Performance-based Road Rehabilitation and Maintenance Contracts (CREMA) in Argentina
A Review of Fifteen Years of Experience (1996-2010)

Maria Marcela Silva and Gerard Liautaud
PERFORMANCE-BASED ROAD REHABILITATION AND MAINTENANCE CONTRACTS (CREMA) IN ARGENTINA


Maria Marcela Silva and Gerard Liautaud
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The road sector is the dominant mode of transport in Argentina carrying nearly 80 percent of total freight volume. The road network has a total length of about 630,000 km (11 percent paved), divided in three administrative levels: national, provincial and municipal. However, more than 70 percent of total traffic volumes are concentrated on the paved national and provincial network, with the municipal network consisting of unpaved roads, access roads to farms and feeder roads with very low traffic volumes.

The national network built in its great majority more than 20 years ago, represents a total asset of about US$7 billion equivalent and carries most of the country's long distance traffic. At the beginning of the 1990’s, the national road network of Argentina was about 38,800 km-long (80 percent paved). Since then, a sustained upgrading and paving program has been implemented that has increased the proportion of paved roads to nearly 90 percent, that is, from 31,000 to 33,500 km. About 80 percent of the paved network consists of flexible structures with granular base-course overlaid either with asphalt concrete (about 40 percent) or double surface dressing (60 percent). Rigid or cement concrete pavements are poorly represented, accounting for less than 0.5 percent of the total length of the network.

Traffic volumes on the paved network cover a wide range, from less than 500/day up to 10,000 to 20,000/day on the most heavily trafficked corridors. Average annual daily traffic volumes on two-lane rural highways generally range between 500 and 3,000 vehicles/day. Between 1990 and 1995, traffic growth rates on the main corridors were in the order of 8–13 percent per year but fell thereafter to about 3–5 percent. A typical traffic composition on the national highway network is 50 percent light vehicles and 50 percent commercial vehicles. On unpaved roads, traffic volumes generally vary between less than 50 up to 500 vehicles per day. Road users spend annually an amount equivalent to about US$10 billion for operating their vehicles on that network.

For decades, persistent fiscal crisis and deficient management policies led to under-funding and deterioration of road assets in the country to the point that, in 1990, Argentina ended up with the lowest share of paved roads in good condition among upper-middle income countries. A survey carried out in 1992 confirmed that only 44 percent of the national paved network was in good condition (IRI<4), with a high 35 percent of roads in poor condition.

\footnote{Since 2004, annual growth rates reached about 10 percent, reflecting the economic recovery that followed the 2001 financial crisis.}
Following the deep economic crises of the end of the 1980s, the Government of Argentina supported a series of transformations in the road sector that have enabled important achievements in terms of sector development, including: (i) decentralization of expenditure and financing responsibilities to provincial and local governments; (ii) introduction of private sector financing; (iii) transferring the execution of works to private contractors; and (iv) focusing the capacity of the existing road agencies towards more efficient planning.

The first action taken in 1991 by the government was to concession nearly 9,000 km of the paved network with the highest volumes of traffic (above 2,500 vehicles/day). Altogether 18 concession contracts were awarded to the private sector for a period of 12 years and their up-keep was financed essentially by road user tolls.

Rehabilitation works for the non-concessioned portion were contracted to the private sector under the traditional ad-measurement type or unit price-based system while maintenance activities continued to be carried out by force-account. However, due to internal inefficiencies and because of the sheer size of the needs (the proportion of paved roads with maintenance backlog and in dire need of rehabilitation was high—in the order of 40 percent) the condition of said network remained far from satisfactory and it soon became apparent that neither the routine maintenance nor the traditional capital improvement programs were able to rapidly overcome the important backlog that had accumulated over the years.

In 1993 a loan from the World Bank was approved to finance, for the first time, high priority rehabilitation and maintenance works on the non-concessioned paved network, leading to the development of a long-term maintenance strategy based on the gradual expansion of performance-based contracts, a modality that is currently being replicated in other countries around the world.
ORIGINS AND DEFINITION OF THE CREMA CONTRACTS

The concept of, and experience with, performance-based contracts were not new in Argentina, since an output-oriented concession program was being successfully carried out on the national road system since 1991. Surely, it was primarily funded by tolls recovered from road users, as the volume of traffic on these roads was sufficient to make the system financially self-sustainable. But, for the rest of the paved network, the average density of traffic—a little less than 1,000 vehicles per day on average—was too low to enable tolls to finance the expenditures needed by the restoration works. The only option was to continue funding the works with government resources. Already in 1995-96, building on the experience of the concession program, and with the World Bank’s assistance, the National Directorate of Roads of Argentina (DNV), had initiated a performance-based routine maintenance type of contract called the “km-month” that was designed to apply to the non-concessioned paved roads which had recently been paved or rehabilitated and were in good condition. Those contracts were signed for a period of 4 years and paid by a lump-sum monthly fee. Payment was made not on the basis of unit rates for different items of works, but on the basis of the Contractor’s compliance with pre-determined quality standards and outcome as specified in the contract document. In addition, the system allowed for penalties to be applied when the desired quality or level of service was not achieved.

The success of the concession and the “km-month” contract programs prompted DNV in 1996-97 to imagine a new system that would combine both the rehabilitation and routine maintenance component into one contract, while keeping the concept of performance-based and financing the system with local funds complemented by the Bank’s loan. That new system called CREMA (Contrato de Recuperacion y Mantenimiento) originated in reaction to several factors:

- Delays accumulated in the implementation of the Bank-financed Highway Project on-going at the time, stemming from problems with counterpart funds that became critical with the onset of the macroeconomic crisis in 1995, and which affected all Bank projects in Argentina; such delays being compounded by a lack of stocks of government-prepared detailed engineering projects, ready to bid;
- DNV’s retrenchment process that caused an increasing shortage of personnel in the provinces for supervising and measuring the vast quantities of activities generally involved in the more traditional maintenance contracts and for monitoring performance standards using inputs indicators;
- The frequent cost overruns resulting from inadequate designs and leading to increased quantities of activities included in the original Bill of Quantities,
compounded by the time-consuming efforts wasted in analyzing and justifying a large number of claims and in seeking additional budget allocations before finally drawing up contracts amendments;

- The need to focus more on customers’ satisfaction, seeking to identify outcomes, products and services that road users expect to be delivered, and to monitor and pay for those services on the basis of customer-based performance indicators;
- The desire to shift greater responsibility to Contractors throughout the entire contract period in order to stimulate and profit from their innovative capacity, in line with the government drive for a stronger role of the private sector in the management and financing of infrastructure;
- Make better use of and accelerate disbursements of available Bank’s funds; and finally,
- Promote a system that could reasonably be expected to achieve cost-effectiveness compared to the traditional system, as it would embody, in one large contract, both the rehabilitation and subsequent maintenance of a network of roads over a long period of time, thus enabling the Contractor to better plan and organize its resources in equipment and personnel.

In order to address those issues, the new system was designed with the following features in mind:

- Focus would be on road users’ satisfaction and on Contractor’s performance to achieve a minimum level of service, rather than on inputs, that is, quantity activity and unit rates compliance;
- Require the Contractor to set up his own quality control system, thus reducing the need for time and staff consuming supervision, by eliminating redundant quantities and quality-testing of activities performed, and keeping inspection team size and tasks to a minimum;
- Promote lump-sum contracts in order to reduce the risk of cost overruns;
- Require the Contractor to carry out a detailed engineering design before initiating the works, thus reducing the delays that are due to a lack of stock of prepared sub-projects;
- Deter the Treasury from failing to provide stable funding for road maintenance, as the long-term payment obligations under these contracts become legally binding on the government;
- Reduce the risk of unsatisfactory quality in the capital rehabilitation works since the Contractor is obliged to maintain the roads over a five-year period;
- Foster innovation on part of the Contractors in the programming and execution of works by making payments tied to end results and level of service rather than to rigid specifications related to workmanship.

As originally designed, the CREMA is a combined rehabilitation and maintenance contract that requires the Contractor to rehabilitate and subsequently maintain a sub-network of roads under a lump-sum contract for a total period of five years. The system applies to a paved sub-network that needs to be rehabilitated over a portion (or the totality) of its length and subsequently maintained. Rehabilitation works are
carried out during the first 12 to 18 months of the contract, while maintenance activities are undertaken throughout the 5-year contract period.

The network is defined by the road agency and comprises contiguous or area-specific sections of roads having a total length generally ranging from 100 to 300 km. The contract specifies the sections that need rehabilitation as well as the minimum solution or overlay thickness that is required in order to ensure a positive Net Present Value for the investment at a 12 percent discount rate. It also specifies required road service outputs, and uses a system of penalties to ensure that the Contractor rapidly corrects unsatisfactory performance in execution.

The preliminary design provided by DNV in the bidding documents is based on extensive technical data collected by DNV namely: pavement history, current surface condition (cracking index, pothole areas, rut depths, raveling percentages), roughness and deflection profiles, as well as traffic volumes and composition. In addition, and whenever necessary, preliminary drawings for improvements are provided, such as for the remodeling of intersections, bus stops facilities, weigh bridges platforms, and so on. Experience shows that such information is generally sufficient for bidders to make meaningful proposals.

The contract is awarded to the lowest evaluated bidder. After award, the Contractor is required to carry out a detailed engineering study based on a preliminary design provided by the road agency but he is free to propose, on the basis of his own risk assessment, any rehabilitation solution above the minimum threshold defined in the Contract.

Execution is monitored (i) first, by a mandatory Contractor's own quality control set-up; and (ii) by in-house supervision teams generally comprising of about three people (one site engineer plus two laboratory technicians) periodically supported by safeguards experts from DNV's head office who visit the site from time to time.

Payments are made when a specified level of service is achieved and not on the basis of a pre-determined Bill of Quantities and unit rates as in ad measurement-type of contracts. Performance is assessed during monthly inspections jointly carried out by the Engineer and the Contractor. At the end of every month, the contractor provides a summary of the works that he has completed in accordance with the “Program of Activities” that he submitted with his Detailed Engineering project. Each activity is paid in terms of a percentage of the total rehabilitation works contract.

Performance indicators are kept to the minimum and are easy to monitor and measure: for example, throughout the contract period, rehabilitation works must meet or exceed the minimum thickness of overlay and must comply with the maximum level of roughness, rut depth, cracking, or raveling. Regular monthly visual inspections of maintenance activities focus on a few essential items (about 10) to ensure compliance with the specifications: no visible potholes or unsealed cracks, no excessive rutting, good condition maintained on shoulders, culverts and drains, guardrails, vertical and horizontal signs, as well as on the road side environment. For each item, penalties for non-compliance are set and applied in order to deter the Contractor from failing to comply. For example, a pothole left unrepaired beyond the specified time limit will currently cost the Contractor about
US$1,000 per day until it is patched (see Annex 1 for a detailed list). The total amount of penalties is deducted from the monthly payments.

Time and cost overruns are not allowed, except in cases of force-majeure. In such a case, the type of work to be carried out with their quantities are proposed by the Contractor with associated unit costs based on the unit prices submitted with the detailed design all of which are reviewed, discussed and agreed by DNV. The works are thereafter paid as a lump-sum. Additional time for execution of the compensable event is discussed and agreed between the Contractor and DNV (with Bank's no-objection if financed by the Bank).

Finally, the CREMA Contract provides the mechanisms to be used in the case of disputes. So far, disputes are resolved through an appointed Arbitrator and local Tribunals.
Since the CREMA system of contracting started in 1997, about 24,000 km of the non-concessioned paved network have been maintained under that system, through 148 individual contracts. The total amount of financing assigned to the CREMA programs between 1997 and 2009 represents nearly US$2.5 billion, corresponding to about 20 percent of the total investments allocated by DNV to the maintenance, rehabilitation and improvement of the non-concessioned national network. The World Bank contributed about 42 percent of that total amount through four successive highway rehabilitation loans.

Over the period 1997-2009, the procurement and implementation of the CREMA contracts were made in five distinct phases:

- **The first phase** took place in 1997 when about 59 contracts were bid and awarded covering a total length of network of 11,000 km. This phase came to term in 2002, coinciding with the severe economic downturn that hit the country at the end of 2001. As the crisis halted momentarily the pursuit of the strategy, it was decided to extend for another year or two the routine maintenance component of the ongoing contracts. In 2003 a small follow-up program, conceptually akin to the original CREMA, was procured comprising five contracts covering a length of about 700 km. That small program came to term in 2007.

- **The second phase** took place in 2004 and included about 33 contracts covering a total length of about 5,000 km that will normally come to term in 2009-2010. At the beginning of 2005, another batch of 10 bids totaling about 2,500 km were tendered, but came short of being evaluated and awarded because of a suspicious closeness among the bids and the high financial offers that exceeded official estimates by nearly 35 percent. As the outcome of the 2005 bids was in many respects similar to what was already observed in 2004, it was decided to make a pause in the bidding process and to examine in more details the reasons of the Market’s response, one of which was clearly the crisis-generated inflation that had started since the second quarter of 2004.

- **In 2006, a third phase** was carried out following the recommendations from an Action Plan aimed at mitigating the negative effects of the 2002 crisis. This phase included some 15 contracts covering a length of about 2,500 km of roads. For the first time in the program’s history 8 of those contracts were financed in its entirety with local funds.
• The fourth phase was initiated in 2007, when a larger CREMA program aimed at completing the coverage of the entire 22,000 km-long non-concessioned paved national network was launched. However due to budgetary restraints this phase only covered 29 contracts totaling about 4,400 km (of which 23 contracts were financed with local funds).

• Finally, between 2008 and 2009, a fifth phase was initiated, covering 7 contracts over a total length of about 1,100 km.

Since 1997, procurement of the CREMA contracts has been based on the World Bank's Standard Bidding Document (SBD) for Small Works as periodically revised by the Bank, using the “lump-sum contract” and “program of activities” options while modifications have been introduced through the Bid Data sheet, the Contract Data sheet, and the Technical Specification for the Works. Specially conceived Technical Specifications and conditions for payments were added to the SBD. The last set of CREMA bidding document is based on the 2006 version of the Bank's SBD for Small Works. However, since the beginning of the program, the CREMA system has undergone a number of adjustments both in terms of procurement and rehabilitation design strategy that affected not only the total cost and value of individual contracts but also the market’s response to the system.

The most significant adjustments made on the procurement aspect of the CREMA relate to the financial terms under which the contracts are executed. On the one hand, the payment modalities for the rehabilitation component have been modified in order to reduce the financial charges that were imposed originally to the Contractor. During the CREMA 1 phase (1997-2002), the Contractor received an initial payment of about 5 percent of the total contract value, followed by two payments of 20–25 percent of the contract amount at the end of the first 6 months and upon completing the rehabilitation works, that is, at the end of the prescribed 12-months rehabilitation period. Those payments amounted to only 60–70 percent of the total cost of the rehabilitation component, the remaining part being paid through monthly installments over the five-year duration of the contract. That payment modality was motivated by the desire to maintain the Contractor's presence on site and involvement in the works during the 5-years contract period. However, in retrospect, it is estimated that failure to pay the Contractor the full amount of the expenditures incurred in the execution of the capital improvement component of the contract resulted in a cost overrun in the order of 25–30 percent. That payment mechanism was modified in 2004 for the CREMA 2 phase, when the contract allowed for payment in full to be made as the rehabilitation works advanced, and in accordance with the approved program of activities proposed by the Contractor with the final engineering design.

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2 When the Bank’s Output and Performance Based Road Contracts (OPRC) sample became available it was discussed with DNV but was never adopted for the CREMA program for the following reasons; (i) procurement using the Bank’s SBD had been always successful; (ii) the condition that rehabilitation works should be less than 40–50 percent of the total contract amount, as specified in the OPRC could not be applied to the Argentine situation since most (if not all) of the contracts executed involved rehabilitation works exceeding 50 percent of the total cost (iii) there was no rationale to select an ad-measurement type of payment for the improvement works since the Argentine experience showed that when such improvements can be well defined (in terms of location and items of works), the lump sum modality also applies well.
On the other hand price adjustment mechanisms also became mandatory in order to take into account the inflation that occurred after the 2002 economic crisis, adjustments currently being made on a monthly basis.\(^3\)

On the design aspect of the CREMA, modifications have been made not only to the overlay thickness used for rehabilitation but also to the coverage or extent of the rehabilitation works. When the CREMA started in 1997, the strategy was to use the system to rejuvenate and cover the maximum length of the national network with the limited resources then available. To achieve that objective, the policy adopted by DNV was to select the overlay thickness that would yield the minimum acceptable internal rate of return of 12 percent and to routinely maintain the sections that were in good to regular condition. The HDM model used to carry out the economic evaluation indicated that for the surface and traffic characteristics of the network at the time, the appropriate thickness of asphalt concrete was about 3 to 3.5 cm, and that the overlays were only necessary over about 40 percent of the total length of the network. In a number of cases, a slurry seal was selected as being the minimum economic solution. That policy was uniformly implemented over the 11,000 km of the non-concessioned network involved in the first generation of CREMA. The value of each individual contract was in the order of US$10 million, and rarely exceeded US$12 million, with a unit cost of routine maintenance averaging between US$2,000 and US$3,000 per km per year.

In retrospect, the CREMA 1 strategy has been a success on several fronts:

- There was no cost overrun;
- All the contracts were executed without any major issue or problem;
- The condition or quality of that network at the end of the contracts exceeded all expectations, particularly in terms of riding quality (roughness) and life expectancy;
- The network has performed satisfactorily until the next round of rehabilitation began to be contracted in 2006, meaning that the selected minimum solution lasted for at least 8 to 10 years before another overlay became necessary.

The CREMA 2 phase did not vary much from the original policy in terms of design, except for a slight increase in the thickness of the asphalt concrete overlay as well as in the length over which the overlay would be executed. The decision was motivated by the desire to extend the service life of the rehabilitation segments and to further reduce road users’ costs, thus bringing the solution closer to the optimum strategy recommended by the HDM model. The moderately improved strategy consisted in placing, on average, 4 cm of asphalt concrete overlay over nearly 50 percent of the total length of each contract network (Malla for its name in Spanish). The impact of the new policy on the value of an individual CREMA contract was small, the average contract amount having increased to about 12 millions dollars, with a unit cost of routine maintenance averaging between US$3,000 and US$3,500 per km per year. Road sections included in this phase were not part of the CREMA 1, but showed similar surface condition and traffic volumes as the network of 1996.

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\(^3\) Standard Bank’s unconditional performance guarantee (of about 10 percent) for the contracts was initially used without any problem. After the 2001 economic crisis, the Bank accepted, on an exceptional basis, the use of performance bonds (of about 30 percent) from recognized insurance companies. When rehabilitation works have been completed and accepted by the Employer, the performance guarantee amount is gradually reduced to ultimately cover essentially maintenance activities.
The strategy for the CREMA 3 program that initiated in 2006 started to deviate from the previous programs, not only in terms of overlay thickness and the length of the rehabilitated sections but also in the cost of the routine maintenance component. Albeit with surface condition and traffic volumes akin to the previous two sub-networks, the average overlay thickness increased from 4 cm to 5.5 cm (slightly above the economic optimum solution), and the proportion of the total length of the Malla rehabilitated increased from 50 to nearly 60–65 percent. In addition, the unit cost of routine maintenance increased from US$3,000 to about US$4,500 per year per km. The new strategy caused the average value of a CREMA contract to rise from US$12 millions to nearly US$20 millions. Allowing for the inflation that started in 2004, the increase in cost was primarily due to the much-enhanced design standards.

In June 2007 the CREMA 4 phase started to be implemented. The trend in higher standards and costs continued to accelerate, causing the average value of a CREMA contract (of similar length) to reach between US$25 and US$35 millions, while routine maintenance activities ballooned to about US$6,000 per year per km. The primary determinants of such increase are:

- First, with pavement condition and traffic volumes similar to those of the previous three programs, the overlay thickness has increased from 5.5 cm to slightly over 6 cm, nearly 50 percent above the optimum design of 4 cm recommended by the HDM model for the range of roughness and traffic volumes usually measured on the non-concessioned network;
- Second, the extent of the rehabilitation project now covers about 90 percent of the total length of the Malla, compared to the 40–60 percent range previously used, again for similar pavement surface defects patterns and traffic conditions;
- Third, the quantities of expensive items in the routine maintenance component, such as pothole patching and crack sealing, instead of being reduced to account for the more comfortable overlay design standards, were being overestimated, causing an explosion in the unit cost of this component.
- Fourth, and since 2006, the scope of mandatory works to be executed, in addition to the overlay operations, has been amplified, essentially to improve road safety conditions, such as the inclusion in the contract of mandatory horizontal marking, improvements at critical intersections, and enhancement of guardrails features;

In 2008, a CREMA 5 phase was launched and comprised 7 contracts totaling about 1,100 km of roads that have been tendered between March 2008 and October 2009. Those contracts are now being executed. For the design of that program, it was agreed that overlay standards should be closer to the optimum recommended by the HDM model, while the routine maintenance activities would be more consistent with the improved rehabilitation solutions. The objective of implementing more cost-efficient solutions is being gradually met: on average, overlay thickness is currently in the order of 4 cm, and routine maintenance unit costs are reduced to about US$4,500/km/year (see Annex 2 for a detailed analysis of the cost structure of a CREMA contract).

Table 1 summarizes the evolution that has occurred in the design and cost of the CREMA programs in Argentina over the last fifteen years.
### TABLE 1: SUMMARY OF CREMA PROGRAM FEATURES BETWEEN 1997 AND 2010

<table>
<thead>
<tr>
<th>Program Phase</th>
<th>Bidding Period</th>
<th>No. of contracts</th>
<th>Total Length contracted (Km)</th>
<th>Average Individual Contract Length (Km)</th>
<th>Avg. Roughness prior to Contract signing, IRI</th>
<th>Avg. Daily Traffic prior to Contract signing (veh/day)</th>
<th>Total Contract Value at signing (US$)</th>
<th>Avg. Contract Value at signing (US$)</th>
<th>Avg. Thickness of Overlay applied (cm)</th>
<th>Length rehabilitated as a % of total length</th>
<th>Avg. Unit Cost of Routine Maintenance at contract signing (US$/km/year)</th>
<th>Avg. Unit Cost of Rehabilitation at contract signing (US$/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREMA 1</td>
<td>1/97 - 12/97</td>
<td>59</td>
<td>11,000</td>
<td>186</td>
<td>3.6</td>
<td>773</td>
<td>609,889,810</td>
<td>10,337,115</td>
<td>3.2</td>
<td>40%</td>
<td>3,000</td>
<td>40,445</td>
</tr>
<tr>
<td></td>
<td>6/01 - 9/03</td>
<td>5</td>
<td>677</td>
<td>135</td>
<td>4</td>
<td>1,218</td>
<td>41,814,385</td>
<td>8,362,877</td>
<td>4.0</td>
<td>40%</td>
<td>2,500</td>
<td>49,264</td>
</tr>
<tr>
<td>CREMA 2</td>
<td>4/04 - 6/04</td>
<td>33</td>
<td>5,005</td>
<td>152</td>
<td>3.7</td>
<td>1,267</td>
<td>409,172,391</td>
<td>12,399,163</td>
<td>4.2</td>
<td>50%</td>
<td>3,500</td>
<td>64,253</td>
</tr>
<tr>
<td>CREMA 3</td>
<td>8/05 - 7/06</td>
<td>15</td>
<td>2,518</td>
<td>168</td>
<td>3.3</td>
<td>1,279</td>
<td>293,443,563</td>
<td>19,562,904</td>
<td>5.5</td>
<td>60%</td>
<td>4,900</td>
<td>92,038</td>
</tr>
<tr>
<td>CREMA 4</td>
<td>12/06 - 12/08</td>
<td>29</td>
<td>4,417</td>
<td>152</td>
<td>4.1</td>
<td>1,583</td>
<td>991,534,889</td>
<td>34,190,858</td>
<td>6.5</td>
<td>90%</td>
<td>6,000</td>
<td>194,482</td>
</tr>
<tr>
<td>CREMA 5</td>
<td>3/08 - 10/09</td>
<td>7</td>
<td>1,089</td>
<td>156</td>
<td>3.2</td>
<td>1,000</td>
<td>241,828,720</td>
<td>34,546,960</td>
<td>4.2</td>
<td>90%</td>
<td>4,500</td>
<td>199,565</td>
</tr>
<tr>
<td>Total/Avg</td>
<td></td>
<td>148</td>
<td>24,706</td>
<td>158</td>
<td>3.65</td>
<td>1,187</td>
<td>2,587,683,756</td>
<td>19,899,980</td>
<td>4.6</td>
<td>62%</td>
<td>4,067</td>
<td>105,449</td>
</tr>
</tbody>
</table>

Evolution in the Procurement and the Design Standards of the CREMA Program
Prior to the crisis of 2002, the outcome of bids launched under the CREMA 1 phase was characterized by speedy procurement process and high competitiveness between bidders. Indeed, the average time period between bid opening and contract award was about 3 months. High competitiveness was reflected by a large number of bidders participating in each bidding event: between 6 and 33 bidders with an average of 13 proposals per bidding event. Open competition was indicated by the wide range of bid prices per event, with percentages below and above average bid price ranging typically between –10 percent and +15 percent. Although best bids proposals exceeded official estimates by about 24 percent on average, this was attributable to the payment mechanism of the first phase that induced high up-front financial charges to the contractor (rehabilitation works were not fully paid at the end of their execution) and also, to some extent, to the novelty of the CREMA system. It is also noteworthy that the average spread between the lowest and the highest bids relative to the official budget was large, about 30 percentage points.

However, as a result of the 2002 economic crisis the whole Argentina portfolio was subject to a heightened fiduciary risk. The quick expansion of the road investment program in particular, following Argentina’s rapid economic recovery after the crisis, outpaced the capacity of an industry heavily constrained by the crisis, contributing to a limited competition environment and an escalation of the risk that contractors acted collusively. Indeed, the outcome of bids launched in 2004 and 2005 under the CREMA 2 program was dramatically different from the one observed in the previous phase suggesting reduced competitiveness among bidders, as reflected by: (i) a small number of bidders that participated in each bidding event, typically between 2 and 6 with an average of 3.5 proposals per event; (ii) closeness of bids, as suggested by the very narrow range of bid prices per event, with percentages below and above average bid ranging typically between –3 percent and + 3 percent; (iii) financial offers that exceeded official estimates by nearly 35 percent; and (iv) small average spread of 8 to 10 percentage points between the lowest and the highest bids, relative to the official budget.

An analysis was carried out to ascertain the basis for the higher-than expected bid prices, determine possible factors constraining the market response and develop additional measures to improve governance and strengthen the procurement process under the program. Said analysis showed that in addition to the industry being strained, the country was experiencing an unforeseen inflation on the cost of...
road works (mainly materials, and in particular asphalt, gas-oil, labor and transport). The differences between DNV budget estimates and bids exposed the need to revise the process followed by DNV to set official estimates. Several measures were identified to encourage competition in the sector, enhance the procurement process and improve monitoring which included: (i) implementing institutional strengthening measures in the design and costing of road works within a context of increased volatility of prices (carrying out site measurements on the condition of the roads, revise the required interventions, and so on, to prepare budget estimates that reflect updated market prices before launching any new bid); (ii) closely monitoring the evolution of prices in the sector; (iii) monitoring and assessing the capacity of the construction industry to identify possible issues that may limit competition, and to have a clear view of the characteristics of the market towards which bids are to be aimed; (iv) designing bidding strategies and reformulating the procurement plans to take into consideration the results of the analysis of the capacity of the construction industry; (v) modifying aspects of the bidding documents to increase the entry of new firms to the market and improve competition; and (vi) increasing information available to the public with regards to projects procurement and implementation.

Since 2006, the outcome of bids has improved compared to the results obtained in 2004 and 2005. The total number of bidders participating in each event is larger, generally ranging between 3 and 9, and averaging about 6 per bidding event, compared to the 3.5 previous figure. The average best bid is in the order of 13 percent above official estimate compared to bids launched in 2004 and 2005 that consistently exceeded official estimate by about 25–40 percent. The variance of bids relative to the average bid price is larger than in the previous period, falling generally between –7 and +10 percent, compared to the previous –3 to +3 percent close range. The total average spread relative to official estimate and to average bid prices increased from about 8 to 20 percentage points. The following factors have probably contributed to these improvements:

- The Argentinean economy, has grown stronger since 2004, inducing the market to feel more confident and less apprehensive of a follow-up crisis;
- The demands for road works has increased considerably in the period 2003-2008;
- Official budgets estimate mechanisms have been improved and are routinely factoring in the inflation that started in 2004;

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4 An assessment of the capacity of the construction industry carried out by the Argentinean Chamber of Construction (Cámara Argentina de la Construcción-CAC) highlights as the main issues faced by the industry: (i) the lack of continuity of public investment programs with abrupt changes on the investment cycles limiting the capacity of the industry to adequately plan their activities and requirements in terms of personnel, equipment, capital, and so on, and originating above normal adjustment costs that are not recognized by the public sector in their budget estimates; (ii) the need of a stronger legal framework regulating the relationships between the government and the industry with adequate arbitration mechanisms for the timely resolution of conflicts; (iii) externalities associated to the provision and costs of main materials that account for more than 60 percent of total project costs, out of the control of the construction firms due to market concentration (asphalt and aggregates) and atomization of transport services; (iv) lack of access to credit which limits the executing capacity of the industry and sometimes constitutes an entry barrier for new firms to the public works market; (v) lack of skilled machine operators and experienced professionals after 2001 crisis which together with the availability of main materials and equipment determines the capacity of the industry to “absorb” greater levels of demand for public works; (vi) the need for public sector counterparts with higher technical capacity.
• Monthly price adjustments are in effect in most contracts to offset the impact of inflation;
• Official budget estimates are now officially publicized prior to bidding.

Table 2 summarizes the results of the bidding that took place during the last 12 years under most Bank-financed road projects in Argentina, and reflects the way the market has responded to the evolving procurement modalities of the CREMA system.

<table>
<thead>
<tr>
<th>Project</th>
<th>Period of Bidding</th>
<th>Number of bidding events</th>
<th>Number of participating Firms</th>
<th>Average No. of participants per bid</th>
<th>Avg. % above official of Lowest Bids</th>
<th>Avg. % above average of bids</th>
<th>Avg. % below average of bids</th>
<th>Avg. % above official of Highest Bids</th>
<th>Avg. % below average of bids</th>
<th>Avg. % above average of bids</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREMA 1.1</td>
<td>1/97 - 12/97</td>
<td>50</td>
<td>69</td>
<td>19</td>
<td>24%</td>
<td>56%</td>
<td>-9%</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 1.2</td>
<td>2001-03</td>
<td>5</td>
<td>17</td>
<td>7</td>
<td>-9%</td>
<td>27%</td>
<td>-15%</td>
<td>20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 2.1</td>
<td>5/07</td>
<td>33</td>
<td>46</td>
<td>4</td>
<td>26%</td>
<td>33%</td>
<td>-3%</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 2.2 (cancelled)</td>
<td>6/05</td>
<td>10</td>
<td>19</td>
<td>4</td>
<td>39%</td>
<td>49%</td>
<td>-2%</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 3-a Bank funded</td>
<td>10/05 - 12/07</td>
<td>7</td>
<td>24</td>
<td>6</td>
<td>12%</td>
<td>35%</td>
<td>-8%</td>
<td>13%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 3-b Local fund</td>
<td>3/05 - 3/06</td>
<td>8</td>
<td>20</td>
<td>4</td>
<td>12%</td>
<td>26%</td>
<td>-5%</td>
<td>9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 4-a Bank funded</td>
<td>11/07 - 12/08</td>
<td>6</td>
<td>50</td>
<td>10</td>
<td>-8%</td>
<td>11%</td>
<td>8%</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 4-b Local fund</td>
<td>12/06 - 3/08</td>
<td>23</td>
<td>n.a</td>
<td>6</td>
<td>15%</td>
<td>37%</td>
<td>-5%</td>
<td>8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CREMA 5 Bank-funded</td>
<td>3/08 -10/09</td>
<td>7</td>
<td>36</td>
<td>6</td>
<td>-7%</td>
<td>11%</td>
<td>-8%</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The successful implementation of the CREMA system has had a dramatic impact on the condition and riding quality of the national network. Time-series roughness measurements over the last 12 years show the positive outcome of a system that combines both the rehabilitation and subsequent maintenance of the pavements. The following figures illustrate the improvement in the ride quality of the network achieved through the execution of the program.

On the one hand, and because of the quality of the maintenance activities carried out, the actual roughness values measured on the 11,000 km-long CREMA 1 phase between 1996 and 2006 are lower than those predicted by the HDM model.
On the other hand, and regarding the entire 22,000 km-long non-concessioned network, the impact of the first four CREMA phases of the program has been impressive, as illustrated in Figures 4 and 5 below. The maintenance backlog that is, the proportion of roads with an IRI > 4 have been reduced from about 35 percent to 10 percent. The proportion of roads in poor to bad condition, that is, with an IRI > 5, has been reduced from 11 percent to a current value of about 2 percent, while the proportion in good condition has increased from 65 percent to 90 percent. In terms of road users’ costs, the savings that have accrued from the realization of the CREMAs on the non concessioned network are substantial and estimated to be at least in the order of US$275 million annually.
Assessing the cost effectiveness of the CREMA system compared to the more conventional ad-measurement type of contracts was a difficult exercise for the first generation of CREMA. Indeed, the payment system used induced significant financial charges that were not easy to determine, and the Contractor’s detailed Bill of Quantities and unit rates analyses were not readily available since the contract was let on a lump sum basis, with no obligation from the bidders to produce up-front their cost analyses and unit rates.

With the economic downturn that hit the country in 2001-2002 and the need that ensued to reassess contract prices to adjust for inflation, it became necessary to obtain from the Contractors a detailed analysis of their costs. Also, from the second generation onwards, CREMA contracts now provide for full payment of the first-year rehabilitation works once they are executed and include a price adjustment mechanism throughout the entire contract period to allow for inflation. In addition to that, and in order to better evaluate the lump sum proposals, DNV specified that bidders would provide with their bids their priced Bill of Quantities, upon request and for indicative purposes. By doing so, it became possible to capture the rates used for the various items of the contract and to arrive at a more meaningful comparison of the CREMAs unit costs against short-term traditional rehabilitation projects.

A comparison between the unit costs of the rehabilitation works of the CREMA to those offered in the more conventional ad-measurement contracts shows that the long-term performance-based system is, overall, more cost efficient. For example, taking an average thickness of asphalt overlay of about 5 cm similar to what has been placed on the CREMA network, the average unit cost of the CREMA (inflation-adjusted at December 2009) is about US$177,200 per km, compared to US$154,200 per km obtained under the traditional unit-price system, that is, a cost difference of only 15 percent5.

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5 Unit cost as awarded for both contracts (does not include variations/cost overruns.)
However, for that price the CREMA incorporates a number of additional features that would normally be separately priced under a traditional ad-measurement type of contracts. Those costs that would normally be borne by the road agency under a traditional contract are estimated to be in the order of 39 percent of the contract value as detailed below. Considering these additional benefits, the overall net cost effectiveness of the CREMA is in order of 24 percent. Similar results on the cost efficiency and cost effectiveness of performance-based contracts worldwide compared to the traditional ad-measurement system have been quoted in a recent World Bank publication (Queiroz, 2006).

<table>
<thead>
<tr>
<th>Thickness of Asphalt Concrete Overlay (cm)</th>
<th>Unit Cost of overlay in CREMA US$/km (Dec 2009)</th>
<th>Unit Cost of overlay in Traditional Contracts US$/km (Dec. 2009)</th>
<th>Ratio CREMA/Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>121,347</td>
<td>101,786</td>
<td>1.19</td>
</tr>
<tr>
<td>4</td>
<td>149,273</td>
<td>127,988</td>
<td>1.17</td>
</tr>
<tr>
<td>5</td>
<td>177,200</td>
<td>154,189</td>
<td>1.15</td>
</tr>
<tr>
<td>6</td>
<td>205,126</td>
<td>180,391</td>
<td>1.14</td>
</tr>
<tr>
<td>7</td>
<td>233,053</td>
<td>206,593</td>
<td>1.13</td>
</tr>
<tr>
<td>8</td>
<td>260,979</td>
<td>232,794</td>
<td>1.12</td>
</tr>
<tr>
<td>9</td>
<td>288,906</td>
<td>258,996</td>
<td>1.12</td>
</tr>
<tr>
<td>10</td>
<td>316,832</td>
<td>285,197</td>
<td>1.11</td>
</tr>
<tr>
<td>11</td>
<td>344,759</td>
<td>311,399</td>
<td>1.11</td>
</tr>
<tr>
<td>12</td>
<td>372,685</td>
<td>337,600</td>
<td>1.10</td>
</tr>
</tbody>
</table>
In addition to the above empirical assessment, a theoretical study was carried out using the HDM-4 Model to evaluate the cost effectiveness and cost efficiency of the CREMA in terms of the economic benefits that are accrued not only to the highway agency but also to road users over a 20-years analysis period. The study assumed various scenarios of traffic volumes, road condition before rehabilitation, and overlay solutions, and contrasted the sustained maintenance strategy of the CREMA with the usual policy implemented in traditional contracts that consists of less-than-optimum recurrent maintenance activities followed by another overlay or indeed reconstruction when the pavement has reached a critical condition. The study shows that in terms of cost effectiveness (that is, better outcome, expressed in terms of the Maximum Net present Value, for a given solution or investment level), the CREMA is, on average, 15 percent more cost-effective than traditional contracts for conditions akin to those prevailing on the non-concessioned paved network of Argentina (that is initial roughness in the order of 3.5 to 4 before rehabilitation, and traffic volume in the range of 1,500 to 2,000 vehicles per day).

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An interesting result from the analysis is that cost-effectiveness is reduced as the overlay thickness increases and for the current condition and traffic of the argentine non-concessioned network, the optimum economic overlay solution lies between 3 and 5 cm of asphalt concrete. Beyond a threshold of 5 cm and unless traffic volumes are high, that is, above 2000 vehicles per day, cost-effectiveness of the CREMA is severely affected, which also confirms conclusions seen in other instances on the justification for preventive maintenance for low traffic roads.

### TABLE 5: CREMA COST EFFECTIVENESS (HDM-4 THEORETICAL ANALYSIS)

<table>
<thead>
<tr>
<th>cm AC</th>
<th>ADT=750</th>
<th>ADT=1000</th>
<th>ADT=1500</th>
<th>ADT=2000</th>
<th>ADT=3000</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness Rate %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRio=3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>-1.9</td>
<td>3.6</td>
<td>11.8</td>
<td>26.85</td>
<td>41.9</td>
<td>16.5</td>
</tr>
<tr>
<td>4</td>
<td>-5.4</td>
<td>0.6</td>
<td>6.6</td>
<td>22.85</td>
<td>39.1</td>
<td>12.8</td>
</tr>
<tr>
<td>5</td>
<td>-8.4</td>
<td>0</td>
<td>3.7</td>
<td>19.5</td>
<td>35.3</td>
<td>10.0</td>
</tr>
<tr>
<td>6</td>
<td>-11</td>
<td>0</td>
<td>1.4</td>
<td>10</td>
<td>18.6</td>
<td>3.8</td>
</tr>
<tr>
<td>IRio=4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.4</td>
<td>7.3</td>
<td>16.3</td>
<td>28.5</td>
<td>40.7</td>
<td>18.8</td>
</tr>
<tr>
<td>4</td>
<td>-3.0</td>
<td>2.1</td>
<td>8.5</td>
<td>20.75</td>
<td>33</td>
<td>12.3</td>
</tr>
<tr>
<td>5</td>
<td>-5.3</td>
<td>0</td>
<td>5.6</td>
<td>16.45</td>
<td>27.3</td>
<td>8.8</td>
</tr>
<tr>
<td>6</td>
<td>-7.4</td>
<td>0</td>
<td>2.2</td>
<td>16.2</td>
<td>30.2</td>
<td>8.2</td>
</tr>
<tr>
<td>IRio=5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>19.8</td>
<td>30.5</td>
<td>88.3</td>
<td>99.2</td>
<td>110.1</td>
<td>69.6</td>
</tr>
<tr>
<td>4</td>
<td>4.5</td>
<td>9.9</td>
<td>21.7</td>
<td>36.75</td>
<td>51.8</td>
<td>30.0</td>
</tr>
<tr>
<td>5</td>
<td>-2.7</td>
<td>0.6</td>
<td>6.2</td>
<td>20.4</td>
<td>34.6</td>
<td>15.5</td>
</tr>
<tr>
<td>6</td>
<td>-4.2</td>
<td>0</td>
<td>3</td>
<td>18.7</td>
<td>34.4</td>
<td>14.0</td>
</tr>
</tbody>
</table>

Also, in terms of cost-efficiency (that is, better cost for a similar outcome expressed in terms of the Maximum Net Present Value), the CREMA is on average 70 percent more cost efficient when the initial roughness before rehabilitation lies between 3.5 and 4 and when traffic volume is in the order of 1,500 vehicles per day.

### TABLE 6: CREMA COST EFFICIENCY (HDM-4 THEORETICAL ANALYSIS)

<table>
<thead>
<tr>
<th>IRio</th>
<th>ADT=750</th>
<th>ADT=1000</th>
<th>ADT=1500</th>
<th>ADT=3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency Rate %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>14%</td>
<td>33%</td>
<td>67%</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>4</td>
<td>14%</td>
<td>28%</td>
<td>75%</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>5</td>
<td>13%</td>
<td>20%</td>
<td>40%</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>6</td>
<td>9%</td>
<td>17%</td>
<td>25%</td>
<td>&gt;40%</td>
</tr>
<tr>
<td>Average</td>
<td>13%</td>
<td>25%</td>
<td>52%</td>
<td>&gt;70%</td>
</tr>
</tbody>
</table>
The outcome of the study can be profitably used as a guide for future CREMA programs. Also, further improvements in design and costing strategies can be achieved by: (i) rationalizing the coverage or extent of the rehabilitation component; and (ii) tailor-fitting the routine maintenance activities, particularly those related to the pavement itself (pothole patching and crack sealing) in consonance with the scope of the capital improvement component, and by carrying direct observations on the performance of the rehabilitated segments during the contract period.
BANK’S STRATEGY AND ROLE IN THE ROAD SECTOR IN ARGENTINA

Probably the most important milestone in the history of Bank-financed road projects in Argentina has been the encouragement and financial support provided to the government in its effort to introduce and implement the CREMA contracts. The widespread success of the system (not only in Argentina, but also across the Region and abroad) continues to motivate the Bank in the pursuit of its assistance towards the consolidation and further improvement of this innovative network management system, not only at the federal level but also at the provincial one (see Annex 3 for data on the provincial experience with CREMAs).

Bank engagement in Argentina’s road agenda, as reflected in the CREMA philosophy, has focused on the development of a more comprehensive and efficient management strategy that ensures the convergence of the road assets towards a steady state-condition. The Bank’s overall strategy for the road sector development in the country relies on five building blocks:

1. **Supporting adequate road financing strategies within a sound fiscal framework that enables to achieve the sustainability of the core network but at the same time, breaks up the vicious cycle of postponing interventions in the poorer less developed parts of the country.** Traditionally, focus has been placed on arresting deterioration of the core road network through important periodic maintenance and rehabilitation interventions to upgrade its overall condition and overcome the backlog of deferred maintenance. This strategy implies higher financial requirements than those under a steady-state scenario (where the network deterioration reaches a relatively constant level year after year and future interventions can be anticipated and reasonably taken care of with a given level of resources) thus requiring to postpone interventions in less developed areas, or limiting the possibilities to address other needs.

The design and implementation of a sound system for the financing of the road network should consider: (a) efficient work programs that are aligned with existing budgets creating space to address other needs; (b) resource allocation based on cost-effective policies according to agreed and coherent priorities; (c) sound financial planning mechanisms adequately linked to investment plans to avoid disruptive “stop-and-go” implementation resulting from volatility in budget allocations.
2. **Building-up planning capacity and improving mechanisms to establish investment priorities under network-wide approaches.** The Bank strategy is based on the development and implementation of strategic road programs that take care of the entire road network, according to traffic and physical conditions of the different segments, prioritizing interventions based on sound economic criteria. This implies designing and implementing investment plans in line with budget constraints, ensuring an efficient allocation of resources between competing needs (capacity expansion, regional integration, rehabilitation and maintenance) and strengthening the technical capacities in support of the use of appropriate design and maintenance standards. The main goal is to build-up the required institutional capacity driven by basic principles such as efficiency, accountability, and transparency to best address user’s needs. Road agencies in the country need to evolve as the sector evolves, in order to manage road assets under a results oriented environment focused on client satisfaction.

3. **Implementing cost-efficient asset management policies to make the most of the available resources.** In an aim to ensure the sustainability of the interventions, the Bank’s strategy aims to promote the implementation of more efficient managerial schemes based on target or results-oriented programs. In such effort, road agencies need to rely more systematically on the private sector even for the execution of the routine maintenance activities. Private sector participation through toll road concessions in high traffic corridors where the capacity exists is a first step in the evolution and transformation of the sector. The introduction of performance based contracts elsewhere, enhances the overall management of existing road assets in many respects: (i) linking budget allocations with multi-year expenditure requirements established under the contracts; (ii) increasing cost-efficiency as compared to ad-measurement type contracts; (iii) minimizing delays in project implementation; (iv) eliminating cost overruns; (v) reducing the risk of unsatisfactory quality in the rehabilitation and subsequent maintenance works improving the condition of the network; and (vii) fostering innovation in the programming and execution of works.

4. **Improving governance, driving policy and decision making with a focus on the degree of institutional rationality, increased transparency and social accountability.** The main purpose is to develop a system that clearly establishes what is being achieved, at what cost, and how that cost compares to internationally accepted benchmarks in order to actually achieve and transfer to the society the benefits from cost-efficient decision making and asset management. The Bank has engaged in a dialogue with the country to develop alternative options and additional measures to improve governance and build-up the capacities of the agencies involved in procurement processes, the
ultimate goal being the implementation of a framework to track key indicators that will allow identifying factors that could jeopardize the achievement of cost-efficiency in the sector.

5. **Addressing externalities by mainstreaming road safety initiatives and environmental management and into government’s policy agendas.** Due to the ever-growing number of casualties and fatalities occurring on the road network, road safety has become a common and prominent issue at all levels of government in Argentina. Road fatalities in Argentina are the first cause of death among the younger generation of less than 35 years old, and the third cause of death in general. The Bank strategy increasingly and aggressively is addressing the issue through the design of an integrated, multi-disciplinary and results-focused approach for road safety. Similarly the Bank’s strategy foresees the introduction of the environmental and social dimensions in road management in the country.

6. **Expanding support to provinces through tailormade operations that address specific issues in key strategic provinces in the country.** The strategy aims at rolling out Bank’s support to develop a more direct and in-depth policy dialogue with key strategic provinces in the country. The approach includes: (i) initial “template” operations executed through the federal government further extended to provincial governments willing to participate in a sector program; moving towards (ii) stand-alone operations directly with provinces which allows fostering the generation of a strong strategic partnership between the Bank and key strategic provinces to deal with more province-specific issues.

Helping to strengthen governance, enhance competition, and further increase the cost-effectiveness of the CREMA system are at the core of Bank’s strategy as it look forward in the future. To achieve those objectives the Bank’s role and continued assistance activities are articulated around a multi-pronged approach that encompasses three critical areas: (i) project design; (ii) project supervision; and (iii) monitoring and evaluation.

During the **design stage** of the CREMA program, the Bank’s essential role is to ensure that: (i) all proposed capital investments within the project yield a minimum Internal Economic Rate of Return of 12 percent, as usually specified in the Loan Agreement; (ii) the set of road sections and road works included in the program are duly prioritized through an optimization process, using generally the HDM-4 recommended incremental Benefit/Cost ranking method; and (iii) the proposed investments are within the budget constraint and are fiscally sustainable. Most of the time, the project team’s responsibility is to prevent that extravagant designs and associated costs are applied jeopardizing the economic benefits of the project. To achieve that objective, the project team needs to check the design and specifications of the rehabilitation solutions (that is, the extent and thickness of proposed overlays and/or reconstructions) as well as the official budget estimate including the quantities and unit rates of the activities involved both in the rehabilitation and
routine maintenance component of the project. Prior to bidding the Bank will also verify that the proper procurement method and related tender documents are used.

To complete the process, the Bank will check that the award of the contracts is based on transparent and fair bids evaluation.

During **supervision**, the Bank’s role is to ensure that: (i) the proceeds of the Loan are used for the purpose for which they were granted, with due consideration given to economy and efficiency; and (ii) the progress and quality of the works are satisfactory and consistent with the contracts specifications and requirements.

Finally, the Bank plays a key role in **monitoring and evaluating** the overall results and accomplishments of the program, and in particular the Bank has devoted additional efforts around two main dimensions: prices and contract performance. Over the last two years, the project team has initiated a **price monitoring** exercise aimed at better assessing the evolution of costs and at capturing the market’s response to the various rounds of biddings launched by the road agencies in Argentina. The system comprises two main components: a database that incorporates the essential features that characterize a bidding event, and a database of unit rates for most of the items of the Bill of Quantities, comparing the official and the best bids estimates. The bidding database includes in the form of an Excel table the following information: the Loan Number, the Identification number of the Contract (or Malla), the Province in which it is located, the Date of the Bid opening, the number and names of the bidders that participated, the Official budget estimate (revised one month prior to bid opening), the financial proposals offered by each bidder, the name of the winning bidder, the percentage above and/or below the official estimate of each bid, the average value of all bids and the variance of each bid relative to the average bid price. This information is helpful in detecting, at any given time or over a period of time, the degree of competitiveness among bidders, suspicious closeness of bids, flaws in official budget estimates or collusive practices between bidders leading to artificially high bid prices, patterns of repartition of awards among bidders. That database covers all the CREMA programs that have been financed since 1997, both at national and provincial levels and also other ad-measurement type of contracts in the provinces. The unit rates database helps to build, over time, a series of fairly representative unit costs for each work activity and to detect suspiciously high or low values in relation to the statistical averages. It can further help identify market’s response differences between provinces, programs, and road agencies, and to capture the magnitude of inflation. In addition to unit rates for specific work items, information is also assembled that allows combined work activities to be monitored such as the unit costs of “rehabilitation” or of “routine maintenance”. That database includes both CREMA and unit-price contracts awarded in most Bank-financed highway rehabilitation projects in Argentina since 2004.

With regards to **contract performance** in addition to the regular supervision missions carried out by the project team, the Bank has recently started financing with its own funds independent performance audits during the execution of the works on a random sample of CREMAs each year, to check whether contracts are
Bank's Strategy and Role in the Road Sector in Argentina

being complied with and the expected results are being obtained. The goals of such audits are manifold:

- To verify that the works are executed in accordance with the program of activities proposed by the contractor and approved by DNV, in terms of substance, progress and quality;
- To detect and report, if necessary through additional testing, any deficiency or non-compliance with the specifications and to check whether or not appropriate penalties have been applied when warranted and as mandated by the contract;
- To check that payments to the Contractor are made in accordance with the terms and condition of the contract; and
- To recommend any measures or actions that the Auditor deems necessary or susceptible to improve the design, costing, and execution of the CREMA system of contracting.

The main findings of said audits (see Annex 5) have, one hand, allowed to confirm that works carried out usually comply with the contract requirements thus achieving the expected results in terms of overall road condition and service to road users, but also brought into attention some behaviors or issues that need to be revisited so as to ensure that the CREMA concept remains valid and achieves its full performance potential. In particular the audits detected some flaws in the supervision and implementation of the contracts including: (i) variation orders in a series of contracts due to modifications of design during execution, that are normally not permitted under the lump-sum model; and (ii) less-than-optimal routine maintenance activities that are not penalized by the supervision as provided under the terms of the contracts.
LESSONS LEARNED

Valuable conclusions and general lessons can be derived from the past fifteen year experience:

- The promotion and expansion of a long-term performance-based system such as the CREMA is achievable when: (1) the political will at the highest level exists, (2) the local highway construction industry is strong and responsive to innovation, and (3) the implementing agency is committed to outsourcing the management of its assets to the private sector, has a long standing tradition of conducting reliable annual surveys of road condition, and is endowed with qualified staff to carry out technical and economic analysis of subprojects, while capacity for procurement and conducting environmental assessment is strong.

- With the adoption of CREMA as an asset management modality, DNV's workforce has been reduced at an average rate of about 4 percent per year, (from about 3,700 in 1994 to about 2,100 in 2010) while maintenance by force-account has also been reduced from over 50 percent to about 30 percent (including unpaved roads). DNV's role currently focuses on strategic planning and management of national budgets and the related contracts, and no longer on execution of works.

- In practice, CREMA contracts can become a useful mechanism to ensure some minimum level of road maintenance funding. Experience during implementation shows that even at time of fiscal constraints, the budget process honored the CREMA contract as a long-term commitment, and funds were allocated to them in priority.

- Using formal planning tools such as the HDM – or other holistic life-cycle system - for cost analysis, including user’s costs, and for determining optimum design thickness of overlays and budget allocations for road maintenance and renewal, is instrumental for the successful implementation of CREMA.

- The CREMA contract, with its mix of capital intensive, high value rehabilitation works, and labor intensive low cost routine maintenance, encourages large contractors to subcontract the latter work and helps promote a healthy development of small local contractors, while the main Contractor retains the overall responsibility for the whole contract.

- In an environment where the CREMA system is being tested for the first time, Bank's financing, at a high cost-sharing, is likely to provide strong assurances that funds will be available for payments and could be instrumental in getting contractors to bid for the works. Once the system is well entrenched in the country’s culture, Bank’s financing becomes less relevant (locally-financed CREMAs in Argentina over the last 5 years have also enjoyed a good response from Contractors).

- The magnitude of rehabilitation works is not considered to be a factor for deciding to use or not a performance-based contract. In Argentina, the system
has proved successful when no rehabilitation works are included in the contract (for ex. on the former km-month contracts) or when the rehabilitation works are significant. The length of the contract could be adjusted depending on the degree of the rehabilitation works and the life-cycle of such interventions.

- When overlay design thickness is close to the optimum and when the entire contract length is to be renewed or rehabilitated, a five years contract period is probably too short and consideration should be given to extend the contract duration to between 7 and 8 years, thus engaging the Contractor’s responsibility for maintenance for over a period of 5 to 6 years after rehabilitation.

Other relevant lessons are related to contract management decisions during the project cycle under the control of the road agency that if not properly addressed, could jeopardize the overall cost-efficiency of the system. In particular:

- **Design stage:** (i) the need to ensure that preliminary designs are commensurate to surface and traffic characteristics of the network, avoiding unnecessarily high rehabilitation standards that could deviate from the optimum strategy that provides the maximum rate of return. Each additional cm of asphalt concrete overlay in the network costs around US$20,000/km, representing US$3 million in a typical 150 km-long Malla; (ii) the need to adequately establish the routine maintenance activities required over the entire network, considering the extent of the rehabilitation works carried out, to avoid excessive increases in the costs of this activity. Unreasonable quantities assumed for activities such as pothole patching and crack sealing that will not occur on a recently rehabilitated pavement and will not be carried out by the Contractor, while paid to him on a lump-sum basis, will have an important impact in the cost-efficiency of the contract. The patching component for instance can represent between 5 and 50 percent of the total cost of the routine maintenance and could add up to US$2 million for a particular contract.

- **Procurement stage:** The importance of building the required capacity to understand the market in which the road sector operate to better design projects, plan activities and enhance competition, transparency and cost-efficiency in the procurement of works.

- **Implementation stage:** (i) The importance of enforcing the contract agreement and in particular, applying the agreed penalties when non-compliances with the terms of the contracts are detected; (ii) the need to refrain from approving variation orders during contract execution that are essentially intended to enhance and/or correct the originally specified design, as opposed to being the result of unforeseeable or exceptional events as is normally allowed under the terms of the CREMA lump-sum contract.
## ANNEX 1: PENALTIES FOR NON-COMPLIANCE WITH MANDATORY REQUIREMENTS CREMA CONTRACTS (2009)

<table>
<thead>
<tr>
<th>Sections</th>
<th>Parameter</th>
<th>Requirement</th>
<th>Penalty in UTM (see footnote 14)</th>
<th>US$equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject to rehabilitation</strong></td>
<td>Pavement Roughness</td>
<td>IRI&lt;sub&gt;max&lt;/sub. = 3 (AC)</td>
<td>2/week/km</td>
<td>600/week/km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IRI&lt;sub&gt;max&lt;/sub. = 3.5 S.T/RC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pavement Rut Depth</td>
<td>1 cm max.</td>
<td>4/week/km</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Pavement Edge drop</td>
<td>0 cm</td>
<td>4/week/sector</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Pothole dia.&gt; 2.5cm</td>
<td>100% patched</td>
<td>4/pothole/day</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Cracking</td>
<td>100% sealed, and &lt; 15% tipo 2 or 4</td>
<td>2/week/km</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Concrete pavement joint cracks</td>
<td>100% sealed</td>
<td>2/week/km</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Raveling</td>
<td>0%, and &lt; 2% if surface treatment</td>
<td>2/week/km</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Edge drop</td>
<td>3 cm max</td>
<td>4/week/sector</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Cracking</td>
<td>100% sealed up to tipo 4</td>
<td>2/week/km</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>Pothole</td>
<td>100% patched</td>
<td>4/day/pothole</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Raveling</td>
<td>100% patched</td>
<td>2/week/km</td>
<td>600</td>
</tr>
<tr>
<td><strong>Subject to Routine maintenance</strong></td>
<td>Paved Shoulders</td>
<td>Pothole/raveling=0;</td>
<td>4/week/km</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edge drop=0;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rutting &lt; 12mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cracks sealed up to tipo 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unpaved shoulders</td>
<td>No erosion, no rut, good transversal slope; edge drop &lt;2 cm; width &gt;=3m.</td>
<td>4/week/km</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td>Bush Clearing</td>
<td>Bush height &lt; 15cm over 15m.</td>
<td>0.5/ha/week</td>
<td>150</td>
</tr>
</tbody>
</table>
### Performance-based Road Rehabilitation and Maintenance Contracts (CREMA) in Argentina

<table>
<thead>
<tr>
<th>Item</th>
<th>Condition</th>
<th>Frequency</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culvert/drain/bridge cleaning</td>
<td>Clean/Unobstructed</td>
<td>2/day/km</td>
<td>600</td>
</tr>
<tr>
<td>Cleaning of Right-of-Way</td>
<td>No debris; maintain green areas</td>
<td>2/day/km</td>
<td>600</td>
</tr>
<tr>
<td>Vertical Signs</td>
<td>Well maintained &amp; Visible day and night</td>
<td>0.5/day/sign</td>
<td>150</td>
</tr>
<tr>
<td>Lighting</td>
<td>Well maintained</td>
<td>0.5/day/light</td>
<td>150</td>
</tr>
<tr>
<td>Horizontal Marking</td>
<td>Well maintained &amp; Visible day and night</td>
<td>1/day/line/km</td>
<td>300</td>
</tr>
<tr>
<td>Guardrails</td>
<td>In good condition</td>
<td>4/week/location</td>
<td>1,200</td>
</tr>
</tbody>
</table>

**Notes:**

1. Penalty application are waived during initial 3 months of contract, generally;
2. Roughness on sections subject to routine maintenance is measured for indicative purposes only;
3. 10 percent of Malla has to be inspected every month, by individual segments of 2 km;
4. Reduction of original thickness of wearing course not allowed;
5. Milling of rut allowed only if material milled is replaced
6. Surface treatment over Asphalt concrete not allowed;
7. When crack type > 4, sealing may be replaced by other treatment (ex: slurry seal, micro-asphalt);
8. UTM = Unidad Tecnica de Multa = 1/100,000 contract value
9. One month routine maintenance = US$300/month*200 km=US$60,000/month, on avg. per malla
10. Ex: 1 pothole remaining open every 10 km during one week = 1000*7days*200/10 km= US$140,000 penalty;
11. 4 horizontal marking lines missing over 10 km during one week = 4*300*7*10 = US$84,000 penalty;
12. More than half of the above penalty parameters relate to road safety concerns (risk of accidents);
13. Since 2006, Unidad de Multa = 1/100,000 contract amount; for ex. if contract value = US$30,000,000, then Unidad de Multa = US$300 and penalty for 1 pothole open = US$1,200/day.
ANNEX 2: COST STRUCTURE OF THE CREMA

Although some variations do occur among CREMA designs and contracts values, it is possible, on the basis of past experience, to assess the cost structure that is, the percentage distribution of the various work activities that are involved in a typical CREMA contract. To that effect, a representative sample of contracts carried out over the last three years, both at national and provincial levels, was analyzed and decomposed into the following work categories:

- **Preparatory works** on the existing pavement including pothole patching, crack sealing, milling, depression and/or rut filling, recycling of the old pavement, and application of prime and/or tack coat;
- **Overlay works**, involving the execution of a new asphalt concrete carpet, including eventually a new bituminous base-course;
- **Shoulders rehabilitation**, involving the re-gravelling, reshaping and grading of the shoulders;
- **Road signs**, including the horizontal marking of the pavement and the vertical signs along the road;
- **Other Mandatory Works**, including essentially enhanced road safety features such as guardrails, mile-posts, remodeling of intersections, bus stops areas and axle load control platforms; as well as the restoration of drainage structures; and finally
- **The Routine Maintenance** activities that will be executed during the 5-years contract period.

The following graphs show the average percentage cost distribution of the various work activities that comprise a CREMA contract. The percentages refer either to the total cost of rehabilitation or to the total contract value, i.e., rehabilitation and routine maintenance.
In terms of average unit costs, and assuming a 5 cm-thick overlay solution, the following Table gives current average unit costs (at December 2009) and percentage distributions for the main work categories involved in a typical CREMA contract.

<table>
<thead>
<tr>
<th>Work Activity</th>
<th>US$/km</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparatory Works</td>
<td>41,910</td>
<td>17%</td>
</tr>
<tr>
<td>Overlay (5 cm-thick)</td>
<td>115,741</td>
<td>46%</td>
</tr>
<tr>
<td>Shoulders rehabilitation</td>
<td>11,430</td>
<td>5%</td>
</tr>
<tr>
<td>Road signs and pavement marking</td>
<td>8,363</td>
<td>3%</td>
</tr>
<tr>
<td>Other mandatory works</td>
<td>36,830</td>
<td>15%</td>
</tr>
<tr>
<td>Routine maintenance over 5 years</td>
<td>39,726</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>254,000</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
ANNEX 3: CREMA IN THE PROVINCES OF ARGENTINA

Building on the successful experience of the CREMA system on the national highways of Argentina, the Bank has recently provided assistance to some provinces for implementing on the network under their jurisdiction performance-based contracts that are, in all respects, akin to the national CREMA. Similar design methodology, cost estimates, procurement arrangements, and technical specifications as well as works supervision modalities are being used.

Thus far, the provinces of Buenos Aires, Cordoba, Corrientes and Santa Fe are participating to that effort. In total, 9 Mallas have been identified, designed and tendered, representing a cumulative length of about 1,200 km. The average pavement and traffic conditions, prior to rehabilitation, are similar to those measured on the national highways and can be illustrated by the following figures:

The overlay thickness distribution is also similar to that used for the national highways and is shown in the following figure.
Table 2 below summarizes the location, lengths and cost values of the current provincial CREMAs.

**Table 2: CREMAs in the Provinces of Argentina (2007-08)**

<table>
<thead>
<tr>
<th>Province</th>
<th>Bid Date</th>
<th>Malla ID</th>
<th>Length (Km)</th>
<th>% of total length Rehab.</th>
<th>Best Bid amount @ bid opening (US$)</th>
<th>Best Bid Rehab+OIO @ bid Opening Cost (US$)</th>
<th>Best Bid Routine Maint. Cost @ bid opening (US$)</th>
<th>Weighted thickness of overlay (cm)</th>
<th>Best bid Unit cost of RM @ 12/09 (US$/km/yr)</th>
<th>Best Bid Rehab. Unit Cost @ 12/09 (US$/km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buenos Aires</td>
<td>4/2009</td>
<td>101</td>
<td>82</td>
<td>100</td>
<td>16,567,024</td>
<td>14,567,024</td>
<td>2,000,000</td>
<td>5.0</td>
<td>5,163</td>
<td>188,009</td>
</tr>
<tr>
<td>Cordoba</td>
<td>9/2007</td>
<td>101</td>
<td>113</td>
<td>100</td>
<td>25,100,882</td>
<td>22,465,289</td>
<td>2,635,593</td>
<td>6.4</td>
<td>5,924</td>
<td>213,971</td>
</tr>
<tr>
<td>Cordoba</td>
<td>9/2007</td>
<td>102</td>
<td>114</td>
<td>100</td>
<td>23,077,408</td>
<td>20,215,809</td>
<td>2,861,599</td>
<td>5.8</td>
<td>6,376</td>
<td>225,211</td>
</tr>
<tr>
<td>Cordoba</td>
<td>11/2006</td>
<td>103</td>
<td>71</td>
<td>100</td>
<td>19,511,373</td>
<td>17,801,930</td>
<td>1,709,443</td>
<td>14.0</td>
<td>6,115</td>
<td>318,429</td>
</tr>
<tr>
<td>Cordoba</td>
<td>11/2008</td>
<td>105</td>
<td>136.9</td>
<td>100</td>
<td>33,926,667</td>
<td>31,823,214</td>
<td>2,103,453</td>
<td>12.4</td>
<td>3,903</td>
<td>295,219</td>
</tr>
<tr>
<td>Corrientes</td>
<td>8/2007</td>
<td>1</td>
<td>158.1</td>
<td>60</td>
<td>22,225,806</td>
<td>17,513,935</td>
<td>4,711,871</td>
<td>2.9</td>
<td>7,570</td>
<td>140,688</td>
</tr>
<tr>
<td>Corrientes</td>
<td>8/2007</td>
<td>2</td>
<td>176.7</td>
<td>100</td>
<td>18,062,343</td>
<td>12,986,826</td>
<td>5,075,516</td>
<td>1.7</td>
<td>7,296</td>
<td>93,341</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>11/2008</td>
<td>5</td>
<td>221.7</td>
<td>60</td>
<td>27,931,280</td>
<td>22,335,182</td>
<td>5,596,098</td>
<td>3.4</td>
<td>6,411</td>
<td>127,946</td>
</tr>
<tr>
<td>Santa Fe</td>
<td>9/2009</td>
<td>6</td>
<td>142.6</td>
<td>100</td>
<td>22,727,273</td>
<td>19,545,455</td>
<td>3,181,818</td>
<td>4.1</td>
<td>4,723</td>
<td>145,060</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>Average</strong></td>
<td><strong>131</strong></td>
<td><strong>92</strong></td>
<td></td>
<td><strong>23,301,190</strong></td>
<td><strong>20,070,258</strong></td>
<td><strong>3,230,931</strong></td>
<td><strong>5.9</strong></td>
<td><strong>5,915</strong></td>
<td><strong>199,777</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
<td><strong>1,325</strong></td>
<td></td>
<td></td>
<td><strong>233,011,895</strong></td>
<td><strong>200,702,583</strong></td>
<td><strong>32,309,312</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SISTEMA DE CONTRATO DE REHABILITACIÓN Y MANTENIMIENTO (C.RE.MA.)

PLIEGO DE ESPECIFICACIONES TÉCNICAS PARTICULARES

MALLA Nº 2

Especificaciones Técnicas y Condiciones de Cumplimiento

R. P. Nº 27 – Tr: 4 Bocas – Goya - Prog 0,00 (4 Bocas) - Prog 60,00 – Sección: (S1) A

MALLA Nº 2

RUTA PROVINCIAL Nº: 27

PROVINCIA: CORRIENTES

TRAMO: 4 Bocas – Goya

SECCIÓN: S1

Pk inicio: 0,00 Pk final: 60,00 Prog 0,00 (4 Bocas) - Prog 60,00

Longitud del Tramo: 60,00

PERFIL TRANSVERSAL EXIGIDO

- Ancho de calzada: 7,30 m
- Ancho de Banquina Pavimentada:
- Ancho de Banquina Total: 3,00 m
- Ancho de Coronamiento: 12,70 m
- Pendiente de Calzada: 2%
- Pendiente de Banquina: 4%
- Espesor de Capas Asfálticas Existentes: 0,31 m

CONDICIONES EXIGIBLES

<table>
<thead>
<tr>
<th>Tramos con obras de recuperacion</th>
<th>Tramos sin Obras de Recuperacion</th>
</tr>
</thead>
<tbody>
<tr>
<td>No hay</td>
<td>100% de fisuras selladas</td>
</tr>
<tr>
<td></td>
<td>0% de baches</td>
</tr>
<tr>
<td></td>
<td>Ahuellamiento máximo: 12mm</td>
</tr>
</tbody>
</table>
OTRAS INTERVENCIONES OBLIGATORIAS

- Señalamiento Horizontal provisorio con pintura en frío según especificaciones particulares
- Limpieza de zona de camino
- Completamiento de banquinas con suelo, sin compactación especial
- Sellado de grietas y fisuras
- Bacheo profundo de capas no ligadas y asfálticas
- Bacheo superficial de capas asfálticas
- Relleno de huellas con mezcla asfáltica en secciones varias
- Fresado de carpeta en 0,01m de espesor promedio en secciones varias
- Tratamiento superficial tipo lechada asfáltica
- Señalamiento horizontal con pintura termoplástica reflectante al finalizar la obra de recuperación en toda la sección
- Señalamiento vertical al finalizar la obra de recuperación en toda la sección
- Recuperación de gálibo y Refuerzo de calzada con concreto asfáltico, espesor total 0,07m entre Prog.56,00 y Prog.59,00
- Defensa contra erosiones en alcantarilla transversal de Prg. 39,92
- Construcción de seis (6) dársenas para vehículos de pasajeros, en lugares a designar por la Supervisión
- Provisión de dos balanzas móviles para control de cargas, incluida la homologación correspondiente
- Señalamiento Horizontal provisorio con pintura en frío según especificaciones particulares
- Provisión y colocación de mojones kilométricos en toda la longitud

TODAS LAS TAREAS SE EJECUTARÁN DE ACUERDO AL PLIEGO DE ESPECIFICACIONES TECNICAS GENERALES DE LA DNV —

SISTEMA DE CONTRATO DE REHABILITACIÓN Y MANTENIMIENTO (C.RE.MA.)

PLIEGO DE ESPECIFICACIONES TÉCNICAS PARTICULARES

MALLA Nº 2

RUTA PROVINCIAL Nº :27

PROVINCIA: CORRIENTES

TRAMO: Mburucuya-RN No 118 Pk inicio: 0.00 Pk final: 50.30 Longitud del Tramo: 50.30 km
<table>
<thead>
<tr>
<th>PERFIL TRANSVERSAL EXIGIDO</th>
<th>TAREAS DE RECUPERACION</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ancho de calzada: 7,30 m</td>
<td>Bacheo profundo incluida la capa asfáltica</td>
</tr>
<tr>
<td>- Ancho de Banquina Pavimentada: ---</td>
<td>Bacheo superficial de la capa asfáltica</td>
</tr>
<tr>
<td>- Ancho de Banquina Total: 3,00m</td>
<td>Sellado de grietas y fisuras</td>
</tr>
<tr>
<td>- Ancho de Coronamiento: 12,70m</td>
<td>Relleno de huellas con mezcla asfaltica</td>
</tr>
<tr>
<td>- Pendiente de Calzada: 2%</td>
<td>Construccion de carpeta asfaltica en caliente</td>
</tr>
<tr>
<td>- Pendiente de Banquina: 4% minimo</td>
<td>en 6.70m de ancho y 0.03 m de espesor</td>
</tr>
<tr>
<td>- Espesor de Capas Asfálticas Existentes: 0,31m</td>
<td>en toda la seccion</td>
</tr>
<tr>
<td></td>
<td>Completamiento de banquinas de 3.00 m de ancho y 0.03 m de espesor mínimo</td>
</tr>
</tbody>
</table>

**CONDICIONES EXIGIBLES**

<table>
<thead>
<tr>
<th>Tramos con Obras de recuperacion</th>
<th>Tramos sin Obras de recuperacion</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI max: 2.8m/km</td>
<td>No hay</td>
</tr>
<tr>
<td>Ahuellamiento max.: 12mm</td>
<td></td>
</tr>
<tr>
<td>Fisuras maximas: Tipo4 en 15%</td>
<td></td>
</tr>
<tr>
<td>Baches: 0%</td>
<td></td>
</tr>
<tr>
<td>Indice de Estado min.: 6</td>
<td></td>
</tr>
<tr>
<td>Hundimiento o levantamiento de borde de calzada: No se admiten</td>
<td></td>
</tr>
</tbody>
</table>

**OTRAS INTERVENCIONES OBLIGATORIAS**

- Señalamiento Horizontal provisorio con pintura en frío según especificaciones particulares - Limpieza de zona de camino
- Completamiento de banquinas con suelo, sin compactación especial
- Sellado de grietas y fisuras
- Bacheo profundo de capas no ligadas y asfálticas
- Bacheo superficial de capas asfálticas

- Relleno de huellas con mezcla asfáltica en secciones varias

- Fresado de carpeta en 0,01m de espesor promedio en secciones varias

- Tratamiento superficial tipo lechada asfáltica

- Señalamiento horizontal con pintura termoplástica reflectante al finalizar la obra de recuperación en toda la sección

- Señalamiento vertical al finalizar la obra de recuperación en toda la sección

- Construcción de cuatro (4) dársenas para vehículos de pasajeros, en lugares a designar por la Supervisión

- Señalamiento Horizontal provisorio con pintura en frío según especificaciones particulares

- Provisión y colocación de mojones kilométricos en toda la longitud.

- TODAS LAS TAREAS SE EJECUTARÁN DE ACUERDO AL PLIEGO DE ESPECIFICACIONES TECNICAS GENERALES DE LA DNV -
ANNEX 5: SUMMARY FINDINGS OF TECHNICAL AUDITS CARRIED OUT BETWEEN 2007 AND 2009

As part of its fiduciary responsibility and in order to enhance the performance of its routine supervision missions, the Bank has appointed an independent Consultant to carry out a number of technical audits on a sample of the CREMA contracts that were being executed between 2004 and 2010. The Terms of Reference of this assignment are given in Appendix 1 of this report. Basically, the audits were intended to verify the extent to which the Contractors and the Supervision teams of DNV were executing their respective works and functions in accordance with the terms of the contracts.

The audits were carried out between June 2007 and May 2010 and covered 19 contracts (or Mallas) totaling 3,048 km, representing about 26 percent of the totality of contracts awarded and in execution between December 2004 and December 2008 (77 contracts covering about 11,900 km). Each audit lasted about 10 to 12 days, including 2 to 3 days of preparatory tasks (desk review of contracts documents), 6 to 7 days of field visits, and 2 to 3 days of reporting. The audits covered both the contracts that are financed with Bank’s loans and those that are funded locally from the Treasury, as shown in the following Table.

<table>
<thead>
<tr>
<th>Malla No.</th>
<th>Province</th>
<th>Length (km)</th>
<th>Original Contract Value US$M</th>
<th>Contract execution Period</th>
<th>Date of Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank’s funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>102B</td>
<td>Chubut</td>
<td>230.4</td>
<td>11.8</td>
<td>12/2004-12/2009</td>
<td>6/07</td>
</tr>
<tr>
<td>332</td>
<td>San Juan</td>
<td>105.3</td>
<td>17.6</td>
<td>4/2005-4/2010</td>
<td>6/07</td>
</tr>
<tr>
<td>301</td>
<td>San Luis</td>
<td>235.8</td>
<td>11.9</td>
<td>2/2005-2/2010</td>
<td>6/07</td>
</tr>
<tr>
<td>402A</td>
<td>Sgo del Estero</td>
<td>96.2</td>
<td>10.3</td>
<td>7/2005-7/2010</td>
<td>3/08</td>
</tr>
<tr>
<td>330</td>
<td>Mendoza</td>
<td>182.1</td>
<td>27.6</td>
<td>1/2007-1/2012</td>
<td>3/08</td>
</tr>
<tr>
<td>507</td>
<td>Corrientes</td>
<td>108.2</td>
<td>18.8</td>
<td>5/2008-5/2013</td>
<td>1/09</td>
</tr>
<tr>
<td>505</td>
<td>Formosa</td>
<td>181.4</td>
<td>21.9</td>
<td>5/2008-5/2013</td>
<td>2/09</td>
</tr>
</tbody>
</table>
50 Performance-based Road Rehabilitation and Maintenance Contracts (CREMA) in Argentina

<table>
<thead>
<tr>
<th></th>
<th>Province</th>
<th>Length (km)</th>
<th>Pavement Condition</th>
<th>Start-End</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>437</td>
<td>Tucuman</td>
<td>145.7</td>
<td>25.8</td>
<td>5/2007-5/2012</td>
<td>11/09</td>
</tr>
<tr>
<td>133</td>
<td>Neuquen</td>
<td>120.6</td>
<td>14.6</td>
<td>10/2007-10/2012</td>
<td>5/10</td>
</tr>
<tr>
<td>513A</td>
<td>Entre Rios</td>
<td>90.3</td>
<td>11.7</td>
<td>1/2005-1/2010</td>
<td>5/10</td>
</tr>
</tbody>
</table>

**Treasury’s funds**

|   | Province       | Length (km) | Pavement Condition | Start-End | Completion |   |
|---|----------------|-------------|--------------------|-----------|-----------|
| 502 | Entre Rios     | 146.7       | 46.1               | 5/2007-5/2013 | 6/09      |
| 441 | Catamarca      | 66          | 25.9               | 2/2008-2/2013  | 9/09      |
| 309 | La Rioja       | 300.8       | 24.2               | 7/2007-7/2012  | 11/09     |

**Total**

|   | Province       | Length (km) | Pavement Condition | Start-End | Completion |   |
|---|----------------|-------------|--------------------|-----------|-----------|
|   |                | 3047.8      | 381.8              |           |           |   |

The main findings of the audits are summarized below:

1. By and large, winning bidders accept the technical solutions indicated in the bidding documents and their detailed engineering studies generally endorse the rehabilitation standards derived and proposed by DNV from its preliminary design; sometimes albeit with some significant differences in their assessment of pavement surface condition and traffic volumes along the length of the corridor;

2. Rehabilitation works usually comply with the contracts requirements in terms of overlay thickness and roughness values. Rarely, are asphalt concrete overlay thickness, as determined from coring during the audits, found to be below the minimum thickness specified in the contract documents. Likewise, roughness measurements carried out during the audits show that after rehabilitation the average IRI is in the order of 2.2 and never exceeds the maximum specified threshold of 3 IRI. 80 percent of all results fall within the range of 1.9-2.3 IRI, thus confirming international experience;

3. Other mandatory interventions are also executed in accordance with the contracts specifications. They usually relate to road safety enhancement works such as remodeling of intersections, urban crossings features, construction of passengers’ bus stops, horizontal markings and vertical signs, or guardrails;

4. Regrettably, a number of Variation Orders due to design modifications during execution have been identified during the audits (mainly increases in overlay thickness) that are not consistent with the terms of a CREMA contract. Indeed, most of the modifications are not a result of “exceptional or force-majeure events” as would be allowed under the lump-sum CREMA contracts but rather of decisions taken by the Supervision, often in response to the Contractors requests. Of the 19 contracts audited by the Bank, variation orders in 6 contracts have been approved by DNV for a total amount of US$26 million, representing about 22 percent of the original contract value or 27 percent of the value of the rehabilitation component. The Bank only gave the no-objection to finance one variation Order on Malla 133 for an amount of US$3.5 million, (due to exceptional rainfall in 2008 that led to the need for providing additional deep drainage) the remaining US$22.5 million having been financed with local funds. Including audits carried out by the General Auditor of the Nation (Auditoria General de la Nación) on an additional package of 13 contracts that were bid in 2004, the total number of Variation Orders accepted by DNV
amounts to 10 out of 32 audits. When compared to the total value of the 74 contracts executed during that period (about 1.6 billion dollars), the total amount of the 10 Variation Orders identified in the 43 percent audited sample represents

5. US$37 million, that is equivalent to about 2.3 percent of the total value of the 74 contracts.

6. The audits did not find any evidence of pothole patching after rehabilitation works were completed. Up to two and a half years after the execution of the overlays, and although some reflection cracking was sometimes observed, no potholes developed at the surface of the pavement that required intervention. This was a valuable lesson that invalidates the practice of DNV that consists in considering in the cost estimate of routine maintenance the need for pothole patching (often between 2 and 10 cu.m/km/year, which is excessive) during the 2 to 3 years following rehabilitation;

7. In all of the audits, initial non-compliance with the terms of the contracts was detected essentially, and to varying degrees, in the execution of the routine maintenance component. Unsealed cracks, open potholes, partially obstructed culverts, and insufficient grass cutting on the verge of the pavement were the dominant forms of non-compliances;

8. Likewise, the minimum number of equipment specified by the contracts was not always available on site during the inspection;

9. Often, penalties were not applied as specified to remedy the Contractors’ failure to comply with the routine maintenance requirements;

10. Substantial delays occurred in the payment of Contractor’s certificates, typically between 60 and 90 days (beyond the 60 days period indicated in the general conditions of the contracts);

Based on the above observations, the auditor’s recommendations for the Supervision and/or for contract improvement are generally the following:

- To rigidly apply penalties as dictated in the contracts specifications;
- To assess on a regular basis the quantities of potholes patching and crack sealing executed after rehabilitation works, in order to fine-tune the cost estimate of these items in the routine maintenance component of the contract;
• To specify a maximum roughness value, not only per km measured, but also per section of a km, for example 300 meters, in order to avoid locally high spots of bad roughness;
• To specify two fronts of rehabilitation works instead of one and avoid the 24 months execution period for such works, particularly when the Malla is too long or when the rehabilitation works involve time-consuming recycling or large thickness of asphalt concrete overlay;

In addition, and based on the audits results, the project team would further recommends that:

• Rather than “specifying” in the bidding document a list of the minimum equipment to be available on site, DNV should provide such list as “indicative” only, thus avoiding to specify “inputs” as opposed to “outputs”, in line with the spirit of a performance-based contract;
• Refrain from approving variation orders during contract execution that are essentially intended to enhance and/or to correct the originally specified design, as opposed to being the result of unforeseeable or exceptional events as is normally allowed under the terms of the CREMA lump-sum contract;
• Remove from the list of “compensable events” a sub-clause that says: “an event shall be considered as compensable whenever the Engineer assesses that such event is justified for safety reasons or for any other reasons” (Clause54 (g) of the General Conditions of Contract) otherwise, that could open the door to an excessive number of Variation Orders that are not really the result of unforeseeable events).
• Reduce the delays in payment to the Contractor, as the impact of such delays is probably incorporated in bidders’ proposals;
• Rather than paying the rehabilitation works in accordance with a monthly detailed (and sometimes complicated) works program activity, such works (including the other mandatory interventions) should be paid - as was the case in the first CREMA program - upon the completion of portions of overlay works (or kilometers of asphalt concrete carpet executed), for example on a quarterly basis.
ANNEX 6: PHOTOS OF CREMA WORKS, 2007-2008

Preparatory Works Prior to Execution of Overlay

Sign at the entrance of a CREAM contract

Malla 507 Milling of Pavement

Sign locating Claim Book for Road Users

Malla 507 Cracks sealed

Malla 507 Patching of Potholes

Malla 330 Pavement ready for overlay
54 Performance-based Road Rehabilitation and Maintenance Contracts (CREMA) in Argentina

**Execution of Overlay**

- **Malla 330** Asphalt Plant 100 T/hour
- **Malla 507** Executing Asphalt concrete overlay
- **Malla 330** Laying 4 cm thick carpet
- **Malla 507** Compaction of Overlay
- **Malla 431** Compacting overlay
- **Malla 507** Overlay completed
Execution of Other Mandatory Interventions

Malla 301 Guardrail executed

Malla 408D Bus stop

Malla 301 Weigh Station (Axle load control)

Malla 408 D Horizontal Marking

Malla 301 Remodeling of Intersection

Malla 431 Vertical Signs
Routine Maintenance Component

Malla 408 D Crack Sealing

Malla 330 Joint Filling at Bridge deck

Malla 408 D Cracks Sealed

Malla 408 D Potholes Patched

Malla 507 Grass Cutting

Malla 330 Side drains cleaning
**Independent Technical Audit**

- **Malla 332 Roughness Measurement 5th wheel**
- **La Patagonia Overall Malla appearance**
- **Checking Rut Depth**
- **Checking Obstruction at Culvert entrance**
- **Malla in good maintenance condition**
- **Malla 402 Core testing Overlay thickn**
**APPENDIX 1**

**Terms of Reference- Technical Audits for CREMA contracts in Argentina**

**Antecedentes**

La República de Argentina ha recibido dos préstamos del Banco Internacional de Reconstrucción y Fomento – BIRF equivalentes a US$600 millones con el fin de financiar parcialmente el costo del Proyecto de Gestión de Activos Viales Nacionales (Préstamo 7242-AR y 7473-AR).

El objetivo del proyecto es consolidar gradualmente la estrategia de manejo de la red vial de manera eficiente, y asegurar los recursos necesarios para preservar la red nacional vial a largo plazo. Uno de los objetivos específicos del proyecto es el mantenimiento de los activos viales nacionales esenciales, mediante la expansión gradual de contratos con funcionamiento basado en los resultados para la rehabilitación y mantenimiento de la red vial pavimentada no concesionada (Contratos CREMA).

El contrato CREMA es un contrato de 5 años, basado en los resultados, que requiere que el contratista rehabilité porciones seleccionadas dentro de una malla y que haga el mantenimiento rutinario de la misma durante los 5 años del periodo del contrato. El uso de contratos CREMA y el nivel de inversión han incrementado rápidamente en Argentina. El Banco ha financiado este tipo de contrato al nivel federal desde 1997 y su uso se ha expandido a las Provincias mediante varios proyectos independientes.

La calidad de la supervisión de contratos CREMA es esencial para asegurar su eficiencia y eficacia como sistema de gestión, en función de costos, y número y de km de ruta rehabilitada y mantenida. La estrategia propuesta por el Banco para fortalecer la capacidad de DNV en la supervisión y control de calidad de contratos CREMA se organiza alrededor de cinco puntos primordialmente:

1. Fortalecer la capacidad de la DNV en el diseño de los contratos CREMA para mejorar la calidad y eficiencia en función de costos del diseño estructural de las soluciones de rehabilitación propuestas y la evaluación de los costos asociados;
2. Llevar a cabo capacitación de los empleados de DNV involucrados en el diseño y supervisión de los contratos CREMA, mediante su participación en cursos periódicos y seminarios;
3. Reforzar cuando sea necesario los equipos de trabajo en los Distritos de Vialidad mediante la contratación, de consultores individuales y competentes para que sean incluidos en el equipo de supervisión;
4. Complementar las actividades de supervisión de la DNV con auditorias técnicas independientes hechas por expertos competentes, con mucha experiencia en la
supervisión de obras viales y particularmente en el diseño y ejecución de contratos basados en el desempeño.

5. Fortalecer la auditoría mencionada precedentemente a través de la contratación y la incorporación de un ingeniero adicional en la Unidad de Coordinación del Proyecto, con el rol de hacer el monitoreo continuo y visita de sitio del programa CREMA, y asistir la preparación y ejecución de auditorias técnicas independientes.

**Objetivo de la Consultoría**

El objetivo de la presente consultoría es llevar a cabo auditorias periódicas sobre el desempeño de los contratos CREMA en ejecución en Argentina, particularmente (i) revisando que las obras CREMA se estén ejecutando en concordancia con lo establecido en los documentos de dichos contratos; y (ii) hacer recomendaciones, cuando sean necesarios, para mejorar la ejecución de las obras y/o la supervisión hecha por Vialidad.

**Descripción de los Servicios**

1. **Auditoría Proyectos CREMA**

Se espera que el consultor realice las siguientes actividades:

**A. Durante el periodo de rehabilitación y en secciones que están siendo rehabilitadas:**

- Verificar si el programa de actividades, incluyendo la obra de carpeta y otras intervenciones obligatorias, se han ejecutado según lo indicado en el proyecto ejecutivo, y de acuerdo con lo convenido con la DNV;
- Revisar la consistencia entre las obras ejecutadas, objetivos, y certificados de obras aprobados por el supervisor;
- Revisar, en caso de incumplimiento, si las multas se han aplicado según lo estipulado en los documentos de contrato;
- Revisar la puntualidad de pagos hechos al contratista, y la consistencia con el cronograma de desembolso (flujo de fondos);
- Si las obras sobre la carpeta asfáltica ha sido parcialmente ejecutada, verificar durante la auditoría, el cumplimiento con los requisitos de las especificaciones técnicas (espessor mínimo de carpeta, rugosidad máxima, ahuellamiento, baches, fisuras y grietas, and so on);
- Verificar la ocurrencia de eventos compensables en el contrato;
- Para todas las intervenciones obligatorias, evaluar visualmente el estado de la ejecución o de la terminación;

**B. Después que las obras de rehabilitación han sido concluidas y en secciones que se han rehabilitado completamente**

- Evaluar la calidad de todas las secciones de la carpeta rehabilitada y analizar la documentación que contiene la información sobre las mediciones realizadas por la supervisión después de la ejecución de la obra;
- Comparar la información sobre la rugosidad con medidas reales que se hagan durante la auditoría;
• Revisar si las multas por incumplimiento se han aplicado o no, o si se han debido aplicar
• Chequear si las otras intervenciones obligatorias importantes se han ejecutado correctamente (inspección visual y el mejor juicio)
• Para lo anterior, verificar la consistencia y la puntualidad entre los pagos y los certificados de contratistas

C. En secciones que deben ser mantenidas solamente

• Chequear visualmente si los 13 ítems específicos sujetos a inspección se han cumplido y corresponden con los estándares del contrato (ver Tabla de especificaciones mínimas requeridas en los contratos y multas aplicables en caso de incumplimiento).
• Chequear si las multas que deben haber sido aplicadas se han aplicado;
• Chequear la disposición del control automático del contratista, incluyendo su laboratorio;
• Chequear la puntualidad de pagos al contratista
• Chequear informes de tráfico, control de cargas y libro de reclamos.

Methodología y logística para la realización de los servicios de auditoria contratos CREMA: Existen cerca de 50 Mallas CREMA en ejecución a nivel nacional. Para auditar las mallas durante los 5 años de ejecución (2005-2010), se estima que el auditor debe realizar por lo menos dos auditorías por año cubriendo 3 Mallas aleatorias en cada ocasión.

El consultor deberá familiarizarse con los documentos que hacen parte de un contrato CREMA antes de iniciar la auditoría específica. Se espera que el auditor haga un resumen de las cláusulas y obligaciones más relevantes del contrato a ser verificadas en campo.

Las Mallas a ser auditadas deben tener por lo menos entre 3 y 6 meses en ejecución para evitar coincidir con el periodo en el cual el cumplimiento de las especificaciones no está vigente.

Se debe coordinar con la DNV con por lo menos 1 mes de anticipación cada auditoria para requerir la información disponible y solicitar la disponibilidad del equipo de mediciones que se requiera (contrato, informes de la supervisión, proyecto ejecutivo definitivo, programa de obras actualizado, certificados de obras y pagos, mediciones de rugosidad, equipos para hacer mediciones de rugosidad durante la auditoria y para toma de muestras para medir espesores finales de carpetas ejecutadas, and so on)

2. Calificación del consultor

El consultor debe ser ingeniero de carreteras, con más de 10 años de experiencia en el diseño y supervisión de proyectos de rehabilitación y mantenimiento. Debe tener competencia y experiencia practica en contratos CREMA en Argentina.
3. Dependencia

El consultor reportará al Gerente del Proyecto 7242-AR y 7473-AR y 7301-AR.

4. Fecha probable de inicio de la consultoría

Octubre de 2009

5. Duración estimada del Contrato

La duración estimada del contrato será de 60 días a ser ejecutados durante el año fiscal 2010. Los costos de viaje y acomodación (hotel y per-diem) serán reembolsados por el Banco. La organización de las visitas de campo será responsabilidad del Banco y de la DNV.