## Functional Summary

> Flexible modeling environment adaptable to user available data and quality constraints

> Explicit modeling of commodities

> Hierarchical representation of the freight system: long-haul, short-haul and urban freight

> Ability to use coarse level data while estimating fine level truck matrices for assignment

> Unlimited number of commodity groups

> Estimation of commodities produced and consumed

> Segmentation into import/export and internal freight

> Estimates truck, rail, inland waterway and intermodal freight flows

> Explicit representation of logistic nodes

> Segmentation into direct and indirect freight flows

> Estimation of logistic chains for indirect flows

> Estimation of truck flows by truck type

> Estimation of trucks running empty and with load

> Estimation of urban service and local delivery flows

> Ability to test infrastructure and policy changes

> Easy to use model interface using Cube Base

> Direct link for easy mapping presentation graphics with Cube Base

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## Citilabs user services

Citilabs provides comprehensive training, technical support and consulting to optimize the application of Citilabs software products. Training courses are offered several times per year in several locations around the world. On-site courses are also available.

Our products come with free product maintenance for a limited period of time. Clients under maintenance receive program modifications, enhancements and updates as well as technical support via phone, fax or e-mail. Maintenance contracts may be purchased for additional years.

## Hardware & software requirements

In order to use Cube Cargo, the user must own Cube Base and one of the following: Cube Voyager, TP+ , TRIPS or TRANPLAN.

Cube will perform well on all computers using Windows 95, 98, ME, 2000, XP and NT. It is recommended to use at least a Pentium 3 class machine with 256MB of RAM, at least 1 GB of hard drive space.

## Also available for Cube

- Cube Base: the standard user interface for the Cube system. Cube Base provides easy-to-use tools for building and running models and for making stunning presentational graphics
- Cube Voyager: the functional library for personal travel forecasting, offering advanced methodologies for the study or urban, regional and long distance multimodal systems.
- Cube ME: the functional library for estimating statistically optimized base year travel matrices. Cube ME will update existing matrices to the current year or estimate entire matrices given your available data.
- Cube Polar: the functional library for estimating air quality emmissions. Cube Polar allows the modeling of most vehicles and fuel technologies
- Cube Dynasim: The Cube functional library for conducting detailed simulations. Cube Dynasim provides flexible, advanced methodologies for the simulation of automobiles, trucks, buses, and rail vehicles. Cube Dynasim Views provides 2D and 3D graphical displays of the results.


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# Move freight to your forecasting system

Test a wide variety of policies and infrastructure improvements, from pricing strategies to freight-specific facilities. Cube Cargo is the Cube functional library for freight forecasting, offering specific methodologies for studying freight demand using a commodity-based approach. Cube Cargo operates seamlessly with all of Cube including Cube Voyager and Cube ME. Cube Cargo also works with TP+ and TRIPS. With Cube Cargo you can add freight forecasting by leveraging your existing passenger data and models.

**Distinct freight segments**
Cube Cargo models long-haul, short-haul and urban service travel to provide matrices of freight travel by mode and commodity type and matrices of truck travel by truck type.

**Example of freight segmentation**
A scaffolding business has a yard where they store scaffolding poles and trucks. Occasionally, they buy new poles. Every day the scaffolders travel from their homes to the yard. They load the poles onto the trucks and climb aboard. The trucks make tours, traveling from building site to building site. At each site, they erect or dismantle scaffolding. At the end of the day they return to the yard and then go home.
The transport of bulk steel from smelters to the pole factory is a long-haul trip.
The transport of the poles from the factory to the yard is a short-haul trip. The trucks carrying poles and scaffolders are urban trips carrying goods (i.e. poles) and services (i.e. scaffolders).

## Commodity-based freight forecasting

Many areas are recognizing the need to have a better understanding of freight movements, how they will change over time, and how they can take actions to plan for and to improve the flow of goods while mitigating negative financial, environmental and travel impacts. Key elements in freight planning are matrices of commodity and truck flows.

Cube Cargo forecasts:

- Matrices of tons of goods by commodity type by mode for use in the analysis of goods flows, and
- Matrices of the number of trucks by truck type ready to be assigned to estimate truck vehicle flows.

**Long-, short-haul and urban freight**
Cube Cargo models three distinct freight segments:

- Long-haul bulk cargo typically moving from logistic node to logistic node (factories, warehouses, packaging centers)
- Short-haul freight trips for the distribution and collection of goods
- Urban freight and truck travel moving small amounts of goods, or workers, delivering services within a town or city.

**Unlimited commodity segmentation**
Choose your commodity groups according to the level and quality of your data. Accurately model the movement of such diverse goods as milk, oil, grain, paper, and machine tools.

**Regional hierarchy**
Cube Cargo uses a two-level zoning system:

- The Coarse Zone system: where much of the modeling is conducted reflecting the lack of data at detailed zoning levels. *Generation, Distribution, Mode Choice, and the incorporation of Transport Logistics Nodes.*
- The Fine Zone System: typically based on the zoning system for the highway network onto which the vehicles will be assigned. Additional zones are usually added to represent logistic nodes such as ports, railway stations and goods yards, where freight is moved between vehicles. The trip chaining model within the vehicle model uses the logistics nodes when estmating truck pick-up and drop-off tours. *Fine Distribution, Vehicle Model, Urban Service Traffic Model.*

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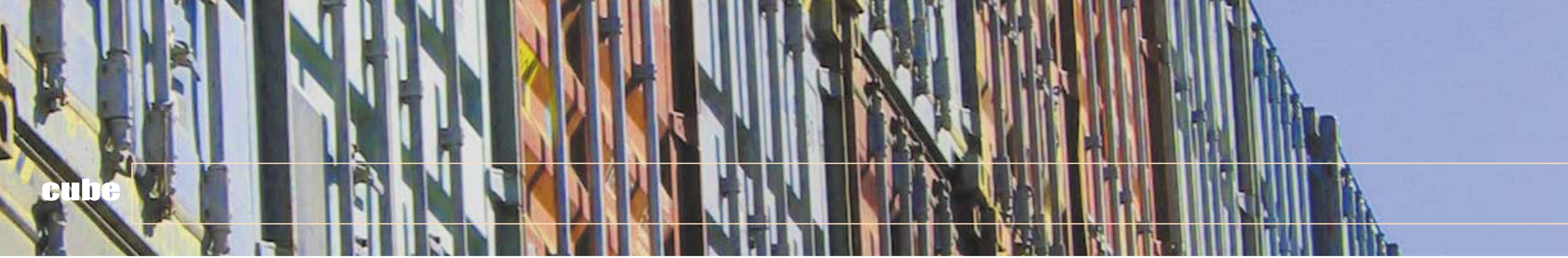

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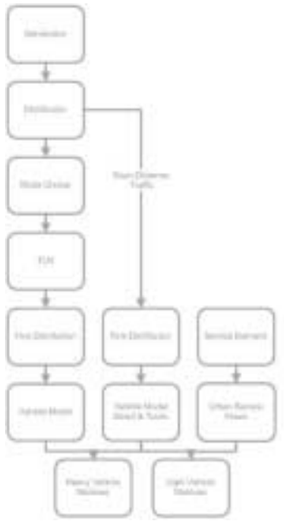
# Comprehensive freight forecasting for urban, regional, state and national planning

Regional hierarchy

The diagram represents the typical hierarchy of regions for a Cube Cargo model. The study area is the smallest region in the diagram. The inner area is the largest enclosing region for which socio-economic data is available. All the places, not in the inner area, which can serve as the origin or destination of freight trips observed in the inner area, form the outer area.


Model flow



## Methodology

Cube Cargo is comprised of seven models:

- Generation - estimates the tons of goods produced and consumed by commodity class by zone
- Distribution - estimates matrices of the tons of goods by commodity class segmented by short-haul and long-haul
- Modal Choice - estimates matrices of the tons of long-haul goods by mode and commodity class
- Transport Logistics Nodes - partitions the long-haul goods by mode and commodity class by direct transport and transport chain tours
- Fine Distribution Model - Distribution of coarse zone information to the finer level zone system
- Vehicle Model - estimates the number of vehicle tours per day by vehicle type
- Urban Goods Model - estimates matrices of local truck travel for local delivery and services.

The resulting matrices are assigned to the network to provide link-level truck flows by truck type.

Assignments are done using either Cube Voyager or TP+ or TRIPS under Cube Base. The assigment models provide additional information such as vehicle miles or kilometers travelled, average speed and volume by road type. This information can then be used to estimate environmental impacts.

## Model details

**Generation**
The generation model forecasts the number of tons, by commodity group, produced and consumed for each coarse-level zone. The productions are segmented into internal productions, which are to be transported to an internal zone, and exports, which are sent to external zones. Similarly, the consumptions are classified as internal or as imports.

Productions and consumptions are estimated using multivariate linear regression models estimated using local data.

**Distribution**
The distribution models allocate the forecasted productions by commodity group from their zone of origin to their zone of consumption. The productions and consumptions are split into short and long-haul trips. Both trip types are distributed using gravity models using different generalized cost functions. Short trips are distributed using distance; long-haul trips are distributed using a composite cost of travel time, distance, and cost. These elements are weighted using parameters from the modal choice models.

**Modal choice**
The modal choice models are applied on the long-haul trip matrices only using multinomial logit choice functions. Short-haul trips are assumed to travel by road. Long-haul trips are split into truck, rail, inland waterway and modal combinations (combined transport).

Generalized cost functions are defined using local data for each combination of commodity group and mode and distance class. The modal choice functions incorporate time, distance and cost.

**Transport Logistics Node model**
Transport logistics nodes (TLN) are places such as major goods yards, multi-modal terminals, railway stations, and ports, where trip chaining occurs.

The Transport Logistics Node model examines the matrices created by the long-haul modal choice model and partitions them into direct transport and transport chain matrices.

The goods in the direct transport matrices will be transported directly from their initial origin to their final destination. The goods in the transport chain matrices are divided into two segments: from origin to the TLN and from the TLN to the destination. Of these two sections, one will be classified as long-haul and the other will be classified as short-haul. At this stage of the model, Cube Cargo has estimated the commodity flow matrices by product type and mode.

**Fine distribution model**
For each combination of mode and commodity group the matrices are converted using gravity formulations to the fine level zone system.

This transition is made in order to produce truck vehicle matrices at a zone level sufficiently fine to provide estimations of link-level truck flows.

**Vehicle model**
The vehicle model estimates the number of vehicle trips per day given the mode and commodity group matrices from the previous model steps.

The model iterates over all origins across all of the various matrices, by commodity class, and applies two models which separately model direct trips and touring vehicle trips.

The results are combined to provide matrices of vehicle truck volumes by truck type for assignment.

**Service traffic model**
In urban areas there is a significant amount of local delivery and non-goods related truck traffic.

This includes transport of relatively small amounts of goods and the transport of services.

The service traffic model generates local truck matrices for these purposes using linear regression generation models and gravity models for distribution.

Direct trips

Direct trips are routed in two ways. In the graphic, the default method is shown which has a truck going from A to B and back to C, running empty in one of the directions. Alternatively, the Direct Trip model can be adjusted to accept certain distances to look for return loads.


Touring trips

The touring model is used to model short-haul vehicle trips whose structure is more complex than A-B-A. It is used separately for heavy and light trucks.

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