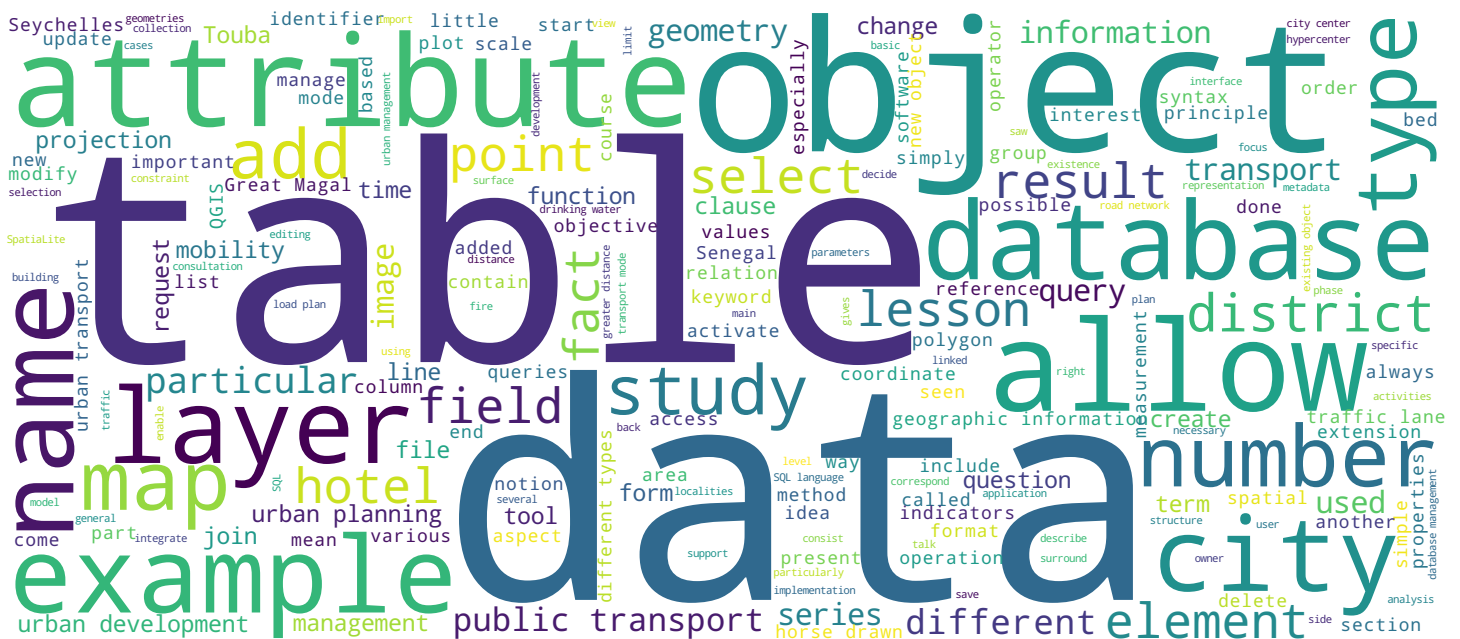


An Introduction to Geographic Information Systems

Case study – Urban development and mobility in Touba

Stéphane Joost, Marc Soutter, Fernand Kouamé, Amadou Sall



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Video



The city of Touba

Touba

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In this case study, we will present a study of urban transports and urban planning on the city of Touba. It is a study that focuses on the questions of transportation management and mobility. With as a filigree, all the thinking on the urban development, the development of the city, the urban management, so a study that involves a large part of questions on transport and mobility a part more... less visible perhaps of urban planning and development and a study that included a GIS section that we are especially interested in. We will first briefly discuss the town of Touba then we will present this study of urban transport and urban planning that we will not see in detail, we will focus on the main results of the study, which we will review a little before focusing more specifically on the GIS module. Touba is in Senegal not far from Thies, about 400 km East of Dakar. We can see already on this satellite photo taken from Google the city of M'Backé which is neighboring the agglomeration of Touba and in the city of Touba, we can easily identify the great mosque in the center and the ring road, the great bypass which surrounds the city and which we will see a few times in all the documents of this study.

Notes

Summary



0m 24s

The city of Touba

A city devoted to spirituality

- The great mosque
- More than 500 secondary mosques
- Several pilgrimages among which the **Grand Magal** bringing together several million people over a couple of days



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Touba is a spiritual city, capital of the Mouride brotherhood, a holy city founded in 1887 by Sheikh Ahmadou Bamba, with a population that was reaching 25,000 inhabitants, thirty years ago and now reaching more than 500,000 inhabitants so an extremely rapid growth. Touba is a city devoted to spirituality with the great mosque which was completed in 1963 and more than 500 secondary mosques in different parts of the city. Amongst the major events that punctuate life in Touba, the great pilgrimage, the Great Magal with other smaller pilgrimages, but the great Magal, which drains several million people in a few days.

Notes

Summary

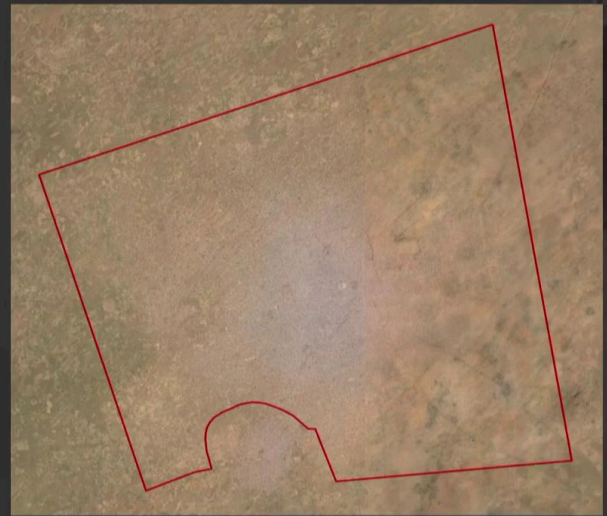


2m 20s

The city of Touba

A city that is not a city !

- The 33'000 ha of the city belong to one private land title
- Lacking official city status, thus lacking city administrative structures: no technical department, no urbanism department, etc.



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Touba is also a city that is not a city since the 33,000 ha occupied by the city, constitute in fact a private land title so that the agglomeration of Touba, since it cannot be called a "city", doesn't have the official status of city, it doesn't have the administrative structures of a city that would be technical services, urban planning services, the deconcentrated (INAUDIBLE) of central ministries etc. etc. The city management is therefore done more empirically, which does not prevent things from working relatively well.

Notes

Summary

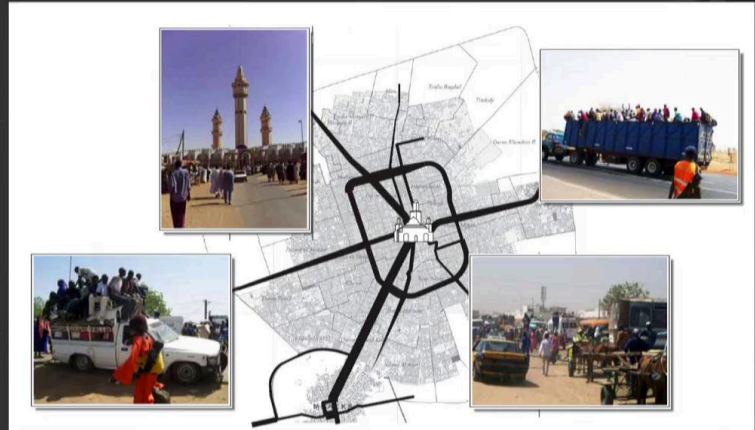


3m 15s

The city of Touba

Planning needs

- Urban development
 - ➔ Housing schemes
 - ➔ Drink water supply and sanitation
 - ➔ Wastes management
 - ➔ Electricity
- Mobility and transportation
 - ➔ Multimodality, roads
 - ➔ Grand Magal period



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Nevertheless, the needs of general planning are important, if only to try to control the urban development which is done at an accelerated pace with the management of plots, the management of drinking water and sanitization, the question of waste, the question of distribution, the connection to electricity and so on. Added to this is the whole dimension of mobility and transports with different types of transport, road networks and especially the transport management during the Grand Magal period, which sees an influx of large crowds.

Notes

Summary



3m 57s

Urban development and mobility

An urban development and mobility study was commissioned by the Agence Autonome de Travaux Routiers from a consortium formed by



Transportation and mobility



Urbanism



GIS



Coordination



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The study of urban transport and urban planning which we will talk about in this presentation was entrusted by the Autonomous Agency of Roadworks of the Republic of Senegal, an office consortium formed by TRANSITEC, an office specialized in transport and mobility, URBAPLAN, an office specialized in urban planning, IPOGEE which dealt with the geographical information system section and MUNICIPALITY SERVICE which has an architect office in Dakar and which coordinated the project onsite in particular.

Notes

Summary



4m 50s

Urban development and mobility

Phasing of the study

- Phase 1**
 - Analysis-diagnosis of the current situation
 - Identification of the constraints
 - Definition or revision of the objectives with the relevant authorities
- Phase 2**
 - Elaboration of a global multimodal concept of urban development and mobility
- Phase 3**
 - Proposals in terms of urbanism
 - Elaboration of a transportation plan
 - Set up of a Geographic Information System – GIS
- Phase 4**
 - Proposal for short-term (2012) actions
 - Elaboration of a global long term (2020) action program

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The objective of the project consisted of first establishing a diagnostic of the current situation, in terms of urban transport and urban development, defining the overall framework in which to develop urbanization and transport networks in the future and in this spirit establishing a traffic plan in a short medium term with a horizon of 3-4 years in 2012 and the means, the measures to implement it and then defining a more global development strategy in the long term in 2020 with, in the 2 types of scenarios we can envisage, first a densification of the existing urban space or possibly as an alternative the development of new poles of activities. It must be said that today everything is centered on the mosque which is the pivot of the whole system, with a number of disadvantages particularly in terms of mobility linked to this situation. The study was programmed in 4 phases a first phase of diagnostic analysis of the current situation, the identification constraints and possibly redefining the objectives depending on the results of this analysis.

Notes

Summary



5m 27s

Urban development and mobility

Phasing of the study

- Phase 1**
 - Analysis-diagnosis of the current situation
 - Identification if the constraints
 - Definition or revision of the objectives with the relevant authorities
- Phase 2**
 - Elaboration of a global multimodal concept of urban development and mobility
- Phase 3**
 - Proposals in terms of urbanism
 - Elaboration of a transportation plan
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- Phase 4**
 - Proposal for short-term (2012) actions
 - Elaboration of a global long term (2020) action program

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In a second phase, the objective was to develop a global and multimodal concept in terms of mobility and urban development In a third phase we wish to get some proposals in termes of urban planning with the elaboration of a transport plan and then all of this accompanied by the start, the implementation of a geographic information system, to accompany this whole process.

Notes

Summary

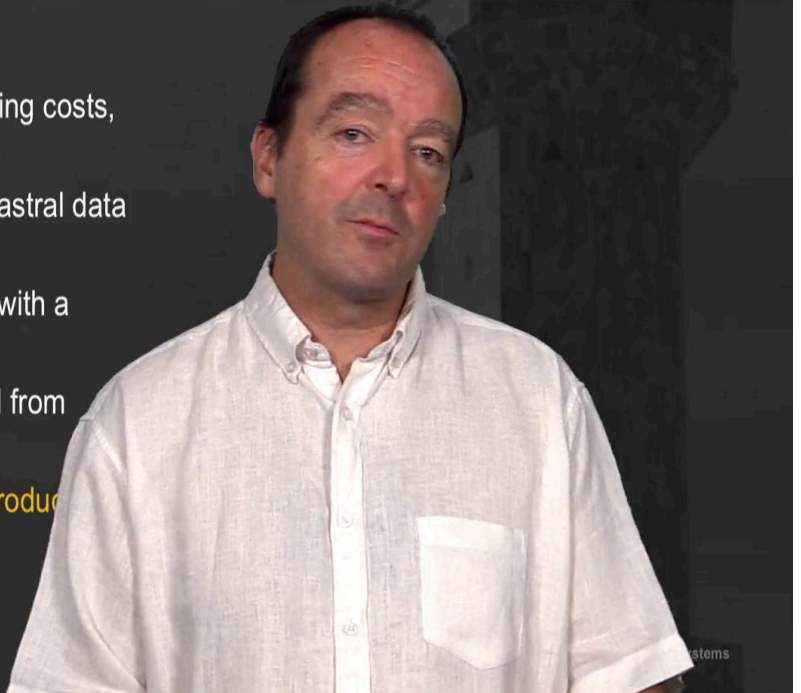


6m 47s

Urban development and mobility

Specific objectives of the GIS component

- To facilitate **access to data** (aspect of licensing costs, simple interface)
- To recover **existing data** (among others cadastral data > 100'000 plots)
- To allow for **data edition** by any user, along with a validation process
- To integrate the **statistical indicators** derived from census data (thematic maps)
- To integrate the whole set of **cartographic products** of the study



And in a final phase, the objective was to propose actions in the short term and then a more global programme in the long term for 2020. The specific objectives, of the geographic information system section of this study consisted first of... facilitating the access to information of a wide range of users with, as a filigree, the ideas of a simple and low cost interface so a somewhat customized development. Second constraint, the idea of being able to take the existing data and in particular, the more than 100,000 existing plots of the land cadastre. Third constraint, the need to be able to entrust the feeding of the database, so the editing of data, to a large number of users. So the implementation of a management system that allows to validate the entries before incorporating them to a final database. Fourth constraint, to be able to have and to be able to calculate indicators which allow to follow or to guide the urban management.

Notes

Summary



7m 25s

Main results

Principales caractéristiques en matière d'urbanisation



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And finally last constraint but not the least the need to be able to integrate all the results of the study in the GIS platform. It is clear that this series of constraints is quite similar to what we had in other cases in Thies and in the Seychelles in particular, with studies in completely different registers. So in this part, we will review the main results of this study and start with the main elements emerging from the diagnosis in terms of urbanization with the existence of a relatively high density area inside the bypass around the mosque with up to 140 inhabitants/ha and then a largely weaker density circle of around 70 inhabitants/ha in the outskirts of the city. In the positive elements identified in this diagnosis... in particular in the spiritual influence which extends beyond the national borders of Senegal with a moral authority which enables this city that is not a city to function quite well after all, an exceptional population growth a respect of the plot plans and then finally quite a generous traffic lane system with wide roads. The weaknesses that were picked up were demographic projections that are not very defensible, very low demographic densities that actually make the cost of extending electricity, drinking water, sanitization...

Notes

Summary



Main results

Eléments positifs relevés à Touba au terme du diagnostic-mobilité

Un signal fort en entrée d'agglomération



Des axes principaux bien structurés



Une rocade qui ceinture l'ensemble du centre-ville



Des axes secondaires de liaison



Des voiries de desserte des quartiers d'habitation



De grandes réserves d'espace en accotement



Photos : Tanor Diang (Municipalité Service) et Pierre Chastellain (Transitec Ingénieurs Conseils)

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it considerably increases the cost of extending these networks. The reason for this low density is in fact the need for the inhabitants of these large plots to actually welcome the families during the great annual pilgrimages. Amongst the positive elements concerning the traffic lanes, the city entrance which is well marked, the main axes well structured, the existence of a bypass that surrounds the whole city center situation that is quite rare in any case in West Africa good secondary roads and then finally... the... generous spaces allotted to the roads.

Notes

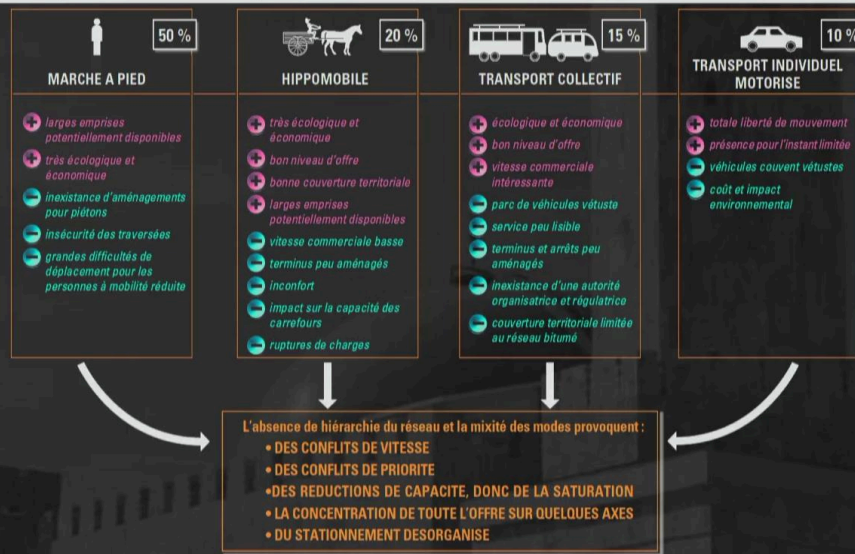
Summary



10m 38s

Main results

Caractéristiques des modes de transport



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Amongst the most problematic elements the question of the mix of transport between pedestrians, horse-drawn transports, heavy vehicles, a certain disorganization in public transports and bus stations, the presence of some heavy vehicles that sometimes hamper the traffic the existence of markets that overflow the roadways, sometimes even constructions that encroach on the public space etc. The diagnostic phase showed that walking is the most important part in the transport mode, with 50% of trips being done by foot. A large part of horse-drawn carriages so carts pulled by horses and what is especially striking, a very small share of individual motorized transport in the order of 10%. The fact that these modes of transport are mixed includes a certain... the fact that these different modes of transport are mixed induces a number of conflicts, in terms of speed, priorities, capacities of the traffic lanes, concentration of the parking space, etc.

Notes

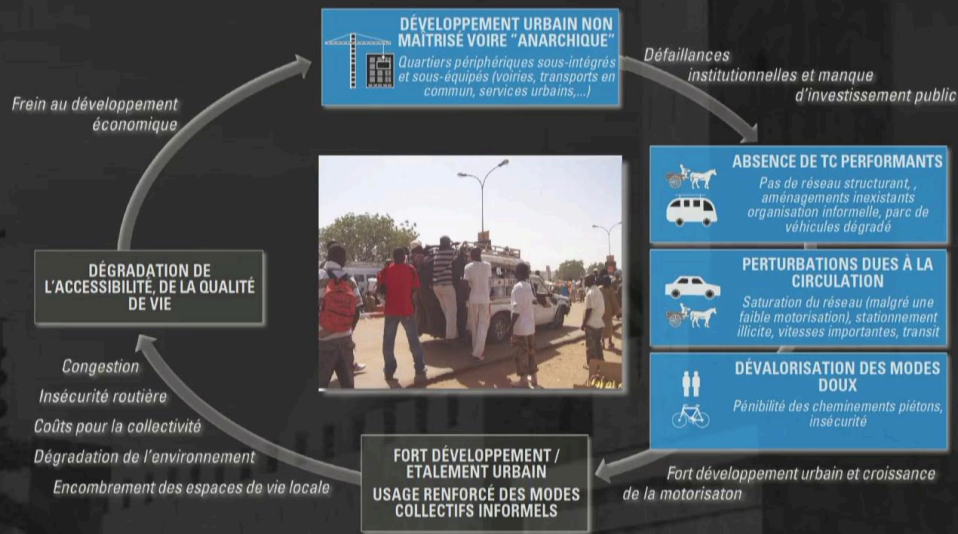
Summary

11m 19s



Main results

Les conséquences de la non-planification de l'urbanisation et des déplacements à Touba



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The shortcomings in terms of development and urban management actually feed a vicious circle which is characterized by the absence of efficient public transports by disturbances due to traffic by the devaluation of the green transport modes in any case the pedestrian mode of transport, or even the bicycle with for...

Notes

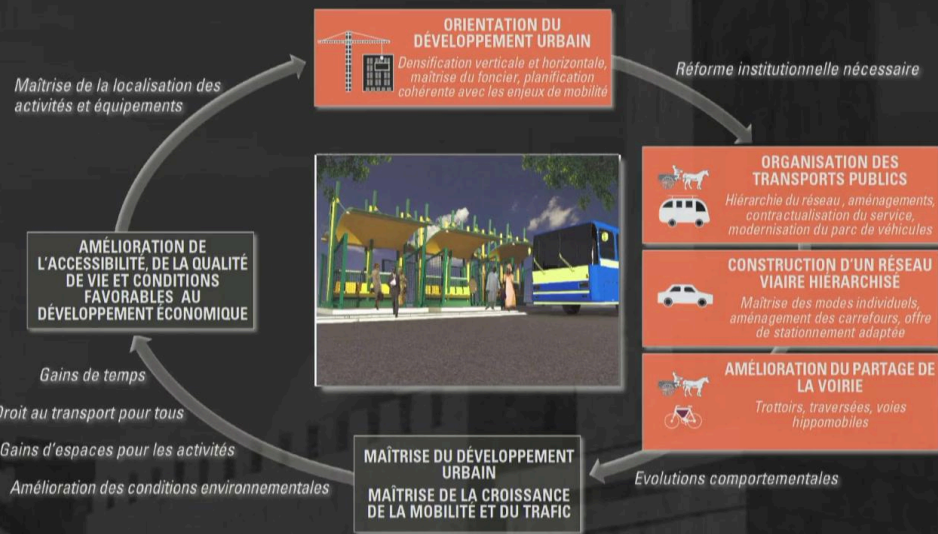
Summary



12m 30s

Main results

Les enjeux de la planification de l'urbanisation et des déplacements à Touba



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consequence.... a strong development, a strong urban sprawl a stronger use of informal collective modes which makes the accessibility more difficult so a deterioration in the quality of life which hinders the economic development which prevents to go to a better controlled urban development, the suburbs are not so much integrated, under-equipped particularly in terms of roads, public transports, urban services, etc. On the contrary, a planning of the urban development and the mobility would enable to start a virtuous cycle through a better organization of public transports, the building of hierarchical traffic lanes network and a better road sharing between the different modes of transport all of which aim at controlling the urban development, controlling the growth and the mobility of traffic an improvement of the accessibility of living conditions, a better control of... the location of activities and equipments and all of this feeding a virtuous circle.

Notes

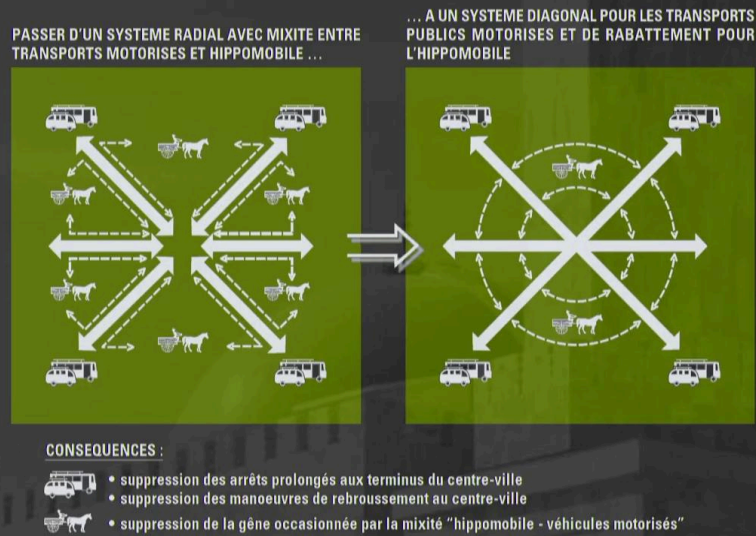
Summary

13m 24s



Main results

Concept général proposé en matière de transports publics



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At the end of this diagnostic phase, the objectives of the study were reaffirmed as we can see here on the 10 elements mentioned quite a strong emphasis put on the dimension of mobility and transport as an element susceptible to promote a... a more harmonious urban development. The general concept proposed for the rest of the planning reflection is based on the idea of switching from a radial system with mixed transport modes to a diagonal system on which motorized public transports would be concentrated, combined with a feeder system for the horse-drawn carriages which would lead to serve the districts in the direction of the main public transport routes. Subsequently the planning and development reflexion led to propose a transport plan by 2012 here for the city center with a first inner boulevard which is actually destined to preserve the tranquility of the large mosque area by banning the circulation of this hypercenter, an inner boulevard that would be doubled by a second boulevard more...

Notes

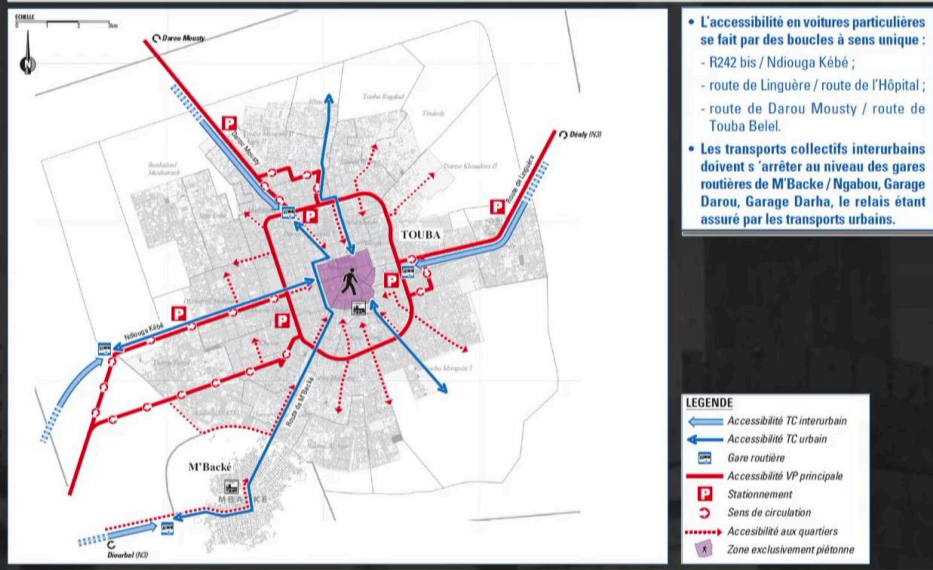
Summary

14m 08s



Main results

Principes d'accès à Touba en période de Grand Magal (2012)



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more... at a slightly greater distance beyond the Ocass market area which would also serve... as a mean of diverting the traffic of the hypercenter and the mosque area. On a larger scale we see that the transport planning plans a succession of bypasses that surround the hypercentre at increasingly greater distances all of it combined with a collective transport system which includes a series of lines that allows crossing the city along diagonals.

Notes

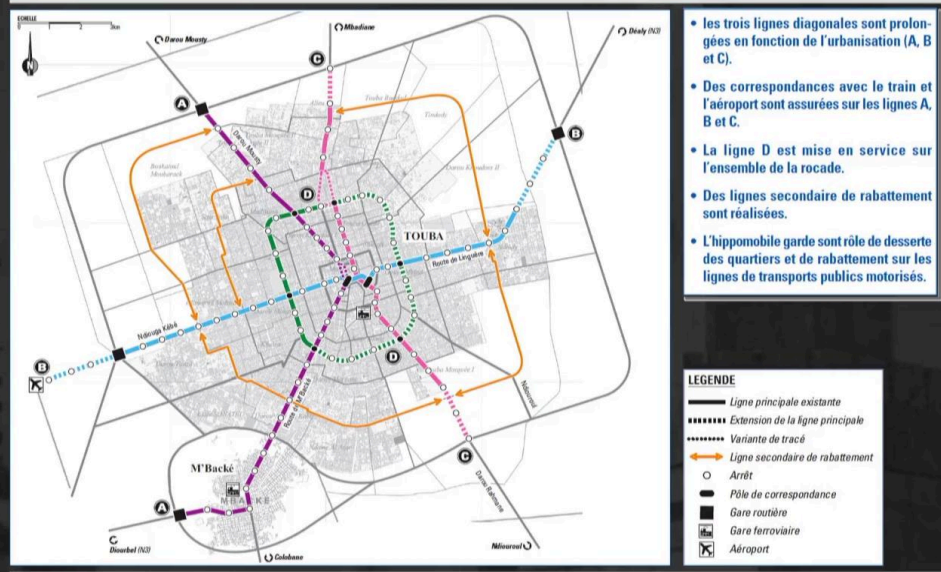
Summary



15m 35s

Main results

Implantation du réseau de transports collectifs principal (2020)



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To these elements of reflection on the organization of transports in general and of...especially public transports... a series of recommendations defining access principles to the city of Touba during the period of the Great Magal by 2012 is added with an enlarged pedestrian zone in the city center and then parking areas to stop the traffic before the big central congestion. This board shows the evolution imagined for the horse-drawn world with the horse-drawn collection in the districts and the servicing of public transport stops along the main roads, in the diagonals, both at the scale in 2012 in dark green and in the longer term in 2020, these are the feeder zone points in white. By 2020, the the traffic lanes plan plans a series of bypasses at an increasingly greater distance of the hypercenter with in the particular case the development of new zones of activities to the West of the city and near the town of M'Backé. Still by 2020 an extension of the implantation of the public transport network with the appearance in particular of a permanent line on the first bypass so on the current ring road.

Notes

Summary

16m 18s



Main results

Plan d'actions à court - moyen termes proposé pour Touba

VOLET STATIONNEMENT :



- ▶ ST 1 - Création d'une offre de stationnement pour les voitures et taxis +
- ▶ ST 2 - Aménagement de parkings temporaires pour le Grand Magal +

VOLET TRANSPORT DE MARCHANDISES :



- ▶ TM 1 - Création d'une réglementation du transport de marchandises et de parkings spécifiques

VOLET INSTITUTIONNEL ET MISE EN OEUVRE :

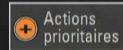


- ▶ IN 1 - Création du Comité Institutionnel des Déplacements de Touba - Mbacké +
- ▶ IN 2 - Création du Service Technique des Déplacements de Touba - Mbacké +
- ▶ SIG 1 - Création d'une cellule SIG +
- ▶ SUI 1 - Assistance à maîtrise d'ouvrage de la cadre de la mise en place du Plan de Déplacements

VOLET COMMUNICATION :



- ▶ COM 1 - Campagnes de communication et de sensibilisation +



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And finally a broader vision for the public influx management during the period of the Great Magal. These different network, public transports plans, etc. are accompanied by a number of measures proposed in a short medium term to promote the urban development and the development of mobility in Touba. So a list of elements related to town planning, infrastructures, public transports and parking aspects for the transport of goods, institutional aspects and implementation and to the aspects of communication. One of the interests of the proposed solution is to allow a gradual development depending on the actual evolution of the city of Touba.

Notes

Summary



17m 55s

Le module SIG

- Application developed with C#
- Using the TatukGIS component
- With a MySQL database

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The various concentric rings can... indeed be realized progressively so that the proposed development plan is spread out and adaptable which in itself is a good thing. The particularity of the GIS model which was developed for this study is to constitute a standalone solution which has been programmed in C Sharp with the TatukGIS component for the cartographic part and then the support of a MySQL database.

Notes

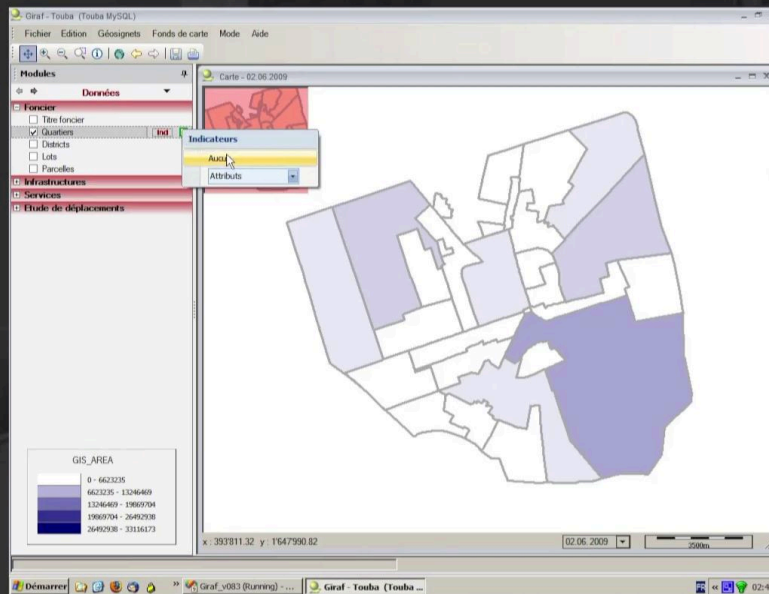
Summary



19m 06s

Le module SIG

Thematic indicators



Then in the data viewing mode, we can already simply display the different layers: here the land title, the districts of the city, we have removed the map background and the Google image, the national road network and the different types of objects, of existing equipment infrastructures in this case the aspects of education hydraulics, farms. The consultation of the attributes of these objects: here a section of road or a well or a borehole, here is a well, these different windows being able to be stacked on top of each other on the edge of the application. Each layer can of course be configured with color, symbol size, type of symbol, transparency, etc. etc. At the level of thematic indicators we add here the layer of districts, the access to these indicators first the access to labels that allow to... to add the names of neighborhoods and through the same intermediary with... with the shift key the indicators where we can actually select the various attributes to build a map, so here simply a map that gives... the hierarchy of the districts according to their sizes.

Notes

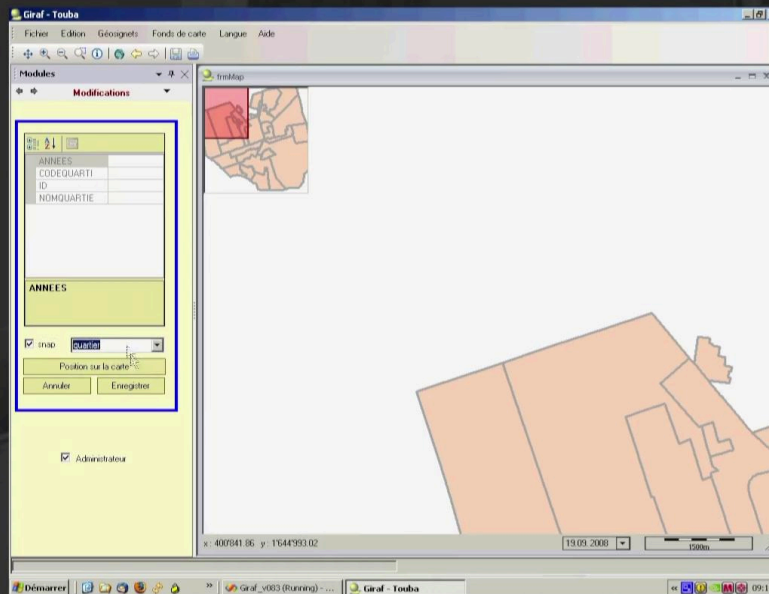
Summary



19m 35s

Le module SIG

Data edition (administrator)



There is more information in a smaller scale which is that of the districts which corresponds in fact to the census districts for which we have a great wealth of attributes which are all the attributes which come from the official census so here a map of the population density and then we see that in all of these indicators, here we are in the "indicators" module, we see that we have... we find all these indicators first built on data and here represented by themes so education, health, poverty, demography, drinking water, sanitization, housing with here particularly as an example the map of the proportion of ... residential buildings that have a.... a cement floor. These thematic maps can be configured by modifying the number of classes, by changing the intervals used so the precision level of the intervals, by changing the color scales or symbol size scales and always the transparency of layers. The editing of data, so a 3rd module where we illustrate the four functions, the 3 adding, modifying and objects deleting functions in the imaginary case where we would like to add a new district with the snap function that is activated which allows to...

Notes

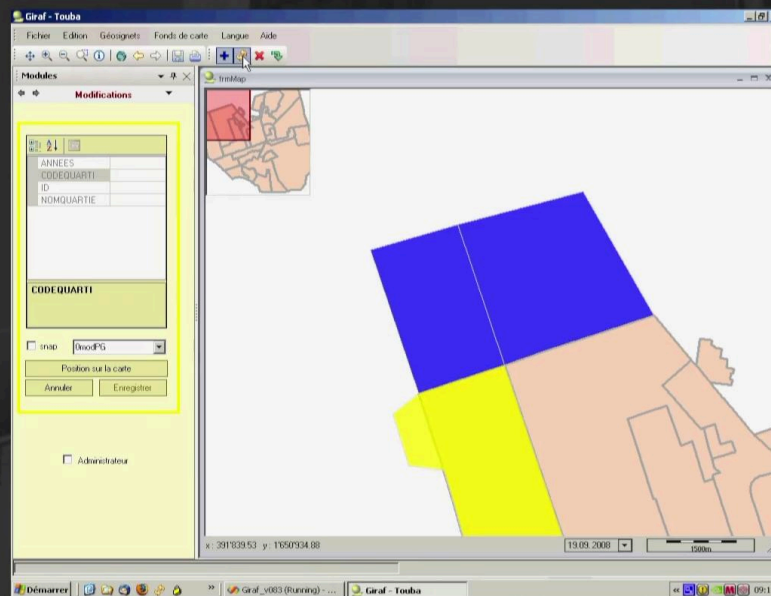
Summary



21m 18s

Le module SIG

Data edition (user)



draw jointing polygons. The saving, as we are in administrator mode, is done directly here in the database. So we... add a second object here which we correct to be perfectly in the right place etc. We see that we can also change an object, modify its attributes, or delete an object. The same thing but now in mode... lambda user mode, where we also add an object with the particularity of... saving this new object in "temporary" mode. Similarly for the second one, we activate the layer of the changed objects to... make a jointing polygon and we see that we have a toolbar that allows... to manage the display of the proposed changes. Here we modify an existing object and we see that if we activate the corresponding button, we display the proposed modification of the existing object.

Notes

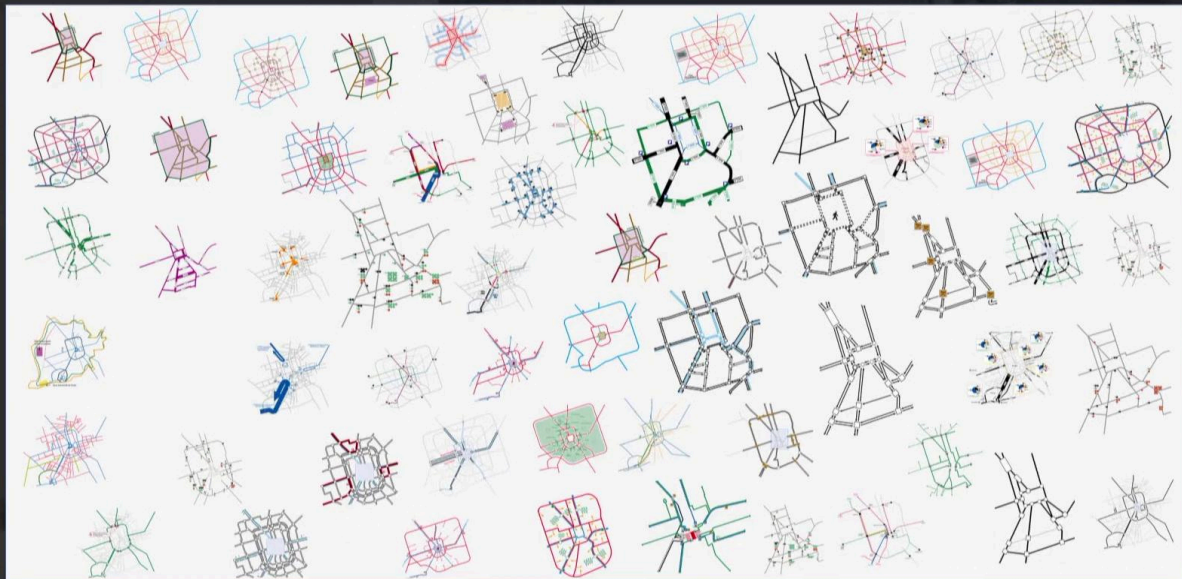
Summary



22m 59s

Le module SIG

Urban development and mobility study



Systems

Same for a deletion, so we save a deletion proposal that we can activate displayed in red. The deletion on the modification proposal is done directly as well as a modification proposal of an existing object. The landed cadastre can be consulted with simple user rights the consultation is limited to the geometry and the identifier of the plots whereas if we go in edit mode in cadastre mode with the rights...to be in a cadastre mode it is necessary to have the administrator rights and at that moment when we select a plot we have all the pieces of information related to this plot including the owner's characteristics, the use, etc. The consultation can be done either by plot or by owner so 2 inputs with a data edition system comparable to standard data. The fact of being registered as a user or as an administrator is decided when we connect to the database. In the case of the urban transport and urban planning study there was production of a... it was not always very simple to integrate these maps in the geographic information system and especially to find one's way around in the many possible components.

Notes

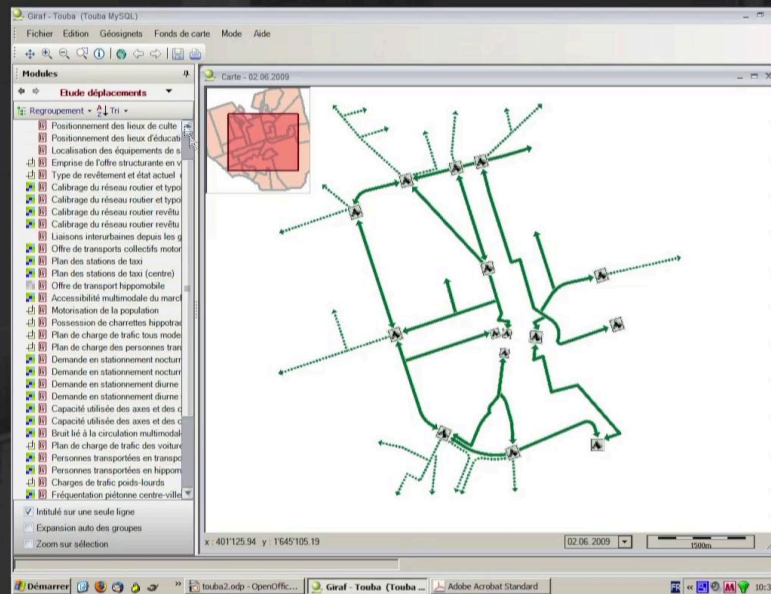
Summary

24m 52s



Le module SIG

Urban development and mobility study



So the "transport study" module allows to manage the way in which the various elements are grouped, by study phase, by chapter of the reports by topic, by mode of transport, by document type, etc. 2012, 2020. We can also group several keys... of groups in order to have a a sampling, a sorting, a prioritization by hand. The different elements usually have two small icons, the first here to activate the vectorial layer. We are here on the traffic load plan so in vectorial mode and the small icon next to the button allows access to the PDF board equivalent from the report of the study. In the case of the small colored icon we have access to... not to a vectorial version of a data layer but simply to... actually to...

Notes

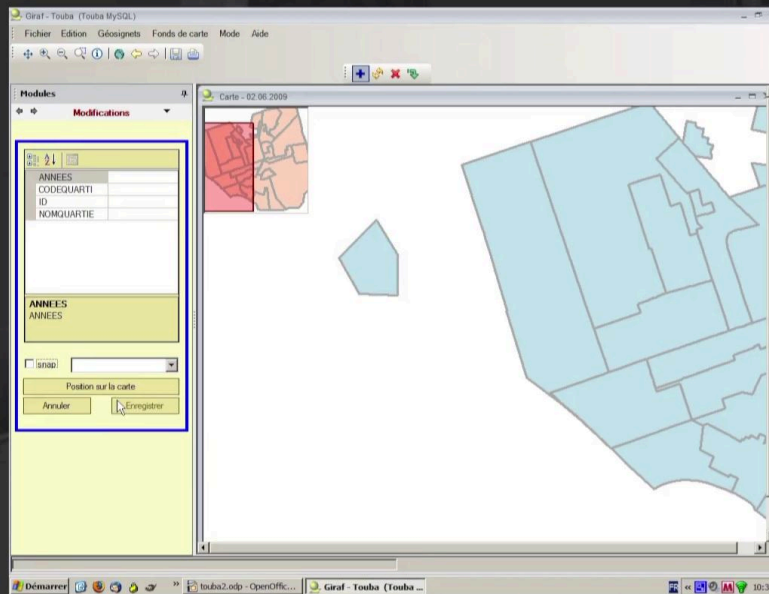
Summary



26m 53s

Le module SIG

Time related aspects



a raster image that has the merit of being transparent and which can be superimposed to other elements of the geographic information system. A second click and the legend of this image appears and as previously the PDF icon provides access to the PDF page of the report concerned. If we take here the example of the load plan and we go back to the side of the data display module, we see that in fact this layer exists as a vectorial layer and in particular that it can be activated and modified so it is possible to come and select an element of this load plan here this section which has 5'000 vehicles days and come to change and update these values. So we can clearly see that the interest of a... of a vectorial system is to provide an update of the data, which is something that the "raster" mode doesn't allow. Finally, the icing on the cake, a temporal follow-up element has been incorporated, what can be illustrated in this example by a... a case in which... we will add a new object, here we are on the district layer as before so we decide to create a... a mock object somewhere, this object...

Notes

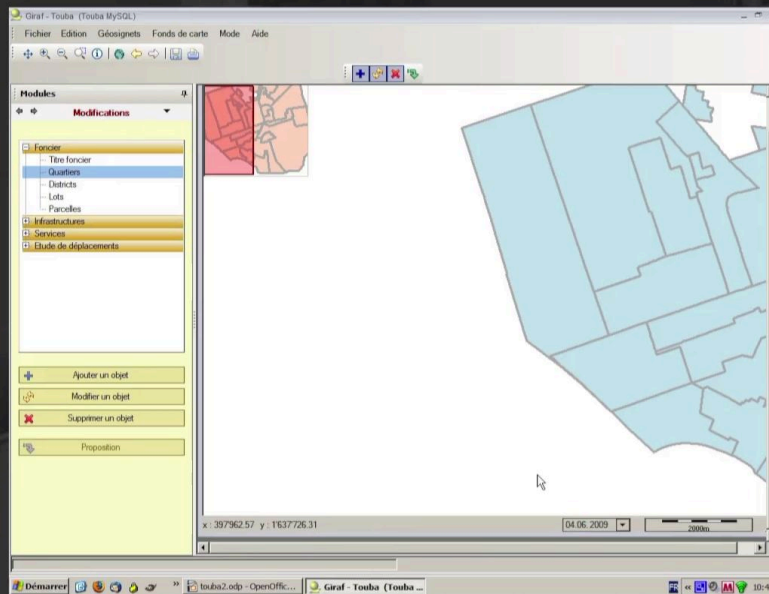
Summary



28m 02s

Le module SIG

Time related aspects



we see that it is linked to a date and we can decide that the next day, we want to change this object so we go into modification mode, we select it and then enlarge it, we can modify its attributes, Two days later we decide to delete this object, so we go in "deletion" mode, we select the object, it disappears. We save the evolution of the management of this object in the database so each time we modify the object, one of its attributes, we create a new object and we keep track of these changes so the evolution of the database can be monitored over time.

Notes

Summary



29m 44s