Transport
Infrastructure
Monitoring

TrIM

Transport Infrastructure Monitoring

Result Book

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Preface

All activities relating to road safety, traffic management, traffic monitoring and monitoring of environmental data need reliable information about the transportation infrastructure as basic information. This can be demonstrated with three central arguments:

- Transportation infrastructure is central for public service provision and is the basis for mobility and economic development. Therefore the adequate management of this infrastructure needs the best tools and procedures available.
- Transportation infrastructure is changing in a dynamic way. Therefore special requirements on data management and maintenance are defined.
- A professional information management is the necessary basis for providing high quality transportation services.

This topic was the focus of TrIM project (Transport Infrastructure Monitoring), which started in September 2008 and concluded in August 2011. TrIM was developed within the framework of the Interreg IVA Austria – Italy program, involving 4 partners, the Regional Government of Carinthia, the Autonomous Region of Friuli Venezia Giulia, Veneto Region and Venice International University.

The main objective of the project was to establish a sustainable and reliable information infrastructure for the tasks of transportation planning, traffic management and infrastructure maintenance The necessary information base is a multi-modal transport network with additional information on reference systems (like mileposts), network conditions and traffic regulations. Within TrIM project a cross-border information model was successfully elaborated and implemented. The resulting cross-border graph can be seen as part of larger European GIS information infrastructure, as defined in the INSPIRE directive. Three pilot projects were elaborated on the basis of this common cross border transportation network, a Road Monitoring Pilot, a Road Safety Pilot and a Logistics Pilot.

The importance of TrIM results and the sustainable use of its results are demonstrated by the fact, that TrIM project is involved in clustering and cross fertilization activities with other projects of Alpine Space area (e.g. Alpcheck2), which were defined in order to communicate and benefit from project results and use the synergies with other projects.

The Regional Government of Carinthia, in its role as Project Leader, acted as organizer and coordinator of the various activities of TrIM Project, which could represent a first step that can become part of an european standard on intelligent traffic systems.

The present brochure summarises the project's ideas and results in a way that local and regional administrations, experts, and road infrastructure operators of road infrastructures may benefit.

Problem statement, Goals and framework conditions

Transportation is the most important factor in generation of accessibility and for enabling cross-border economic and social co-operation. While improvement by means of infrastructural measures is becoming less feasible transportation and the experiences of ever increasing traffic flows pose an increasing problem in environmentally sensitive areas.

Only a truly integrated cross-border approach can improve accessibility and economical co-operation in a sustainable way. Cross-border activities are also seen as the necessary basis for a modal shift in order to achieve the "green goal", since CO2 emissions and traffic flows do not stop at the border.

The tasks to achieve these goals are transportation planning, traffic management and infrastructure maintenance. All of these tasks need reliable and up-to-date base line transport network data. But the existing network graphs often lack detailed and high quality information for these purposes. If available they are usually not compatible cross-border. This lack of information availability and usability has severe consequences, so that

- cross-border co-operation in traffic planning and traffic management lacks foundation and
- common and harmonised management concepts for a modal shift in transport are severely restricted.

On both sides of the border a wide array of institutions is involved in the topic of transportation monitoring and management. Authorities on different administration levels are obliged to make related decisions. For the involved authorities the information about normally well-monitored important transport routes (train / road) ends at the border. Communication to the neighbouring countries about important information, e.g. about neuralgic points, is restricted.

A wide variety of graph data exists within the participating regions, e.g. traffic modelling graphs, cartographic graphs or detail maintenance graphs ("Street cadastre"). But they are mutually incompatible and are not yet integrated. Lack of data integration and information consistency is a main reason for shortages in traffic planning and traffic management. It also impedes data exchange for cross-border harmonised traffic measures.

The implementation of efficient modal shift concepts and the consideration of environment-sensitive decision criteria are impeded by this lack of information and exchange opportunities.

The project framework – goals

The main goal of the project is to secure accessibility of project regions by non-infrastructural means and to help achieving green goal related multimodality. The main operational goal to support this is to create the information infrastructure for transportation planning and traffic management with a long-term usage perspective. For this end the proposed project will

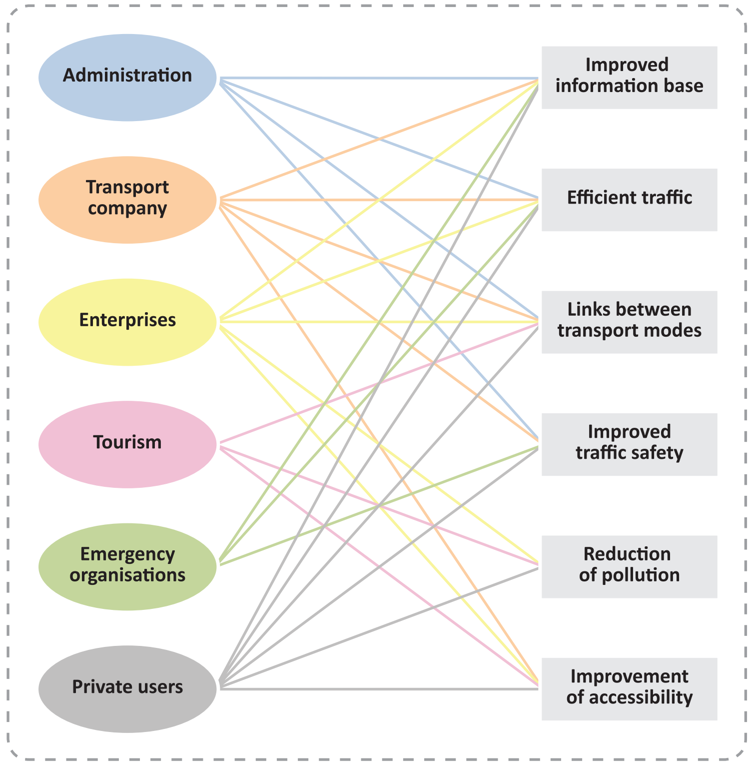

Figure 1: Goal dimensions and benefits for different stakeholders

- enhance existing transport graphs concerning information extent, structure and quality,
- harmonise graphs on a cross-border basis, concerning structure and thematic content,
- integrate these graphs into a common trans-national connected transport graph for the project area,
- improve the information base to allow co-modal trans-national traffic management, traffic planning, infrastructure maintenance, eGovernment and road safety improvement and
- define and implement the organisational procedures for the tasks of long-term sustainable use and maintenance of transport graph and transport infrastructure.

The main benefits concerning different stakeholders can be seen in the graphic below.

The thematic dimension

All the information about the transportation infrastructure is in principle known to the responsible public authorities. Transportation infrastructure is planned, maintained and regulated with direct or indirect involvement of the public authorities. In many cases the involvement is based on legal acts, e.g. decrees for traffic regulations.

But this information more often than not is just a theoretical information pool; the processes of public authorities are often carried out with no reference to locations on a graph, sometimes even in analogue form. Many public authorities have developed GIS based digital network graphs of those parts of the network, for which they are responsible. But these digital data tend to be

- Redundant, e.g. because traffic information centre collects information about the same part of the network as a road maintenance authority does;
- Not compatible, due to different GIS used or different attribute and data models;
- Not integrated, due to the restriction of the use of data within the data managing authority without any information exchange with other authorities;

These organisational challenges are complemented with technical challenges, which have been tackled by TrIM:

- How can a cross-border data organisation be defined, considering the restrictions of horizontal and / or vertical responsibilities for data management?
- How can the update process be carried out current and consistent?
- How can users, who have very heterogeneous technical knowledge, technical systems and usage rhythms collaborate to generate one common homogeneous graph?
- How can the requirements of real-time information modelling be integrated with eGovernment processes?
- How can existing redundant datasets of completly different data models be integrated into one common homogeneous graph?

Approach of TrIM

The project TrIM was setup with several phases for common development and implementation. For the TrIM objectives conceptual, information generation and pilot activities were defined and complemented by continuous dissemination activities.

PHASE I: Organisation and concepts

Activities in this phase define the common organisational procedures and the process standards to be used. Trans-national comparison of existing modelling methods and instruments and identification of data requirements for different tasks. Adjustment of procedures and data models needed to build up, update and connect a trans-national transport graph considering national and European standards. Assessment of existing methods to survey transport network attributes, including a summary of already used attributes in the participating regions. Findings of other projects and standards will be considered (eSafety, Alpcheck,...), resulting in a common and flexibly extensible data model, suitable to all requirements. Development of procedures for sustainable use and maintenance of the transport graph including organisational concepts for the work-flows of project partners.

PHASE II: Information generation and tools

Building a trans-national transport graph, which connects eventually already existing national graphs across the country borders. This graph allows deeper going analyses and is the basis for trans-national traffic planning. Development of integrated software tools for implementation of organisational concepts and methods defined. Development of interfaces to all related policy areas, like transportation modelling, traffic information for end-users or public transport operation.

PHASE III: Pilot actions

The pilots can be seen as operational actions, aspiring the goal of trans-national consistency and of common trans-national (cross-border) standardized handling methods and relevant data for matters dealing with transportation in the project area. The pilot projects were organised in selected regions in all participating countries to survey the current state and attributes of the road infrastructure to get an overview of the expecting effort. The results of the pilot actions provide an excellent basis for cross-border information exchange on transport related policies and the efficiency and practical usability of transportation measures.

- “Road Monitoring Pilot”. New harmonised procedures for collection and validation of road related data will be implemented, by development of tools and procedures. It secures data quality on the long-term and support all road and traffic management tasks on a long-term basis. Within the road monitoring pilot a specific subpilot on logistics platforms will be implemented, providing information on location and traffic generation of logistic centres.
- “Road Safety Pilot” with a targeted black-spot management, based on the defined standards and the data produced. It provides a substantial contribution for improved road safety.
- “Intermodal logistics pilot”. Missing information concerning logistics platforms to support modern spatial planning were identified and integrated into the common graph. Information was collected through on-the-field analyses and relate mainly to private nodes and qualitative-economic data of nodes.

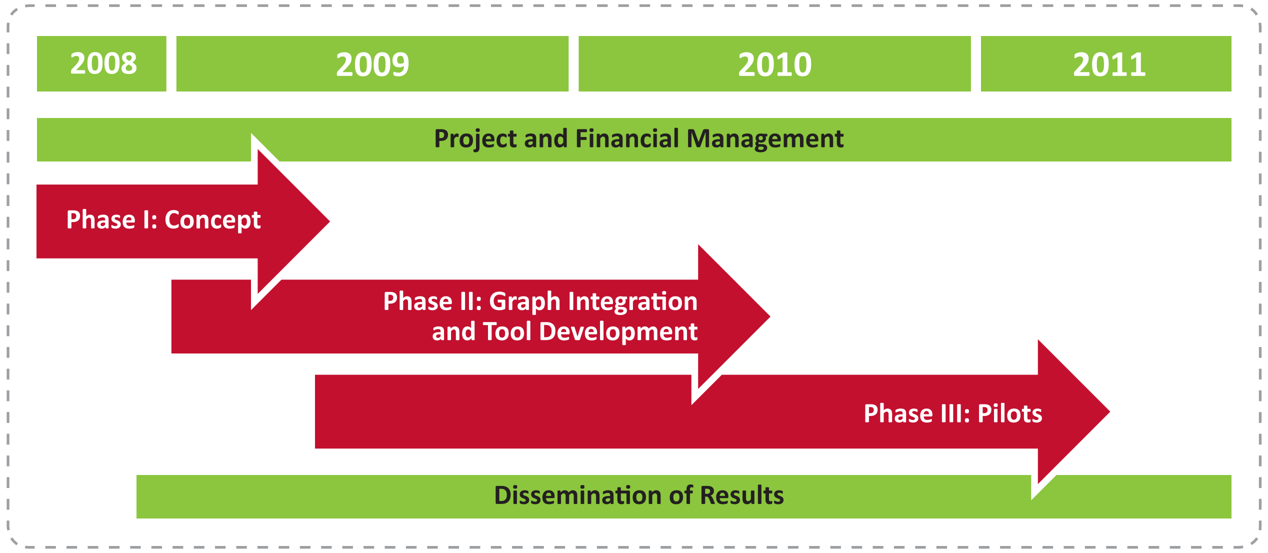

Figure 2: Project activity timetable

Situation – SWOT analysis

The regions of the TrIM project partners have experienced significant changes due to the enlargement of the European Union and the corresponding integration of the neighbouring countries in economic and political terms. This change is especially evident in a change of traffic conditions, which in many cases corresponds to an increase of traffic volume.

SWOT analysis Carinthia

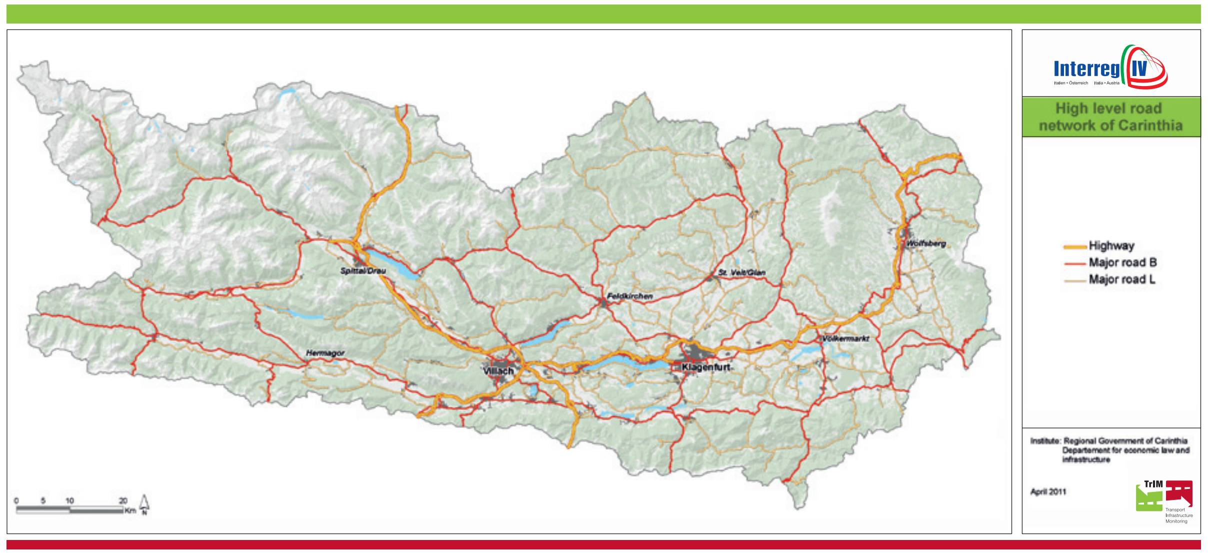

Figure 3: High level road network of Carinthia

Compared to other Austrian regions Carinthia shows a rather low basic traffic volume. Thus the typical traffic problems of large urban areas, like traffic jams or air poluution, are hardly encountered. Critical gaps in infrastructure have been or are being tackled by infrastructure measures, like Katschberg or Koralm tunnels or the investments into Tauern railway.

But high levels of traffic are being experienced especially in holiday season. In goods transport the political changes of the last years have strongly influenced traffic volumes (especially the Balkan crisis in the 1990s and the EU enlargement 2004 and 2007). This will lead to a more significant role in international goods transport of Carinthia. The use of this potential requires new investments. Regarding the restricted public (regional) budgets this means a clear need for alternative investments, other than infrastructure. Optimisation strategies for development of new technologies in transport planning, transportation telematics (ITS) and road management have to be defined and implemented.

In future integrated traffic management will thus be the focus of Carinthian efforts (as opposed to isolated single purpose solutions). A multimodal network management will provide an important base for these efforts, with the outcomes of TrIM project serving as basic information infrastructure.

	Opportunities	Threats
Strengths	Low traffic volumes and low negative traffic impacts.	Increasing importance in international goods transport (needs counter strategies).
	Innovative ITS pilot projects and related research institutions.	High number of innovative ITS pilot projects, but not yet integrated.
Weaknesses	Build management capabilities in regional (austrian) and international co-operations.	Lack of management capabilities.

Figure 4: SWOT analysis Carinthia

SWOT analysis FVG

In all main sectors the transport system of the region Friuli Venetia Giulia is rapidly developing above all because of increasing demand and the recent economical development of new membership countries. The recent enlargement of the European Union to Eastern Europe countries has stimulated a heavy growth of trade exchange with these new markets. Also Italy, for its geographical position, and consequently the Friuli Venetia Giulia can benefit from this evolution: they are located in the central point of the ocean trade routes from the Far East to Europe and the United States.

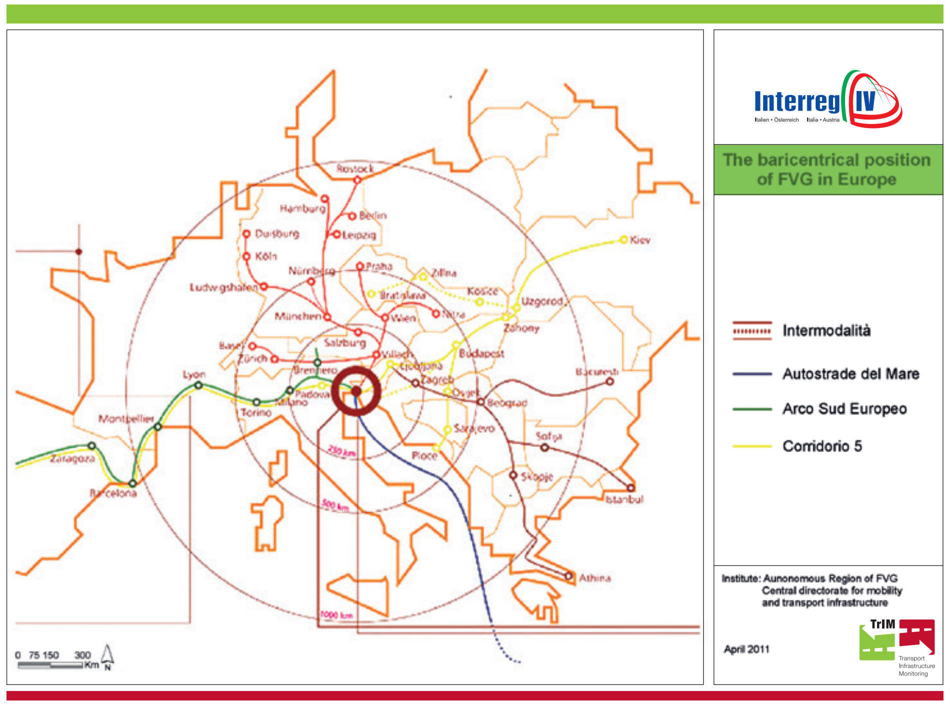

Figure 5: The baricentrical position of Friuli Venezia Giulia in Europe

This situation has produced an on-going increase of the traffic flows for both persons and goods even though this trend has now slowed down due to the recent financial crisis whose effects are still visible. Moreover this increase was added to the endogenous traffic growth, brought about by the transport strategic decisions the national policymakers have taken in the past. These decisions substantially favoured the private transport. A further increase of traffic volume is regarded as unsustainable, considering that the regional roads infrastructures are on the point of collapse. This can be demonstrated by the great number of road accidents and related fatalities involving heavy long trucks, which have become a real plague on the A4 freeway to Venice.

The regional strategy to face these problems is to reverse the trend described and to meet the business sector requirements to fund personal movement needs through a requalification of existing networks with a limited number of infrastructure investments and through systematic actions that help to relieve traffic congestions, to balance the various modalities on behalf of the public transport and reduce accidents.

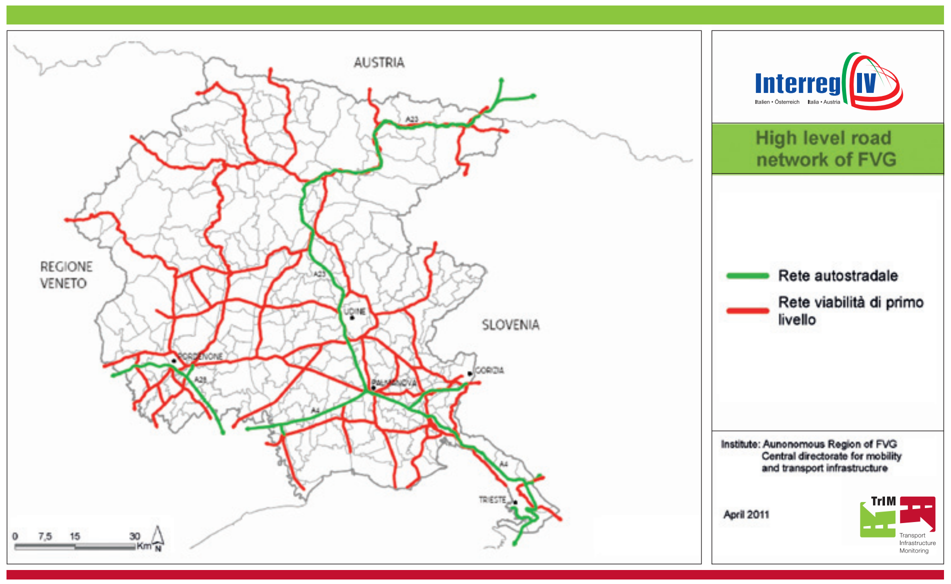

Figure 6: High level road network of Friuli Venezia Giulia

The common graph of TrIM, which describes infrastructure conditions is used as a basis for an authomatic traffic data detection system that provides constantly updated information on the main regional roads. Instruments for decision support are necessary that are able to reliably depict the middle and long term development of transport system on the regional as well as the interregional dimensions. The TrIM project has given the Regione Friuli Venezia Giulia Administration a unique opportunity to lay the foundations for these new instruments.

SWOT analysis Veneto

A transportation system is always characterized by various strong interrelations with other components (settlement patterns, economic system, environmental, etc.) of the regional socio-economic fabric. This is particularly true in the case of Veneto Region, given their considerable complexity and relevance with regards to the dynamics of both the local intra-regional mobility and the long distance crossing traffic.

The regional mobility is influenced by the polycentric system of settlement, which brings about a system of relationships which is complex and widespread, especially along the main arterial roads. In particular, the Veneto central area is affected can be regarded as a widespread metropolitan area, characterized by a high degree of interaction between services resulting from both urban settlement and widespread industrial economies. The metropolitan area comprises, at least partially, the provinces of Padua, Treviso and Venice.

With regard to long distance traffic it is to underline the role of Veneto Region as a crossroad of several transnational axes, with significant relevance in the European context. In fact, the region is crossed by the 5th corridor (PP6 in terms of TEN-T priority projects), in East – West direction, by the PP1 Berlin – Palermo, in North-South direction, and from that extension of PP23 which have gained consensus on a transnational level. Furthermore, the location of the Veneto makes it a transit point for traffics connecting Central Europe and Italy while the ports system, which is facing remarkable developments, provides a gateway to the Mediterranean and in perspective to the Far East.

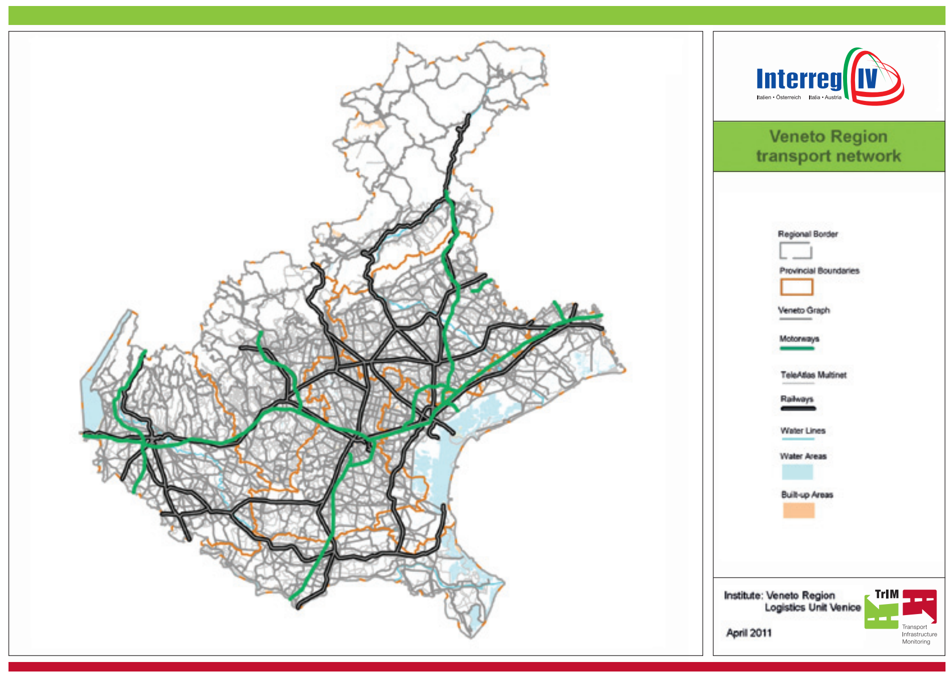

Figure 7: Veneto Region transport network

Moreover, Veneto Region can be considered one of the engines of national economic development and at the same time, one of the most dynamic areas in Europe.

In the recent decades this has led to a significant boost in traffic, which has focused on road transport and especially by private car (with the consequent increase in the number of circulating cars, of road freight vehicles and of average mileage travelled). This growth has implied a considerable increase in congestion levels, due to a delay in the realisation of necessary infrastructure.

In such a complex context, the proper planning and investment management can not ignore the use of appropriate information tools and decision support, in a perspective of data sharing and integration. Consequently, the participation of the Veneto Region in TrIM project, focused precisely on the development of effective information tools regarding traffic flows and shared transport network modelling at the regional level and across borders. The initiative is synergic with other activities of the Region, such as the project AlpCheck2 (developed within the Alpine Space Programme and leaded by Veneto Region) that is developing a decision support system for the whole Alpine Space area. Therefore the activities of TrIM project have enabled the integration of different regional data sources, as the graph produced by the cartographic board and the information system on traffic flows on the regional road network. In addition, the integration in a comprehensive platform, shared with neighbouring regions and in a cross-border context, has enabled the exchange of best practices and analysis of planning tools in a trans-regional dimension (suitable for carrying out evaluations of strategic nature). Finally, given the importance of the issues, a thorough analysis on the integration of safety and logistics data were made in the regional context, through the development of dedicated pilot projects.

	Opportunities	Threats
Strengths	Different data sources available . Support planning and management with value-added information generated from data. Synergies with other activities (e.g. Alpcheck2 project).	High traffic volumes and high negative traffic impacts. Increasing importance in international goods transport .
Weaknesses	Build management capabilities in regional and international co-operations.	LDifficulties for maintenance and update. Management of a complex system.

Figure 8: SWOT analysis Veneto Region

How to – a TrIM methodology

Cataloguing practice and needs

The starting point for TrIM project was a detailed needs assessment. The current status of information management in all partner regions was assessed in detail and was summarised in the TrIM data catalogue. This catalogue was modelled on the basis of EUROROADS project catalogue, but was further refined according to the practical needs of TrIM project partners.

Road network model	FVG	GIP Veneto	GIP Carinthia	Comment for common graph
Q4.1 Brief description	Edges and nodes. Nodes are: border node (junction) and non-border node (geometry).	Edges and nodes. Interaction of different schematization with different levels of detail and purposes.	Edges and nodes. Each non-border node is associated with “plateau”, which corresponds to the area of a junction.	Details of level dependent modelling to be checked for data exchange.
Q4.2 Standards used	GDF.	GDF.	Related to EUROROADS definition.	No need for action.
Q4.3 Explicit or derived topology	Derived.	Derived.	Explicit.	Modelling difference. To be resolved when generating common graph.
Q4.4 Model for explicit topology			Edge has 2 nodes. Node has edge degree.	See above.

Road network model	FVG	GIP Veneto	GIP Carinthia	Comment for common graph
Q4.5 Methods for deriving topology from Geometry			by spatial coincidence and logical level of edge ("subnet").	See above.
Q5.1 Brief description	Shapefile.	Shapefile / ORACLE spatial locator.	ORACLE spatial locator.	Exchange by export / import, not by direct connection of original datasets.
Q5.2 Standards used		? / GDF.	OGC (WKT, WKB).	See above.
Q5.3 Dimensions	2d.	2d.	3–4 (X,Y,Z; M where appropriate for routes).	2d as common denominator.
Q5.4 Types of geometry and interpolation	Points, lines.	Points, lines.	Points, lines, surfaces.	Points and lines as common denominator.
Q5.5 Coordinate reference systems used	Gaussa Boaga fuso Est.	Gauss Boaga fuso Ovest.	GK M31 (EPSG 31255).	Common projection to be defined.
Q5.6 Which reference systems are being used		Linear reference system (planned).	Linear reference system for high level roads (KM). Additional reference systems (addressess, TMC) planned.	No common additional referencing system to be considered.

Figure 9: Data catalogue of TrIM partners and consequences for data modelling

Putting it all together – GIP as solution and GIP interfaces

The Graph Integration Platform was used in TrIM as the technical basis for the common graph. As a common interface the GIP interface for data import was used as a basis and adapted to the specific needs of the project partners of TrIM, including a translation.

The GIP was designed for the establishment and continuous maintenance of the database for a wide variety of applications in road management.

The GIP manages

- road line geometry and base attributes,
- topologically correct mapping of intersections,
- correct road designations, including multiple designations depending on road category,
- all information required for determining the location of events, such as different linear referencing systems or mileposts along the road network,
- all information required for routing and traffic management, such as categorisation or access restrictions for different means of transport.
- As different users have different demands on a digital traffic network, the GIP provides the basis for multi-modal network integration, taking equal account of e government, traffic management and traffic planning applications.

The overview of the intended role of the GIP clearly defined some necessary technical requirements.

For these requirements a set of highly innovative solutions was developed:

- Object identification numbers of network elements do never change when being edited. This allows the usage of these network elements for eGovernment purposes and provides a possibility for third party applications to use the GIP as a reliable location reference system.
- Different organisations, e.g. municipalities can edit their subgraphs in a decentralised manner. These subgraphs are topologically fully connected, but are handled in a sophisticated way so that they do not influence any other subgraphs. Network elements in other subgraphs retain their attributes and their full geometry.
- All graph data are completely historised, so that the graph can serve as a long-term reference system for all legal processes.
- The graph is fully intermodal and manages relevant data about all modes of transport and about their interchange points and conflict points.
- The graph contains all necessary information for location references. This includes different methods of milepost systems, TMC location codes and addresses as well as references to commercial graphs (e.g.: Teleatlas).

With all different types of location reference systems integrated within the GIP, it becomes the central communication interface between different partners and their different reference systems. It thus becomes possible to integrate information, which was generated via GPS (e.g. accident location) into the GIP and output it into milepost system (for road maintenance authority) or into TMC location codes (for traffic messages).

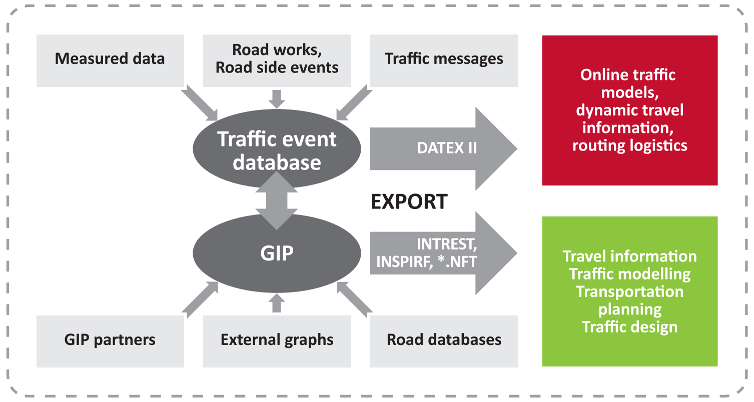

Figure 10: Using the GIP as information hub

The data model of TrIM was modelled according to the GIP approach, which fullfills all the requirements above. The data model is closely following the INSPIRE implementation rule, so that the information provision requirements of public authorities, resulting from the INSPIRE initiative of the European Union can directly be solved.

The data model allows the management of different levels of details, according to the modelling needs of different user groups. On the basis of the simple edge-node base network, a detailed model of cross-sections and use-conditions (like speed limits or travel restrictions for special modes of traffic) can be defined.

Regional graph development – the Veneto example

The Veneto Region Graph (VRG) was developed starting from the Base Graph (BG) that is the geo-referenced cartographic graph produced by the Veneto Region Cartographic Department.

With the aim to develop the VRG, also for modelling purposes, the primary links (in functional sense) of the BG have been identified, in this sense the functional attributes have been collected from the TeleAtlas® Multinet database (MN) as explained below. All activities have been agreed and approved by the Lead partner and are consistent with the "data model" of TRIM system.

The datamodel is set in accordance with the rules of common integration of interchange platform (Interchange Platform GIP). The information required by TRIM model were deducted, where available, from the BG and completed using the MN database.

A detailed analysis of the BG has been carried out performing a check (inclusive of some amendments) on the correction and updateness of the graph itself, using the orthophotos of the regional area and MN database as reference.

In order to extract the VRG arcs from the BG, the functional classification criteria used in MN database has been considered; a specific reference was made (in analogy with the work done by the Lead partner) to the information contained in the fields FRC (Functional Road Class), FOW (Form of Way) and ROUTENUM (Route Number). A specific procedure of "network conflation" between the two graphs (BG and VRG) allowed to associate with each link of the BG the corresponding attributes (FRC, FOW and ROUTENUM) from MN database. It was decided therefore to select the BG links characterized by FRC <= 3 and a non-zero ROUTENUM (choice of detail level representation).

Downstream of these processes, the VRG has been enriched with other link attributes, such as direction, number of lanes, capacity, free flow speed and link cost functions.

Considering as reference the available information sources (orthophotos and MN database), the consistency between Veneto and Friuli-Venezia-Giulia along the border has been verified. The activities described were carried out in cooperation with the working group of the Friuli-Venezia-Giulia.

In the area of logistics a lack of data in regional digital GIS-based networks and graphs concerning logistics platforms and nodes was identified. In particular, information about the "type" of logistics nodes and the "type" of node attributes was missing. The TRIM project developed pilot actions to integrate further strategic information to the existing ones. In particular, within the Logistics pilot private logistics nodes were mapped and information both for existing nodes and new ones was collected. Linking this information to the graph proved to be crucial for modern spatial planning in the field of transportation and logistics.

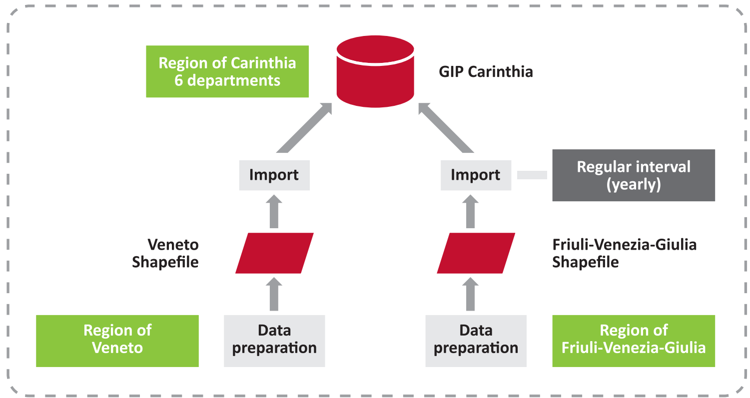

Figure 11: Maintenance of the TrIM graph

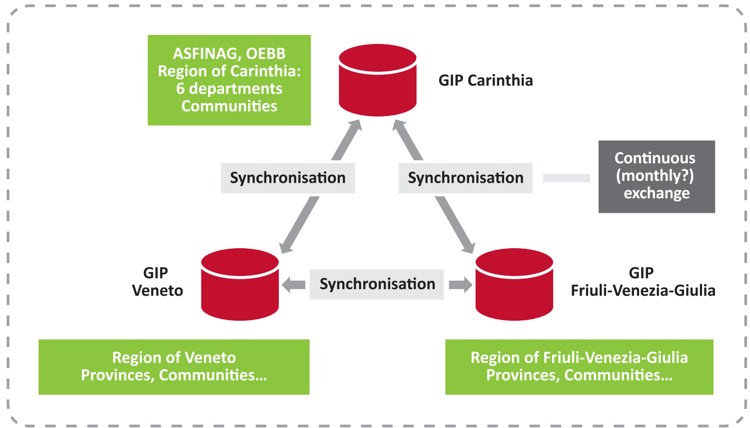

Figure 12: Alternative maintenance architecture for TrIM graph

Graph maintenance beyond TrIM

For the maintenance of the common graph several options were discussed. When defining the requirements of a cross-border graph a yearly update was regarded as sufficient. For this requirement it seen to be sufficient to exchange the graph information on a regular basis, using the shapefile structures defined in TrIM as common interface. Data maintenance is thus carried out as described below.

An alternative solution was discussed, which would allow a continuous update of the common graph. It was discarded because the necessary organisational preparations will not be available at all partners within the next 2 years.

The challenge – assuring quality and up-to-dateness

The situation at the begin of TrIM project showed that very specific approaches to data modelling for different applications of transportation data resulted in a situation of many different digital networks available, which are mutually incompatible. The resulting problem situation can be described as follows:

- A large number of parallel and redundant GIS models of transportation data exist
- They have been modelled with different application areas in mind (e.g. navigation vs. road administration) and cannot be directly exchanged, due to different geometry models, contents and data structures
- The maintenance of these different networks requires high efforts and is carried out redundantly
- This situation makes data exchange difficult, both between cooperating institutions and third-parties and thus makes information usage difficult, e.g. for transportation planning or traffic management
- Current digital networks have a low level of modelling intermodality. This is a hindrance for intermodal routing / navigation and intermodal transportation planning.

With particular reference to road accidents information, the partners have highlighted the shortcomings affecting the data available in the local contexts and their common characteristics with the aim to define a structure for the accidents data model component. In particular specific regard was paid to the quality of location information of accident data.

TrIM did solve some of these problems, like generating one integrated graph (replacing the large number of previously existing ones), providing one common data model for different applications and a sound basis for information exchange with third parties and intermodality.

But still the issue of maintenance remains central, in order to secure the investments of TrIM on a long-term basis.

Organisational considerations for maintenance

Technical considerations are just one dimension of securing data quality on the long term. The organisational issues have to receive at least the same weight, which can be illustrated with the example of related initiatives in Austria. There several steps have been defined organisationally to secure the initial investments:

- Coordination board for the GIS-T (GIP.at), involving all regional governments of Austria, the national government and the national transportation infrastructure providers (railways, motorways). This body governs all further developments of the GIS data initiatives and the development of related tools.
- Coordination board for eGovernment based on the GIS-T (GIP.gv.at). Its intention is to secure eGovernment applications, built on top of the GIS-T information infrastructure. The resulting eGovernment services will secure the data quality of GIS-T on a long-term basis.
- Standardisation initiatives for defining common minimum and standard data model and data maintenance best practice. This resulted in a first standard (GIP.at) in August 2010 and is currently being transformed into a regulation framework, which will become a legal basis for ITS in Austria by 2012. This standard secures data quality on the level of the data providers (administration), but also secures communication with planners and traffic engineers as well as the usage of the information by third-party applications, like navigation services.

eGovernment for road regulations: benefits for data quality

The road network is a highly valuable asset. Its operation and maintenance demand the greatest possible transparency and most efficient use of resources.

Roadside equipment includes a wide range of installations from guard rails, underpasses and flyovers to light installations or noise barriers. This equipment represents a valuable investment and is responsible for the quality of the road infrastructure from the perspective of the road user.

Traffic signs, road markings, road works – all key elements related to road traffic are covered by administrative processes. Yet opportunities for using state-of-the-art information technology in this area remain largely unused. Within TrIM project Carinthia refined its existing SKAT application, which is a modular software package, providing a comprehensive set of functions for E-Government tasks related to Road and Traffic operations. With SKAT, all data is consistently referenced to the digital road network, taking full account of any changes. SKAT information layers are available at all different levels of network generalization and network use – without loss of information. With SKAT the road authorities and road maintenance services have full access to all relevant information at once and in one consistent database.

In addition it became evident that eGovernment procedures in combination with GIP assure high quality and up-to-dateness of transportation data. This provides the reliable information base for the tasks of traffic information and traffic management and can also improve other management tasks, like accident data management or routing services for emergency services. Providing traffic management data for administration units supports the officials in daily work. Permanent valid and quality proofed data are the base for online information systems about traffic infrastructure for traffic services and e-government work-flows.

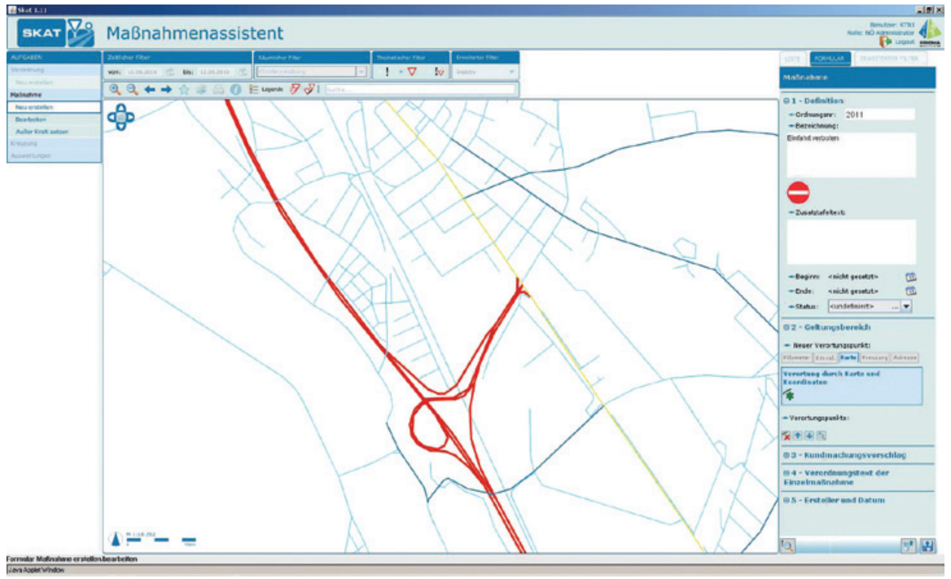

Figure 13: Prototype of future version of eGovernment tools for road authorities

The benefits for using the tools developed during TrIM were shown in several points:

- Permanent availability of traffic signs with link to movie, pictures, and regulation
- Traffic information combined with all kinds of GIS data and services
- Information about history of traffic sign
- E-government work flow with common rules for all districts in Carinthia
- Knowledge about statistical data over speed limits and general restrictions

The methodology developed is not limited to a special region, but can be transferred to other regions easily. In the e-government process Carinthia has shown, that it is possible to connect several administrative units, to improve traffic regulations and to support them efficiency. This will assure on a sustainable basis a consistent data base for traffic management and traffic information services.

Road monitoring

Road monitoring pilot AKL

The public administration has many tasks in the field of traffic management and e-governance which requires information about infrastructure along road network. Therefore a pilot on road monitoring was implemented with the goal to survey the current state and attributes of the road infrastructure to get an overview of the expecting effort. New harmonised procedures for collection and validation of road related data will be implemented, by development of tools and procedures. This will secure data quality and support all road and traffic management tasks on a long-term basis. The main requirements on the pilot 'road monitoring' are based on different aspects:

- **administration**
  there is low knowledge about real inventories of traffic signs, the goal is to get more quality assurance by management of traffic signs, automatic achieving of data of road network and ground markings.
- **traffic safety**
  a daily problem is the fact of too may traffic sign (wood of traffic sign) that can lead to confusion for traffic participants. The goal is to have a tool which can help to reduce traffic signs.
- **legal validity**
  it is known, that some traffic signs are not conform to legal bases. The goal is to get more legal validity by checking traffic consistence.

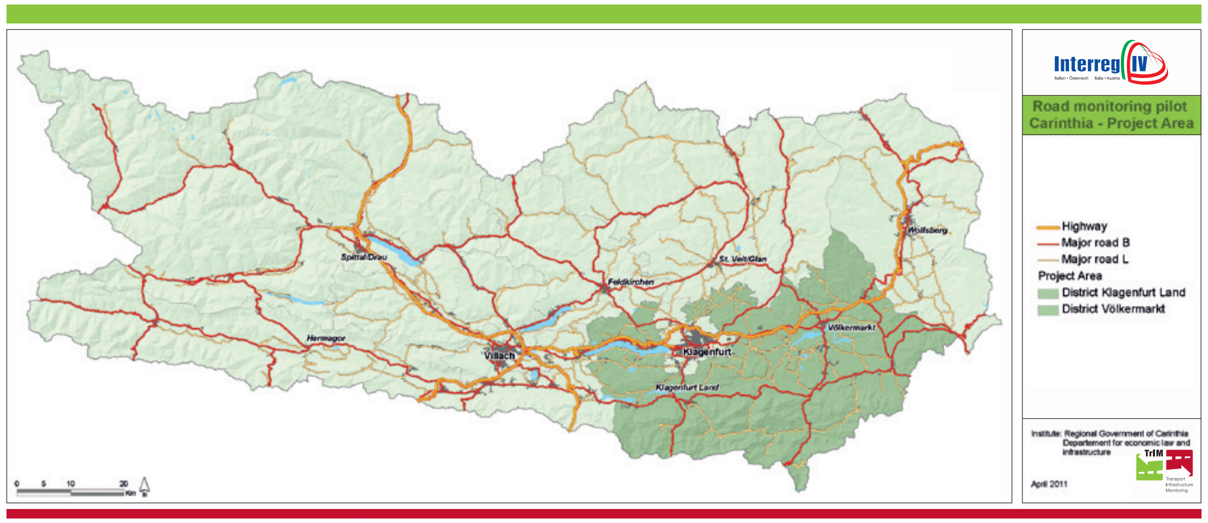

Figure 14: Major roads B and L, district area Klagenfurt Land and Völkermarkt

Within TrIM project in the area of Klagenfurt-Land and Völkermarkt data of traffic signs, road marks, ground markings and road condition were measured.

The data collection was carried out through a driving high performance laboratory, called ‚RoadStar', from the Austrian Institute of Technology (AIT). This was managed during flowing traffic with high precision sensors, dGPS and cameras.

After data collection the data integration and data analysis followed. Data about traffic signs had to be imported in an oracle database and the data quality had to be verified.

Figure 15: Driving high performance laboratory, RoadStar' for data collection and analysed data

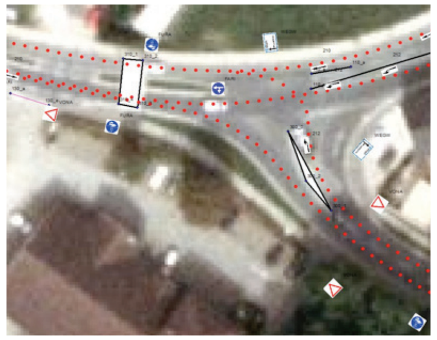

Figure 16: GPS points of Roadstar tracks

Figure 17: Results presented in SKAT system

road type	district area Klagenfurt Land	district area Völkermark
major road B	98,378 km	150,109 km
major road L	251,562 km	197,507 km
km marks	1731	1544

district area Klagenfurt Land	district area Völkermarkt
5143 masts (Steher)	3819 masts (Steher)
6964 views	4597 views
7353 pictures	5546 pictures
10626 traffic signs	6648 traffic signs

Figure 18. Data collection statistics

Improving traffic monitoring in FVG

Constantly providing traffic data plays a crucial role if we want to improve road management in particular in case of emergency and to help providing users with suitable information, and to support decision making in the phase of transport planning and programming.

The Region Friulia Venezia Giulia does not have constantly available information about traffic on its regional road net; the latest traffic surveys about the regional traffic fllows have been carried out in the years 2000 and 2005 and were limited only to some days.

The region Friuli Venezia Giulia has set the goal, within the TrIM project, to develop an authomatic traffic data monitoring system for a specific pilot area of the region. This will be the first step to create a future region-wide traffic monitoring network. The pilot area will be between the two provinces of Udine and of Gorizia and within this area the system will be able to monitor and provide information of traffic flows on some of the main extraurban roads.

The system structure has two levels:

- Peripheral level
- Central level

Peripheral level is made up of 12 traffic detection stations, and each of them will monitor one road section with one lane for each way of traffic. Every monitor station has two “above ground” sensors mounted on a street pole over the center line.

The sensors selected for this pilot study are triple-tech traffic detectors that gather data through the following technologies: passive infrared – PIR, ultrasonic – US and doppler / radar microwave – MW. Using these sensors every detection station collects the following data:

- Detection station ID (to find the correct detection point)
- Day and time (dd / mm / yy – hh:mm:ss)
- Monitored way of traffic
- direction (the system can see if a vehicle is driving in the wrong way, for example during a overtaking)
- running speed
- vehicle lenght (useful for classification)
- classification (we have set 9 vehicle classes: motorcycles, cars, trucks, articulated lorries, busses, etc…)
- GAP (distance between two consecutive vehicles)
- Occupancy rate

Collected data is sent every 15 minutes to the central level via GPRS, that is through mobile network. Every detection station is powered by solar panel and this allows more flexible positioning of the station as no connection to fixed power or telecommunication network is needed.

Central level is made up of:

- a Data Center for data archiving that allows for sensor configuration, system maintenance, etc…
- work station allows operators for looking through and process collected data by means of a specific software

Furthermore system is able to provide previously set statistical reports such as:

- Annual Average Daily Traffic (AADT) calculation
- Traffic peak hour (Tph) calculation
- 30° peak hour calculation
- Trend in traffic variation (comparison to AADT)

The traffic data collected with the software developed in the TrIM project will allow more precise assessments during planning and more reliable traffic simulations.

So the long term goal of the Region Friuli Venezia Giulia is to let this system work on the whole regional traffic system so to have always updated information of the regional road network.

Data collected during this pilot action have also been used for the study the Region Friuli Venezia Giulia has conducted in the WP5 – Road safety pilot – (see also chapter 9), where the same traffic data have been correlated to the road accident data that are archived in the Regional Road Safety Center.

Traffic monitoring in Veneto

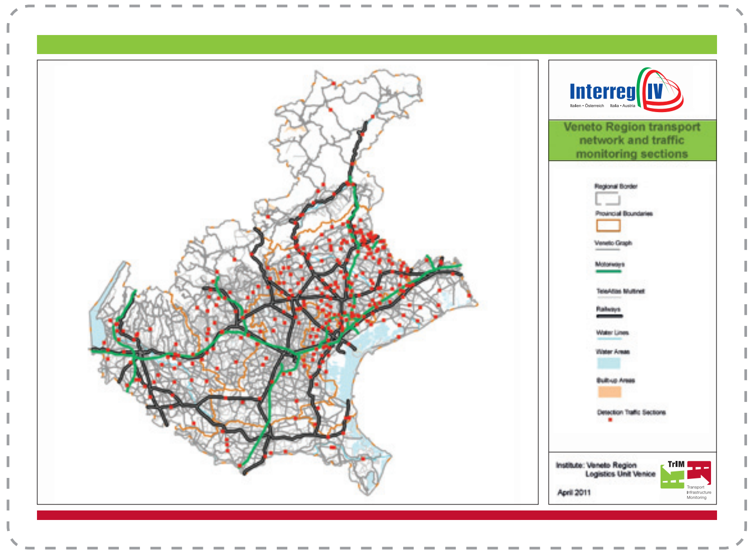

Figure 19: Veneto Region network and traffic monitoring sections

The SIRSE project promoted by Veneto Region with the collaboration of the seven provinces, under the coordination of a group of researchers at the University of Padua, aimed at systematizing the collection and dissemination of monitoring traffic data on roads of regional interest. The first phase of the project (SIRSE 1999 – 2000) had allowed the establishment of a significant basis for a system of automatic detectors for traffic counting of vehicles classified according to different classes (the “SIRSE standard” provides for the classification of vehicles in 7 length classes and 7 same classes as well). In the first phase about 140 measurement points on major roads (including the national, regional and the provincial roads) were activated. To date the points of measure are more than doubled since about 300 stations equipped for automatic detection. Accordingly in the regional information system are loaded data related to 150,000 days of survey. Within TrIM project the each point of measure have been referenced to a specific link of the graph by means of a table of correspondence. This association let to build an effective relational mechanism thus enabling to extract information from data and perform further analysis.

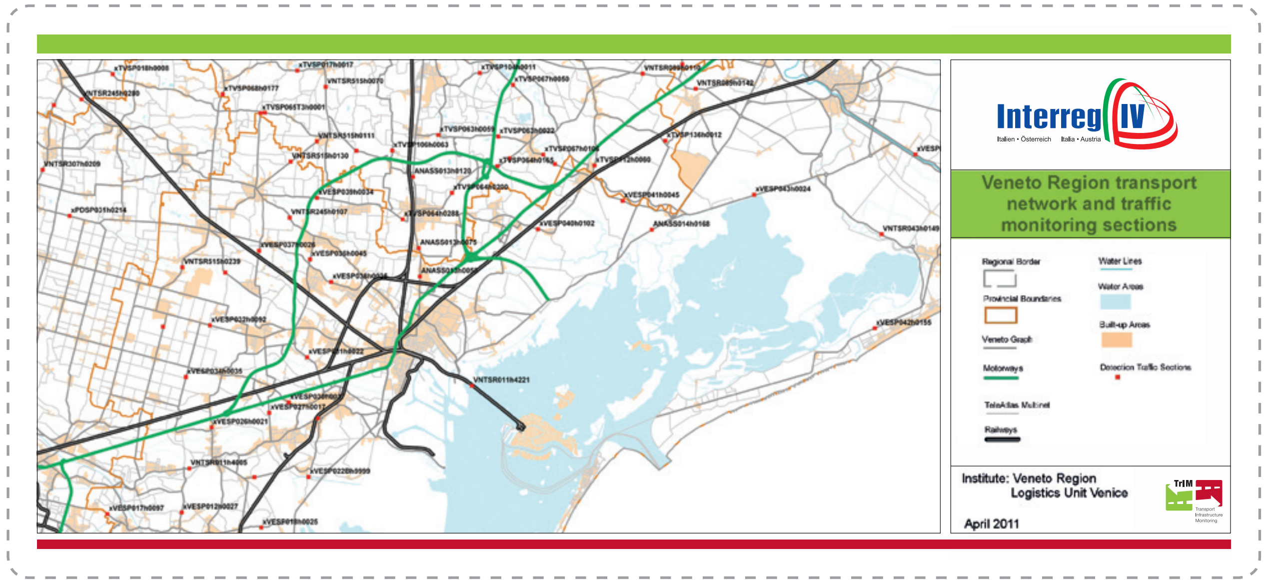

Figure 20: Transport network and traffic monitoring sections (detailed view)

Traffic safety

A group of specific activities of the TrIM project covered the important topic of road accidents. The issue has been addressed from the perspective of setting up the tools for analysing and explaining the phenomenon thus correlating accident data with the parameters describing the infrastructure characteristic. According current practice, the accident rate phenomenon is analyzed mainly with reference to behavioral aspects thus correlating the characteristics of events (such as the type of accident and the type of damage) with the characteristics of the driver (physical or mental condition, type of infringement, etc). Therefore official statistics, which indicates as causes of accidents only human behavior and poor compliance with traffic regulations, determine the tendency to neglect the correlation analysis with the infrastructural characteristics. However many significant experiences have demonstrated the efficacy and opportunitity of accompanying awareness and encouragement of good behavior also with the investigation of infrastructure condition. In fact those conditions proved to be an influencing factor of driving behavior and, consequently, of accident rates.

In general the provision of data related to traffic safety suffers from the quantitative and qualitative point of view. In fact the coverage of the data available is limited to a little portion of the reality of the phenomen. Moreover, even if available, data are often uncomplete and not standardized. A complete and widespread collection of data is the first preliminary step for elaborating information and consequently to develop a comprehensive proposal of solutions shared in an interregional context. In order to cope with these shortcomings specific pilot projects have been developed in both Veneto and Friuli Venezia Giulia.

Traffic safety pilot Veneto region

The starting point of the pilot project "Road Safety" was the definition of a common data model useful to archive road accidents information and, as a consequence, to standardize the features necessary to describe the phenomenon. The model record has been derived from the analysis of the ISTAT (Italian National Institute of Statistics) record form (mod. CTT / INC). This solution matched the road accidents data currently available in the local contexts (Veneto, Friuli Venezia-Giulia and Carinthia).

With reference to the Italian situation there are two different processes that is used to collect data (see figure below): in the first case the polices (local or national) after the detection of the accident (local level) fill the ISTAT form and send it to the ISTAT (National Bureau of Statistic, national level). ISTAT analyses data and produce some statistics about the phenomenon. In the second case a road accidents observatory collect data from polices and send (after a check process) data to ISTAT. Regardless of the process the data are stored using a track record consistent with the ISTAT form CTT / INC.

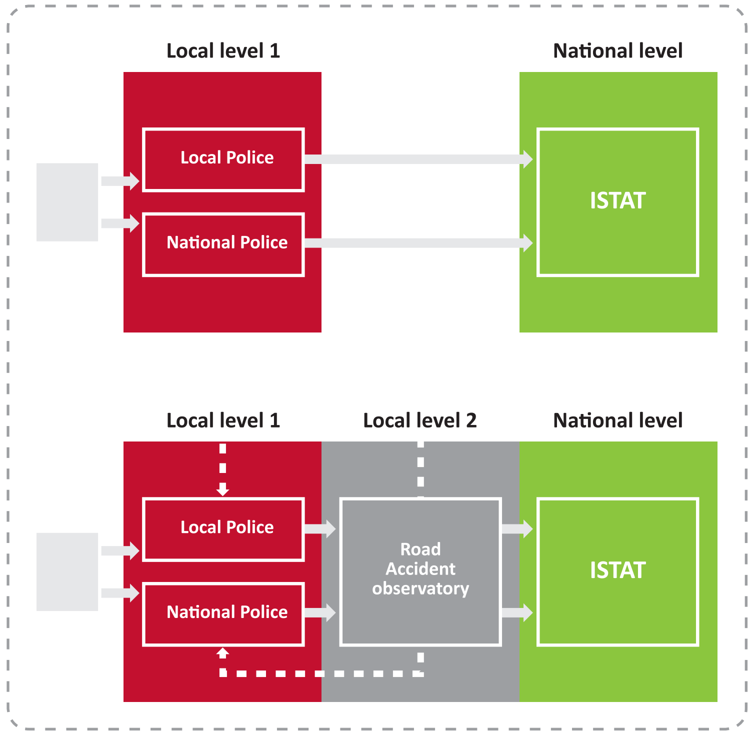

Figure 21: Road accident data in Italy, information flow (from detection to ISTAT)

The ISTAT survey form has some shortcomings regarding the identification of the location of the accident. In fact, the localization ("exact" position along the road segment) of the accident is often imprecise or not available (especially in rural area): the operator (police man) often does not fill the relative field because there are no information available, such as house number or milestone, about the position; moreover, all information related to accident localization is entered into a text field generating problems in decode process (often is qualitative information). Similar shortcomings characterise Austrian accident data.

During the project the partners have identified and developed a road safety data model structure. This structure was inspired to ISTAT form components. The database has been developed in Oracle as a component of the Road Network Information System. After that and with reference to a study area, ISTAT accidents data have been acquired and used to populate the database.

Each event (accident) has been localized over the network using linear referencing system whereas information about the accident's position along the road segment is available (see below).

Using the stored data is possible to assess road accident indicators. These indicators have been identified / selected from a set of indexes reported in the literature consistently with the data available. The information system is able to incorporate other indicators useful to increase the information quality.

For the reasons mentioned previously, within the activities implemented in Veneto Region safety pilot, the development of an informatic tool designed for linking the accident phenomenon with the road infrastructure system (and therefore the TrIM information system) plays a central role. Therefore a purpose of this pilot project was the development of a procedure prototype for the integration of different representation systems of the road and for the automatic spatial correlation of accident events from the multiple spatial referencing systems (coordinates Gauss-Boaga, WGS84, other) or linear (administrative progressive systems, the house numbering system). The information procedure allows the automatic correlation of events (punctual or linear) recorded in various information systems (used by the management authorities) and the information system based on the TrIM representation (figure 9.1). This correlation allows the events (accidents or other events) to be placed in the TrIM system (graph and attribute tables) starting from the original placement features on the different information systems (native position attributes) that have to be integrated.

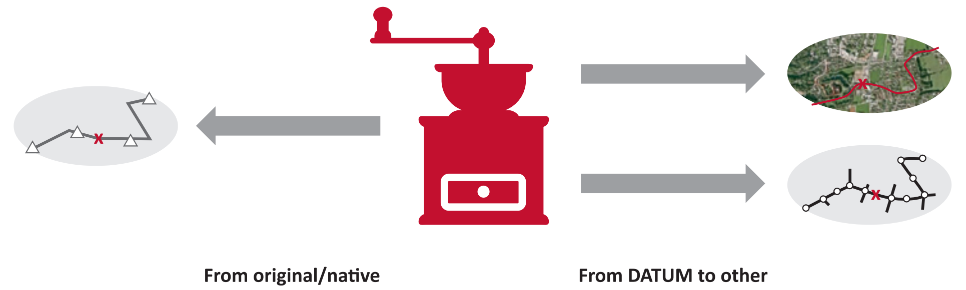

Figure 22: The TrIM grinder produces a direct spatial correlation using a two steps transformation

The TrIM pilot project Road Safety has been implemented on a regional network of 50 km of extension, and allowed to test the functionality and effectiveness of the procedure for accident data correlation with multiple information systems currently in use and in particular with the TrIM system graph. From the methodological point of view, the procedure is based on the identification of a physical system (datum) of spatial reference (anchor-points and anchor-sections) identifiable, at the same time, in the real world and in different systems of representation of the road (linear and geographical).

The procedure has been validated on a sample network of about 50 km using data from different sources and by locating around 1,900 events (accidents, road equipment, and other events) of which 900 punctual events and 1,000 linear events. The events, originally recorded by local owners on different information systems, have different and heterogeneous "native" spatial referencing attributes: several geographical and cartographical references (Gauss Boaga, WGS84); different linear referencing (such as old and new administrative progressive, references to the civic number, references to locations from odometry readings).

The use of the procedure provides a crucial support to the development of the Veneto regional project, aimed at coordinating the statistical accident collection with particular attention to quality of information on the location of events. In fact, the pilot project has shown that only in the 31 % of cases (1,250 accidents as a part of the total 4,000 accidents recorded in the 12 municipalities during the period 2000 – 2008), the location is coded (road code + milepost km). For 1,400 (35 %) cases the position can be reconstructed only with an expensive manual operation of interpretation the description contained in a text field. The remaining 1,350 accidents (34 %) have no spatial referencing attribute. The use of the automatic location procedure of events, with the positioning of the various road network representation systems, has to be considered as an incentive to improve the quality of statistics with particular reference to the spatial referencing attributes.

Traffic safety management in FVG

The Region Friuli Venezia Giulia manages a service called Regional Roadway Safety Center (CRSS) where traffic accident data having taken place on region roads are collected.

The police registers this data directly into the CRSS system using the information reported on the accident surveys. Police also marks every accident on a specific map which will then allow to create a risk map to identify those black points where special measures are required to reduce the number of road accidents.

CRSS also interfaces with data collected by the local health services so every single accident will also have the consequences for the involved persons (type of wounds, prognosis, number of deaths). This allows an estimation of the social costs the road accident has generated. During the Road Pilot Monitoring (see also chapter 8) the Region Friuli Venezia Giulia could also implement the first module for an automatic and continuous traffic data monitoring system which has been applied to a pilot area of the region. Therefore TRIM allowed the regional government to have data related to vehicles moving on the regional road network which is permanently collected and systematically processed whereas before it should implement specific measuring campaigns hold unsystematically and on a limited time.

Using the available data, in particular traffic data collected through a ongoing monitoring which was carried out in a pilot area as well as the accident data applying to the same area and collected between 2007 and 2010, the Region Friuli Venezia Giulia has decided to analyze, within the scope of the Road Safety Pilot, how some endogenous factors (such as volume, composition and speed as a function of time) can influence all factors that potentially can cause an accident. The aim of the Safety Pilot was to set an accident case record related to traffic conditions. Specifically every monitored traffic condition was associated to the number of accidents that a main accident factor had caused which the Italian Statistical Office ISTAT has codified and is used in the police reports.

More in detail, to a certain accident factor and a period of time a Cartesian plane has been used. The variable on the y-axis is the number of homogenous accidents as cause factor referred to a defined past period. The variable on the x-axis represents the traffic characteristics which is the result of a combination of composition, volume and operating speed.

The expected result to achieved at the end of the TRIM project is to have an initial state curve accident abacus (June 2011 – 0 state), that is to say the initial state is where no actions have been taken to decrease the accident risks, according to the research outputs. These curves are defined by traffic characteristics, causal factor and period of time.

In a perspective view (after the TRIM project) we aim to provide an ongoing accident curve evaluation (considering traffic, cause and time after implementation of the measures foreseen to increase safety and in the long time to reach the curves stabilization. This state will show the physiologic relationship between traffic characteristics and single causal factor.

This research could then be applied to the whole region and not just to the pilot area, because of the implementation of the traffic flow monitoring to the entire regional network and the availability of a former accident data set collected at the CRSS.

The added value expected by the end of the research activities (among which testing the effectiveness of actions to increase traffic safety) is the certification of the cross board authorities of increasing traffic safety conditions in the main roadway network up to the stabilization of the accident curves.

Results have been achieved through an evaluation of:

- Traffic data (average values of traffic composition, operative speed and equivalent volume) taken in seven road sections (of a total of eleven) referred to a typical day of operations and to free flow and no-free flow traffic conditions;
- Incidents data (number and main incidental causal factor) referring to the road sections monitored by traffic data collectors.

This first research phase still has got several limitations due to the poor number of traffic data collections. These limitations are going to be fixed soon because of the extension of traffic data collections in the whole Friuli-Venezia Giulia Region and the availability of new incidents data provided by the Police.However, five different probability schemes have been developed, each related to no-free flow traffic couples (each related to each incidental factor). The whole couples represent the selected risk conditions (referred to the incidental factor) of one traffic typology compared with another one in the pilot area of the regional network in the current state (may 2011).

Logistics

Background, requirements and objectives of Pilot Project

The overall goal of the pilot project was to enhance planning and monitoring activities at transnational level by focusing on the logistics aspects, in particular by integrating logistics and multimodal infrastructure information (logistics nodes) into the transnational graph. From official planning documents a lack of information was identified in terms of "type of nodes" and "type of data", since mainly "public" nodes and "quantitative" information are traditionally monitored, while "private" nodes and "performance-based" (qualitative) information are missing.

Monitoring (public and private) logistics platforms with their significant attributes (quantitative and qualitative) and representing them on a graph is essential in modern spatial planning because of various innovations under way that focus on a number of principles:

- **system integration:**
  today logistics planning processes at spatial level focus on the opportunities to "link together" logistics services and transport modes, rather than on single services and modes. Therefore, "friction costs", e.g. those related to logistics platforms, are of utmost importance to develop and optimize an "integrated" system. Logistics nodes and related information should no longer be investigated in isolated terms – therefore producing multiple database – rather they should be integrated in a common database and graph;
- **flows-stock integration:**
  general transport planning objectives directly depend on nodes planning and management, thus nodes and arcs functions should be jointly addressed;
- **logistics chain approach:**
  planners should focus on various specialized logistics chains, rather than generally considering mobility mainly in quantitative terms (O / D matrix, tons, etc.) only. Thus, a qualitative analysis aiming at identifying and monitoring the degree of specialization of logistics platforms is essential. Logistics platforms should no longer be viewed as "unspecified" nodes where "unspecified" flows are moved, rather as nodes with specific (i.e., specialized) functions;
- **added-value logistics services information:**
  in particular the information provided by logistics nodes about specific services (manipulation, assembly, etc.) are of utmost importance. The project will provide such information so as to show where and how added values is created on the territory (through GIS layers);
- **logistics system assessment:**
  logistics system competitiveness should be monitored and assess not only on the basis of traditional quantitative parameters (tons, UTIs, TEUs, etc.) but also based on performance ones (productivity, economic results, etc.). An "economic" and "qualitative" picture of the logistics system is relevant, on top of a traditionally quantitative one. A tremendous lack of appropriate data and information is envisaged in this respect, and it is addressed in the project. TRIM aims to be a front-edge project developing a new information management system to support modern transport and logistics planning activities;
- **logistics as a "territorial resource" and a mean to improve spatial and regional competitiveness:**
  strategic logistics assets such as logistics nodes should be viewed as "resources" of a territory determining its degree of competitiveness, since today logistics is a strategic value-creating activity and it has become more and more important for regions / countries competitiveness. Mapping logistics platforms is useful to identify areas with strong logistics "vocations", therefore enabling policy-makers to assign resources and identify policy actions.

On the basis of the above innovative requirements of modern logistics spatial planning, the pilot project was performed with regards to the eligible areas of the Veneto Region.

Pilot Project activities description

The overall framework consists in the following activities:

1. concept and methodology definition.
The overall methodology can be presented as follows:

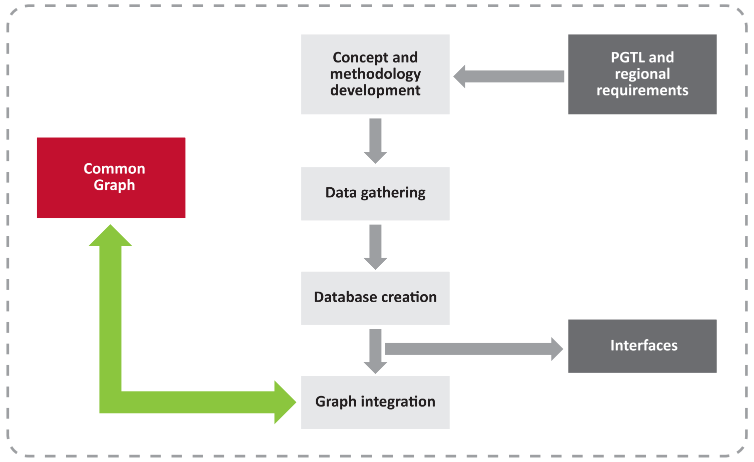

Figure 23: Methodological work-flow of logistics pilot

In particular, the methodology identifies the most important parameters to be surveyed. They were classified in the following sections:

- specialization parameters of the logistics platform (type of node, type of logistics operators, type of product-chain, service portfolio, etc.);
- assets and facilities (location, available space including warehouses, railways and road connections, land / rent costs, ICT endowment, etc.);
- freight traffic (volumes, inbound and outbound markets, etc.);
- performance parameters (quality of logistics services, average inventory, transit-time, working hours, economic results, etc.).

Each parameter can be used as a GIS-layer in order to visualize the appropriate logistics characteristic on the territory.

2. data gathering (survey):
data and information of the logistics platforms were collected through on-the-field activities (questionnaires, interviews, etc.) and official sources and they are managed in a database. Information refers to the eligible areas of the project (Treviso, Vicenza, Belluno);

3. database creation and graph integration (interfaces):
an enhanced logistics database was created with data from the pilot activities, basically concerning new nodes and new parameters. An integration GIS platform was developed with ad-hoc interfaces to feed the common transnational graph. Information usage was based on various queries to obtain different GIS-maps related to various logistics parameters and platforms locations. The tool was designed to be flexible to handle various types of data.

Main results of the TrIM Pilot Project

The pilot project identified 77 logistics nodes in the provinces of Vicenza, Treviso and Belluno. The questionnaires were sent to 50 companies, with a 34 % response rate. Information was collected in a multi-tables database. The database was then integrated in the regional graph through GIS interfaces. In the following, a sample of graphic results are presented.

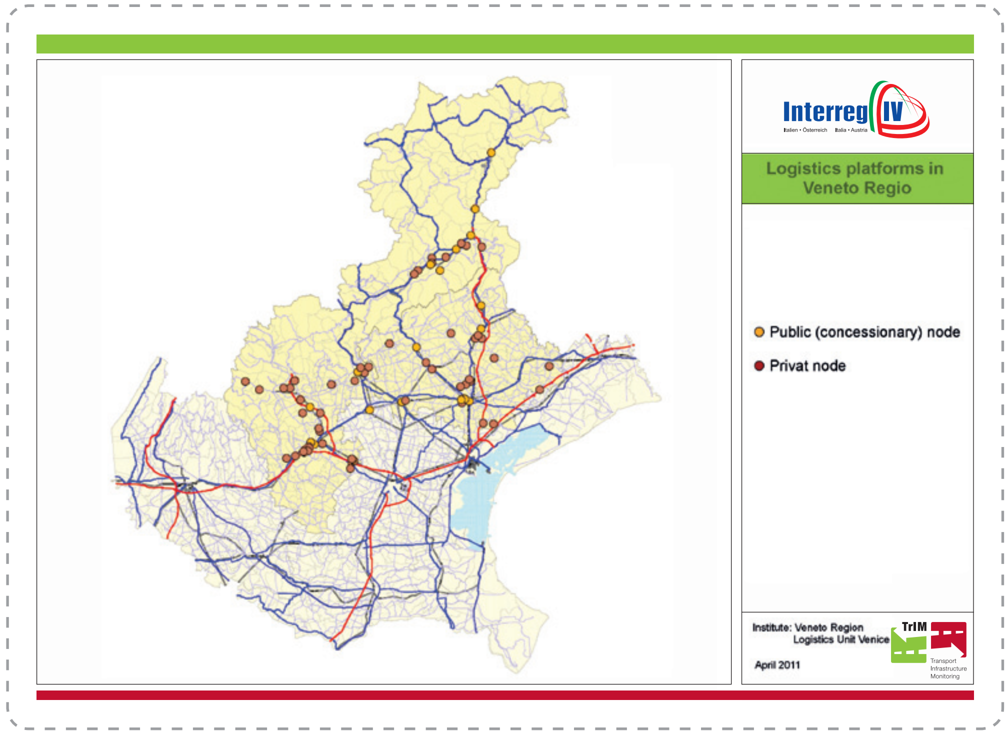

Figure 24: Logistics platform locations in the eligible area in the Veneto Region

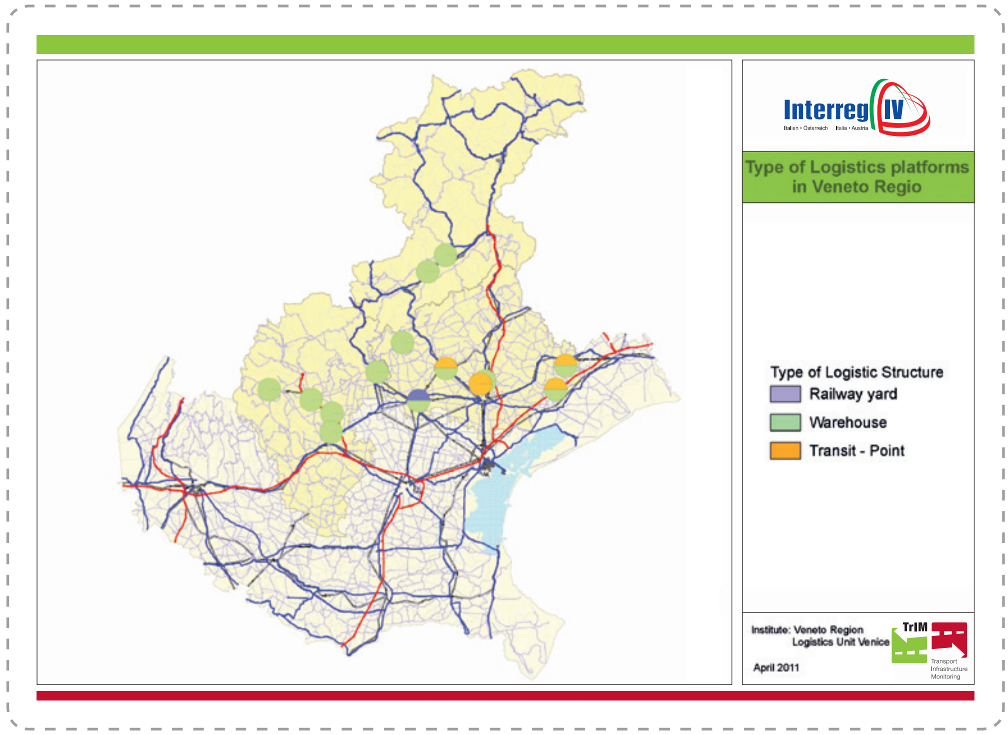

Figure 25: Type of logistics structure

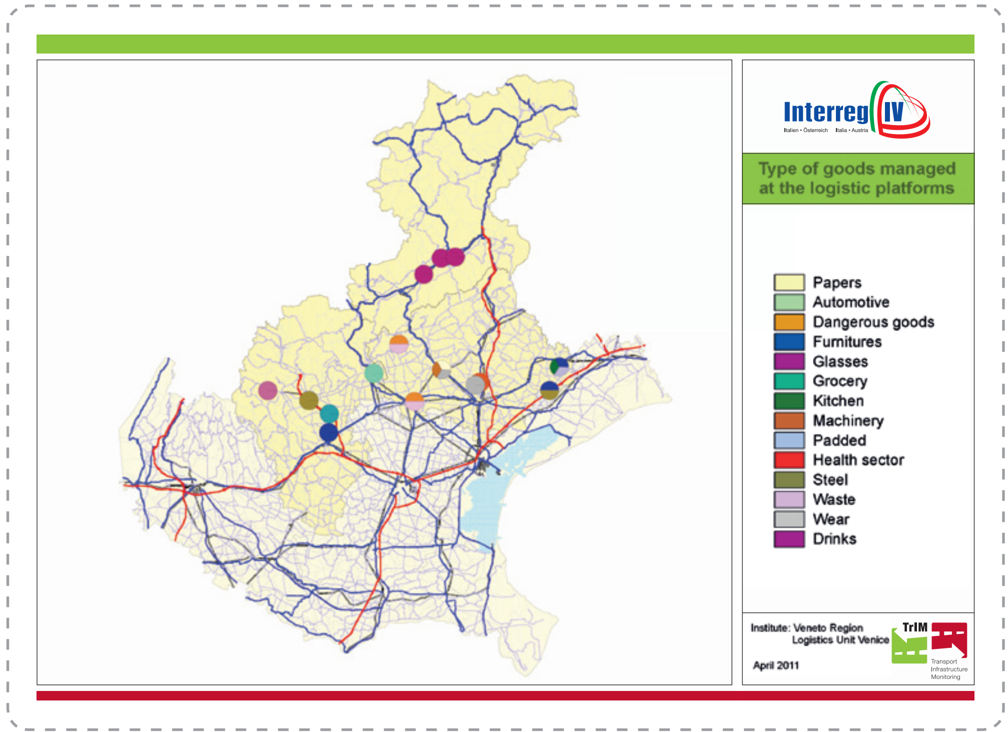

Figure 26: Main product-chains operated at the logistics platforms

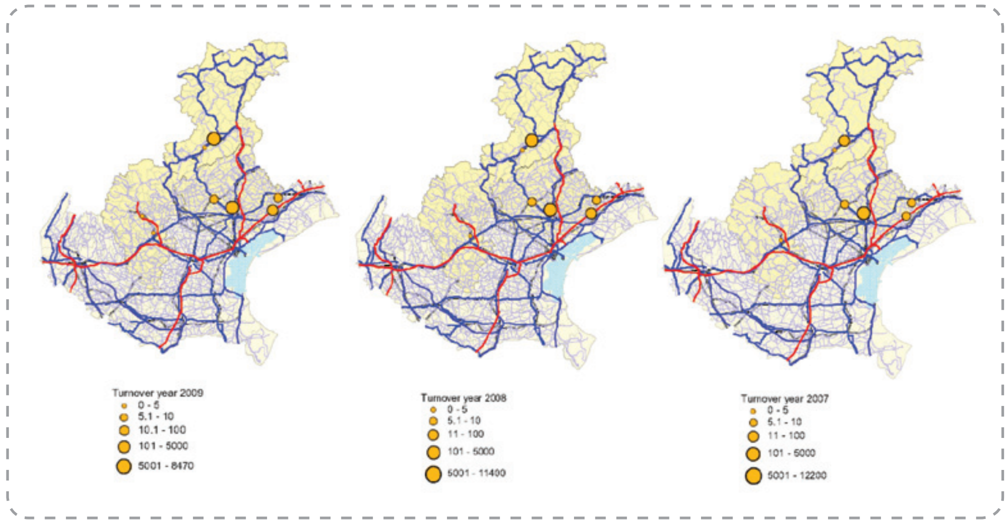

Figure 27: Logistics platform's turnover

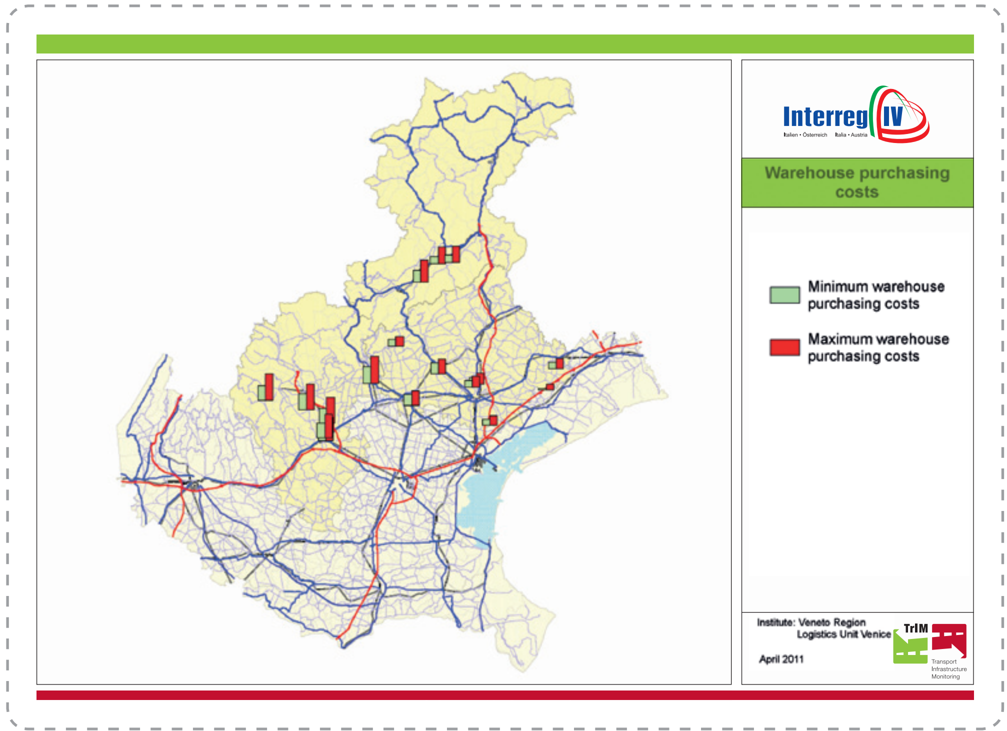

Figure 28: Warehouse purchasing costs (€ / sm) (min and max)

Through the pilot project, we developed an innovative conceptual model and methodological framework, for which ad hoc attributes of logistics platforms were identified. The TRIM pilot project should be viewed as a success story giving a preliminary contribution to the development of an innovative model of spatial transport and logistics planning.

Added value and transferability of the methodology

Based on the innovative approach, various parameters and logistics platform locations, as they are visualized through the GIS interface, are integrated in the common graph, thus bridging a current relevant information gap.

The project produced added value first-hand information, since the approach is innovative and former data were not available. Actually, the pilot application should be viewed as a first step to develop an innovative information system at regional level in the field of logistics planning.

The overall results of the pilot application enable the regional planner to have a more appropriate and exhaustive picture of her territory from a logistics point of view, so as to define effective and fine-tuning policy actions in the field.

The focus of the pilot project was to create a flexible tool: to be able either to receive and handle a wide range of information and to connect to any information system used. In the event of a change in the graph or in the database, the tool will certainly need to be updated and re-set but the methodology and the framework used are certainly applicable to any other geographic information system. This attribute for sure gives an important added value to the developed tool.

Future perspectives of the pilot application

In the pilot application the area of investigation was relatively small, however it allowed to underline important spatial relationships, so it is expected that strategic logistics synergies will be easily identified with a more enlarged area.

The project application, among other things, underlines how logistics information is strategic for regional development and planning. The results that spring up from this information availability are essential to conduct an overall analysis and assessment of a transport and logistics system. Thus, such information needs to be integrated in the technical tools (graph, GIS, etc.) to be used to effectively plan the logistics systems at regional level. Therefore, it is expected that the proposed approach should be extended to other areas of concern, and possibly it should become a core component of the transnational common graph and of the overall planning and management system of transport and logistics. Another important line of development of the tool will be based on the possibility to use it as a monitoring instrument; the mapping could be the basis of a dynamic monitoring of logistics nodes performances, to estimate the changes of competitiveness levels in a region or country.

A further step for a future development could be the realization of a web-based interface that allow to access the data from any internet connected computer, this will multiply the users and the utilization of the instrument, that could be used not only for logistics planning but also for active logistics business.

In particular in the case of previous explained development, an important issue that should be solved is the propriety of data collected and the rules of their dissemination. A balance strategy, able either to protect strategic information and to allow the planner to improve the system should be found.

Summary and future developments, relevance

In Austria the further development of the transport data platform is organised on the basis of GIP as a technical and organisational approach. Currently the technical developments and data integration steps have been carried out and organisations are starting productive use.

It is clearly seen that the success of the platform role will strongly depend on attracting additional users and applications, to place their information onto GIP platform for location referencing and to use existing data from GIP and / or functionality.

This seems realistic, because in principal a high number of thematic fields and related applications rely on a high-quality graph and need to be integrated via the integrated graph. Usually a clear distinction is drawn between data providers, data integrators and data consumers (applying the data for a certain task). With the GIP as the transportation network information platform, this situation changes – as visible in the graphic below. The GIP acts as information integration platform, but using eGovernment processes (as described above) typical “consumers” of transportation data – like the road authority – become information producers. The organisational framework of well-defined eGovernment processes together with the technical methods of GIP assures high data quality and user accetance.

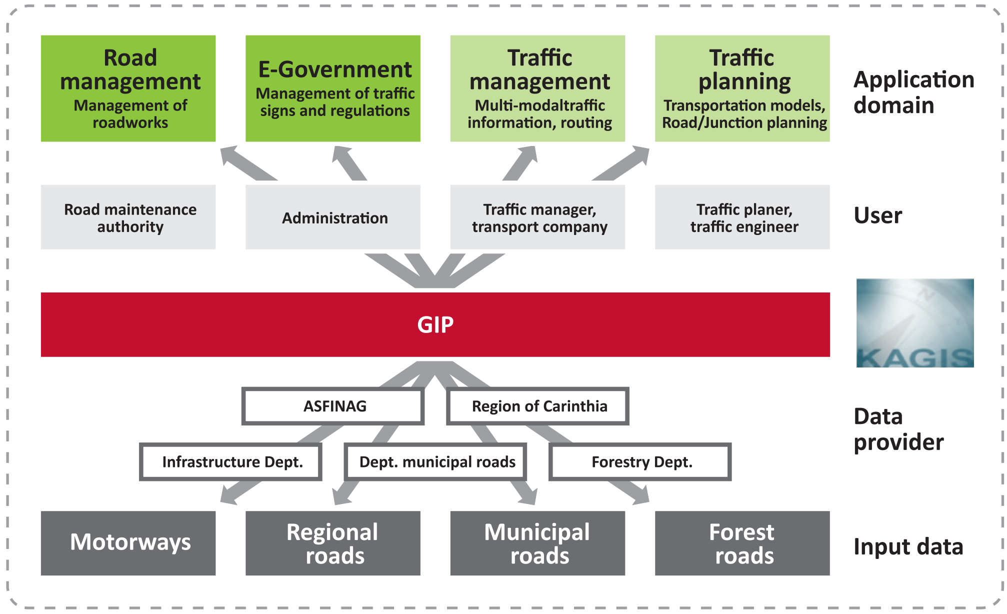

Figure 29: Information integration platform for transportation data (Carinthia as example)

When using the GIP as platform this should in future be achieved via standardised services, which

- allow to exchange location references information between different systems;
- make systems to be integrated aware to location changes; this will be achieved by defining a mechanism for attaching location referencing information to different types of geo-objects in these systems (in a standardised way) and by defining procedures, which maintain these location references in case of changes in the underlying transportation infrastructure
- define notification mechanisms for communicating relevant changes from the GIP to all applications which relate to the features in GIP
- convert location references between different location reference systems, as needed for different systems to be integrated. The integration is based on a comprehensive management of the location reference systems in GIP (especially linear referencing systems)
- integrate data produced with these applications into a GIP based data pool, using the mechanisms of web feature services (WFS), metadata identification and integration via web services.

In cross border context, the TrIM experience has established a bridge for different regional systems. The interface mechanism defined allows to share data and methodologies in consistent way, paving the way to shared and harmonized planning activities in the interregional context. The flexibility of the approach and the chosen interchange mechanism give each partner the possibility to act indepently according to its own need and resouces. Nevertheless, in the mean time, the establishment of solid integration mechanism allows him to act as a part of a network. Moreover, the activities carried out have established a solid framework of interoperability that can be easily further developed covering other themes of common interest. Finally cross fertilizatyion activities established with other Interreg projects confirm the interest on the ideas and solutions developed within TrIM.

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