

# Enterprise GIS in Transportation

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# Outline

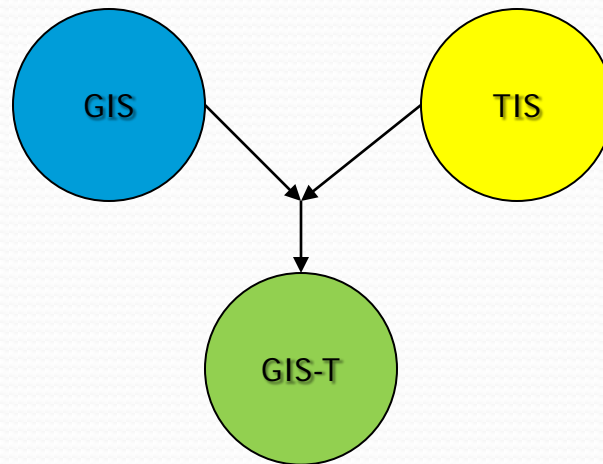
- Enterprise GIS in Transportation
- Enterprise GIS Implementation – Present
  - Case studies
    - Commuter Flow Summaries
    - Traffic Data Management
- Enterprise GIS Implementation – Future
- Conclusions

# GIS in Transportation - Concept

- Implement enterprise GIS to support transportation planning, modeling, and operational activities
- Integrate with other systems to streamline workflows and business processes in transportation modeling, planning, and operations
- Provide real-time data integration, analysis, and decision making capabilities

# What is GIS-T?

- “GIS-T can be viewed as the product of the interaction between improved concepts of both geographic information system (GIS) and transportation information system (TIS)”  
Vonderhoe et al., 1993”



# Enterprise GIS-T - Applications

- Infrastructure planning, design and management
- Transportation Modeling
- Public transit modeling, planning, and operations
- Traffic safety analysis
- Transportation impact analysis
- Intelligent transportation systems (ITS)
  - Advanced Traveller Information Systems (ATIS)
  - Commercial Vehicle Operations (CVO)
  - Incident Detection Management
- Others

# Enterprise GIS-T – MPO Uses

## Modeling

- Socioeconomic Analysis (SE)
- Land Use Modeling (CommunityViz, UrbanSIM, others)
- Transportation Modeling (Travel Demand Modeling and others)

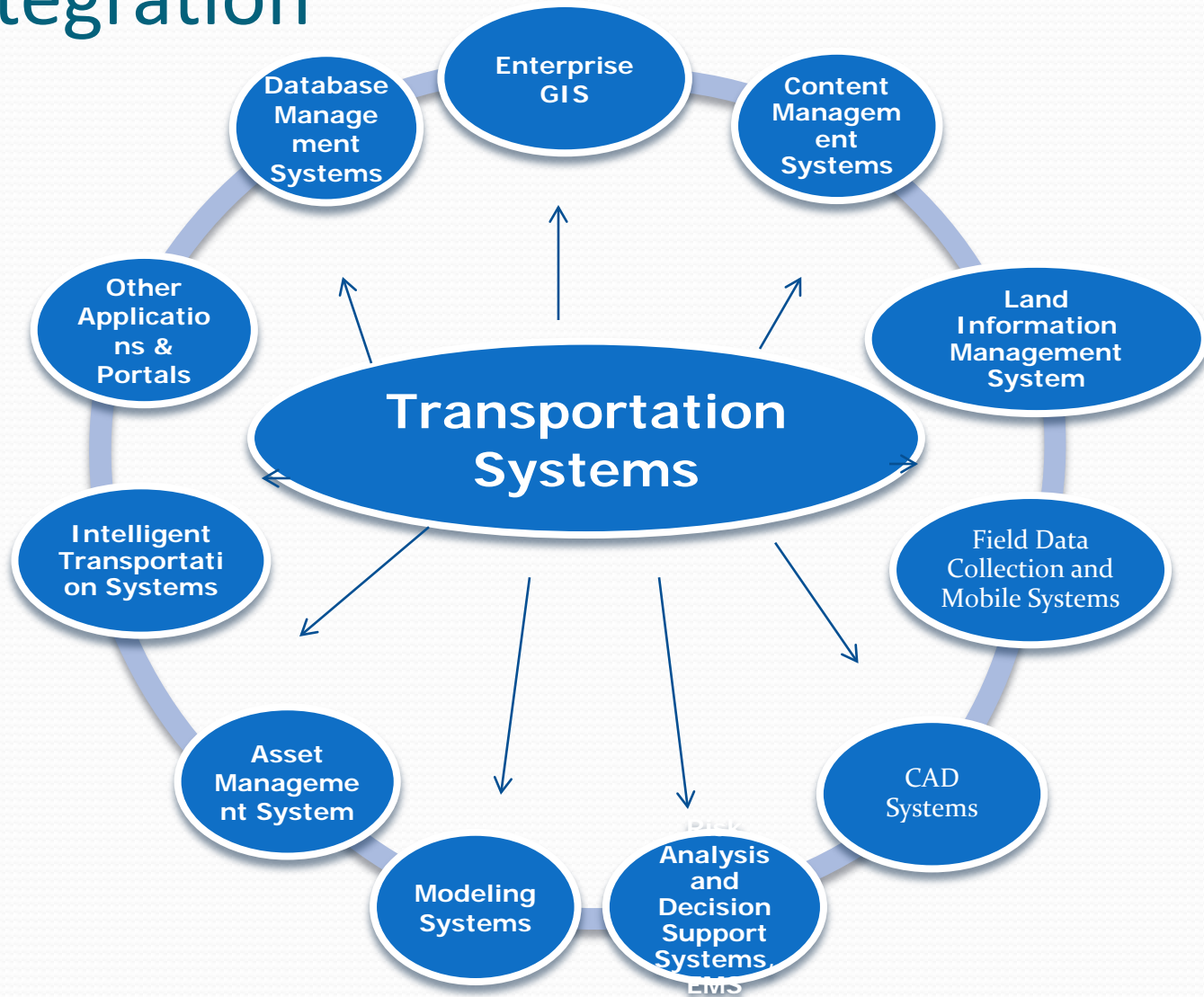
## Planning

- Metropolitan Transportation Plan (MTP)
- Comprehensive Transportation Plan (CTP)
- Transportation Improvement Plan (TIP)
- Collector Street Plan (CSP)
- Municipal bicycle and pedestrian plans (MBPP)

## Operations

- Traffic monitoring and control, congestion management process (CMP, traffic/safety and other traffic data and analysis)
- Intelligent transportation systems –ITS and regulatory activities (Environmental Justice -EJ, Highway Performance Management System-HPMS, Air Quality Conformity etc.)

# Transportation Information Technology Systems and Integration





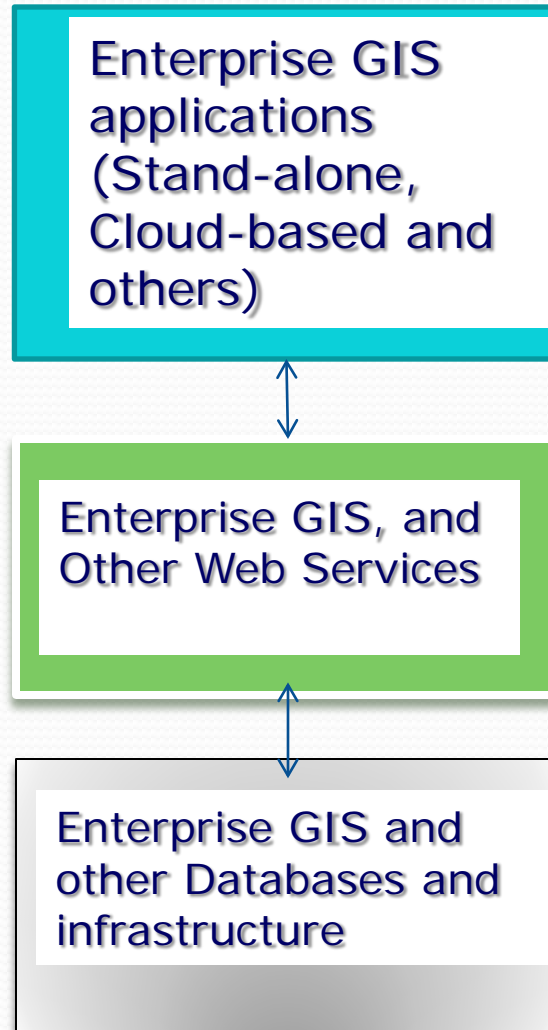
# MPO Implementations



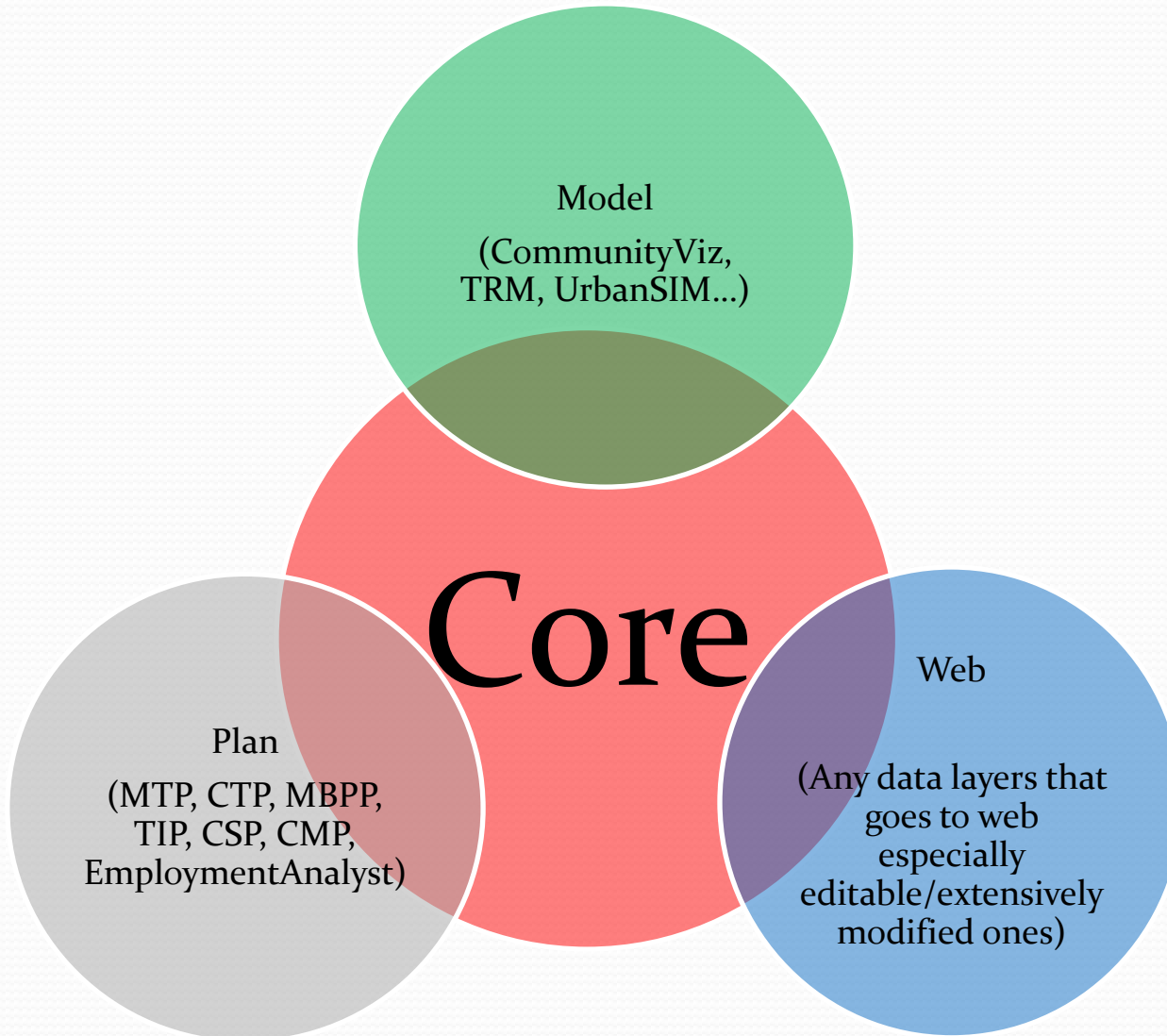


# Enterprise GIS

# Transportation Enterprise GIS Implementation Conceptual Schema



# Enterprise GIS Database Sample Schema



# MPO Enterprise GIS Sample Databases

- webuser@gdbCore.sde
  - gdbCore.MPOGIS.AddressPoint
  - gdbCore.MPOGIS.AdministrativeBoundaries
  - gdbCore.MPOGIS.Base
  - gdbCore.MPOGIS.Biodiversity
  - gdbCore.MPOGIS.BoardofElection
  - gdbCore.MPOGIS.BuildingFootprints
  - gdbCore.MPOGIS.CensusChatham
  - gdbCore.MPOGIS.CensusDurham
  - gdbCore.MPOGIS.CensusESRI
  - gdbCore.MPOGIS.CensusOrange
  - gdbCore.MPOGIS.CensusPerson
  - gdbCore.MPOGIS.ChurchCemetery
  - gdbCore.MPOGIS.EconomyTax
  - gdbCore.MPOGIS.EnvironmentalJustice
  - gdbCore.MPOGIS.Farmland
  - gdbCore.MPOGIS.FloodHydro
  - gdbCore.MPOGIS.Forest
  - gdbCore.MPOGIS.GamelandsHunting
  - gdbCore.MPOGIS.Infrastructure
  - gdbCore.MPOGIS.NAVTEQ
  - gdbCore.MPOGIS.Parcel
  - gdbCore.MPOGIS.ParkingArea
  - gdbCore.MPOGIS.Parkland
  - gdbCore.MPOGIS.ProtectedLands
  - gdbCore.MPOGIS.School
  - gdbCore.MPOGIS.Sidewalk
  - gdbCore.MPOGIS.Signal
  - gdbCore.MPOGIS.Transit
  - gdbCore.MPOGIS.Transportation
  - gdbCore.MPOGIS.WaterSewer
  - gdbCore.MPOGIS.Wetlands
  - gdbCore.MPOGIS.ZoningSubdivision
  - gdbCore.MPOGIS.Chatham\_AddressRangeFeatNameAD
  - gdbCore.MPOGIS.Chatham\_AddressRangeRelADDR2010
  - gdbCore.MPOGIS.Chatham\_FeatNameRelFEATNAMES2I
  - gdbCore.MPOGIS.Chatham\_OtherIdenRelOTHERID2010\_
  - gdbCore.MPOGIS.Chatham\_TopofFaceAreaHydroFACES
  - gdbCore.MPOGIS.Chatham\_TopofFaceAreaLandmarkFA

- webuser@gdbPlan.sde
  - gdbPlan.MPOGIS.CMPAverageDailyTraffic
  - gdbPlan.MPOGIS.CMPCrash\_TEAAS
  - gdbPlan.MPOGIS.CMPNonMotorizedCount
  - gdbPlan.MPOGIS.CMPTravelTime
  - gdbPlan.MPOGIS.CMPTurningMovementCount
  - gdbPlan.MPOGIS.CSPMPOraftAdoptedPlan
  - gdbPlan.MPOGIS.CSPMPOPreDraft
  - gdbPlan.MPOGIS.CSPSWDurham
  - gdbPlan.MPOGIS.CTPInventory
  - gdbPlan.MPOGIS.EmploymentAnalyst2013
  - gdbPlan.MPOGIS.MBPPBicycleLane
  - gdbPlan.MPOGIS.MBPPBikePedestrian
  - gdbPlan.MPOGIS.MBPPCrash
  - gdbPlan.MPOGIS.MBPPSidewalkTrail
  - gdbPlan.MPOGIS.MTP2040
  - gdbPlan.MPOGIS.MTP2040BikePed
  - gdbPlan.MPOGIS.MTP2040Isochrones
  - gdbPlan.MPOGIS.MTP2040Transit
  - gdbPlan.MPOGIS.STIP
  - gdbPlan.MPOGIS.TIPApproved2009to2015
  - gdbPlan.MPOGIS.TIPApproved2012to2018
  - gdbPlan.MPOGIS.TIPDraft2016to2022
  - gdbPlan.MPOGIS.CVEmploymentAnalys2013\_In
  - gdbPlan.MPOGIS.EmploymentAnalyst\_MPO\_Ci
  - gdbPlan.MPOGIS.EmploymentAnalyst\_MPO\_Cc
  - gdbPlan.MPOGIS.EmploymentAnalyst\_MPO\_du
  - gdbPlan.MPOGIS.EmploymentAnalyst\_MPO\_Lo
  - gdbPlan.MPOGIS.EmploymentAnalyst\_MPO\_ZIP

- webuser@gdbModel.sde
  - gdbModel.MPOGIS.CVEmergency
  - gdbModel.MPOGIS.CVHabitat
  - gdbModel.MPOGIS.CVHistoricResource
  - gdbModel.MPOGIS.CVHydrography
  - gdbModel.MPOGIS.CVLandUse
  - gdbModel.MPOGIS.CVSoilGeology
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  - gdbModel.MPOGIS.CWetlands
  - gdbModel.MPOGIS.TRMv5Highway
  - gdbModel.MPOGIS.TRMv5SE
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  - gdbModel.MPOGIS.TRMv6SE
- webuser@gdbWeb.sde
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  - gdbWeb.MPOGIS.EmploymentAnalyst2013
  - gdbWeb.MPOGIS.EnvironmentalJustice
  - gdbWeb.MPOGIS.FunctionalClassUpdate
  - gdbWeb.MPOGIS.HomepageMaps
  - gdbWeb.MPOGIS.LandUse
  - gdbWeb.MPOGIS.LandUseSubregions
  - gdbWeb.MPOGIS.LandUseTJCOG
  - gdbWeb.MPOGIS.testArchiving
  - gdbWeb.MPOGIS.testEditing
  - gdbWeb.MPOGIS.testEditing2Z
  - gdbWeb.MPOGIS.TRMv5
  - gdbWeb.MPOGIS.editZip

# Enterprise GIS – Dataset and Other Lists


- Comprehensive list of the datasets being collected with summary information about the original and migrated data

B Database Name	E Feature Dataset/Catalog	F Feature class/SDE raster name/Table name	G Brief Description of Feature class	H Conversion SOP and QA/QC used	I Conversion Data Model	J Conversion Data Dictionary	K Original Data Source Name	Orig Sou Inter (if th full v
Core	AddressPoint	Chatham_AddressPoints_20140206	Countywide address point				Chatham county	
Core	AddressPoint	Orange_AddressPoints2009_20120112	Countywide address point				Orange County/NC Center for Geographic Information and Analysis	
Core	AddressPoint	Orange_AddressPoints2009_20120112	Countywide address point				Orange County/NC Center for Geographic Information and Analysis	
Core	AddressPoint	NC_MasterAddressPoints2009_20120112	Countywide address point				Orange County/NC Center for Geographic Information and Analysis	
Core	AdministrativeBoundaries	CAMPO_Boundary_20121128	Capital Area Metropolitan Planning Organization (CAMPO) boundary				CAMPO	
Core	AdministrativeBoundaries	Chatham_CityLimit_20121217	County city limit					
Core	AdministrativeBoundaries	Chatham_FireDistricts_20100805	Fire district division					
Core	AdministrativeBoundaries	DCHC_CAMPO_CombinedCoundary	DCHC and CAMPO boundary				City of Durham	

# Enterprise GIS - Database Standards and Documentation

Database standards included the following:

- Implementation standards/documents
- Metadata Standard
- Coordinate System Standard
- GIS Data Standard (includes naming convention and others)
- QAQC standards (checklists)
- Data Migration standards (SOPs)
- Others

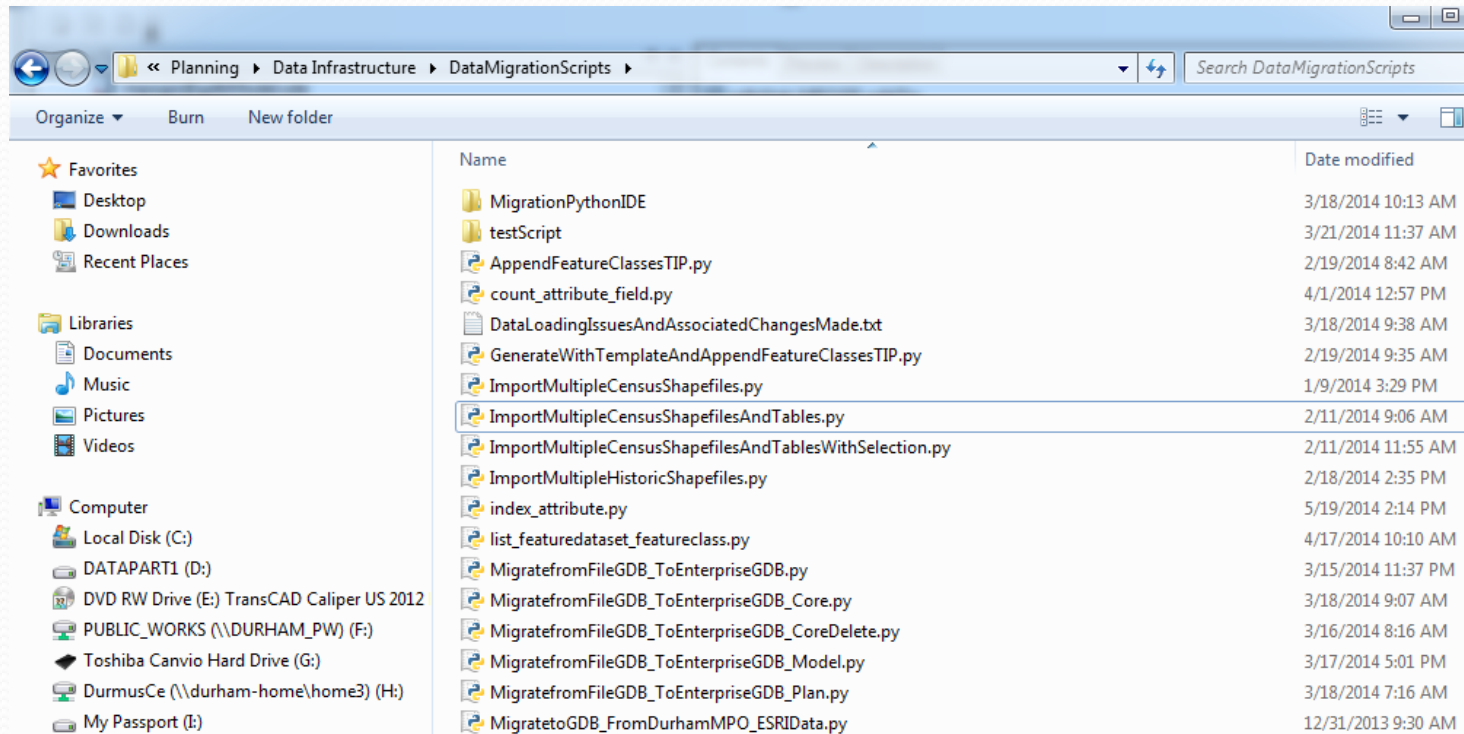
	DCHC MPO GIS Database Web	Date: 12/13/2003 Date Last Updated: 06/05/2014
		Standard of Procedure Number: 7
Objective: Documenting General QA/QC Process Inputs: All GIS Data (Shapefile(s), Geodatabases, DRGs, rasters and any other spatial data metadata information) Outputs: QA/QCed GIS Data Comment: This standard documents the minimum QA/QC checks required to be performed by DCHC MPO personnel to have high quality GIS Data.		

#### General QA/QC Checks

1. Data suppliers (data originators/producers, the person/entity we get the data from) select someone who is familiar with the quality of the source data to perform the QC check.
2. Reviewers check the layer for appropriate file format (shapefile, Geodatabase, and other formats for the final product it should be geodatabase only)

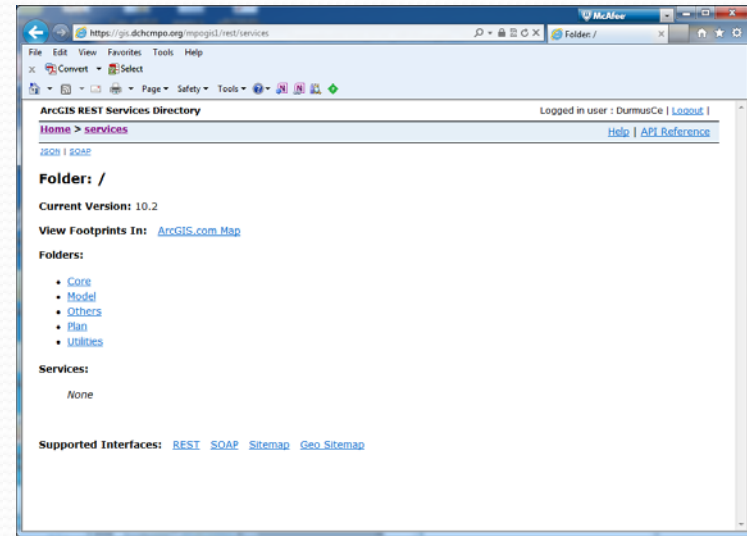
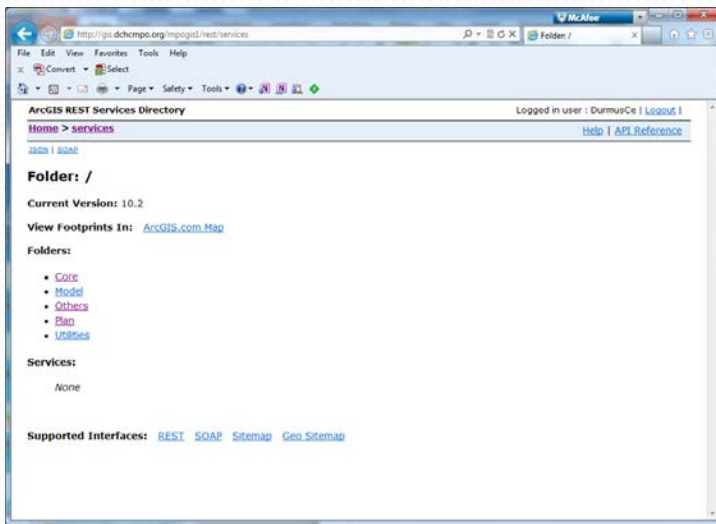
# Enterprise GIS Automation/Customization - Data Migration Tools

- These tools are generated using windows, python, and other scripting to automate data cleanup, migration, and system administration



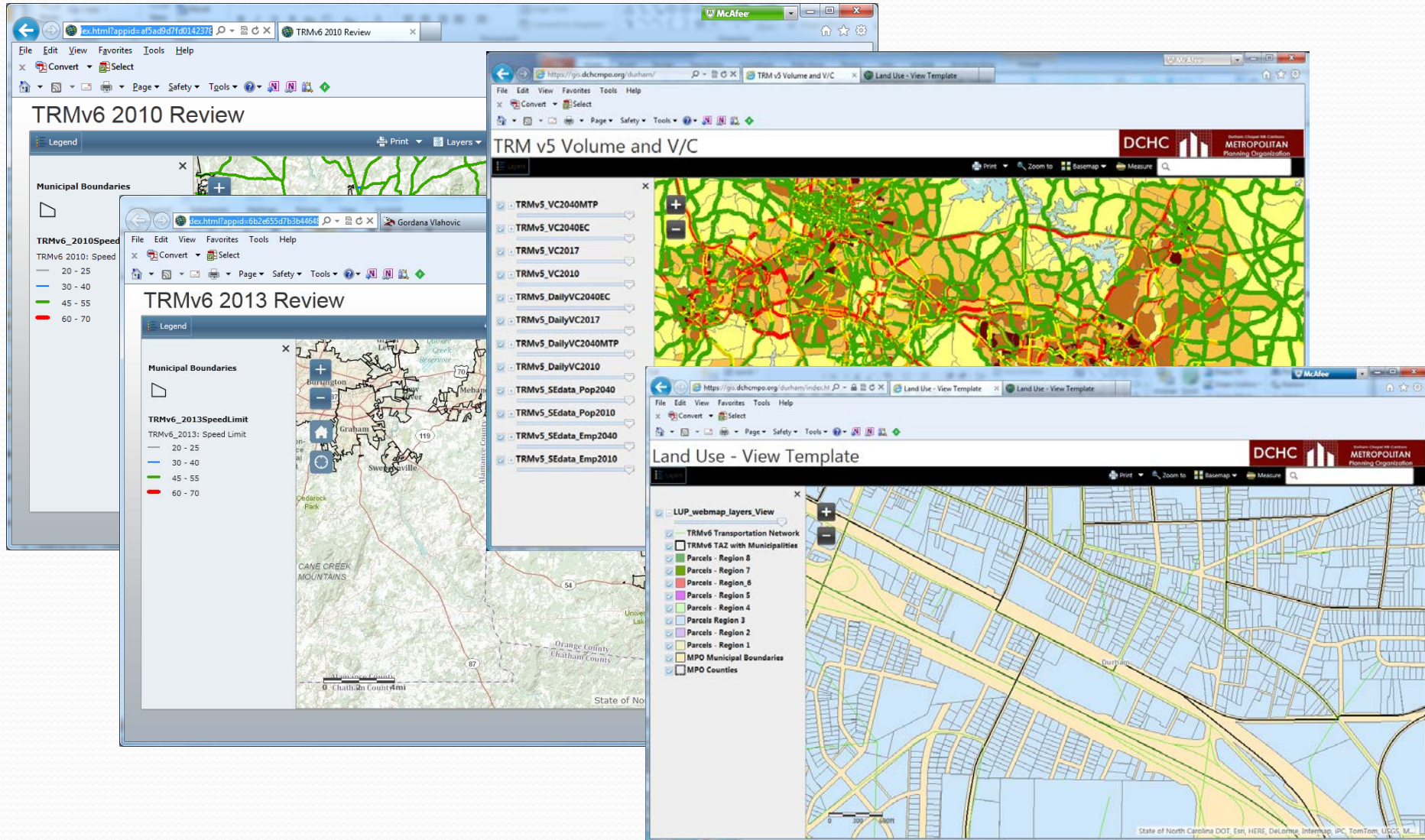
# Enterprise GIS Automation/Customization - Web Services


- GIS and Other web services with associated set up/configuration and security
  - <http://gis.dhcmpo.org/mpogis1/>





# Enterprise GIS Applications (Cloud and Stand-Alone Web Applications and Others)





Case Study : Commuter  
Information  
Analysis/Management using  
Census/ACS Data

# Parameters of Interest

- Commuter flows
- Travel time (mean travel time)
  - Based on total workers population (inclusive of both summaries workers working at home and workers not working at home)
- Travel Mode

Based on total workers population (inclusive of both summaries workers working at home and workers not working at home) and includes the following modes

  - Car drive alone
  - Car pool
  - Bike/Ped (Walking)
  - Public transport
  - Others (taxi etc.)

# Summary Geographies of Interest

- **County**
- **Metropolitan Statistical Area** (MSA, are geographic entities delineated by the Office of Management and Budget, for use by Federal statistical agencies in collecting, tabulating, and publishing Federal statistics. The term "Core Based Statistical Area" (CBSA) is a collective term for both metro and micro areas. A metro area contains a core urban area of 50,000 or more population, and a micro area contains an urban core of at least 10,000 (but less than 50,000) population)
- **Block Group** (Most detailed ACS data geography for commuter information is available)

# Datasets used for summaries (estimates)

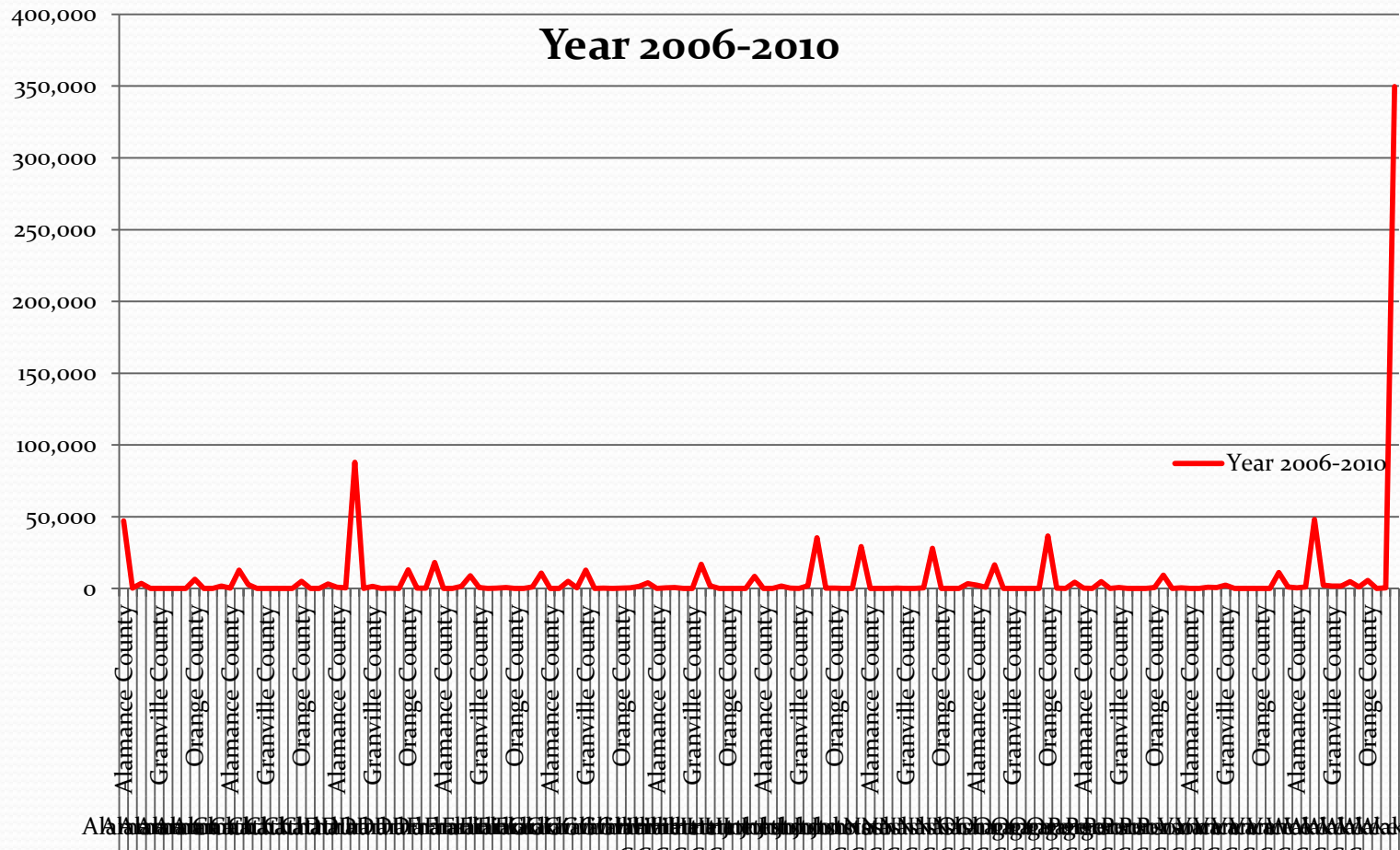
- ACS
  - ACS 5 year – all areas
  - ACS 3 year – areas > 20K population (discontinued after 2013)
  - ACS 1 year data – areas > 65K population
- Census data Summary files (SF1-4) for years earlier than 2009
- Commuter flows
  - Census commuter flow data tables (for commuter flows from County to County) available for select census ACS years and non-public census data at <http://www.census.gov/hhes/commuting/data/commutingflows.html> (from 1990 to 2013 for select years)
  - Census Transportation Planning Products (CTPP) <http://data5.ctpp.transportation.org/ctpp/Browse/browsetables.aspx> (available for 2006-2010 and 2006-2008)
  - From BTS (2000 and 1990)
    - <http://www.transtats.bts.gov/Search.asp>



# Analysis Outcomes

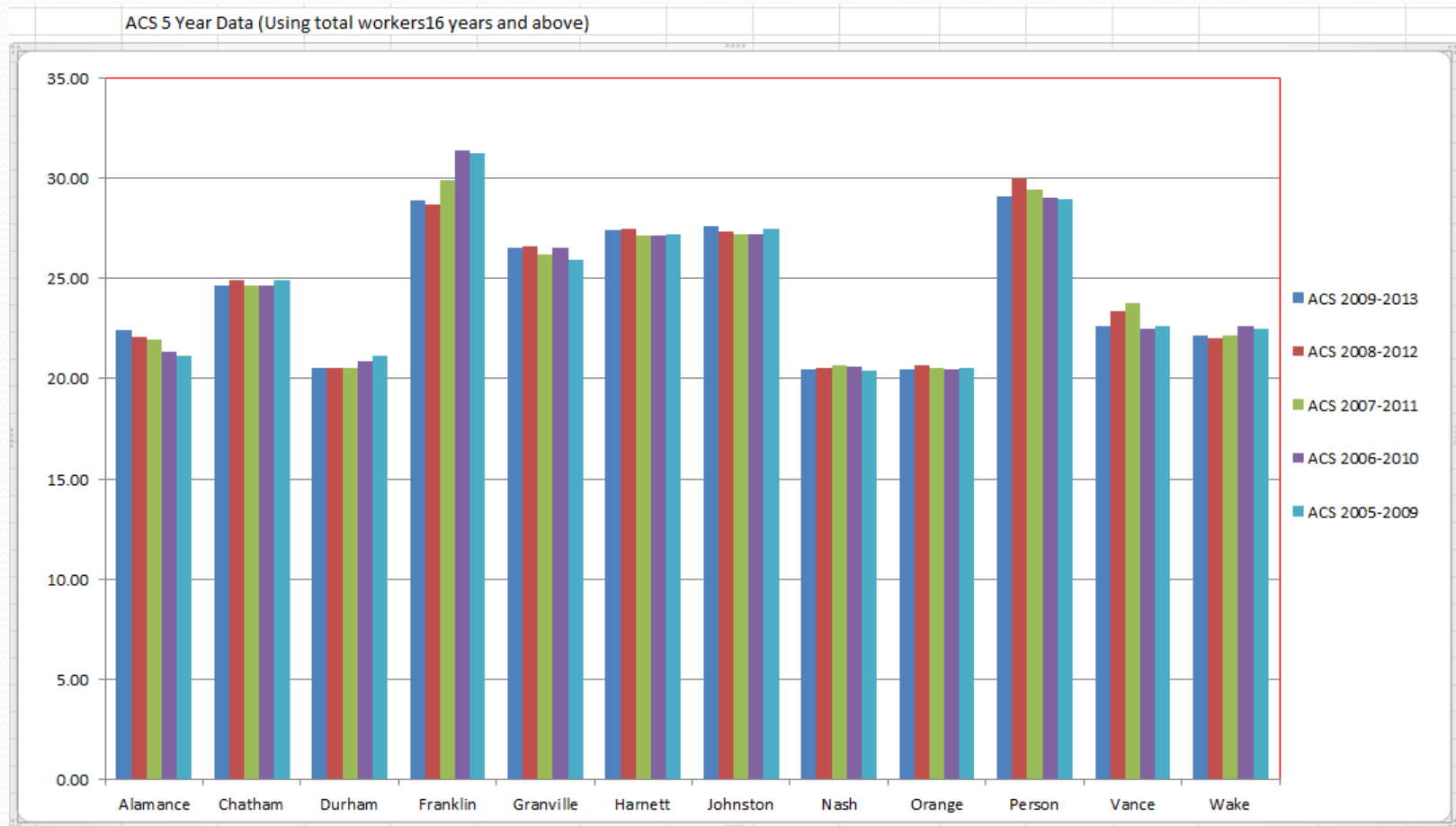


# Commuter Flow for ACS 5 Year 2006-2010 Data



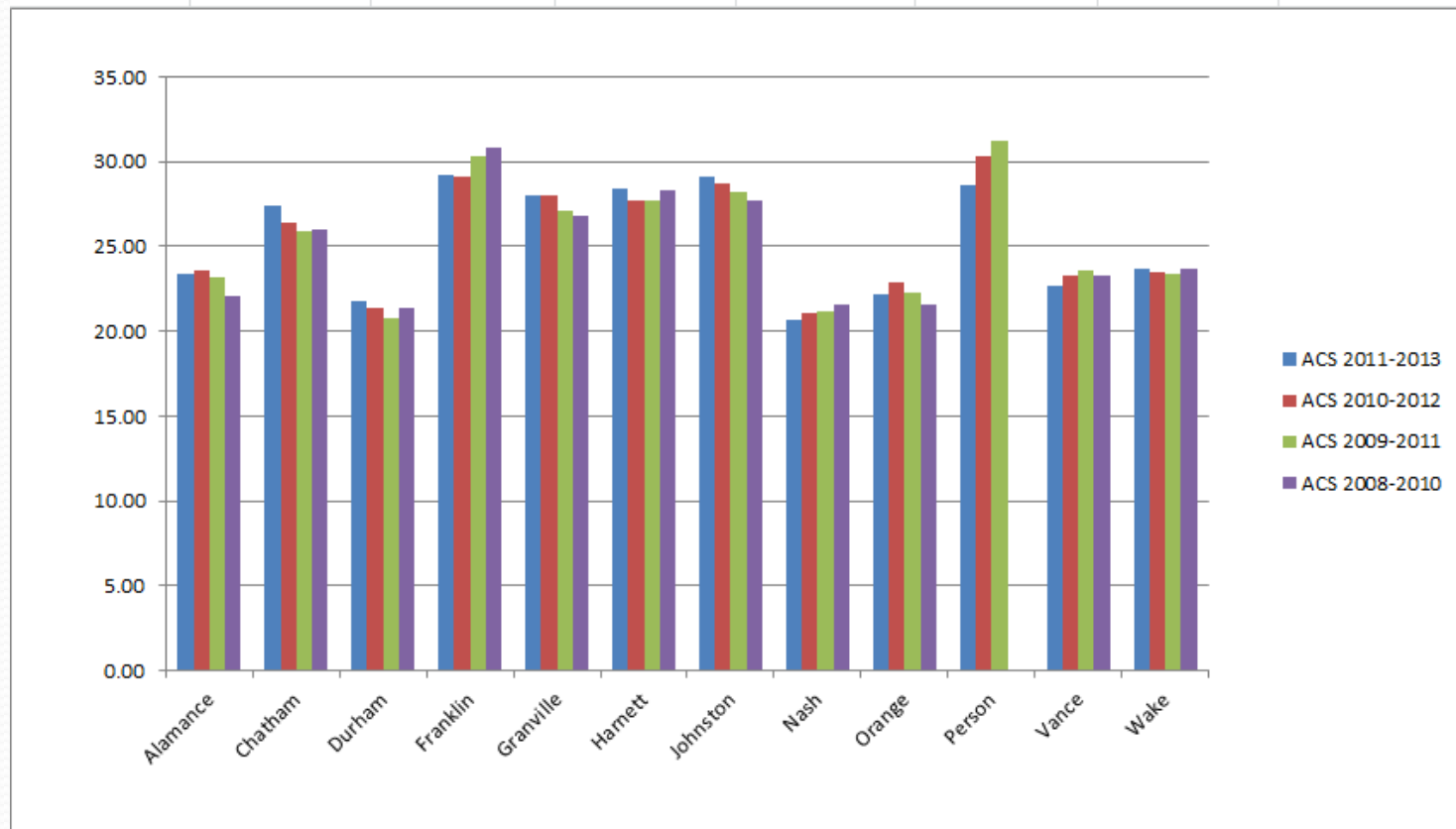


# Mean Travel Time (ACS 5 Years)

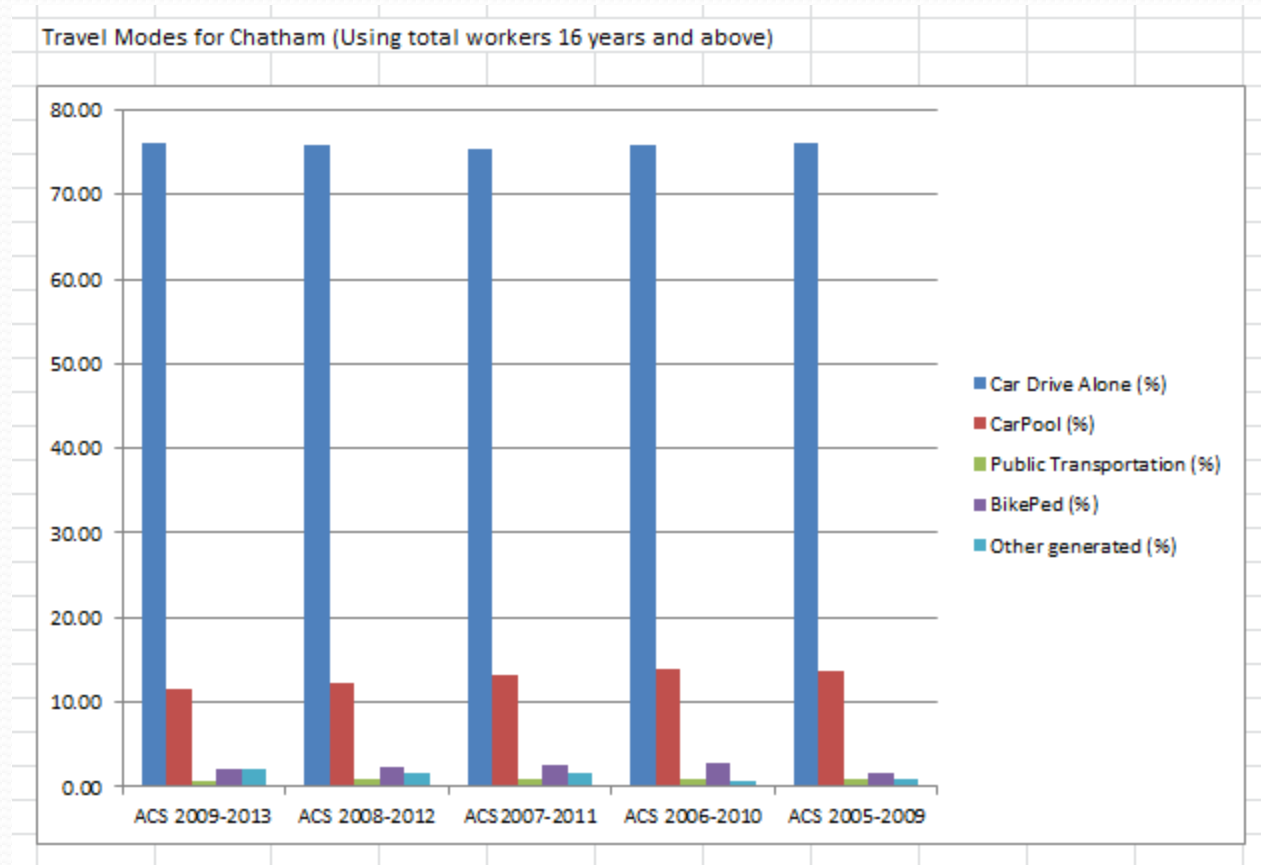


# Mean Travel Time (ACS 3 Years)

ACS 3 Year Data (Using total workers 16 years and above who did not work at home)

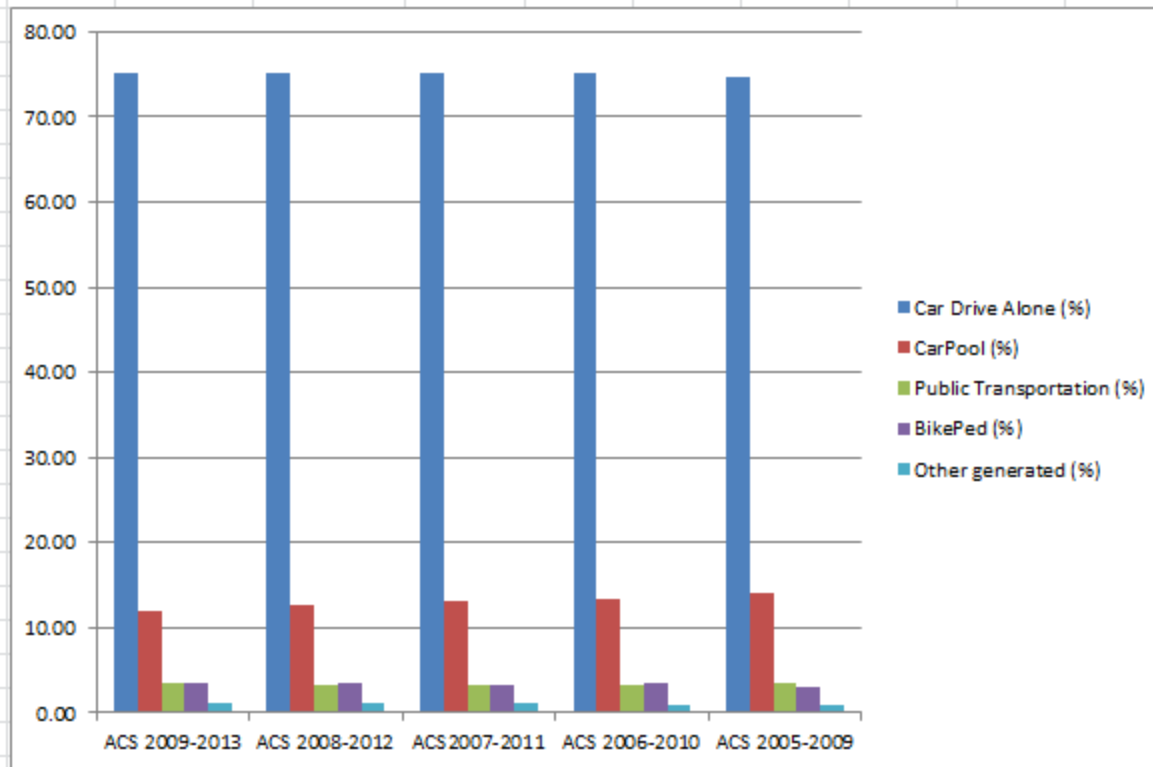


# Travel Mode using ACS 5 Year – Chatham County



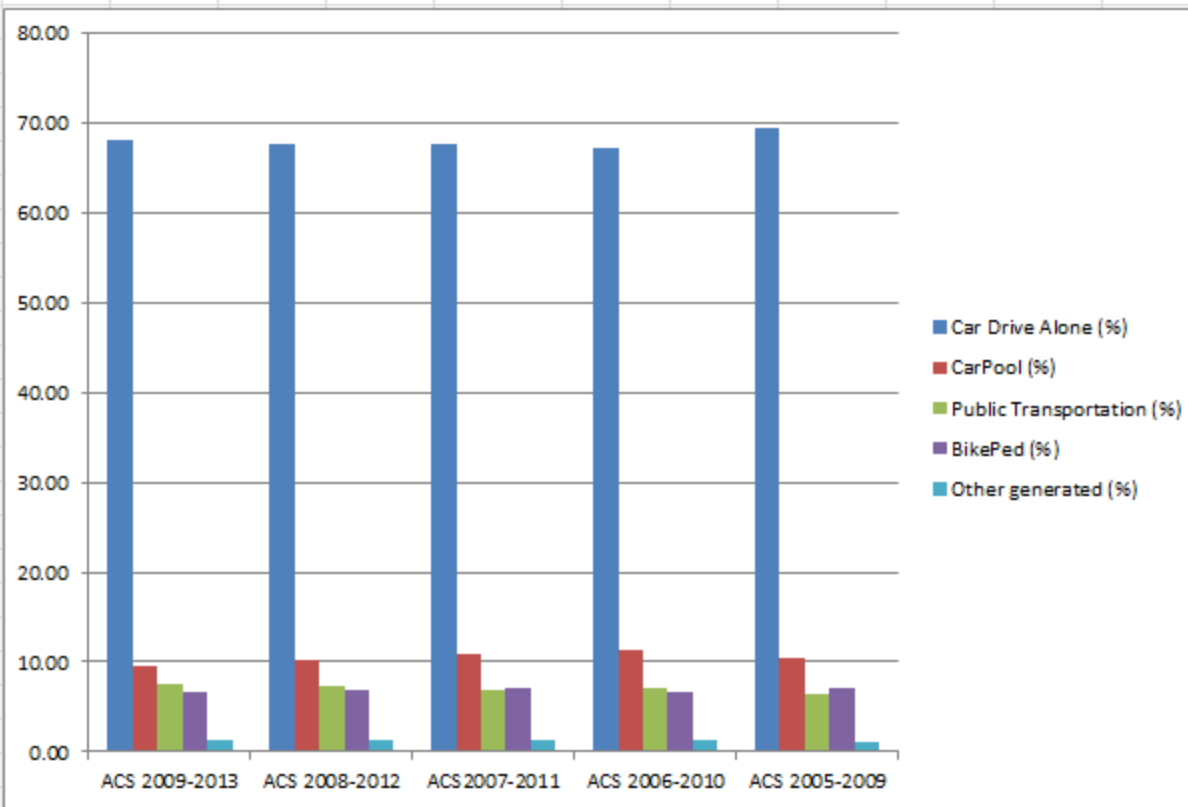
# Travel Mode using ACS 5 Year – Durham County

Travel Modes for Durham (Using total workers 16 years and above)

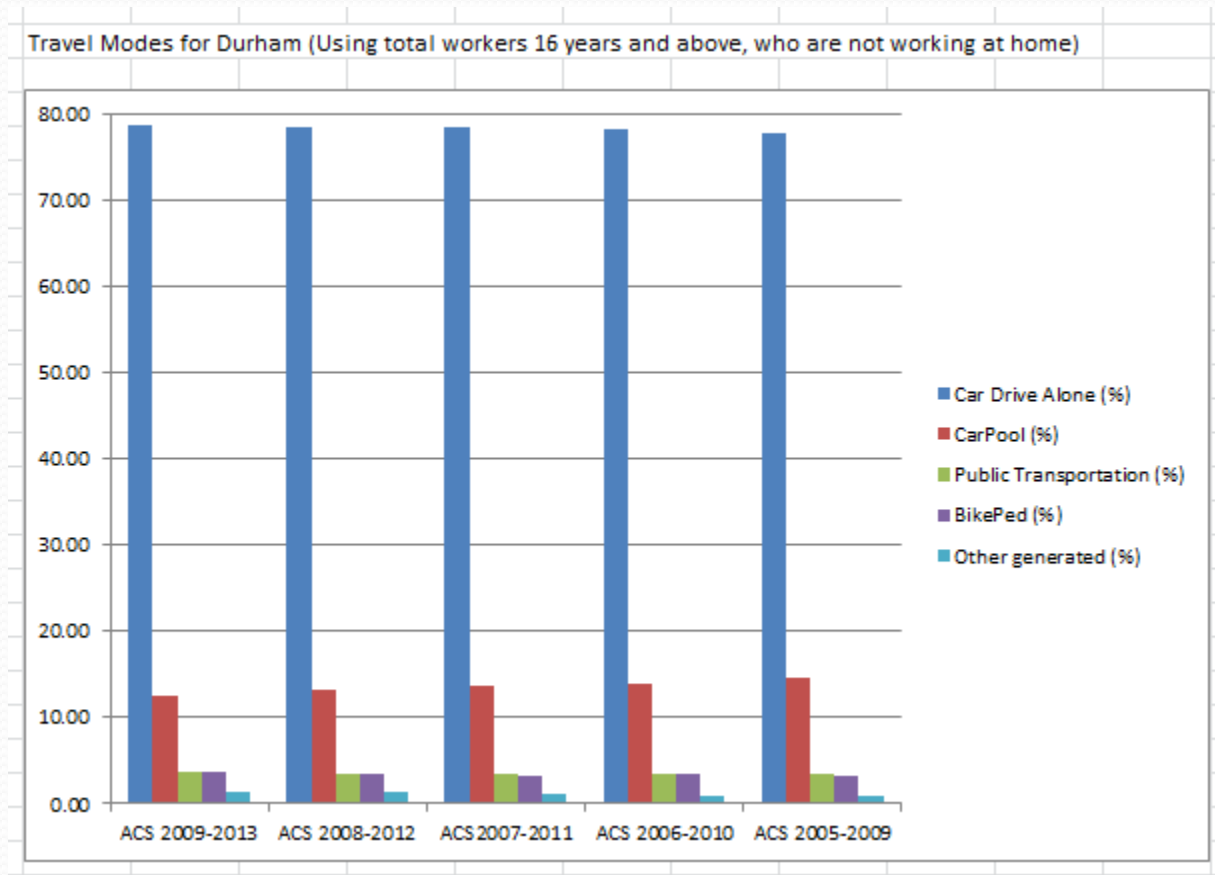


# Travel Mode using ACS 5 Year – Orange County

Travel Modes for Orange County (Using total workers 16 years and above)



# Travel Mode using ACS 5 Year- Durham County



# Analysis Process Automation

- Excel Functions and Scripting

# Progress and Future Work

- Continue processing earlier years ACS/Census data for commuter flow, travel time, and travel mode information using various source data
- Automate analytical processing further, and generate custom, comprehensive and easy to use, reusable tools/applications





# Case Study: Traffic Data and Data Management

# Major Traffic Data Collected/Compiled

- ADT (classified, bi-directional, 15-min, speed)
- TT (trajectory data, cruise speed data)
- TMC (including bike and pedestrian, heavy vehicles)
- Non-motorized counts (bike and ped)
- Safety data (Traffic Engineering Accident Analysis System- TEAAS from NCDOT and others)
- Transit (Automated passenger count -APC)
- Special collections for some study/plans/projects as needed such as UNC-CH, TIAs

# Traffic Data Spatial Resolutions

- Locations
  - Points
    - Station
    - GPS latitude/longitude location
  - Lines (Segment)
    - Directional measurements
    - Non-directional measurements
  - Lines (Routes)
    - Directional flow measurements
    - Non-directional measurements

# Traffic Data Temporal Resolution

- Time
  - Range/Interval (AM, PM, Noon, Off peak intervals)
  - Point in time
  - Average

# Data Details

- Data attributes

# Statistical Summaries/Indices

- TTI
- LOS
- AADT
- Confidence, C-value
- Mean (daily, hourly, mean measurement, 85<sup>th</sup> percentile day, 85<sup>th</sup> percentile hour)
- P.H.V., P.H.F, H.V., peak hour etc.
- Difference ratio
- Others

# Data Issues

- Unique, consistent, reusable IDs for years
- Missing data/gaps
- Missing attributes (details)
- Differing data formats and data standardization
- Differing data accuracies
- Errors/mistakes
- Data reconciliation/augmentation issues for data collected by different agencies/contractors/people etc.

# Data to Serve

- Partners
  - Data needed (what to serve)
  - Details of the data to be served (Spatial/temporal resolution and detail)
  - How to Serve (Portals and various applications)
- Public
  - Data needed (what to serve)
  - Details of the data to be served (Spatial/temporal resolution and detail)
  - How to serve (Portals and various applications)
- Technical Experts/Engineers
  - Data needed (what to serve)
  - Details of the data to be served (Spatial/temporal resolution and other details)
  - How to serve
    - MS2
    - Manual (send USB/Harddrive/DVD each time)
    - Others (such as zip and make it available with some readme file through ftp site)



# Data Review/Revisions for Portal

- Unique IDs
  - Matching our IDs (may or may not be unique) with MS2 IDs in case we are not going to adopt MS2 IDs
- Data details/resolutions
- Data structure/formats (templates)
- Further customization
- Others

# Addressing Data Issues/QA/QC/Summaries

- Scripting
- Development of tools
- Development of applications

# MS2 Platform (Demo)

- Traffic Count (TCDS)
- Travel Time (TTDS)

The screenshot shows the MS2 Transportation Data Management System interface. The top navigation bar includes 'Home', 'LRSMS', 'TTDS', 'PMS', 'PMDS', 'RSMS', 'NMDS', 'PMMS', 'WOLLS', and 'RTLV'. The main content area displays a record for Location ID 670071, which is a SPOT type located on SR 1009. The record details include MPO ID, HPMS ID, On NHS, LRS ID, LRS Loc PL, SF Group, AF Group, CF Group, Route Type, Class Dist Gp, WIM Group, QC Group, and Fract Class.

The screenshot displays the 'STATION DATA' section with a table for AADT (Average Annual Daily Traffic) and a 'VOLUME COUNT' table. The AADT table shows data for the years 2013, 2011, 2009, 2007, and 2006. The volume count table shows data for the years 2013, 2011, 2009, and 2007.

Year	AAOT	DHV-30	K %	D %	PA	DC	SP
2013	6,700						
2011	5,500						
2009	5,500						
2007	5,500						
2006	5,500						

The screenshot displays the 'Network Traffic Analysis' section, which includes a map of the network and a 'Monthly Trends - Travel Time Index' chart. The map shows a network of roads with color-coded segments representing different travel time indices. The chart shows the travel time index for all months from January to December, with a peak in the summer months and a low in the winter months.

**Monthly Trends - Travel Time Index**  
All Months, Mon-Fri, 4PM-6PM

Month	Travel Time Index
Jan	1.35
Feb	1.35
Mar	1.35
Apr	1.35
May	1.35
Jun	1.35
Jul	1.35
Aug	1.35
Sep	1.35
Oct	1.35
Nov	1.35
Dec	1.35

# GIS-T at MPO Future

- Better understanding of the needs/requirements
- Better Integrated/Responsive/Real Time Applications
- Better Platforms/Portals
- Standard/Policy Updates and Implementation
- Support and Training
- Streamlining business processes/workflows
- Automation/Customization
- Expansion/Enhancement
- Integration

Thank you !!!

Any questions ???

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