Improving freight operations and planning by applying data mining techniques over data collected from Intelligent Transport Systems

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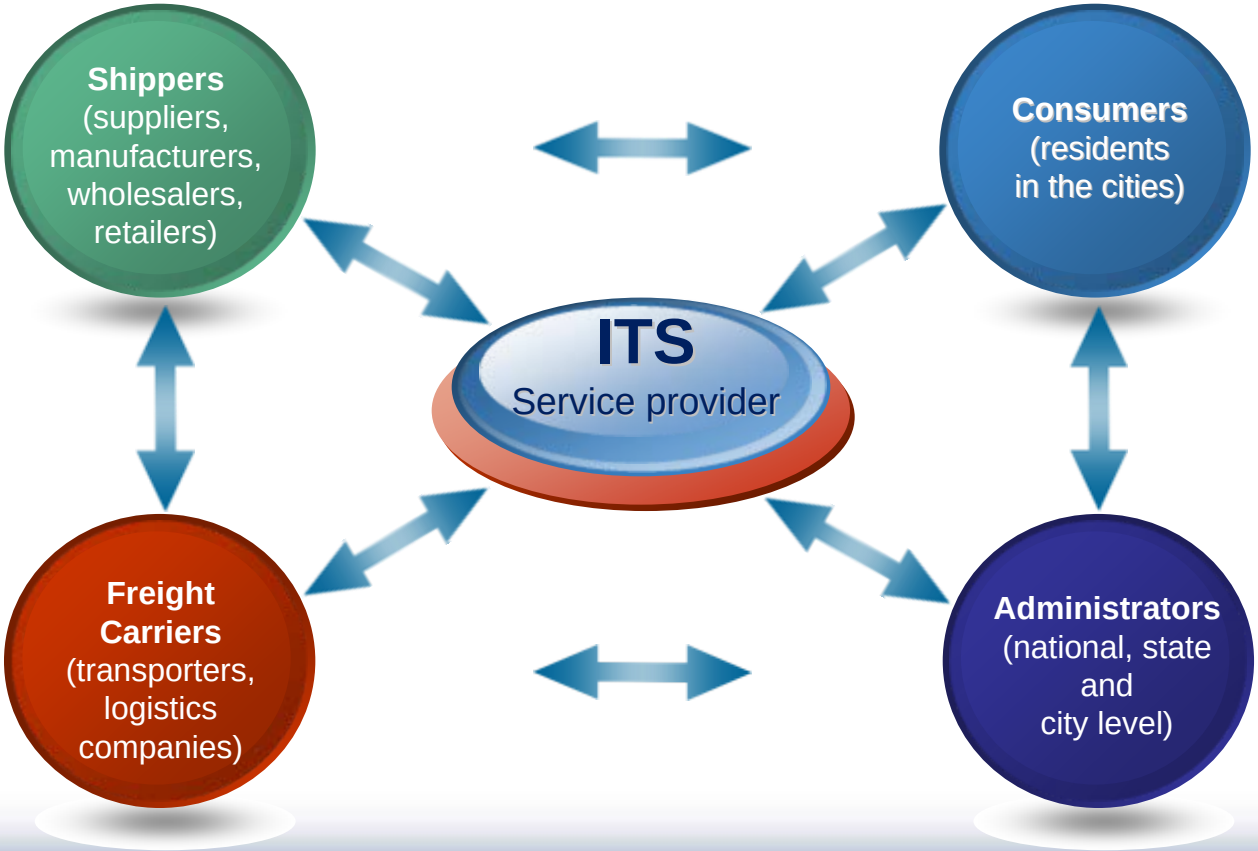
Introduction

"the application of information and communication technologies to the planning an operation of transport systems" [B. McQueen and J. McQueen, 1999]



Introduction

Data mining

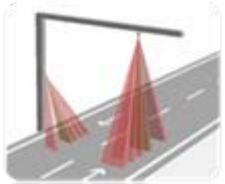
Sources Type of data Collecting Integration Selection Transformation Filtering Formating	DM technique Criteria Software tool	Patterns Prediction models Knowledge

Data sourcing

Loop detectors
Number of vehicles,
speed, classification

Digital tachographs
Speed over time

Laser scanners
Classification



Infrared sensors
Detection of vehicles

Microwave radar
Speed

Weigh-in-motion
Classification

CCTV
Speed, classification,
license plate reading,
detection of accidents

RFID
Identification and tracking

FCD
Speed, location, in-vehicle
information

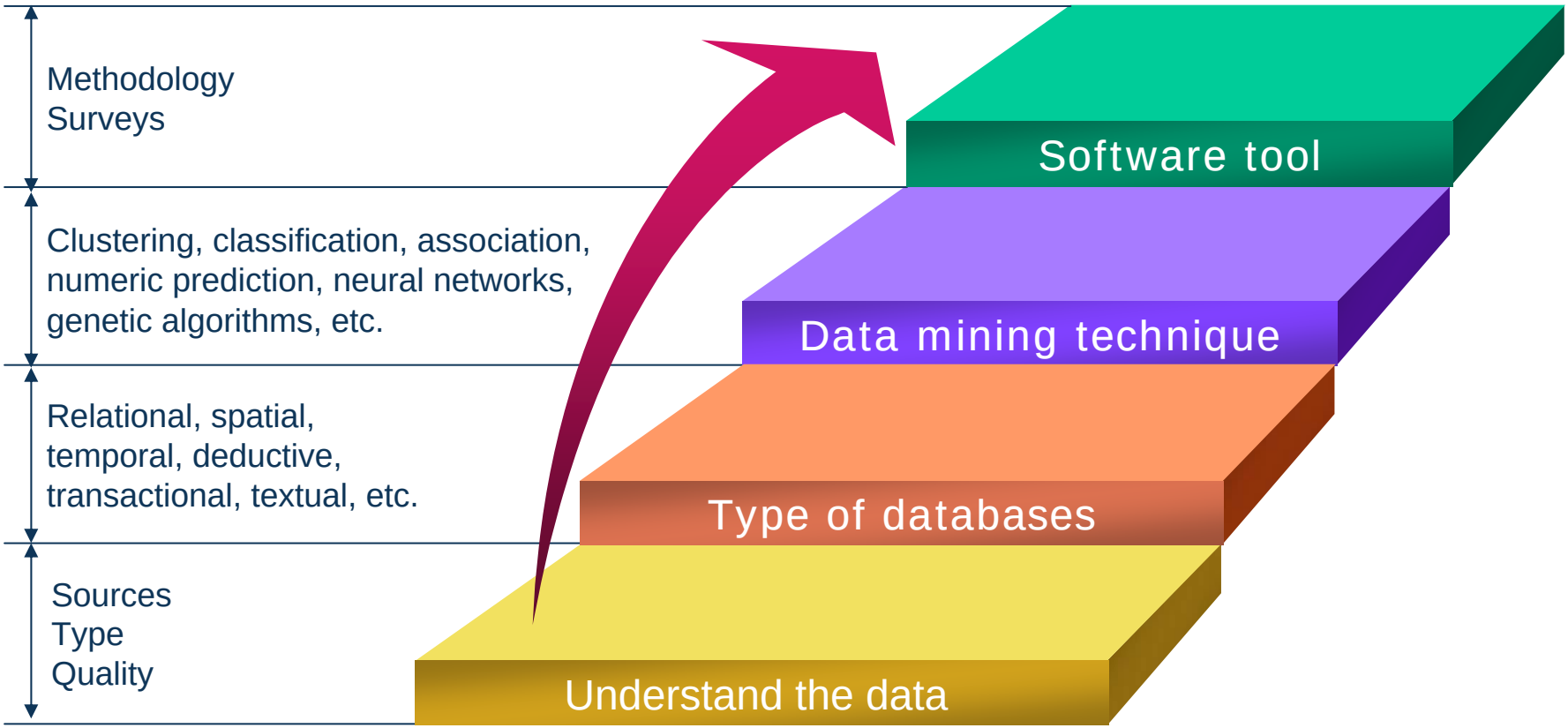
Weather sensors
Temperature, humidity,
condition of the road

Data sourcing

- capacity of the road to move freight at desired volume/weight level
- travel time (dwell time, processing time and transit time)
- tonnage and value of shipments to different markets
- shipment rates
- pricing
- infrastructure, administrative, enforcement cost
- economic, logistics, business, regulatory costs incurred by carriers
- environmental, energy, social, safety costs
- economic and demographic factors

Data exploration

How to choose a suitable data mining tool



Data exploration

- The **classification technique** is used to mine a database with logical and numerical values containing information about asphalt projects to find rules and patterns that will support decision making within a **pavement management system** [K. Nassar, 2007].

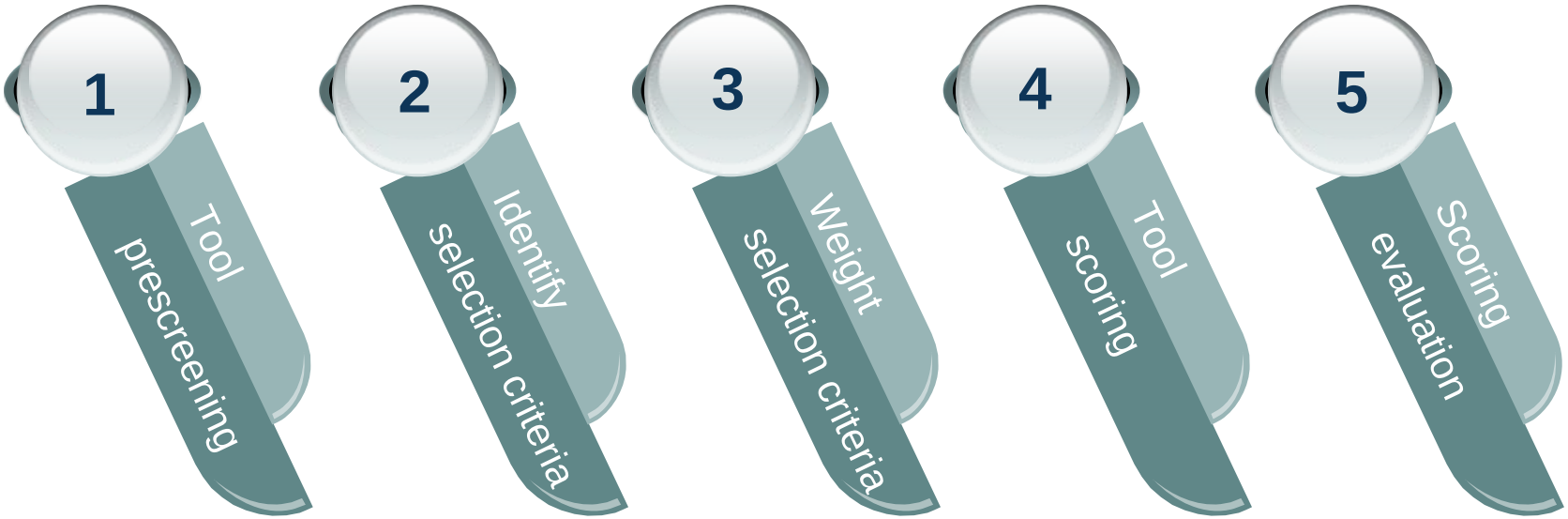
- When searching in a database with **statistics of accidents** that contains groups of attributes, **association rules technique** can be used to discover common combinations of attributes that occur most frequently within a given data set [P. Haluzova, 2008].

- In [D.H. Lee et al., 2004] an **investigation of traffic incident situations** is done by using a relation finder algorithm and **clustering techniques** over a database with numerical records grouped into categories.

- **Identification of rear-end crash patterns** on instrumented freeways is analyzed in [A. Pande & M. Abdel-Aty, 2005] over a traffic surveillance database using **neural networks techniques**.

Data exploration

Evaluation and selection of a data mining tool:



Criteria for evaluating data mining tools:

-Performance

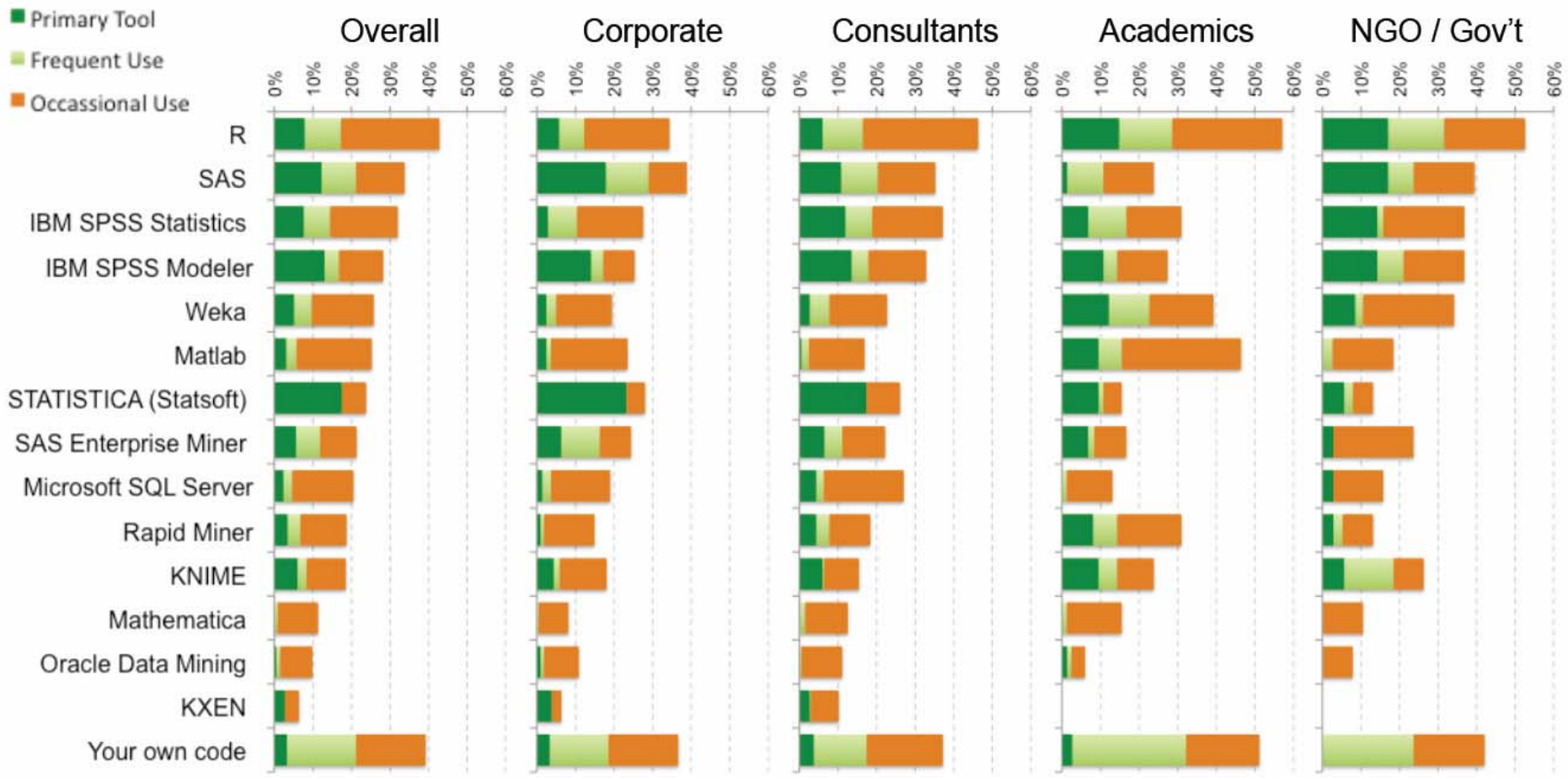
-Functionality

-Usability

-Support of ancillary activities

Source: “A Methodology for Evaluating and Selecting Data Mining Software” [K. Collier et al., 1999]

Data exploration



Source: Rexer Analytics 2010 survey

Applications

Self-driven truck platoons:

•Advanced Driver Assistant Systems
•Communication with Ad-Hoc networks
•Reduce air drag, fuel consumption and the space needed by trucks on the road
•Patterns and predictive models to help choosing a certain route and a certain time window

Driver drowsiness detection systems:

•ITS data: route, speed profile, weather conditions, time of day
•Adapt drivers' working hours accordingly using patterns corresponding to each driver
•Increase safety by preventing accidents

Applications

Truck-sharing:

- Create user profiles based using pattern analysis techniques
- Avoid situations in which vehicles are not fully loaded
- Shorten the distribution time and avoid peak hours
- Reduce the number of freight vehicles on the road

Traffic prediction:

- Information about the travel time, from door to door, including parking and waiting
- Special events (such as games, festivals or holidays), weather forecasts, planned road maintenance
- Models to predict traffic loads in the future
- Route vehicles to avoid traffic congestion

Applications

Goods condition:

•Use of RFID tags

•Use of BAP tags to connect to external sensors such as temperature sensors, humidity sensors, shock sensors

•Improve goods condition and reliability of transport

Fleet maintenance:

•Data from in-vehicle systems about speed, traveled kilometers, critical components of the vehicle

•Create models that will predict vehicle behavior

•Improvement of routine maintenance and parts delivery

Conclusions

- Reduce congestion and delays, reduce air pollution
- Reduce distribution time
- Improve goods condition and reliability of transport
- Optimal use of resources
- Long-range planning and forecasting
- Better-managed freight operations
- Enhances efficiency and saves money
- Improve the supply chain management and partnership amongst stakeholders

Thank You !