THE REHABILITATION OF THE ANTWERP RING ROAD: ACCOMPANYING MEASURES

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ABSTRACT

The city and the port of Antwerp are situated in the heart of the Trans European Road Network (TERN). The Antwerp Ring Road (R1) assures the mobility of the agglomeration and the access from the port. The Ring Road has been functioning for 35 years and has not been serviced since 1977. A quick and fundamental renovation had become necessary in 1999. The pavement and the foundations, the sewer system and the draining system, the safety equipment and many constructions were in a bad shape. The rehabilitation works also wanted at one hand to improve the road security and at the other hand to assure the exploitation of the traffic. When the idea of rehabilitation was launched by the Flemish government, experts announced a big economic loss. Together with the world of entrepreneurs and the other actors in the domain of traffic and transport, the administration drew up an action program in order to reduce the nuisances and to guarantee the mobility. The action program contained among other things: the reorientation of the traffic, the construction of temporary bridges, the improvement of the public transport and of the bicycle network, the realisation of parking 'Park and Ride', a pro-active communication, the choice of technical solutions and the organization of the work site with a minimum of impact on the traffic. The road works were successfully carried out in 2004-2005 without big perturbations. At the end of the works an evaluation of the accompanying measures has been made.

1. INTRODUCTION

xx Antwerp is situated in the north of Belgium between Rotterdam and Brussels. In the north of the city there is the harbour area of Antwerp, one of the biggest in Europe and in the world. The Ring Road of Antwerp was put into use on 31st May 1969. It's an urban motorway situated some 3 km from the centre of the city. With a length of 14 km it contains between 3 and 6 stretches of road for each direction and it includes the Kennedy tunnel under the Scheldt and a lot of art works. Situated in the heart of the Trans European Road Network the Ring Road welcomes each day more than 200.000 vehicles, of which 25% trucks.

After more than 35 years of intense use the Ring Road needed a solid and structural renovation. The assumed project was not only unique in Belgium for its amplitude but also for the integrated approach during its realization. Everything which could need some service sooner or later, which could cause annoyances for the traffic, has been added to the renovation program. Moreover there was not only the reconstruction of the Ring Road itself, but also of the access and exit roads with a total length of almost 30 km, and also

the complete system for the evacuation of the surface water and of the drainage with ± 170 km of pipes and about 3.000 manholes. Let's not forget the works of art such as the Kennedy tunnel, the viaduct of Merksem, 22 bridges and 9 tunnels for technical pipes, and also the lightning, the signing and the security barriers.

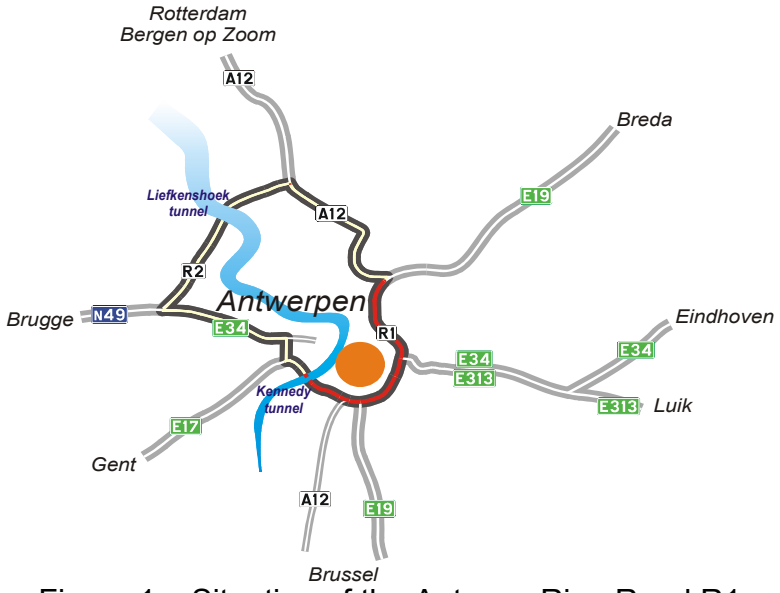

Figure 1 – Situation of the Antwerp Ring Road R1

2. PREPARATION AND REALIZATION OF THE ROAD WORKS

The tender specifications have been finished after a limited period of study of 9 months. Then the awarding of contract has been given after a European open tendering. The attribution criteria were based on the price (50%), the approach concerning the quality of the works (25%) and the delays of realization proposed by the entrepreneur with respect of course to the imposed limits by the administration (25%). The entrepreneur also had to suggest a system of bonus-malus / premiums and fines in connection with the delays of finishing the principal periods in the road works.

As a result of the open tendering, the works were attributed to a temporary association for the price of about 100 millions of euros. This amount didn't contain the works necessary for the reduction of nuisances. The administration as well as the entrepreneur radically chose a very quick realization of the works, but applying a new pavement with low maintenance cost and a long life-span. Because a strict regime of bonus-malus was applied, the entrepreneur could obtain a bonus up to 10 % when he worked more quickly than was expected and lose the equivalent in case of delay. Finally he obtained the maximum of bonus, even when the delays in realization proposed by him were already rather short.

The rehabilitation of the Ring Road took place during two big periods, one for each direction. During each period of about 5 months in 2004 and 2005 the traffic on the Ring Road was always maintained on 2 or 3 lanes in each direction, in order to limit the perturbations. Because the free flow of the international and local traffic and the accessibility to the Antwerp agglomeration had to be guaranteed, a very important operation was established (in order) to reduce the nuisances. This operation has cost almost as much as the road works themselves and has been realized with the cooperation of a lot of partners in the political, economic, social and tourist world etc., but also in the world of public and private transport.

Figure 2 – Views on the Ring before and after the rehabilitation

3. MEASURES AS PART OF THE PROJECT

3.1. The choice of pavement

The original pavement of the Ring Road consisted of asphalt on a base of lean concrete or chippings. To choose the type of materials for the new pavement, a comparative study was made of the two possible solutions: asphalt or continuous reinforced concrete pavement (CRCP). First a life-cycle cost analysis (LCCA) was made. This analysis is based on the costs of construction, maintenance and reconstruction at long term. Then, the non-budgetary aspects were integrated into the comparison by a multi-criteria analysis (MCA).

For the bridges, the access roads and the motorway-interchanges the preliminary choice of asphalt was based on the limit of overweight, the sinuous alignment and on the fact that the traffic couldn't be interrupted. This way the choice between asphalt and CRCP was only to be made for the continuous lanes of the motorway.

According to the method LCCA, the global costs of construction, maintenance and reconstruction at long term were almost the same, with a small advantage for CRCP. The comparison according to the MCA also showed slightly better results for CRCP than for asphalt. Still, this difference was not really determining. Because of the longer life-cycle and the limited maintenance, the decision was made in favour of concrete. The cost of the accompanying measures and the impact of the road works on the social and economic life lead to the conclusion that maintenance had to be reduced and a next reconstruction had to be postponed.

3.2. The recycling

Big quantities of crushed material, the short delay in realization and the wish of not encumbering the neighbouring network with the evacuation and the arrival of materials, made the project include a maximum of recycling. Of course, this measure is also beneficial for the environment because of the smaller quantities of materials and scrap to be eliminated.

A detailed study of the recycling possibilities was made. One has taken into account the assumed life-span of the new road structure, the very big quantities of recycling materials and the gained experience in Belgium and abroad. The recycling itself was not new but the scale was not seen before and exceptional.

The existing pavement was partly recycled in the new bituminous pavement mixes. Another part was used in a base layer of scraped asphalt mixed with cement, known as “cement bound asphalt rubble” (CBAR).

The existing foundation – mainly in lean concrete and in a limited measure of chippings – and also the linear elements and the not-reinforced concrete pavement of the Kennedy Tunnel were recycled in the sub base layer of the new road structure.

3.3. Organization of the construction zone

For the whole distance of the project an independent road for construction traffic was made in order to permit the passage of the intervention vehicles, together with the circulation on the construction zone. At different connections of the Ring Road with other motorways, that road for construction traffic went over the circulation by means of provisional bridges.

We were ordered to install two plants at the construction zone itself for the mixing of the scrap materials to be recycled and for the production of concrete. In this way it was not necessary to impose the supplementary charge of the construction traffic on the surrounding road network.

At the central reserve a screen was placed to separate by sight the normal circulation concentrated at one side of the Ring Road and the activities taking place at the other side. This way, traffic jams due to the curiosity of the drivers were avoided.

4. ACCOMPANYING MEASURES APART FROM THE PROJECT

Long before the beginning of the road works, we started the study and the drawing up of a scenario in order to guarantee the free flow of the traffic on the Ring Road or to offer alternatives to maintain the accessibility to the agglomeration and port of Antwerp. Anyway the economic importance of the region and the port was fundamental.

The authors of the project and a lot of other partners involved (the transport sector, the drivers’ associations, contractors,…) were aware of the complexity level of this project from the beginning and all of them understood that important measures were necessary in order to create a sufficient acceptance level for the population. Anyhow this base had to exist before the start of the road works.

Within all the domains and as much as possible, measures were taken and kept in reserve to cope with an anticipated chaos on the circulation level. The public and the enterprises were extremely preoccupied when the experts foresaw an economic loss of 900 millions of euros.

Different scenarios were studied with a particular attention to the free flow of the traffic, the road safety, a good communication and an optimal organization of the construction zone.

4.1. Measures on the circulation level

4.1.1. *Measures for circulation vehicles*

All the local accesses and exits of the Ring Road were closed. The through traffic and the traffic to the port were kept on the Ring Road this way. The circulation models showed that the decreased capacity of the Ring Road was sufficient to assure the free flow of this traffic.

The traffic for or coming from Antwerp was diverted via the Singel, a parallel alternative route to the Ring Road, playing the part of local ring around the city. To guarantee the free flow of the traffic on the Singel 5 provisional bridges were build and 35 crossings caused a rearrangement or adaptation of the traffic lights.

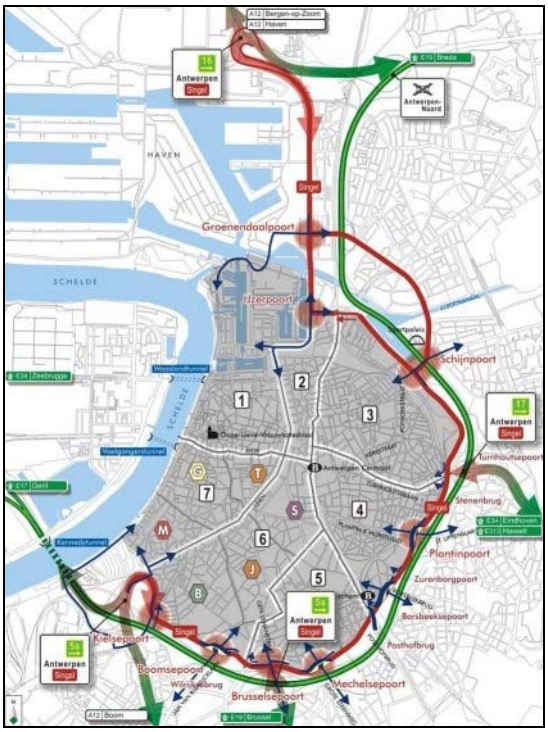

Figure 3 – Structure Ring-Singel during construction

Alternative relief roads had to assure that the traffic passed at the side of the city. On these relief roads a bigger capacity was realized by the adaptation of the traffic lights. At the radial roads the capacity was kept, while the public transport had an enlarged priority to encourage the drivers to adopt this way of transport.

Even in the Walloon provinces of Belgium, in the Netherlands and in Germany, fixed and variable traffic signs were placed. The diversion of the traffic aimed at the same time at the long distance traffic and the traffic of middle distance among other things via the Liefkenshoek tunnel. In this toll-tunnel special tariffs for the trucks were applied.

In case of incidents or unexpected measures, a quick system by email was put into operation to warn the national and international traffic federations as quickly as possible and by this way also the transport companies. This instrument has been very useful.

The reduced capacity in case of incidents or accident was quickly restored by means of an efficient and enlarged incident management.

The important routes had to stay free from all sorts of nuisance caused by road works, manifestations, market days and others. A study agency “Less Nuisance”, which crystallizes all the described measures, categorized these routes according to the priority of the traffic of vehicles, the public transport or the bicycle transport. So the involved route was kept free for this type of transport.

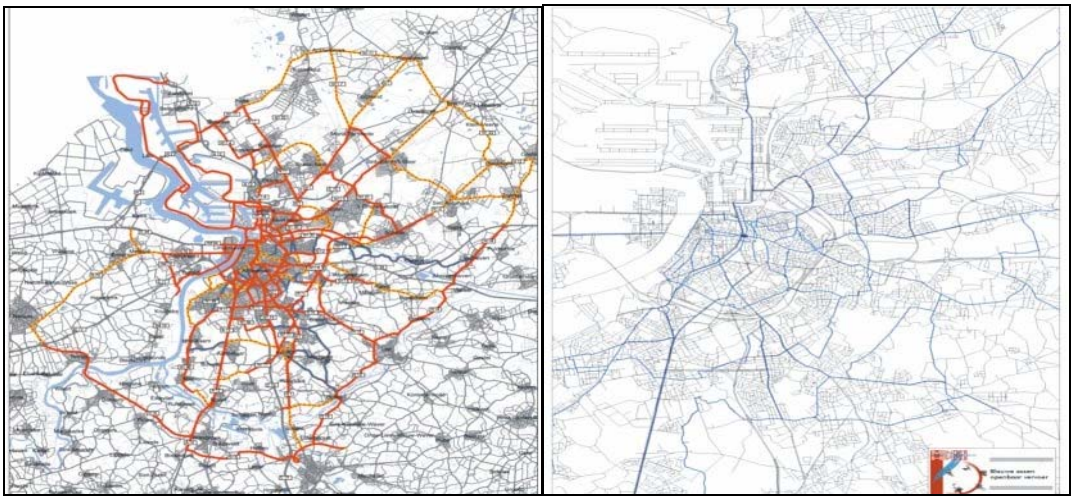

Figure 4 – Road network with priority for private cars (red axes) and for public transport (blue axes)

4.1.2. *Measures for public transport*

The company of public transport De Lijn (buses and trams) reinforced its offer by ordering 130 new articulated buses and 10 new trams. This way the public transport could play a more important part in the general circulation.

On some radial motorways in areas with a relatively slight public transport a quick bus service was organized leaving from the parking “park and ride”, next to the motorway junctions, and using reserved hard shoulders on the motorways.

Supplementary trains were also put on to open up the Antwerp port, and even in the east of Antwerp a new temporary station was equipped by the Railway Company.

4.1.3. *Measures for cyclists*

Figure 5 – Cyclists network after rehabilitation and signing

During the three years before the start of the road works, the cycling network of the city was enlarged and improved. This attracted a lot of cyclists, even those coming from a long distance. Particular attention was paid to the direction signing coming from the surrounding area towards the city. The cycle routes on these lanes were indicated by road marking. New bicycle sheds were created on the parking “P+R”; and in bus and train stations, which made the cycling even more attractive.

4.1.4. *Measures for enterprises*

The world of enterprises was informed in detail and was made sensitive 2 years before the beginning of the road works. A “Task Force Enterprises” was especially organized to study specific measures and to put them into action. A number of enterprises provided in flexible working hours and variable moments of loading and unloading. 16,1 % of the enterprises offered more common transport. A lot of enterprises foresaw an urgency plan for disastrous situations.

4.1.5. *Measures for other types of transport*

A fund of mobility was provided for a better utilisation of the skipping traffic by the nocturnal transport of the merchandise. The society of the Antwerp port, the Flemish government and the private sector each undertook to pay a third of the supplementary costs.

The operation of the locks on the Albert canal was enlarged. The Railway Company optimized by its Narcom program the transit of the containers in the main hub of the Antwerp port and also a regular transport towards the local multimodal hubs.

4.1.6. *Measures for urgency services*

The urgency services were worried a lot about a loss of their being operational as a consequence of the reduced capacity of the Ring Road. To avoid this risk the following measures were taken.

The urgency services could use the local accesses and exits. On the building site, the construction road or a traffic lane had always to be kept in reach for them. Between the building site and the traffic zone on the Ring Road a continuous screen was put to distract the drivers’ attention from the road works and to avoid accidents this way. The fire brigade provided in water tanks for the distance of the whole Ring Road. All the urgency services were put together in a centre of command.

4.1.7. *Measures for exceptional transport*

A special squad was installed to direct the exceptional transport towards the appropriate routes in consultation with the sector itself and the government services.

4.2. Communication

Communication was an essential element within the project. There were two kinds of.

4.2.1. *Communication towards the key-groups*

For the key-groups, the Flemish Region, customer of the road works, indicated some “key-group managers” or “accessibility managers”. They played a crucial part overhearing what the concerned key-group was thinking, communicating them the measures taken by the government, urging them to utilize these means and stimulating them to work out measures themselves. The managers were active within the enterprises, the local

administrations (local authorities, provinces, …), the international organizations, the other construction clients of the road works, the organizers of events, etc.

A lot of information sessions were organized to spread the appropriate message.

4.2.2. *General communication*

For this kind of communication a specialized office was asked. For the general communication the call-centre of the Flemish government was used. The public had also access to a special website with links to other interesting web addresses, and where they could ask for a complete file with details of all “less nuisance” measures.

The internet sites allowed getting a signing by email of the informative electronic letters.

The population was permanently informed about the evolution of the road works by the written and audiovisual press. There were among other things regular news editions about the works on the local TV channel.

Someone in charge of the communication of the building site took care of the contact with the local population and answered the questions asked by the interested citizens.

5. EVALUATION

The integrated impact management of road works explicitly had the intention to tackle several areas. To provide a coherent overview, the approach is evaluated from different angles.

5.1. Perception and support acquisition

The specific impact management approach to the general public and to the specific target groups resulted in a growing positive perception on the road works. The initially negative responses of self-employment organisations and trade union federations were bent explicitly to a positive acceptance of the road works and an active support for the further implementation of the work. Most important elements in this process proved to be: spreading general information on the road works at strategically chosen moments to get the correct response to the critical work phases, timely supply of correct and detailed information on the road works and the specific consultation sessions with the target groups such as area-specific approach of companies and schools and events.

5.2. Shifts in the multi-modal transport system

During the road works we noticed an important shift in the way trips to and from Antwerp (destination trips) were realised.

Of the trips to and from Antwerp, which went in former days by means of the head road network, some 10% have been omitted during the work on the Antwerp ring. It concerns here modifications in a mobility pattern, stimulated by e.g. e-working, the use of regional offices outside Antwerp, ...

For the remaining trips, a modification was especially aimed at trips which, before the road works, were realised by car using the highways to Antwerp and which followed further on the ring to the closest exit.

Since these exits were closed during the ring road works, another mobility pattern was enforced in a binding matter: partly trips were still made by car but, partly by means of another route, partly by changes to another mode. The next figure reflects this shift.

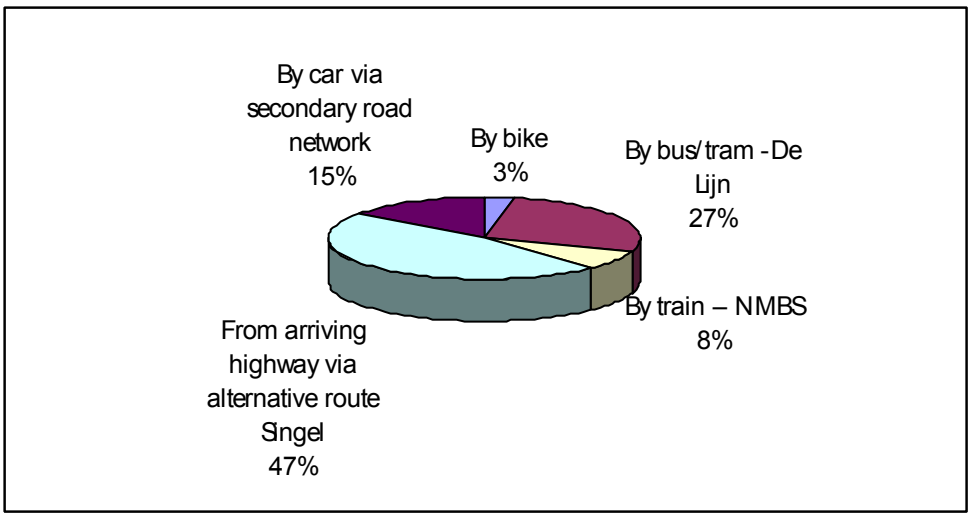

Figure 6: Modal split of trips which went via the arriving highways and the rind road before the road works

5.3. Specific impact by mode

5.3.1. *Bus and tram use*

In order to get an insight in the number of public transport travellers, travellers were counted at various times by the public transport operator De Lijn. Counts were carried out before the start of the road works, during the road works, between the two phases of the road works when the maximum road capacity was available and after the road works.

The counts on the most important irruption ways to and from Antwerp during the first phase of the road works revealed that De Lijn, during mornings and evening rush hour together transported 27% or 43,500 travellers more. Especially the extended express bus network showed a very strong increase in the number of travellers (+66%). Also between the two main phases, the travellers remained faithful to public transport. And finally also in the long term, people continued to use the impact management measures of De Lijn.

The use of the especially arranged P&R parking was limited, possibly by insufficient specific communication and the still insufficient frequency of service.

5.3.2. *Train use*

From the monthly evolution of sale of train cards, tickets and passes, appears that at all three categories the strongest impact of the road works is perceptible at the beginning of the first (+20%) and second phase (+15%).

In the mean period half of the new acquired travellers continued to use the train as a transport means to and from Antwerp. Supposedly there are many dropouts that have considered the train as an alternative during the period of the road works and which did not intend to travel permanent by train. It is also possible that one has tried the train and found that comfort (travel time, privacy) was not comparable with the car.

During the second phase of the work the number of new travellers rose again.

Station parking, which were extended, knew a high use to even overuse. The success is due especially to the fact that this is already a known concept and a high reliability of service is guaranteed.

5.3.3. *Cyclists*

Based on counts, it can be decided that the bicycle movements have increased to a great extent during the work on the Antwerp ring road. During the work on the Antwerp ring road, an increase of 2,200 cyclists (+220%) was observed during an evening rush-hour hour (compared with 1000 cyclists before the road works), what can be converted to an increase of 5,500 cyclists on daily basis.

5.3.4. *Truck traffic*

From the quantitative interviews it appears that businesses have followed the recall to modal-shift wherever possible. On the one hand flows of goods were reorganised by means of track, on the other hand goods transport happened by means of inland shipping. At the second stage of the work the reorganisation of the goods transport increased still further.

The strong increase of the track can be explained by the fact that the Narcom-programme (shuttle connection between important terminals) of the NMBS became operational at the beginning of the work. Moreover a special train link was established between the left bank and the right bank of the Schelde to avoid transport via R1 and the Kennedy tunnel.

The increase in the inland shipping is explained by the actual increasing trend of the last years and the increasing use of short sea shipping in the period of the work.

5.3.5. *Car traffic via the region Antwerp*

For the through traffic one can speak only to a limited extent of a modification in transport choice in relation to the work on the Antwerp ring. Here especially the impact of rerouting on long distances plays an important role in the decrease of the number of vehicles.

Yet, concerning the passenger transport, the railroad operator indicated an increase in travellers by train on the relations which go over Antwerp and which can be attributed to the work on the Antwerp ring.

Also for the goods transport a restricted shift is determined, for the benefit of the inland shipping and in a more limited degree for the train.

Concerning the vehicle intensities on the highways to and from Antwerp a strong decrease is determined during the work, related to both through and destination traffic to Antwerp. This decrease has become, however, smaller in the second head period. The closer to Antwerp, the larger the decrease is that is determined. On shorter distances of Antwerp, the alternatives played an important role. The rerouting on long distance has distracted a part of the traffic, which used the Ring road, to other main roads.

5.4. Overall costs-benefits evaluation impact management

Social costs-benefits analysis makes an assessment between direct (immediately quantifiable) as well as indirect (social) costs and benefits that are related to several surrounding variables.

It was decided to make an estimation of the direct costs and benefits, which can be related to impact management, taken within the framework of the road works to the Antwerp ring. The costs, which are taken along are the total costs made for the realisation of the impact management measures. The benefits are calculated on the basis of a modification in loss times for car traffic in a situation with and without impact management measures during the work to the Antwerp ring.

To complete, the traffic system is qualitatively examined (on social field):

- Has the traffic system worked and why did it or did it not?
- Are there any elements in the system, which we would omit in the future on the basis of the experiences?
- Could we have obtained more profit (socially seen) from another traffic system?

5.4.1. *Overview of costs*

Supporting measures:

- Contact Point Impact Management: permanent support and accessibility managers
- Lay-out of the scenario
- Mobility shop
- Communication
- Operational traffic management
- Measures taken by the government for businesses

Traffic optimisation schemes:
Costs made for design, realisation and adjustments of traffic optimisation schemes: development of the impact management strategy, layout traffic circulation and –signalisation plans, infrastructure works, extension Singel, cost traffic regulators, traffic lights, lighting, barrier, camera, public transport flow, Park and Ride and extension station parking, suburban parking, bicycle measures and bicycle marking, Fast, signalisation, measures for emergency services, fold land-marks Kennedy, intervention teams, organisation public transport and decomposing of the impact management measures.

The direct costs mentioned above, also include work provided by the transport agents and the road administrators.

5.4.2. *Overview of benefits*

In this analysis the benefits are restricted to the directly quantifiable dates, i.e. the difference in cost of the loss times of car traffic in both head periods of the work, calculated in a scenario with and a scenario without impact management measures.

This does not take into account the benefits of the other traffic modes and in general the social benefits of this project:

- Public transport users who continued to use public transport: time profit by the import of flow measures (esp. users of express services);
- Car users who have changed to public transport: common social profit by contributing to less congestion, less emissions, less accidents, ... but perhaps additional costs in displacement time which then is compensated by less stress, less sickness and less absenteeism....;
- Car users who have changed to bicycle: common social profit (see also public transport), additional costs in displacement time, compensated fall in costs (petrol, parking costs, ...) and a better condition, ...;

- Cyclists who continued to cycle: general profit by provision of additional bicycle infrastructures and protected bicycle crossings (with priority on car).

But the most important benefit is perhaps the “good feeling”, being the confidence of the public that road works can be carried out in a fast and efficient way. This has to be taken into account for future road works; the expectations will be high after the experiences gained at the work to the Antwerp ring.

5.4.3. *General costs-benefits analysis of impact management measures of road works Antwerp*

The total costs of impact management measures are roughly valued at 67 million euro. The total direct benefits are estimated at about 179 million euro. This means that direct cost-benefit analysis has a positive balance of approximately 110 million euro.

Once more it has to be mentioned that this is a minimum turnover, given it only takes into account direct costs and benefits, which are measured and calculated. If all social costs and benefits would be charged here (incl. economic, social, environmental technical...), the positive balance would be much higher.

Furthermore once more the emphasis needs to be laid on the fact that the whole of the measures has contributed to this result. Each measure in itself has made a contribution, yet will not have worked one without the other.

5.5. General conclusion

A persistent and integrated impact management has a strong positive impact on the perception and the support of serious infrastructure works and guarantees a qualitative multimode accessibility of the metropolis Antwerp.

The implemented measures to limit the negative impact of the work to the ring around Antwerp led to a stable support, where a growing positive perception of the work was obtained. Also important shifts in the multi-modal traffic system were obtained. Many travellers to and from Antwerp have chosen during the road works to use a durable transport mode as an alternative for the car. Only a small percentage has chosen not to make the displacement at all. In general public transport, bicycle, goods transport over water and by train have taken over an important part of the traffic flows, that before the work were made by car and by truck. Finally the routes of the through traffic have been modified by the impact management measures so that the amount of traffic in the region of the work was limited additionally.

It seems essentially that impact management has to be present and addressed at all stages of the work: during the design, the phasing and planning and the implementation, and that all actors and target groups are involved.

Next figure gives a synthesis of the actions, which guarantees a successful integrated impact management approach.

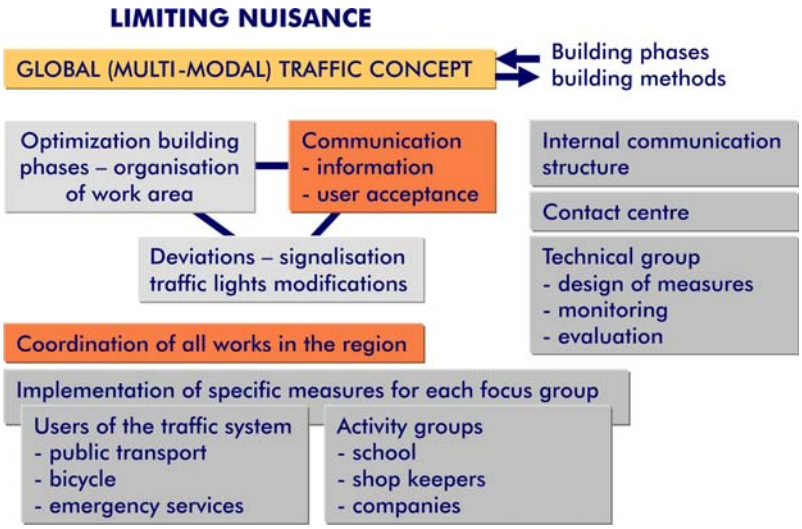

Figure 7: Actions integrated impact management approach