

NOACA

Technical Memorandum

**INTEGRATION[®] SOFTWARE
FOR THE CLEVELAND INNERBELT
STUDY**



The Northeast Ohio Areawide Coordinating Agency (NOACA) is a public Organization serving the counties of and municipalities & townships within Cuyahoga, Geauga, Lake, Lorain and Medina (covering an area with 2.1 million people). NOACA is the agency designated or recognized to perform the following functions:

- **Serve as the Metropolitan Planning Organization (MPO), with responsibility for comprehensive cooperative and continuous planning for highways, public transit, and bikeways, as defined in the Transportation Equity Act for the 21st Century.**
- **Perform continuous water quality, transportation-related air quality and other environmental planning functions.**
- **Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.**
- **Conduct transportation and environmental planning and related demographic, economic and land use research.**
- **Serve as an information center for transportation and environmental and related planning.**
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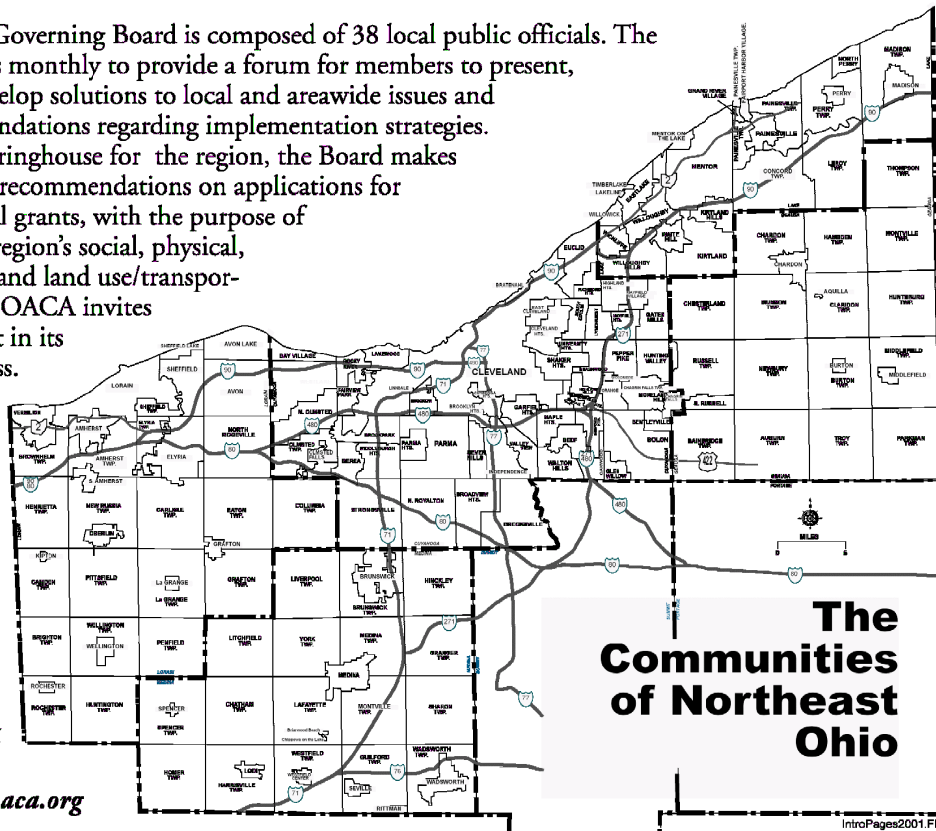
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FOR THE CLEVELAND INNERBELT STUDY

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Abstract

The following INTEGRATION Technical Memorandum briefly describes INTEGRATION's use in the Cleveland Innerbelt Study and its advantages over other modeling software, as well as NOACA's role in developing the model.

NOACA has two roles in the Cleveland Innerbelt Study. NOACA staff completed the first stage of the INTEGRATION model development by extracting a draft network from the TRANPLAN regional planning model, reviewing and inputting street geometry, signal and traffic count data, and editing the network extensively to comply with the requirements of INTEGRATION as an operational model. In addition, NOACA will continue to provide local expertise and guidance to the consultants throughout the study.

Introduction

This memorandum informs interested parties as to NOACA's role in the Cleveland Innerbelt Study with respect to the development of the traffic simulation model. The specific work is detailed at the end of this memorandum in an excerpt of the proposal from Burgess & Niple, Limited to ODOT. Briefly stated, NOACA developed the INTEGRATION model that Burgess & Niple will use to test alternative strategies for improving traffic along the Innerbelt.

ODOT's Cleveland Innerbelt Study website (www.innerbelt.org) states: *the purpose of the study is to develop a strategy for the intelligent renewal of the transportation infrastructure within the Innerbelt Corridor. The majority of this infrastructure was constructed over a ten-year period that began in the late 1950's. This corridor has endured nearly forty years of traffic and an equal number of Northeast Ohio winters. As a result, the bridge decks and pavements are approaching the end of their useful lives and will require major rehabilitation or replacement before the end of this decade.*

INTEGRATION is a traffic simulation model that gives modelers a graphical picture of traffic flowing through an area. INTEGRATION has been used internationally to test alternatives in Major Investment Studies (MIS) and for Intelligent Transportation Systems (ITS) strategies. Other traffic simulation (operational model) software exists, but INTEGRATION is the only software available that incorporates traffic assignment, traffic counts and ITS.

Once this model is calibrated and validated (i.e., fine-tuned) by Burgess & Niple, it can be used for other studies in the downtown area. INTEGRATION can also be used to create new models in areas outside the boundary of the Cleveland Innerbelt Study.

What is INTEGRATION?

INTEGRATION is a traffic simulation model designed specifically for the analysis of integrated arterials and freeways. It models the interactions of individual vehicles on the roadway system, traffic signals, and ITS technologies, as well as driver rerouting in congested conditions. The ability to capture the dynamic interaction between multiple traffic control and management strategies reveals one way in which INTEGRATION is unique to other traffic simulation programs.

How is this different from NOACA's planning model?

Regional Travel Demand Models (also known as 'planning' models) such as TRANPLAN or TP+ estimate the number of cars that travel on each portion of the network (road system) using assignment techniques of origin-destination (OD) tables. The outputs represent a static traffic flow. Traffic *simulation* software (also known as 'operational' models) attempt to simulate the movement of individual cars through the network, and allows users to view these movements on-screen. Inputs include predetermined traffic flow, usually from traffic counts. INTEGRATION combines the OD table assignment and the operational vehicle movements. It also provides a

variety of numerical output such as speed, delay, stops, queuing, fuel consumption, and emissions.

How large of an area can we cover with an INTEGRATION network?

The maximum possible network size is not based on square mileage, but on the number of links in the network. Links are pieces of roadway divided by intersections, lane number changes, turn lanes, load links, or other breaks needed to depict road curvature. Links are one-way, meaning that for two-way streets, two links exist, one for each direction of traffic.

INTEGRATION comes in five “sizes”: Small, Medium, Large, Extra Large and Huge. NOACA purchased the huge version, which includes the smaller sizes. When running an INTEGRATION simulation, it is best to use the smallest size possible to allow the fastest run. All requirements for a given size must be met for INTEGRATION to work. According to the INTEGRATION User’s Manual, these are the limits for each size:

	S	M	L	XL*	Huge
Highest link number	250	1,250	3,500	5,000	10,000
Highest node number	250	1,250	3,500	5,000	10,000
Max network size (lane-km)	250	1,250	3,500	5,000	10,000
Max number of lanes	1,750	8,750	24,500	50,000	50,000
Max total vehicles	25,000	125,000	350,000	400,000	500,000
Max concurr. vehicles on network	5,000	25,500	70,000	100,000	150,000
Highest macro zone cluster number	10	25	100	≈125	150
Highest zone number	25	125	350	400	500
Max number of OD demand loading	250	1,250	35,000	≈70,000	100,000
Highest signal/ramp meter number	25	125	350	500	1,000
Max concurr. routing trees/veh class	5	5	5	5	5
Max number of incidents/blockages	5	12	35	50	100
Highest detector station number	250	1,250	3,500	5,000	10,000

** The numbers for XL were not provided in the user’s manual. They were either obtained through the output files or estimated.*

Why was INTEGRATION chosen over other operational models?

INTEGRATION was chosen for the Cleveland Innerbelt Study because it is the only modeling software available that can combine traffic assignment, traffic counts and ITS strategies. A second reason is the size of the study area. The Cleveland Innerbelt Study area included in the model is bound by Fulton Ave to the west, East 55th to the east, I-490 to the south to Lake Erie to the north. This area has more than 2,500 links and about 65,000 vehicles in the one-hour simulation during the morning peak hour (7:00-8:00 A.M.). A network of this size cannot be modeled with other operational models.

How will INTEGRATION be used for the Innerbelt Study?

INTEGRATION will first be used to simulate current traffic conditions. The consultants will then test future year 2025 traffic conditions with no changes in the network. Finally, the consultants will analyze the selected alternatives by testing lane additions and removals, new roads and freeways, new road alignments, traffic signalization changes, ITS measures, or any other changes stated in the alternatives. NOACA will receive a final copy of the model.

Who else has used INTEGRATION?

INTEGRATION has been used for various studies in the United States, Canada and Europe. Some examples are:

- Ontario, Canada: Highway 401 Study. The Ministry of Transportation of Ontario hired consultants to determine rehabilitation needs and develop strategies for relieving congestion.
- Washington, D.C.: Partners in Motion tested the effectiveness of existing ITS strategies.
- Detroit, MI: Detroit Corridor Evaluation Plan. MDOT tested the effectiveness of existing ITS strategies, and evaluated proposed strategies for congestion relief.

The Cleveland Innerbelt Study will use INTEGRATION in innovative ways. The Cleveland Innerbelt Study is one of the most complex areas ever modeled using INTEGRATION. The Innerbelt Study Area has many complicated street intersections and freeway interchanges that introduced new challenges to the developers of INTEGRATION. Additionally, the development of a future-year scenario is a new use of INTEGRATION that led to the creation of the “handshake method” between INTEGRATION and TRANPLAN.

How long will it take to create the Innerbelt Study network?

The time needed to build an INTEGRATION model depends on the number of roads to be included, as well as the complexity of the intersections and freeways. The Innerbelt Study INTEGRATION network will take more than one full year to create. This process includes calibration and validation of the model, which is being undertaken by the consultants at this time.

How long will it take to create alternative networks?

Depending on the complexity of the alternative, it can take anywhere from as little as several hours or as long as several weeks to modify the network to model an alternative. Testing alternatives using the INTEGRATION network is not a push-button effort. One cannot stop a simulation midstream, make a change, and continue the simulation. Currently, INTEGRATION’s input files are all text files and cannot be edited graphically as with other modeling programs.

Where do we get the data?

INTEGRATION data is obtained from multiple data sources. NOACA staff created the draft network from a cutout of the TRANPLAN model. Staff then extensively modified the network to improve intersections, freeway ramp connections, and turn lanes because INTEGRATION requires a more accurate portrayal of intersection and freeway connections than does TRANPLAN. NOACA staff input all signal, count and geometry data, as well as all other inputs for the draft network. The consultants provided signal and geometry data; NOACA staff reviewed and edited this data to create an up-to-date set. Some traffic counts were borrowed from the Flats Oxbow Association, but most were obtained through ODOT and the consultants. For estimated data, such as saturation flow rate and speed at capacity, values were assigned by functional class in accordance with Highway Capacity Manual Standards. Exceptions were allowed for unique areas such as the Innerbelt Curve and the Jennings merge.

How was the INTEGRATION model developed for the Innerbelt Study?

NOACA staff created the draft INTEGRATION network using these steps:

- Determined the traffic zones from the TRANPLAN regional planning model to be included in the INTEGRATION model. The zones within the study area were selected, and external zones were created to allow vehicles in and out of the study area network. Some internal zones were split to work better with the regional parking allocation model.
- Extracted the initial network from the TRANPLAN model.
- Edited the initial network to remove extraneous roads and nodes.
- Reviewed signal and road geometry data. Review of second and third version data sets, additional data collection by NOACA staff, and related correspondence with the consultants added weeks of unanticipated work.
- Edited the network to include turn lanes.
- Created the lane-striping file.
- Created AM and PM signal data files.
- Reviewed network to find coding errors.
- Reviewed AM and PM count data for streets.
- Reviewed Existing and Future (E&F) Conditions Report- with special focus on traffic flows provided in the report.
- Reviewed and edited files to change values that deviated from INTEGRATION defaults. This included gap acceptance, saturation flow and travel speed.
- Reviewed AM and PM count data for freeways and ramps.
- Reviewed CORSIM input data files.
- Developed QueensOD input files. QueensOD uses some INTEGRATION files, but had a few files specific to QueensOD, namely files that used count data.

- Did extensive editing to improve network flow. Network editing was a recurring task that was revisited as INTEGRATION and/or QueensOD files were changed.

What were some unexpected difficulties encountered during the development of the Cleveland Innerbelt INTEGRATION model?

Tasks beyond the original scope of work and technical difficulties caused NOACA staff to spend much more time developing the model than anticipated. Staff had to learn two new programs, both INTEGRATION and QueensOD, which creates the synthetic OD table. Because of the software developer's small size, technical questions often caused work delays. Several times during model development, work was postponed for days at a time while software and hardware bugs were worked out.

NOACA staff spent a considerable amount of time working with Burgess & Niple to review and correct data such as intersections' signal timing and geometry, and freeway mainline and ramp count information. In addition, staff conducted fieldwork to check signal timings at selected intersections. This fieldwork and data review was beyond NOACA's scope of work as described in the contract.

Conclusion

INTEGRATION is a powerful modeling software selected for the Cleveland Innerbelt Study because of its ability to handle a large network while also integrating traffic assignment, traffic counts and ITS strategies for both arterials and freeways. INTEGRATION can also be used in future traffic studies. If the study were in the downtown Cleveland area, it could use the existing INTEGRATION model. If the study were outside of the Innerbelt Study Area, a new network would have to be developed.

NOACA'S role in developing the INTEGRATION model for the Cleveland Innerbelt Study proved invaluable due to the complexity of the area and the challenges it presented. NOACA staff spent a great deal of time completing unanticipated work outside of the original scope to make sure the model is as accurate as possible. NOACA staff's knowledge of the area was especially helpful to the Cleveland Innerbelt Study.

Excerpt from Burgess & Niple, Limited's Price Proposal for the Central Viaduct/Innerbelt Corridor Major Investment Study (2000), describing NOACA's role. NOACA's name and participation requirements are in bold for emphasis.

Task 2.3 - Existing Conditions Analysis

Utilizing the data collected in Tasks 2.1 and 2.2, appropriate analyses activities will be undertaken to determine existing conditions in the study area. These analyses will focus on two main areas:

- Travel Demand and Operational Model Analysis

Split Central Business District Zones

The downtown Traffic Analysis Zones (TAZs) will be subdivided in conjunction with the parking allocation model. Once a plan for subdividing the TAZs is agreed upon by the consultant team, the travel demand model will be modified accordingly. The socioeconomic data will have to be portioned to the subdivided zones using data collected for the parking allocation model and other sources. We will update the highway and transit networks (if appropriate) accordingly. Most importantly, the model job stream will have to be modified to facilitate the expanded zone system. A thorough check of all programs, Tranplan control files, and third-party programs must be conducted. Modifications will be made where necessary. **This task will be performed by NOACA** with Burgess & Niple, Limited oversight.

Parking Allocation Model

The parking allocation model will reallocate trips in downtown Cleveland based on parking supply and demand. In Central Business Districts (CBDs), people typically do not park in the zone where they work. Furthermore, in CBDs with limited parking, people typically find a parking area that is nearby and within their price range. The current "floating zone" system in the travel demand model is used only to estimate downtown parking costs for mode choice. The parking allocation model will be executed just prior to highway assignment so that vehicles will be assigned to the appropriate parking facility. Utilizing the information collected in Tasks 2.1 and 2.2, the parking allocation model will be developed and subsequently calibrated. When the base year results are calibrated, the model will be incorporated into the Tranplan model job stream.

Build, Calibrate, and Validate INTEGRATION Model

Utilizing the mapping and data collected as part of Tasks 2.1 and 2.2, the INTEGRATION operational model will be coded. The vehicle trip tables from the travel demand model will feed into the INTEGRATION model by means of a computer program. The INTEGRATION model will then be calibrated and validated using the traffic counts and travel time data collected. The calibration process consists of adjusting the INTEGRATION model so that when executed this model with the Tranplan vehicle trip table data will output data similar to a portion of the

observed current day count data. Once calibrated, the model will be validated using the remaining portion of the current day count data.

NOACA' staff with Burgess & Niple, Limited oversight will perform the task of building the INTEGRATION model. Burgess & Niple, Limited will calibrate and validate the model. One copy of INTEGRATION will be bought for this project. It will be used by Burgess & Niple, Limited and turned over to ODOT at the completion of the project.

Hesham Rakha and URS/Greiner are available for Quality Assurance/Quality Check (QA/QC) throughout this process. Hesham Rakha is a founding team member of INTEGRATION and will be a key technical expert. He will help create the work plan for the INTEGRATION model development and be a key resource during its development and use.