

Modeling in Geographic Information Systems: Data Amalgamation and Integration



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Presentation Outline

- ▶ Introduction
 - Why modeling has become mainstream GIS?
 - Enterprise level integration
 - Data amalgamation
- ▶ Organization Enterprise Solutions
 - Organization plan for integrated solution
 - GIS life cycle
- ▶ Data Amalgamation
 - Necessary understanding
 - Cautions
- ▶ Case Study: Emergency Response – the need and benefits of GIS for Modeling
 - Liquid pipeline regulations
 - Model specifications
 - Cautions
- ▶ Conclusion



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Introduction

- ▶ Why modeling has become mainstream GIS?
 - Technological advances
 - ▶ Computer processing
 - ▶ GIS software capabilities
 - Improved data quality
 - ▶ Advances in Remote Sensing and Surveying
 - Cost Savings
 - Recognized tool for decision support within many industries



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Introduction

- ▶ Enterprise Level Integration
 - Common Repository to house majority of company data, therefore more data is easily assessable
- ▶ Data Amalgamation
 - In order to produce models that represent the real world, many disparate data sets are needed
 - Overcoming data diversity means datasets with different geometries, data types, projections and datums, accuracies, and resolutions

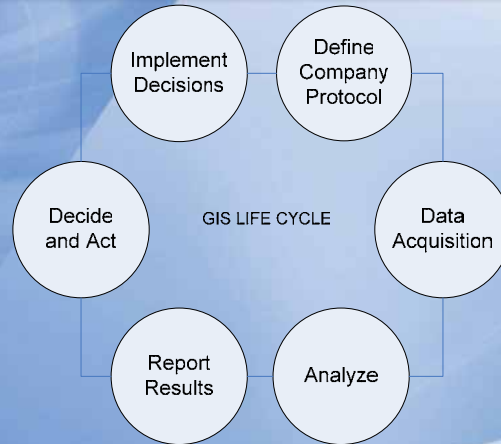


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Organizational Enterprise Solution



GIS Life Cycle



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Organizational Enterprise Solution

- ▶ Overall “vision” and plan is necessary for successful implementation of an organizational wide GIS
- ▶ The plan should outlines:
 - What spatial datasets are important
 - How they will be collected
 - How they will be used and stored
 - Ensures that the results are properly interpreted and implemented



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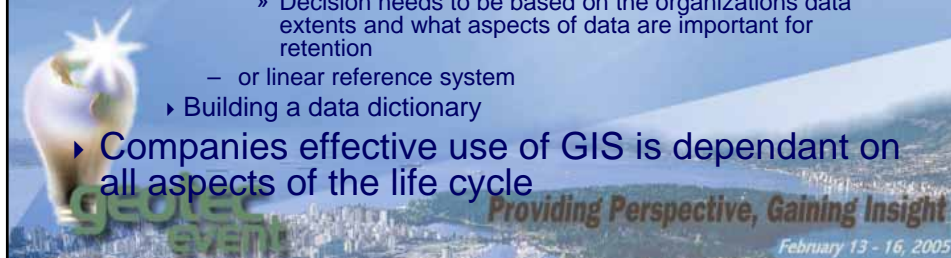
Organizational Enterprise Solution

- ▶ Data Acquisition
 - Accumulation of company data over the years in many varying formats
 - Gather relevant datasets across the organization in a manner which lends itself to support overall business goals



Organizational Enterprise Solution

- ▶ Integration
 - This phase is the most challenging
 - Sets the stage for the ability to amalgamate datasets
 - Steps include:
 - ▶ Determining where data will reside
 - Data repository
 - Common database
 - ▶ Development of a common reference system
 - Spatial reference system (integration through x and y coordinates)
 - » Decision needs to be based on the organizations data extents and what aspects of data are important for retention
 - or linear reference system
 - ▶ Building a data dictionary
 - ▶ Companies effective use of GIS is dependant on all aspects of the life cycle



Data Amalgamation

- ▶ What is it?
 - The ability to combine disparate data sets in widely varying formats into a single composite dataset
- ▶ Necessary Analyst skills
 - Possess competency
 - Understanding of data mining
 - Understand integrity of the data
 - ▶ To include data structures, data sources, data formats, and accuracy



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Data Amalgamation

- ▶ Analyst must understand the product that will be produced
 - QA/QC (insert checks and balances to ensure data integrity)
 - New metadata
- ▶ Cautions and Concerns
 - Accuracy
 - ▶ Comparing incomparable datasets
 - Timeliness of the dataset



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Case Study – Emergency Response

49 CFR Part 195 of Liquid Pipeline Regulations in USA

- ▶ An operator must include in its integrity management program:
 - Identification of all pipeline segments that **could** affect a high consequence area
 - Consequences of a failure, and
 - Identification of measures taken to protect the High Consequence Area



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Case Study – Emergency Response

Regulatory Recommendations

- 1.Terrain surrounding the pipeline...
- 2.Drainage systems...
- 3.Crossing of farm tiles...
- 4.Crossing of roadways...
- 5.Product characteristics...
- 6.Physical support...
- 7.Operating conditions...
- 8...Hydraulic gradient...
- 9...Potential release volume...
- 10.Potential physical pathways...
- 11.Response capability...
- 12.Potential natural forces...

Model Considerations

- 1.Digital Elevation Model
- 2.Hydrography
- 3.Crossings
- 4.Crossings and transportation
- 5.Fluid properties
- 6.Special Case
- 7.Operating conditions
- 8.Hydraulic gradient
- 9.Potential release volume
- 10.Potential physical travel paths
- 11.Response time
- 12.Probability



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Case Study – Emergency Response

Additional Factors to consider

- ▶ Land Use/Land Cover
- ▶ Soil Properties
- ▶ Flow types
- ▶ Weather conditions
- ▶ Downhill flow constraint



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Case Study – Emergency Response

- ▶ Modeling Considerations
 - Not all datasets must be included
 - ▶ Excluding datasets will lead to divergence from reality
 - Ex. Surface Cover
 - Consideration must be given to data availability and data quality
 - ▶ The higher the accuracy of inputs will lead to high accuracy of outputs
 - ▶ Company using model should have quality assurance in place stating the max resolution for the output to be used in decision support



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Case Study – Emergency Response

- ▶ Modeling Considerations
 - Availability of quality data
 - ▶ Effective model must be adaptable to unavailable data, poor quality data, or the use of overriding assumptions
 - Vintage of data
 - ▶ Data completeness

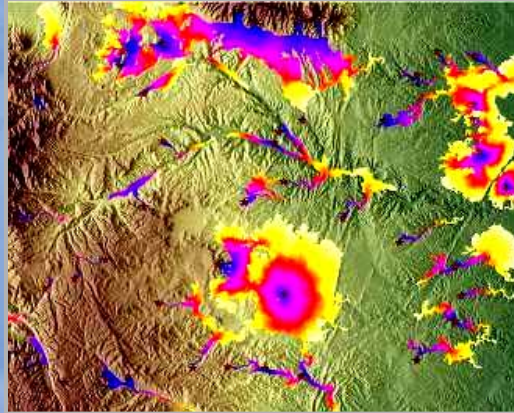


Case Study – Emergency Response

- ▶ Data Preprocessing (Amalgamation)
 - This model runs in a raster environment, so....
 - ▶ Must convert all vectors to raster
 - Reclassification (land cover and soil properties) of datasets
 - Derivation of datasets (primary topographic attributes)
 - Flow resistance surface
- ▶ Cautions
 - Actions of analyst are very important
 - Simple miscalculations will lead to error propagation



Case Study – Emergency Response



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Conclusion

- ▶ Model Outputs are extremely valuable tools in organizations to:
 - ▶ facilitate decision support
 - ▶ Produce mandatory results for regulators
- ▶ Amalgamation is quite powerful in completed procedurally correct
- ▶ Advances in GIS and data quality are opening doors to new industries and developing methodologies for process reengineering in current industries.



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Questions?



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