PROVIDED AND PERCEIVED QUALITY FOR PERFORMANCE-BASED ROAD MANAGEMENT: A COMPARISON MODEL

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ABSTRACT

Performance measurement of infrastructure functionality pertaining at section and network levels has become a fundamental point in the management of road administration. The development and application of performance-related specifications requires that the road administration create a system for the measurement of the quality of service provided, but often it does not consider the non-technical point of view of the user/customer. Thus, it is necessary to shift attention towards the perceived quality of the service to measure user satisfaction.
The Province of Florence has developed a double experience in “road global service” by outsourcing the operation and management of a section of a dual carriageway expressway (with two lanes in each direction 100 km in length) as well as a part of its own road network (about 300 Km in length). For contract management in both cases, the administration developed a system for verifying the trend of many performance indicators. In addition, periodic surveys were made to measure customer satisfaction. Comprehensive evaluation of these aspects of quality service is important for enabling decision makers in strategic management of available financial resources. The final aim is a closer agreement between desired and conditions obtainable with available resources, thus individuating sustainable quality and improving road safety awareness.

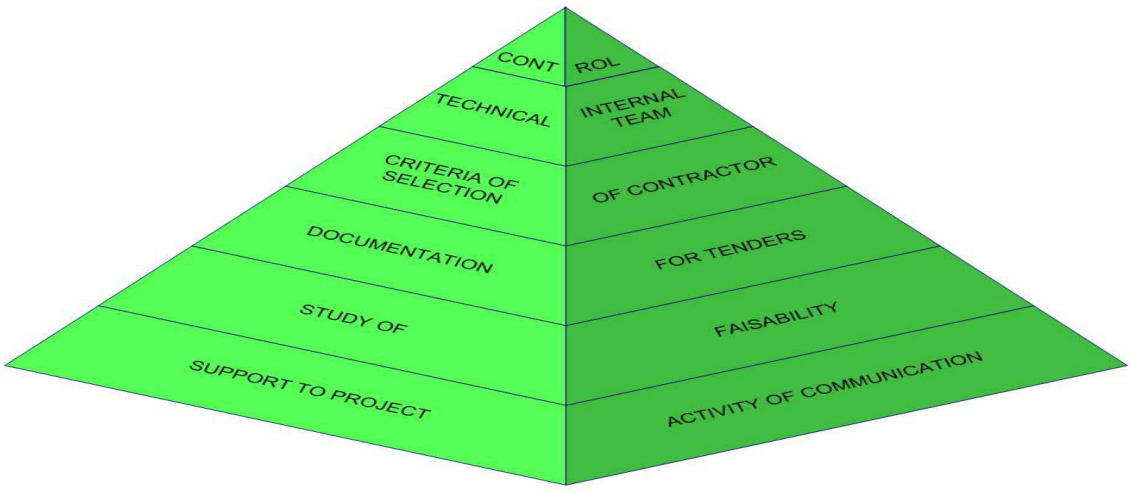
1 – THE PERSPECTIVE OF THE PERFORMANCE-BASED SPECIFICATIONS FOR ROAD MANAGEMENT

The growing difficulty in guaranteeing the integration of managerial and operational services is inducing road administrations to look for new solutions for road network maintenance, to optimize the use of available resources. The road administrations themselves are gradually changing traditional management strategies involving internal specialization and direct use of their own equipment and human resources. The trend is in the direction of management based on attention to the demands of the citizen (whether of a functional or informative nature), entrusting the organization of operational aspects to specialists able to coordinate the necessary activities.
At the same time the local Public Authorities, that run the road network, require absolutely reliable information concerning the maintenance costs of its road property.
For these reasons the relationship between local Public Authorities and those entrusted with the maintenance of the road networks is gradually evolving: remarkable efforts are being made to reach an evaluation of maintenance activity and management from the point of view of performance.
In this case the principal objective is maintenance of the property at a defined quality level with established costs; a performance-based contract with result obligation inscribed is prepared; the road administration defines specifications as well as documents that clarify expected results but do not concern how they are to be attained. Therefore, the contractor does not simply assume responsibility for good and prompt execution of the work commissioned but is fully independent to decide what means and actions to adopt to achieve the objectives fixed by the road administration.

The road administration checks that the objectives are reached by measurement of significant objective parameters. Rewards or penalties may be applied depending on whether the performance was above or below the requested qualitative standards.
For instance the general criteria expounded above are, described when drafting contracts for “global service”, recently coming into use in Italy, for the maintenance and management of road networks. In this sector the performance-based challenge is still in the early stages, and sometimes suffers from excessively high expectations, out of proportion with respect to available resources and realistic results.
In the organization of a global road service the preparatory phases (fig. 1) become extremely important, because the success of the total operation depends largely on their accuracy. The operations can be organised into several phases:

- political and technical support from the administration including communication with the external parties involved;
- a feasibility study to define what services are to be entrusted to “road global service”, with service levels and costs;
- elaboration of clear and exhaustive documents for tenders;
- definition of modality of choice of the global service provider, with particular attention to organizational reliability;
- preparation and training of an internal technical team able to manage all the aspects of the contract;
- definition of programs for verification of activities included in the road global service.

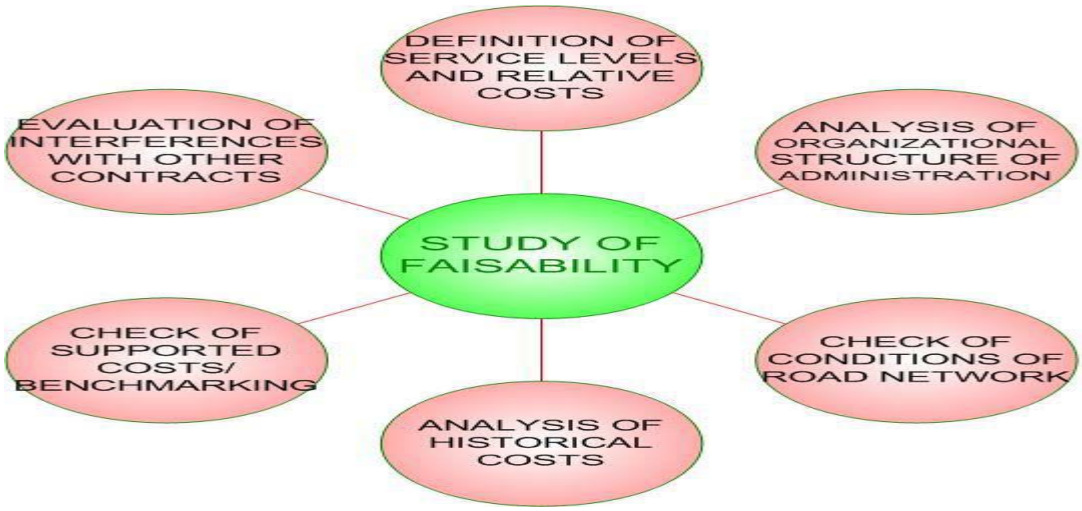
Internal support and communication activity must create the prerequisites necessary for the "global service operation" so the problems of retraining personnel and the relationship with the social and economic tissue of the territory can be approached correctly. In fact the changeover from traditional management to global service outsourcing is a dual change: a necessary reduction in technical staff and an increased requirement for professional capacities (skills).



“Figure 1 – Preparatory phases in road global service”

The feasibility study of the global service is the core of the whole operation and deserves to be examined in its principal aspects.
Initially, the organizational and technical configurations dedicated to the management of the road network structure should be analysed (including the necessity of retraining staff), as this is a fundamental element in the choice of the portion of road network to manage in global service.

Therefore it is necessary to have a systematic picture of the current situation of the road competency network. Unfortunately in many cases only superficial surveys or even only data based exclusively on a visual examination are available. So, finding data on the state of repair of the surfacing or the conditions of the bridges is almost impossible.
The investigation of past costs bound to the management and maintenance of the road network potentially to be entrusted in global service enables a first estimate to be made of the resources necessary to guarantee definite qualitative standards. This technical and administrative reconnaissance, which can be demanding where there is extreme fragmentation of the activities to be examined, also enables the validity of the results achieved till now to be evaluated, when it is possible to compare local experience with that of other similar situations.
In the case in which the current qualitative level of the road network is judged deficient, it is also appropriate to evaluate the possibility of arranging necessary structural intervention before, or together with the contract of global service itself.



“Figure 2 – Themes of feasibility study of the road global service”

Furthermore, any possible interrelations with contractors already previously engaged for road activity and still at work must be evaluated, because independent operating and planning of the global service provider, that derives from the "consignment" of the road to the contractor by the administration, can be considerably hampered by the presence of third parties on the road.
The final phase of a feasibility study obviously concerns the conclusions: a) identification of the road network on which to plan the global service; b) definition of the qualitative standards required in function of the aims of the road authority and available resources; c) definition of the finances available for tenders.

2 –EXPERIMENTATION OF PERFORMANCE-BASED SPECIFICATIONS FOR ROAD MANAGEMENT

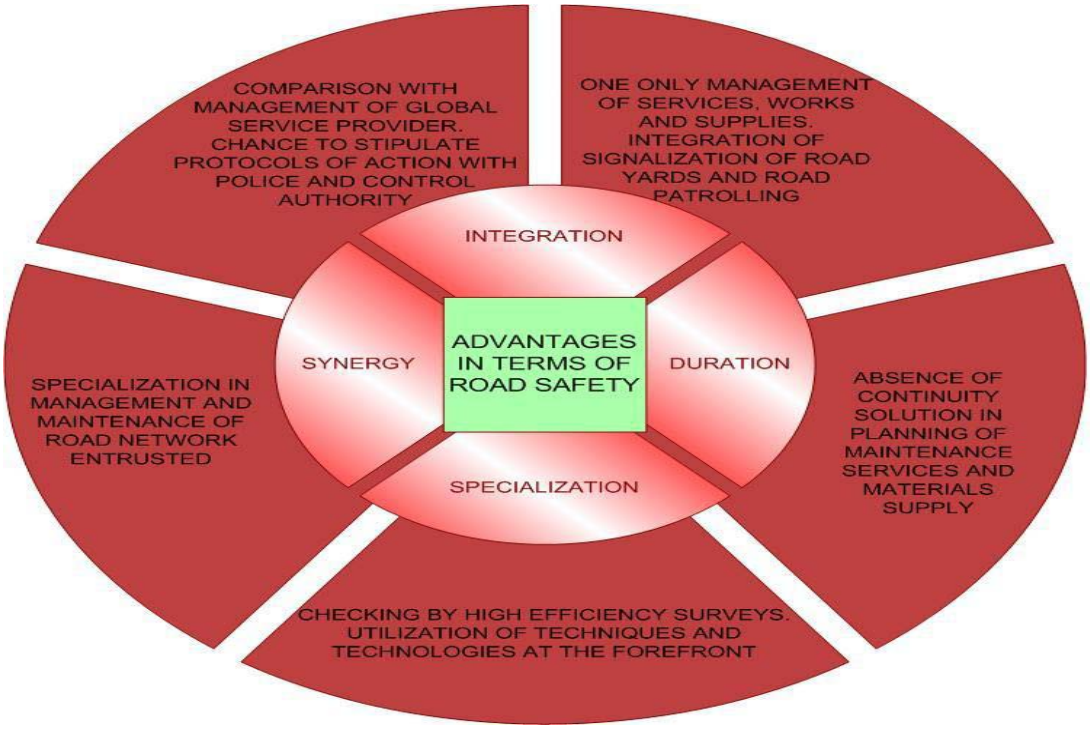
The Province of Florence has initiated a dual experience for maintenance and management in outsourcing of a portion of its road network. The administration has entrusted the S.G.C. Firenze-Pisa-Livorno (fig. 3) and a portion of its ordinary road network to a global service. The “S.G.C. Firenze-Pisa-Livorno” is a dual carriageway of about 100 Km length with two lanes in each direction, characterised by a part in common that starts from Florence and splits after about 60km into two branches, one towards Pisa and the other one towards Livorno. The road directly links Florence and the “A1” highway

with the port in Livorno, Pisa airport, and the “A12” highway. The road is accessed through interchanges (grade separated intersections), while accessing the various service areas located along the road is possible through acceleration and deceleration lanes. ,One of the main components of light vehicle traffic is constituted by commuters.
Nevertheless, heavy vehicles representing a large fraction of the total flow of vehicles, often travel up and down longer stretches, taking advantage of the link provided by the “S.G.C. Firenze-Pisa-Livorno” between highway interchanges and towards Livorno port and viceversa. On some stretches of the road, the total daily number of vehicles may be above 40,000.
The portion road network the object of the second global service contract is about 300 km in length.
Since April 2003 management and maintenance of S.G.C. Firenze-Pisa-Livorno has been entrusted to a temporary contractor partnership headed by the main Italian motorway concessionary “Autostrade per l’Italia”.
The aim of this outsourcing is to guarantee the maintenance of the road network at high qualitative levels regarding availability, safety, comfort, cleanliness. The activities of the Province of Florence are confined to the functions of direction and verification, including the use of advanced management tools to optimize the control of the conditions of roads and the satisfaction of customers and residents.

“Figure 3 – The S.G.C. Firenze-Pisa-Livorno”

At this point the global service provider does not limit its activity to the supply of operative services and works but must provide engineering and management support. The global service provider, in fact, has had to organize several advanced services, such as setting up a call center for citizens as well as installing a traffic information system (preceded by a survey of the necessary data concerning the infrastructure and the traffic), ensuring furthermore the choice of innovative methodologies for controlling infrastructures and carrying out preventive maintenance.
These services are additional to those related to operational activities (patrolling and ready intervention in case of accident or danger, winter services for snow and ice, rubbish removal, management of grass shoulders along the road and advertising boards), besides normal activities of ordinary and special maintenance of the infrastructure (road paving, vertical and horizontal road signs, lateral protection barriers, verification of the security of bridges, viaducts, walls, tunnels, maintenance of drainage of surface waters, etc.).
The quality of the services provided is ensured by the Province of Florence by testing many service level indicators, via sampling or during or specific measuring campaigns.

The territory served (besides that through which the SGC Firenze-Pisa-Livorno runs) is constituted by 16 municipalities with a total population of about 160.000 inhabitants, about 20.000 of whom are citizens residing along the roads entrusted in outsourcing management. They therefore have considerably greater interests and more complex demands than the simple road users.
The network entrusted in “global service” constitutes a huge front-line, able to produce a high number of requests for intervention, also in consequence of the high degree of interconnection with the municipal and local networks and extreme variety of construction and environmental characteristics.
The management of the global service contract is therefore characterized by a strong demand for services to citizens and municipalities.
This involved the necessity of defining integrated operational procedures between the administration and the global service provider to enhance the quality of services supplied. One example of integration is procedures aiming to increase control over the network. i.e. setting up road works, exceptional loads, recognition of unauthorised activities are managed by the global service provider, to which the activities of authorization, concession, vigilance and control of execution/regularity have been entrusted by the administration. The administration carries on organising activities concerning fines and penalties in the case of violations of the highway code.
The management of these two global services for these three years has been a demanding task and a stimulating challenge for the technical teams of both the administration and the global service provider because it was the first experience in Italy for a non-urban road network.
The management of a road network according to performance-based specifications produces several strategic advantages in the improvement road safety conditions of the network itself (fig. 4). However, some potential critical states of the management system, if not adequately solved, can arouse distress and dysfunctions which overall or partially lower road safety standards.

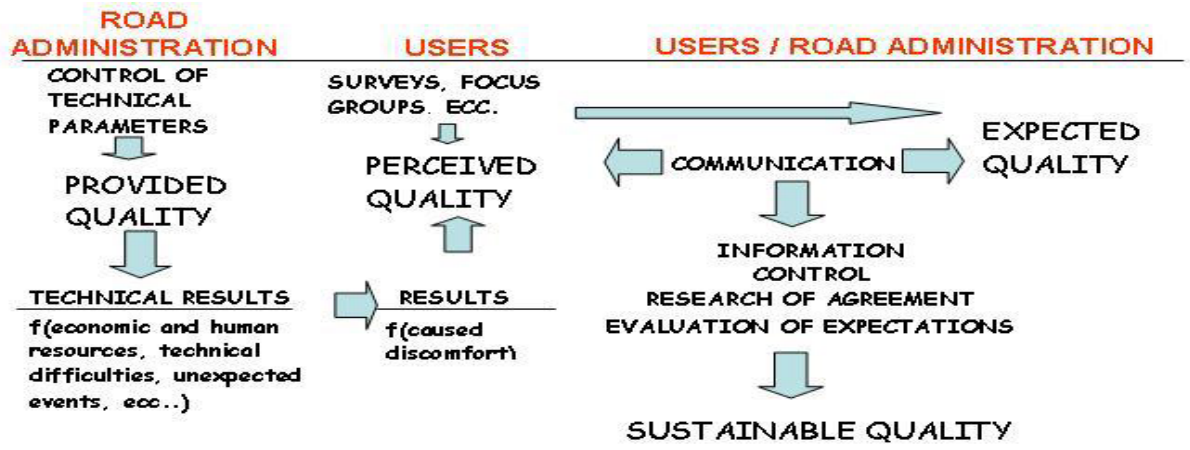


“Figure 4 – The advantages in terms of road safety in cases of outsourcing of management and maintenance”

Integration of various activities concerning the road involves unitary management which has repercussions on a marked specialization and standardization of road works, with clear advantages in the improvement of road safety levels. To this we must add the advantage that the activity related to signalling road works can, in this case, be integrated and coordinated with that of patrolling and the ready intervention.
Also the duration of the contract, usually not less than five years and often longer (up to nine years), allows programming that would otherwise be impracticable (Pavement Management System, Bridge Management System, management of the system of signs, management of the barriers, ecc).
Technical comparison with the control structure of the administration must move towards a potentially very useful synergy in terms of aims: for instance, the duration of the contractual relationship in fact allows agreements and operating protocols to be stipulated between the road network authorities and the traffic police involving the global service provider itself. This familiarization with the requirements and the expectations of the organs of control favours a standardization of road works, so sending a clear message to road users in terms of road safety.
The above is hardly possible with a plurality of parties called on to develop the various activities on roads as traditionally happens with the management via single assignments.

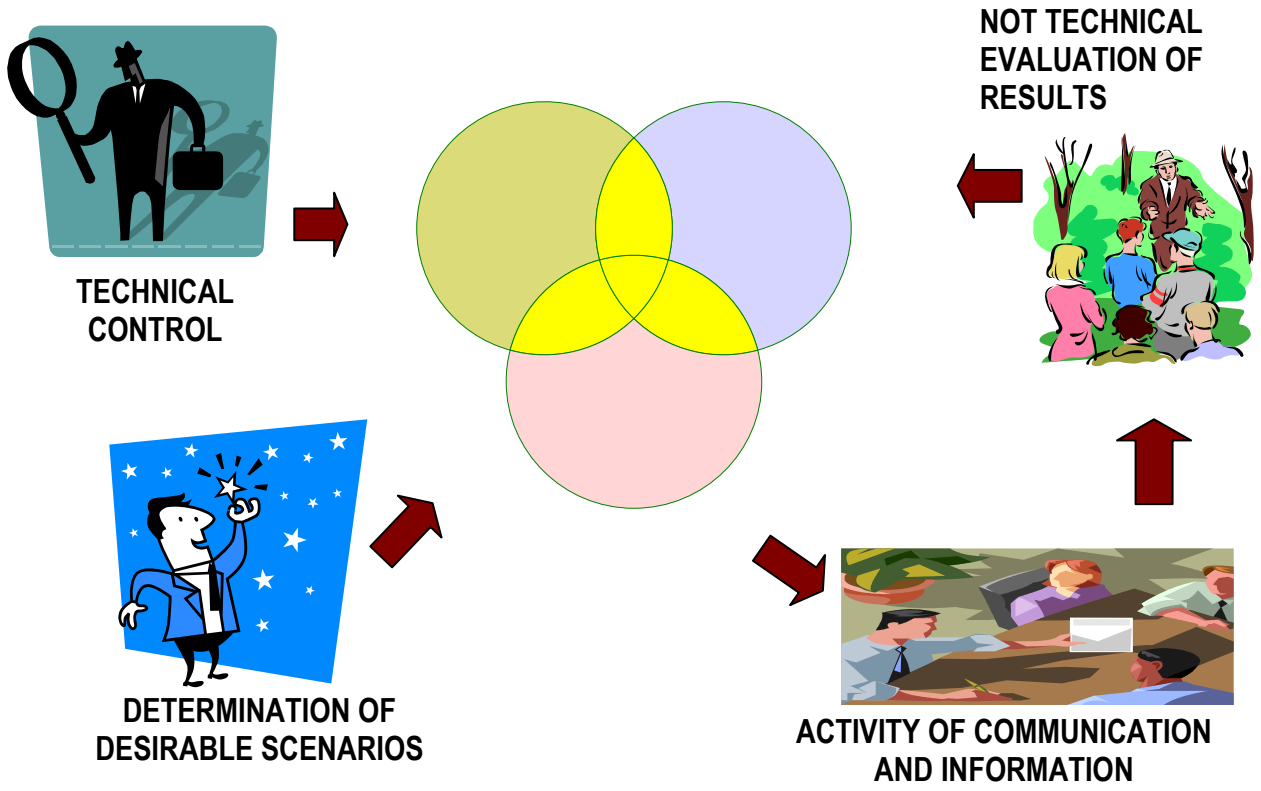
3 –VARIOUS ASPECTS OF QUALITY

At present, this being first time in Italy that these kinds of specifications have been applied to the road system, fragmentation in controlling the activity of the global service provider to a detailed level is unavoidable, partly because technical staff in the administration must acquire awareness. Consequently, trying to evaluate the effectiveness of the total service from the standpoint of the user becomes very important.
The verification of the quality provided is based on measurable parameters which testify the "technical results" achieved by the global service provider. Such results can be put in relation to the economic and human resources used and to the difficulties or unforeseen events encountered. In practice, the users of the road infrastructure examine some results (with a non technical approach) in relation to the distress caused by measures implemented to achieving these results (presence of road works, tail-backs, signalling modes, ecc): therefore we talk about "perceived quality". In this case the service developed by the global service provider is evaluated on the basis of user satisfaction and is obtained via opinion polls, focus groups and other specific techniques which serve to identify the critical scenarios.



"Figure 5 – The way towards the sustainable quality"

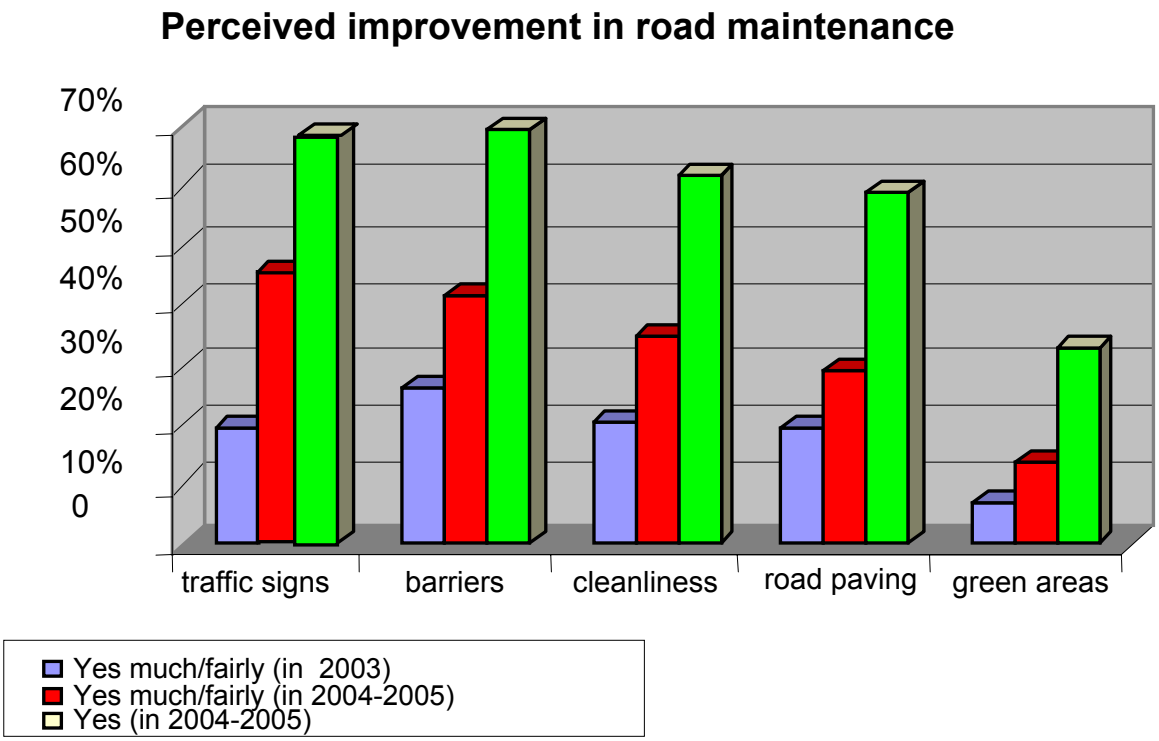
But opinion polls also provide other data: "expected" service can be outlined by the users, allowing the definition of the scenarios desired in the abstract. These scenarios, in fact, are divest of information concerning economic or technical feasibility.
Since the level of "expected" quality is at present superior to that of perceived quality, two requirements emerge. On the one hand we must try to improve the services supplied in the direction of priorities identified by the users, on the other hand we must provide efficiently information to users concerning direct and indirect costs for improvement of the quality levels judged deficient.
The common purpose of these two operations is to reduce the gap between expected and perceived quality by trying to identify the "sustainable" threshold for the quality of the infrastructure conditions. Sustainable quality is understood, therefore, as the characterization of desired scenarios with sustainable costs in function of the available resources.



"Figure 6 – The various aspects of the quality"

Obviously in the search for a definition of the perceived quality, the distinctions between the expectations of the users and those of the residents who live along the infrastructure must be taken into account.
However, even when the users' overall opinion is critical towards the road administration (perhaps because of expectations of structural improvement of the roads and not just their management), the efforts made to improve maintenance activities are noticed. This clearly emerges for instance, from the results of opinion polls carried out between 2003 (starting up of the activity) and 2005, in the context of management in the global service of the SGC Firenze-Pisa-Livorno. Two interesting considerations arise from the interpretation of the results of these opinion polls (the opinion polls asked for the public to give a mark of 1 to 10 to some aspects related to the road). The first consideration is that the total evaluation of the conditions of the road practically coincided with the evaluation of its safety;

furthermore, total evaluation of the conditions of the road, although remaining below adequate, improved over the three years. Simultaneously however, to the request for specific evaluation of the system of signs and for side protection barriers (guard-rails) the users' answers definitely provided increasingly positive evaluations, well above adequate. Moreover, when an evaluation was requested on the perception of improvements in the maintenance of the road, up to 70% of the interviewees answered they had noticed an improvement over the last three years. Therefore although overall evaluation of the conditions of the road was not positive because of structural faults, the efforts to optimize the management and the maintenance of the road had been clearly perceived by the users. Specific ongoing interventions were planned to improve the infrastructural conditions.
A possibly more systematic comparison between the various aspects of quality in relation to the management of an infrastructure can be effected by comparing data through a specific quality report. Therefore it is necessary to compare evaluations of the same parameter from different points of view and using different methodologies. On the one hand we have an exclusively performance and technical approach to evaluate the behaviour of a party entrusted with developing services/works related to the road, on the other, we have a more descriptive approach to evaluate how effective and useful the same intervention is judged. The two evaluations risk being far distant from each other if a complex and effective form of communication between the various reference stakeholders is lacking. An example of criteria for comparison between numerical evaluations concerning a few parameters is reported in figure 8. This grid could serve as the basis for setting up a suitable communication campaign .



"Figure 7 –Users' evaluations expressed in opinion polls on the S.G.C. Firenze-Pisa-Livorno"

As regards the experience of the Province of Florence, the evaluation of the quality provided is based on the criteria contained in the performance-based specifications. These specifications are based essentially on the definition of the activities to be carried out with

the respective minimum qualitative standards to be guaranteed, basing the administration-global service provider relationship on a very elaborate system of annual rewards-penalties, also arranging the definition of conditions in which the presuppositions for rescission of contract are created.
For each activity, therefore, the specifications take care of explicating the aims, the parameters and the control modes, of the qualitative standards (defined as service levels). The evaluation of the service level serves to identify the real level of performance and place it in the rewards or penalties context, by the implementation of a fairly simple algorithm according to the characteristics of the activity itself. For the activity of “call center”, for instance, the "accessibility to the operator" was established as an evaluation parameter. This parameter corresponds to the time elapsing between the ringing signal and the operator's answer. The chosen survey mode consists in direct spot checks by administrative staff . The minimum service level to be guaranteed is identified as "60 seconds" and the "number of times per year in which the service level was not respected" is used to define reward or penalty.
Because to every single activity a relative weight was assigned, the coefficient of total evaluation was determined as the weighed sum of the coefficients of all the activities contemplated. Planning the controls obviously involves organizing a rota of inspections, instrumental verifications and implementations of the informative system. This organization is highly complex as it must consider the frequency of various controls, the necessity of setting up a timely debate with the global service provider and creation of archives and minutes, the calculation of parameters for determining rewards and penalties, control of responsibilities which depend on the “consignment” of the road. Providing specific software to enable management to manage the whole system of controls has proved to be the most effective way to coordinate these demands .

4 –EVALUATION OF THE PRESENT EXPERIMENTATIONS

After each contractual year, for the first three years, the total effectiveness of this particular type of contract for the management and maintenance of the road network was evaluated.
Each activity was examined and broken down into single components that were classified in three categories, according to the result achieved: services developed with satisfactory results, services in which development disputes rose during the first contractual year and services not included in the performance-based specifications but thought useful for improving the conditions of the road. The integrations which proved necessary were mostly linked to improvements in structural or functional type of the infrastructure and they emerged thanks to the results of highly efficient technologies for surveys carried out in the initial phase of the contractual period. In some cases a few activities complementary to the services already foreseen were judged useful. The necessity of these complementary contract activities emerged during the first year of contract. Some of these demands arose after start up .
Overall, the services were preponderantly satisfactory and their number increased over the contractual years. Obviously several problems related to services over which disputes arose, were quite arduous to solve without modifying the contractual terms.
When deciding on the choice of this type of contract several objectives were identified and after three years of contract a critical evaluation was made not only of the degree to which they were achieved but also their functionality with respect to the total result, as referred to customer satisfaction . The aim of adjusting the administration’s activities to the functions of strategy and control required equipping and training a technical and administrative office able to manage a complex contract involving a not negligible sum.

QUALITY REPORT		PROVIDE QUALITY		PERCEIVED QUALITY		EXPECTED QUALITY	
		Service provided both by road administration's staff and global service provider. Service level is evaluated on the basis of performance standards.		Service perceived both by road administration's staff and global service provider. Service level evaluated on the basis of measured satisfaction of users through opinion polls and focus groups. Characterization of critical scenarios.		Service expected by users. Service level defined by results of communication between users and local road authority. Expectations and costs related must be put in evidence and available resources too. Characterization of desirable scenarios at sustainable costs.	
N.	INDICATORS	STAKEHOLDERS					
		PROVINCE		USERS		USERS / PROVINCE	
		DESCRIPTION	PARAMETER OF MEASURE	DESCRIPTION	PARAMETER OF MEASURE	DESCRIPTION	PARAMETER OF MEASURE
1	SAFETY ROAD	General conditions of safety of isolated vehicle and in relation to other vehicles	f=f(deducible value through safety audit ; N° of accidents ; n° dead and injured; global and deadly rate of accidents)	Sensation of safety ; personal evaluation of number of accidents and of their gravity	Numerical evaluation (from 1 to 10) of reality of affirmations or negations as « Side protection barriers always looks in good conditions" "Anti-skid conditions of the road are generally good »	Sensation of safety ; personal evaluation of number of accidents and of their gravity Characterization of desirable safety conditions	Numerical evaluation (from 1 to 10) of possible improvements. Evaluation of the relation between safety speed and speed limits
2	ROAD TRAFFIC CONDITIONS	Road traffic conditions in relation to the traffic flow and planning of maintenance (works during the night, double shifts,ecc.)	Total duration of tailback in relation to traffic conditions. f=f(Hours of tailback because of presence of road yards)	Memorization of predominant conditions of road traffic	Numerical evaluation (from 1 to 10) of reality of affirmations or negations as "Road traffic prevalently flows in regular conditions"	Memorization of predominant conditions of road traffic. Characterization of expected threshold and sustainable threshold in terms of fluency with road yards.	Numerical evaluation (from 1 to 10) of possible improvements. expected threshold and sustainable threshold of monthly hours of queues.
3	PATROLLING AND EMERGENCY RESPONSE SERVICE	Effectiveness of patrolling and emergency response service	f=f(Percentage of times in which fast operation service is called by patrolling service ; evaluation of possible repairing intervention, of correct arrangement of traffic signs and of traffic management)	Familiarization with the presence of a patrolling and emergency response service	Numerical evaluation (from 1 to 10) of reality of affirmations or negations as "On the road are often present patrolling vehicle and in case of necessity emergency response service comes just in time and effectively	Familiarization with the presence of a patrolling and emergency response service. Characterization of desirable conditions of emergency response	Choice among different assigned values to reference parameters. Desirable time of intervention and frequency of patrolling

"Figure 8 – Comparison example between the various aspects of the quality"

The advantages for the Province of avoiding the load of administrative work involved in the procedures for tenders and the preparation of single contracts is irrefutable, not to mention avoiding traditional accounting for the works and management of purchases and stores, as well as that of management of the operating staff.
Nonetheless, interfacing with local authorities (such as municipalities) and citizens cannot be assigned to the global service provider since the management of such relationships mingles with the institutional activity of the administration itself.
The stated aim to use the most modern technical instrumentation for data surveys, to enable, a tightly planned, complete maintenance of the infrastructure, proved to be a point of strength.
The shortage of basic data in this sector is chronic and structural and programming optimized activities and resources is hardly possible without previously maximizing the level of knowledge of the state of the road. Thanks to the global service contract we now dispose of a rich data bank regarding the thicknesses and the modulus of the layers of the road paving (and therefore its bearing capacity), skidding resistance (CAT), the regularity (IRI), the retro-reflection of horizontal system of signs, the system of vertical signs and the characteristics and conditions of the bridges. Thanks to the institution of an archive of accidents along the S.G.C. Fi-Pi-Li it is now possible to analyse the relationships between the conditions of paving and the distribution of accidents. This give us a further verification of the classification of priorities in maintenance work. For the first time since the road itself was built, we have at our disposal sufficient data in relation to the bearing capacity and the consistency of the single layers of paving, which allows us to aim our choice of interventions to structural rehabilitation with consequent economic optimization.
Finally, thanks to a comparison between data concerning the quality provided, obtained through verification of the global service provider's activity and data concerning the expected quality obtained through users' opinion polls, it is now possible to set up the necessary communication campaign. The communication campaign must provide the required information to increase user awareness of the choices made in terms of road network management as a function of available resources. This communication campaign has already partly started, driven by the necessity of extensive maintenance work to enhance the safety level of the S.G.C. Firenze-Pisa-Livorno. In concomitance with the opening of the road works on this infrastructure, a dedicated patrolling and emergency response service has been organized. This service is integrated with a road information system based on the use of both mass media and panels for dynamic message signs. These panels are both fixed and mobile (i.e. installed on trucks for patrolling). Together with the use of video cameras, they guarantee the spread of news concerning traffic trends owing to the presence of the road works. All this was coordinated through drafting a protocol with the local government units involved and the organs of road police for the management of emergencies, and the whole operation was divulged via a communication campaign called "Fipilissima".