Mobility Diagnostics

11

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Abstract

To capture the entire momentum of Smart Mobility a holistic, mobility targeted analysis is a key instrument for decision makers and influencers. These days, technical advancements offer analytical and methodological procedures for real-time calculation and a digitally enabled predictive discourse on mobility matters. An increasing number of data sources and data volumes emerge. The large field of mobility targeted analysis we refer to as Mobility Diagnostics. We have encountered already analytical streams in the context of traffic data driven analysis (so called Smart Traffic). In the area of service oriented analytics, Service Diagnostics is playing a key role.

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11.1 Traffic Data Management

With respect to traffic data management the potential for Smart Mobility triggered analytics is huge. The rise of big data and real-time processing allows us to derive traffic

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management related benchmarks. The most relevant *Key Performance Indicators* (*KPIs*) and who they are serving are depicted in Table 11.1.

Table 11.1 Data diagnostics examples with relevance to Smart Traffic

ID	Smart Traffic analytics detailing	Service bundling with	Applicability especially for
S1	Traffic Monitoring		City, region
S2	Traffic Abnormal Discovery		City, region
S3	Temporary Zoning Control Plan for City Event		City, region
S4	Entry Control Policies	S5, S6	City, region, district, event, campus
S5	Vehicle License Control Policies	S4, S6	City, region, district, event, campus
S6	Congestion Charge Policies	S4, S5	City, region, district, event, campus
S7	Incident Prioritizing		City, region, district, event, campus
S8	Operations planning and operational research for emergency vehicles and police cars		City, region, district, event, campus
S9	Event triggered operations planning		City, region, district, event, campus
S10	Equipment information browsing for police officer's equipment		Public security personnel
S12	Driver Analysis		Fleet manager
S13	Commuter Insights		City, region, district, event, campus
S14	City related traffic management and traffic bundles	S8, S9, S10, S13	City, region, district, event, campus
B1	Operations monitoring and alert system		City, region, district, event, campus
B2	Resource management planning and imbalance management for means of transport dependent on traffic volume		Bus
B3	Bus planning simulation		Bus

Table 11.1 (continued)

ID	Smart Traffic analytics detailing	Service bundling with	Applicability especially for
B4	Public transit planning for commuters		Bus
B5	Bus service level analysis		Bus
B6	Bus ticketing analysis and pricing strategy		Bus
B7	Bus lane setting and what-if analysis		Bus
B8	Estimated time of arrival for buses		Bus
C1	Taxi capacity analysis		Taxi
C2	Tariff planning and service pricing for taxis		Taxi
C3	Taxi operation monitoring	B1	Taxi
C4	Taxi Dispatching and Guidance		Taxi
C5	Taxi station layout planning	B3	Taxi
C6	Emergency Management for Taxis		Taxi
C7	Taxi driver productivity and business compass	C3	Taxi
M1	Metro passenger evacuation management		Metro
V1	Visualization schemas		All

Example for Smart Traffic Applications The company SAP drives a number of projects in European and Asian cities with respect to Smart Traffic:

> "As cities grow fast and face challenges in terms of resources and infrastructure, they need transparent, collaborative and innovative technology to help them prosper. […] this technology shows how Big Data-driven insights based on real-time traffic conditions and predictive analytics can help cities run smarter. Smart traffic control shows how optimized traffic light controls and additional car lanes help avoid rush-hour traffic congestion. Congestion indexes and speed controls based on data from RFID, GPS, cameras and induction loop technologies provide pictures of real-time traffic issues and compare conditions with other cities and city sectors. Origin-destination analysis compares travel behaviors between city sectors, areas, streets and multimodal travel." [146]

One of the advantages of Smart Traffic is the identification, analysis, and visualization of personae dependent KPIs. Big data applications are applicable due to a high number of access points and data volumes, and serve the segmentation of KPIs according to city district, means of transport, and time and date for example. Being faced with an infrastructure burden and high maintenance efforts, the analysis of digitally connected vehicles allows us to derive resolutions in infrastructure planning [147].

With respect to requirements that personae have, bus operators seek resolutions, for example when to plan for a new bus line and how to get bus riders on board for the change. Another issue to be resolved is knowing the number of travelers that will be affected on board and to estimate the profitability of a new bus line.

In the context of customer service, operators seek to predict the number of people that are waiting to board at subsequent stations and to what extent the transit operator should increase or decrease the frequency of its assets. One key area that benefits from Smart Traffic is the design of service level agreements for one operator and the coordination among multiple transport operators. On the advantages of digitization, a benefit is the digital capture of service level agreements and their compliance checks.

11.2 Service Driven Analytics

How service oriented KPIs are being distilled and evaluated is the subject of the following example. The example illustrates the scope of service analytics in the field of cycling. Where two-wheeled means of transport are augmented technically with sensors or tags, the earlier introduced Smart Traffic KPIs (see Table 5.3) can be applied to bikes, e-bikes, and scooters, too. In cases where two-wheel means of transport are not captured within the traffic flow analysis or where cycling related traffic situation analysis does not take place, the following considerations might be useful.

Example: Service Diagnostics for Bikes

Overall, a mobility driven analysis for a city or region reveals insights into the optimization potential for the cycling community: firstly concerning the utilization of the given infrastructure and secondly concerning the increase of traffic safety for cyclists. Performance indicators play a significant role for decision makers and layout planners. Likewsie, can service designers benefit from performance indicators in the form of gaining insights and hints on adapting existing and designing additional services? Table 11.2 compares both viewpoints.

11.3 Intersection Analysis and Relevant Action Items

What is the benefit of a holistic view of cargo movements and mobility consumption? The so-called intersection analysis aims to distill those conditions from any potential ones that harm cargo related traffic flow in a critical segment or corridor of the observed transport route network.

Table 11.2 Mobility analysis of the traffic infrastructure with respect to cycling

Mobility services for cyclists	Performance indicators for the bike
Accident prevention analytics and measures	Average cost/damage per accident
Accommodate bike lanes to usage pattern	Average cycling speed
Accommodate bike lanes to usage pattern	Average trip duration
Accommodate bike lanes to usage pattern	Average trip length per person
Promote bike usage, provide incentives to cyclists	Bicycle use in relation to total modes of mobility
City planning: adapt infrastructure to demands	Bike lane percentage per district in relation to total street space
City planning: adapt infrastructure to demands	Cycling kilometers per year
Accident prevention analytics and measures	Frequency of accidents
Improve navigation, speed and enhanced safety of cyclists	GPS coverage for mobile navigation systems
City planning: adapt infrastructure to demands	Length of bike lane network per city
City planning: adapt infrastructure to demands	Level of stress (accessibility)
City planning: adapt infrastructure to demands	Number of bike racks
City planning: adapt infrastructure to demands	Number of bike racks on busses
City planning: adapt infrastructure to demands	Number of bikes per 1000 people
City planning: adapt infrastructure to demands	Number of intersections
City planning: adapt infrastructure to demands, Investment advice	Number of public bike share stations
City planning: adapt infrastructure to demands	Number of public shared bikes
Steering of traffic flows, improve safety of cyclists	Peak times for cycling activity
City planning: adapt infrastructure to demands (designated areas)	Percentage of people cycling for fun
City planning: adapt infrastructure to demands	Percentage of people cycling to work
City planning: adapt infrastructure to demands	Square feet of space per cyclist (level of service)
Steering of traffic flows, intelligent routes	Waiting time at traffic lights

Table 11.2 (continued)

City planning: adapt infrastructure to demands	Waiting time in relation to time spent cycling
Insurance companies, risk and premium calculations	Average cost/damage per accident
Intelligent routes	Average cycling speed
Intelligent routes, city planning	Average trip duration
Intelligent routes, city planning	Average trip length per person
Planning of bike lanes	Bicycle use in relation to total mobility modes
Planning of bike lanes, insurance companies	Bike lane percentage per district in relation to total street space
Planning of bike lanes	Cycling kilometers per year
Insurance companies, risk and premium calculations	Frequency of accidents
Intelligent routes	GPS coverage for mobile navigation systems
Planning of bike lanes, insurance companies	Length of bike lane network per city
Insurance companies, risk and premium calculations, planning of bike lanes	Level of stress (accessibility)
City planning: adapt infrastructure to demands	Number of bike racks
Procurement of public transport provider	Number of bike racks on busses
City planning: adapt infrastructure to demands	Number of bikes per 1000 people
City planning: adapt infrastructure to demands	Number of intersections
City planning: adapt infrastructure to demands	Number of public bike share stations
Demand analysis, planning of bike stations (location, quantity of bikes)	Number of public shared bikes
City planning: traffic lights, intelligent routes	Peak times for cycling activity
Bike lanes outside the city in recreational areas	Percentage of people cycling for fun
City planning: adapt infrastructure to demands	Percentage of people cycling to work
Accident prevention analytics and measures	Square feet of space per cyclist (level of service)
Accommodate bike lanes to usage pattern	Waiting time at traffic lights
City planning: intelligent traffic lights and routes for mobile navigation systems	Waiting time in relation to time spent cycling

Table 11.3 Usage scenario intersection analysis

Elements	Detailing the key elements
Addressees	Regional and/or intersection related transport road network analysis for the cargo business
Motives	Being dependent on third party incidents that occur in the neighborhood and lead to higher traffic volume and congestion in own municipality
Value Drivers	Optimized traffic flow management Reduce traffic load Reduce air pollution and noise Foster service provisioning of regional providers
Owner	Regional and municipal government
Personae	Hub operators such as ports and cargo terminals Navigation providers Providers of external infrastructure (surface, soil condition, bridges, streets, etc.) Resource providers Service providers for drivers, vehicles, vehicle components, production, repair, re-utilization and maintenance System integrators Technology providers Telematics providers and enablers Territorial communities Transport network providers Urban layout planners and community authorities
Market Offerings	Data dashboards Forecasting traffic flow and traffic situation
Degree of Deployment	Established: Phase 1, Phase 2 First deployments: Phase 3, Phase 4
Roadmap	Phase 1: Analysis of current and projected traffic volume Phase 2: Matching result with other and field trial data Phase 3: Transferring results into service design Phase 4: Considering the design and establishment of a personae driven data portal

Applying the significant design elements, the usage scenario with respect to mobility turns into the following, as outlined in Table 11.3.

The roadmap for the intersection analysis consists of four phases:

Phase 1 Phase 1 starts with an analysis of current and projected traffic volume. The key activities are:

- Assessment of current volume and classification of freight moved through the region
- Identification of hubs and analysis of freight movements within the targeted corridors
- Agreeing upon and determining the critical performance indicators as to why a certain corridor is mostly affected by cargo traffic, by freight volume and/or by diverted traffic
- Identifying the key success factors for urban hubs to optimize space, infrastructure measures such as road maintenance, bridges, commuter lanes, and any other public and private service provisioning
- Conduct of field test(s)
- Drawing conclusions about maintenance efforts for streets and bridges, commuter lanes, and others.

One of the key prerequisites to drive Phase 1 is access to data. For any of the individual efforts it is recommended you design a digital worksheet that lists the known data sources. Expanded by and enriched with further data that are sourced from government and other data providers the analysis continues.

Phase 2 The value proposition for any participating stakeholder presented by an innovative urban traffic and transport management system is subjected to Phase 2. It covers the first round of analyzing the cost-benefit effects and the framework for Return on Investment (RoI) calculations. Depending on the progress in the field test and the accessibility of data, an analysis of costs versus reduction in congestion takes place, too. Cost types include costs for smart traffic solutions, infrastructure efforts, and further design and deployment efforts. Next to congestion reduction, secondary benefits that affect business entities and constituents will be observed where possible.

Phase 2 compares the outcome of, or observations and the impact in, one field test on other urban hubs. In case communalities have been identified, further field trials make sure that the efforts are on the right track and reveal additional parameters and dependencies.

Phase 3 All parameters and results are depicted in a service-design driven manner. Thus service relevant roles and responsibilities are studied and documented.

Phase 4 Phases 4 focuses on the need, how-to and design of parameters for one commonly used data portal. Here we will be investigating the value of open data and the potential obstacles of using open data, private data, and/or user generated data. In the market you find terms such as Data Dashboards and Open Government Data Lab. In most cases there is a willingness to share data from a public provider's point of view. One of the prominent examples is the portal from Transport for London (TfL) [148]. Another example is the recently founded VAO GmbH, a traffic information portal for Austria [149]. Those reflections about open access, free-of-charge, and right to re-use go hand in hand with the construct and conduct of *Data Gates;* or as we call them *Trust Gates*.

Trust Gates Trust Gates, hence gating systems, are in use to control the provisioning and sourcing of data in accordance with a classification system along private, confidential, access driven, and publicly available lines. Trust Gates operate through identification and authentication, payment terms, billing and usage, reporting, and governing trust. Codes of individual and business conduct monitor compliance and govern which data are being published, anonymized, or not published at all. The depicted scenario is also applicable to passenger transport.