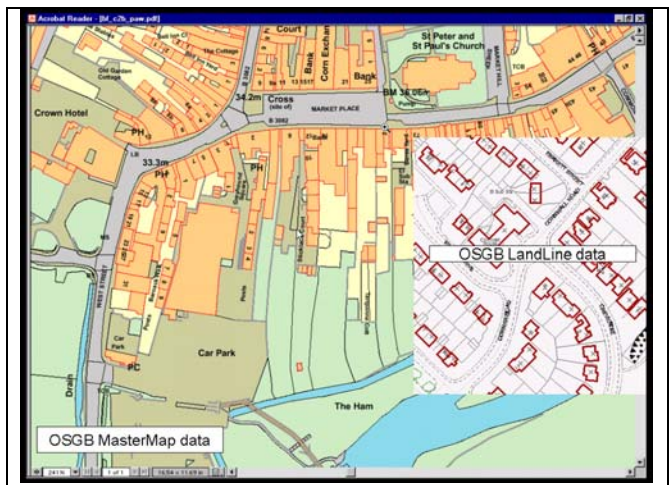


Re-engineering

From spaghetti lines to meaningful areas

LAMPS2 is the engine that cleaned and structured LandLine to create the OS MasterMap area objects at Ordnance Survey GB.

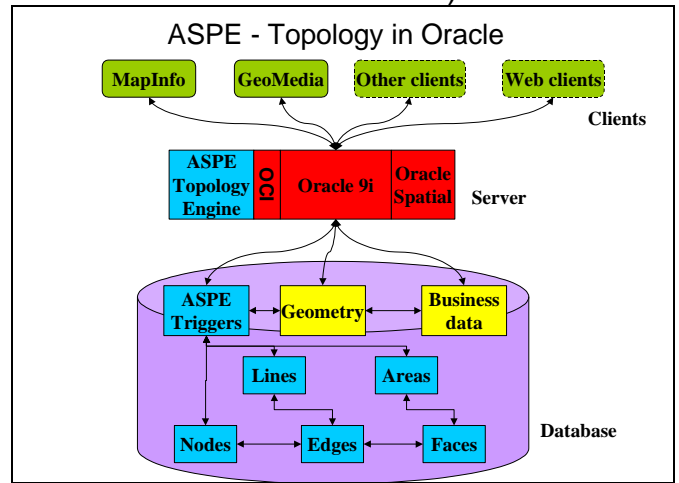
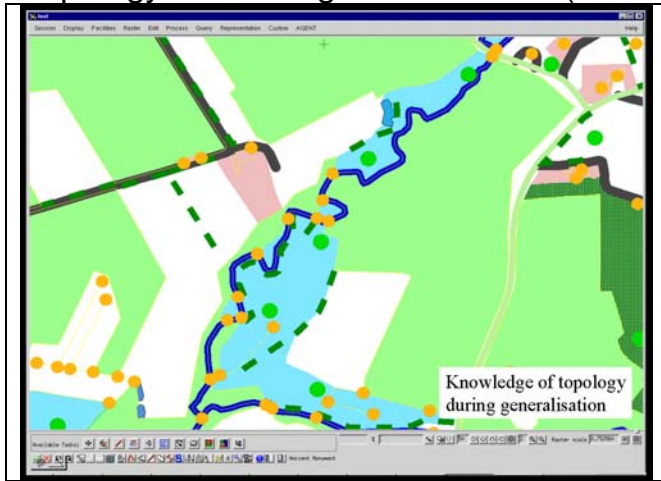
The transformation for the whole country (230,000 map sheets) was achieved in one year (from 4/2000)




OSGB LandLine data

OSGB MasterMap data

Topology is vital to generalisation - (soon available as extension to Oracle)



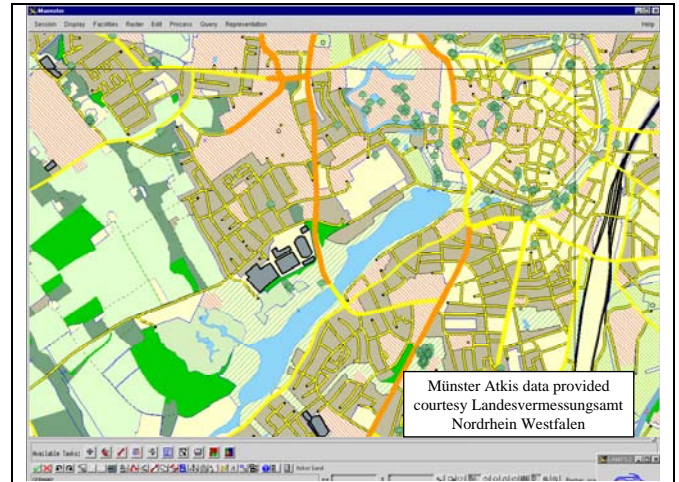
Landscape Model Generalisation




Model generalisation

- Selected by German Länder (NRW, BW, RP) for generalisation of ATKIS base model to produce a 1:50K derived landscape model
- Initial scope is for data products (no displacement)
- Second phase is to produce 1:50K mapping

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Summary



Summary

- Widespread need for multi-scale production
 - costs too high if maintained in parallel
 - need new products to satisfy market demands
- O-O spatial processing environment
 - rich data models, knowledge of topology and space
 - active objects for processing and representation
- Gothic Generaliser
 - generalisation processes to apply intelligent algorithms
 - Agent infrastructure provides context
 - extensible and adaptable

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Agent generalisation and Active object mapping

Is the Way Ahead !



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