

Are Indian Rural Roads Ready for Performance Based Maintenance Contracts?

Experience of Pilot Project in Uttarakhand

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ABSTRACT

The performance based maintenance contracting (PBMC) have been practiced by several countries in the world for their range of benefits. In India, it has been piloted in the states of Uttarakhand and Himachal Pradesh for the first time on rural roads - thanks to Pradhan Mantri Gram Sadak Yojna (PMGSY). This paper brings out the experience of the Pilot PBMC project in Uttarakhand which was done tried out for one year in 2015-16 covering various aspects of planning and execution. The paper also makes a cost comparison of PBMC pilot with other maintenance contracts which endorse the financial feasibility of PBMC and encourage the road agencies to take it up on wider scale and for longer duration for further detailed studies.

1. Introduction

One of the major achievements of Pradhan Mantri Gram Sadak Yojana (Prime Minister’s Rural Road Scheme or PMGSY), in addition to unprecedented rural connectivity in India, is to draw the attention of road maintenance agencies to the importance and inevitability of asset management to preserve the large network of rural roads. Several significant steps were taken in this direction such as formulating and notifying maintenance policies by the states which are responsible for maintaining the rural roads, implementation of maintenance management systems with emphasis on routine maintenance and capacity of building. To reinforce their effort in this direction, the National Rural Roads Development Agency (NRRDA) has entered in to an agreement with International Labour Organization (ILO) as a development partner to assist the states in asset management.

As a part of bringing in the innovative maintenance methodology, the ILO was tasked to

assist in implementation of pilot projects on Performance Based Maintenance Contract (PBMC) in two states, viz. Uttarakhand and Himachal Pradesh (HP). This paper discusses the planning and implementation of PBMC pilot project in Uttarakhand along with the cost comparisons. The paper also discusses the feasibility of cost of the pilot project and draws parallel with other pilot done in Himachal Pradesh and cost of routine maintenance of roads under defect liability period of PMGSY roads.

2. Performance Based Maintenance Contracts (PBMC) - an overview

PBMC is a contract in which the contractor is paid for keeping the road at minimum specified standard for a specified period rather than for performing specified works as is done in traditional maintenance contracts (Hyman, 2009; MoRD, 2015; Stankevich et al., 2005; Zietlow, 2005). It is up to the contractor to choose the application of technology and materials, process and management to achieve the results. The PBMC places higher risk on the contractor, but at the same time he can profit from improved efficiencies and effectiveness of design, process, technology or management to reduce the cost of achieving the specified performance standards (Hyman, 2009; MoRD, 2015; Stankevich, Qureshi, & Queiroz, 2005; Zietlow, 2005). The shift from traditional road maintenance contracts based on bill of quantities (BoQ) to PBMC can be seen as a paradigm shift from “minimizing the cost to maximizing value” (Gransberg et al., 2010) and an effective means to “improve efficiency and public accountability” (Liataud, 2004).

The PBMC was first tried out in British Columbia, Canada in 1989 with limited freedom to contractor in terms of work procedures and technologies rather than freedom in the application of new technologies (Zietlow, 2005). In New Zealand, a mix of output and performance based road maintenance has been in place on New Zealand State Highway and Territorial Local Authority road networks, through which a variety of contract delivery methods have been developed over a period (Hunter and Kyle, 2001). It was introduced in Argentina on 3,600 km paved road network in good and fair condition in 1995 (Liataud, 2004). In the mid-nineties, Uruguay also piloted PBMC, first on a small portion of its national network and then on the main urban roads of Montevideo. only five years later, 50% of the national roads in Uruguay were being maintained through

performance contracts. Shortly thereafter, other Latin American countries such as Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico and Peru also started adopting a performance-based approach (Stankevich, Qureshi, & Queiroz, 2005; Zietlow, 2005).

PBMC has been prominently used in Australia, New Zealand, England, and Finland. In US, Virginia DOT began PBMC in 1996 and subsequently several states have followed suit. By 2005, about 50 countries were practicing performance based contracts (Hyman, 2009). The performance contracts, which have spread to European, African and Asian countries, are strongly supported by international donors like the World Bank, the European Bank for Reconstruction and Development and the Asian Development Bank (Zietlow, 2005).

Some important benefits of PBMC over traditional maintenance contracts as given below (Stankevich, 2005; Hyman, 2009):

- (a) Cost savings in managing and maintaining road assets and enhanced asset management;
- (b) Ability to manage the road network with fewer agency staff
- (c) Stable multi-year financing of maintenance.
- (d) Better customer satisfaction due to improved level of service
- (e) The transfer of risk to the contractor
- (f) More innovation
- (g) More integrated services

3. Planning for PBMC Pilot Project in Uttarakhand

Planning mainly involves the selection of suitable road for the pilot project and preparation of estimates for drafting bid document. On allotment of pilot to Uttarakhand, the representatives of Uttarakhand Rural Roads Development Agency (URRDA) and ILO had extensive interaction



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for selection of suitable road for the pilot project as well as for preparation of estimates.

3.1 Selection of Road

For the pilot, the pre-requisite is that the road is in fairly good condition so that the initial repairs to bring the road to desired standard does not cost too high and does not take too long. At the same time, the road should be sufficiently long so as to give credible feedback. Initially, ten roads were considered for pilot by an expert panel of engineers constituted for this purpose. Keeping in view the effort required to bring the road to the desired standard and the length, “Raipur –Thano-Bhuyiya Temple Motor Road” having a length of 18.44km falling under other



Figure 1. Map showing the alignment of Raipur–Thano-Bhuyiya Temple Motor Road (courtesy: Google Maps)

district roads (ODR) category, was considered the right candidate for the pilot project. The funds required to carry out the PBMC Pilot were also within the allocation approved by the State Government.

The road is located near Dehradun, capital of Uttarakhand, and is in hilly terrain. The road serves mainly the origin and destination with very small habitations on the way. The road is atwo-lane blacktop road and the average daily traffic is generally less than 500 PCU.

The average maximum temperature varies from about 35°C in the months of May and June to about 20°C from December to February. The average minimum temperatures vary from about 23°C during the month of Jun to about 6°C during the month of January. The average annual rainfall is about 2200 mm with maximum average monthly rainfall of about 700mm in the months of July and August.

From the climatic and the terrain conditions, it can be understood that the selected road is subjected significantly to the vagaries of temperature variations as well as rainfall.

3.2 Preparation of Estimates

The contract consisted of two distinct periods, Period-1, in which the contractor, at the beginning of the contract, carries out repairs to the road to bring it to a specified service level and Period-2, the rest of the contract period during which the contractor will keep the road maintained at the same service level. To reap maximum benefit of a well-maintained road, it is imperative that the Period-1 be kept to a minimum.

The cost was to be estimated for the item of works to be done during Period-1 to attain the condition of the road to the required service level and the lump sum amount required in Period-2 to sustain its maintenance to its original required condition for the rest of the contract period. The cost of routine maintenance activities were estimated on the basis of Routine Maintenance Norms approved by the State Committee, which was specifically constituted in Uttarakhand State under the Chairmanship of Engineer-in-Chief of State Public

Works Department (PWD) and other senior engineers nominated as members of this committee. The estimated cost of other proposed activities required to be executed during pre-rehabilitation i.e. Period-1, to bring the road to the desired service level were based on bill of quantities (BoQ) as per road condition survey carried out and costs computed on the basis of schedule of rates. Great care was taken in preparation of the estimates so as to avoid any discrepancies in future that can precipitate in future conflict between department and the contractor.

The total amount required as per the estimate for carrying out the work under Period-1 was ₹2,29,759 and for Period-2 it was ₹5,11,313 making total bid price for the Pilot Project ₹7,41,072.

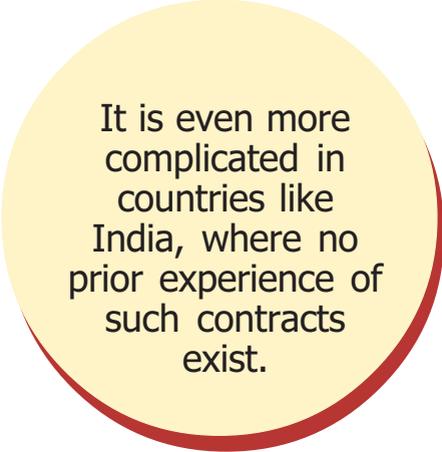
Being a Pilot Project, the period of the project was limited to only one year, out of which a period of one month was allowed for Period-1.

4. Bid process for PBMC pilot

A standard bid document was developed by the ILO for PBMC giving the performance measures that constitute the contract. The same document was adopted for the pilot. Various performance criteria along with maintenance measures, intervention periods and weightages for each type component of maintenance were decided, by URRDA, in consultation with the representative of the ILO as

given in Table 1.

Maintenance of pavement, shoulders and drainage constitute 85% of the weightage with various indicators as given in table 1 serving as proxies to the maintenance level. Since simple and unambiguous performance indicators will improve contract performance (Bull et al., 2014) the indicators were restricted to necessary minimum. Since the pilot was being carried out for rural roads, surface properties such as roughness, texture or skid resistance which are generally incorporated in PBMCs in developed countries like Australia, New Zealand (Gransberg, Scheepbouwer, & Tighe, 2010; Segal et al., 2003) were not taken into consideration in view of the difficulties in measurement.



It is even more complicated in countries like India, where no prior experience of such contracts exist.

Table 1. Weightages, performance criteria and intervention periods for defect rectification for releasing payments in Period-2

Ser No	Defect	Performance Criteria (Permissible allowance within one km of road section)	Notice Period	Maintenance measure	Intervention Period (Minimum Frequency of undertaking maintenance measures to control defect)	Weight-age
1	Pavement					40
	(i) Surface patches* (Due to stripping, raveling, de-lamination)	Pavement surface damaged [due to cracks (> 5mm), stripping, raveling, de-lamination] should be less than 1/2 % of the total surface area of carriageway	One month	Surface Patching	I) Once in every two months. ii) One month before the onset of the monsoon period	20
	(ii) Potholes	Not more than 4 potholes in one km stretch with diameter more than 300mm . Not more than 1 Sqm of area of potholes No pothole more than (depth of the wearing course + 50mm)	Two weeks	Pothole repair	Once every month	10
	(iii) Surface deformations (all depressed, rutted or corrugated surfaces)	No depression, rutting or corrugated surface is more than 50mm deep (measured with 3.0m straight edge) No depression, rutting or corrugated surface is more than 1.5m long	Two weeks	Repair surface deformations	Once every month	8
	(Cordella and Cordella, 2014) Surface Bleeding	No isolated bleeding surface should be more than 5 sqm	Two weeks	Treat Bleeding	Once every month	2
2	Edges & Shoulders					25
	(i) Edge Break	No edge break should be more than 150mm wide (also refer Cl. 29.2 of Section 5) On either side, the cumulative length of the edge break should be less than 20m No isolated continuous edge break more than 5m	Four weeks	Repair road edge, including adjacent shoulder Fill / Scrap and compact the Shoulder to maintain its profile Repair road edge, including adjacent shoulder	Once every month Once every month Once every month	10
	(ii) Deformation/ Scouring of Shoulders (Berms)	No scour / pothole in shoulder more than 50mm deep Drop off of shoulder from carriageway edge top is not more than 50mm deep, for 5m isolated stretch or 20m cumulative length on either side of road	One month	Fill / Scrap and compact the Shoulder to maintain its profile	Once every month	15

Ser No	Defect	Performance Criteria (Permissible allowance within one km of road section)	Notice Period	Maintenance measure	Intervention Period (Minimum Frequency of undertaking maintenance measures to control defect)	Weightage
		No portion of the shoulder is above the edge of the carriageway (also refer Cl. 29.3 of Section 5)				
		The slope of the shoulder should be between 3.0%-5.0%				
3 Drainage						20
	(i) Surface runoff	Water should not pond on road after rainfall (Maximum 10 instances . Each ponding instance not more than one sqm ponding area and 20mm ponding depth)	4 hours	Drain out the water from Carriageway and shoulders	Within One day of stoppage of rain	2
	(ii) Side drains	The path of the drain should be clear, and water should flow in drain without any obstruction	Two weeks	Clean the side drains of any Silt, debris or any obstruction	I) Once every month. ii) One month before the onset of the monsoon period	8
	(iii) Cross-Drains (Culverts)	Culvert passage or pipe should allow free flow of water	Two weeks	Clean the culvert passage/ pipe, inlet and outlet of any Silt, debris or any obstruction	I) Once every two months. ii) One month before the onset of the monsoon period	10
4 Vegetation Control						5
	(i) Shrubs, Bushes, Grass	The Carriageway and the shoulders should be clear of any growth of grass and bushes/ shrubs. Maximum grass height should be 100mm	Two weeks	Cut the grass. Clear the bushes / shrubs	Once every month	3
	(ii) Tree branches	The Vision of a bus/truck driver should not be obstructed from hanging/obstructing branches of trees with a vertical clearance of 5.00m all along the formation width	Two weeks	Prune the branches (after the clearance of the forest department, if required)	Once every month	2
5 Road Safety						10
	(i) Blockage on carriageway	No obstructions on carriageway such as broken branches, dead animals etc.	24 hours	Remove Blockage (to a safe distance from shoulders)	Within 4 hours of observation by Contractor or notification to Contractor by the Engineer / any public representative / police	1
	(ii) Road Signage & Road Marking	(i) Road signage should be visible to the road user (also refer Cl. 37.4 of Section 5)	one week	Keep clean all the road signage	I) Once every month. ii) Once every fortnight during monsoon period	3
		(ii) Damaged road signage should be repaired	two weeks	Repair road signs	I) At the earliest after damage coming to the notice of Contractor.	

Ser No	Defect	Performance Criteria (Permissible allowance within one km of road section)	Notice Period	Maintenance measure	Intervention Period (Minimum Frequency of undertaking maintenance measures to control defect)	Weight-age
					ii) Within two weeks of Employer notifying the Contractor	
		(iii) Missing Road sign should be reported	one week	Report the missing road signs to Employer	In the monthly report to Employer	
		(Cordella & Cordella, 2014) Road marking should be visible to the motorists (also refer Cl. 37.4 of Section 5)	one month	Repaint road markings	Repaint once every six months	
	(iii) Railings of Bridges & Parapets of Culverts	Existing Bridge railings should be in place. No existing parapet should be missing/damaged.	two weeks	Replace/Repair bridge railings. Construct/ Repair parapet of the culverts	Within two weeks of observation by Contractor or notification to Contractor by the Engineer/ any public representative / police	4
	(Cordella & Cordella, 2014) Maintenance of 200m, Km and guard stones	All, Km and guard stones should be in place	one month	Replace any missing 200m, km and guard stones.	Once every month	2
		All 200m, Km and guard stones should be repaired and repainted (also refer Cl. 37.4 of Section 5)	one month	Repair and repaint 200m, km and guard stones	Once in a year	
6 Side slopes (in case of hilly areas)						
	(i) Landslides / Slips (Hill Side)	(i) Remove the debris from carriageway	one day	Clear the debris from carriageway	I) At the earliest after slide / slip coming to the notice of Contractor or notification to Contractor by the Engineer/ any public representative / police ii) Within 24 hours of occurrence	
		(ii) Remove the debris from shoulders	two days	Clear the debris from Shoulders	Within 48 Hours of occurrence	
	(ii) Erosion of Slopes (Valley Side)	Protect the carriageway and provide road safety measures	one day	Secure the Shoulder / Carriageway with Road Safety measures	At the earliest after erosion coming to the notice of Contractor or notification to Contractor by the Engineer/ any public representative / police	
		(ii) Reconstruct the slopes	two weeks	Rebuild / Stabilize the slopes	Within one fortnight	

* Cracked surface, having cracks of width more than 5mm, shall be considered as area eligible for surface patching (A single isolated crack will be assessed as having equivalent surface area of 0.5 sqm per metre length)

In general, the following maintenance activities were mainly required to be attended by the Contractor on regular basis to keep the road maintenance to the desired level of service.

- Road surface crack-less and free from potholes.
- Drains open and clean.
- Vegetation on shoulder not more than 10 cm high.
- Road signs and km stones/hectometre Stones present and in good condition
- Maintenance of road side shoulders.
- Maintenance of scupper/culvert/causeway and bridges.
- Maintaining the road free from slip and derbies.

4.1 Pre-Bid Meeting

Two months prior to the commencement of contract, a pre-bid meeting was conducted to explain the methodology of the contract to both the engineers and contractors. Specialists from International Labour Organization (ILO) along with Chief Engineer Uttarakhand Rural Roads Development Agency (URRDA) and other senior engineers. This type of contract being new to the environment, the complete details about each clause of the Bid Document, the procedure of inspecting the work, the method of releasing monthly payment and deductions to be affected for failure to comply with the conditions were explained to the participants and their queries were answered by the officials of the ILO Mission.

4.2 Receipt of the Bids

Since this was the first tender of its kind, the contractors, understandably, were apprehensive to bid for the work. The amount of the bid was also very low since only one road could be identified for the pilot project which rendered the contract unattractive for the 'A' Class contractors. Only two contractors gave bids for this Pilot Project and with concerted effort from URRDA, the contract began on 01/03/2015.

5. Execution of contract

The items of work pertaining to Period-1 of the contract were completed by the contractor on 09/04/2015 with nine days extension due to additional works such as shoulder repairs and works on road markings and guard rails that had to be carried out by the contractor with the approval of executive engineer at the prevailing rates.

During Period-2 of the contract the Contractor was required to maintain that condition of the road to

the pre-defined service level for the entire duration of the Contract. The monthly weighted equated payments to the contractors were released after proper verification to ensure that the road was maintained to its required service level.

The monthly payments released to the contractor indicate that, by and large, the contractor was able to maintain the condition of the road to the defined service level. Except for the month of May (60%) and July (82%), all the other monthly equated payments released were above 90%. The retention of payment during May 2015 was owing to the deficiencies in the following maintenance works:

- Shrubs and vegetation on off-carriageway was beyond the acceptable limit
- Slope/level of the shoulder needed rectification at certain places
- Hectometre Stone re-fixing work needed at certain places
- Edge drop needed to be rectified at certain places
- Cleaning of side drains needed at certain places
- Clearance of cross drain needed at one culvert

The main concern of a bidder in PBMC is the uncertainty of the resources to be deployed during Period-2 since the workload will have to be anticipated in the absence of factual data. It is even more complicated in countries like India, where no prior experience of such contracts exist. The details of the work days of the labor deployed by the contractor for attending to Period-2 maintenance activities during each month was maintained by the project implementation unit (PIU) and the same has been shown in Figure 2. With diligent planning and consultation during estimation of resources, the actual deployment of manpower did not vary significantly from that of estimation. The month-wise utilization of tractor and JCB is also given in Figure 2.

From the data above the work days which work out to be 0.25 per km per day, which is less than norms approved by the state which is 0.40 (per lane) and that of NHAI which is 0.75

6. Discussion

To make the PBMC more successful, the desired length of package of roads under each contract is 50-100 km, under the conditions in which pilot was carried out, to enable the contractor maintain a steady force of labor throughout the year unlike the deployment in the pilot as shown in Figure 2. A larger network under

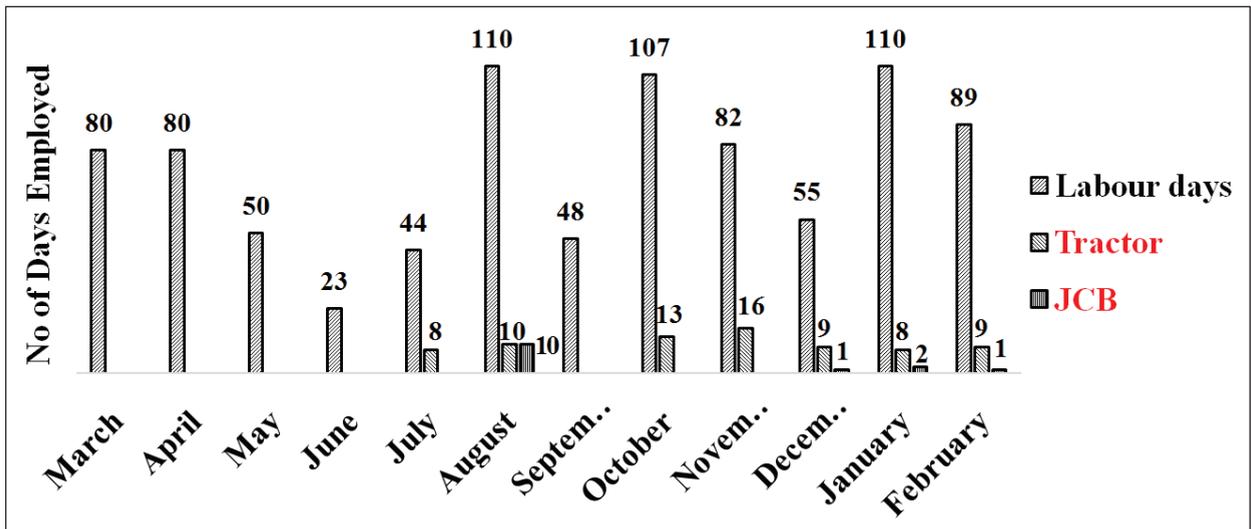


Figure 2. Month-wise deployment of labor (labor days) by the contractor

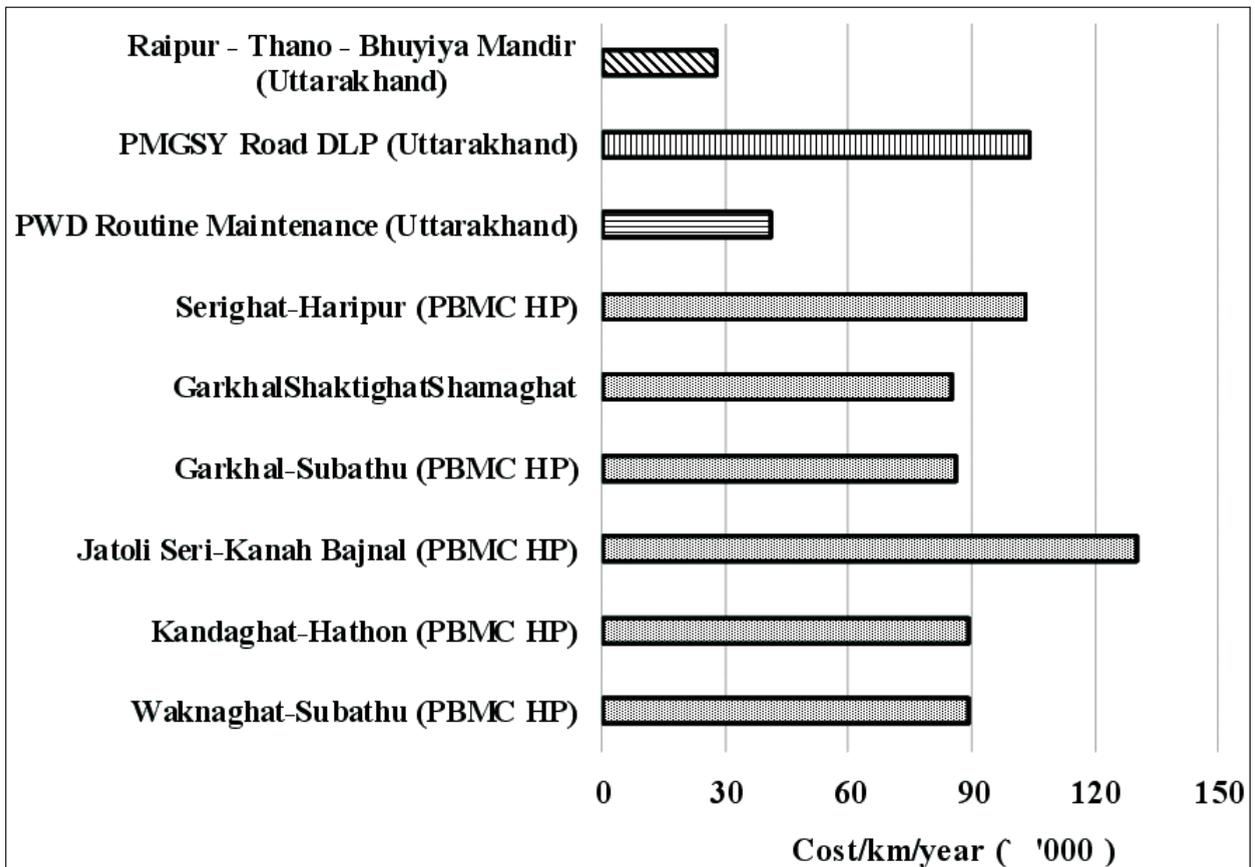


Figure 3. Cost Comparison between PBMC Uttarakhand and routine maintenance cost, PMGSY DLP cost and PBMC Himachal Pradesh

PBMC can help the contractor in scheduling his works in such a way as to prevent draining of expertise and frequent training of new labor. It also helps in frequent hiring and firing of labour which can pose problems, particularly in harvest season.

To increase financial viability of the contract, it is desirable that the period of the contract be at least three years so that the contractor can economically deploy his tools and plant (T&P). There will also be savings in training and maintenance of workforce. An ideal arrangement will be to contract for a period of 5-6 years so that at the end of the contract the road can be retendered under same type of contract with a renewal coat at the beginning.

While considering the road for PBMC, the agency should carefully consider complications that can arise from jurisdictional conflicts and local laws. In the pilot, the shoulders of the road were eroded due to heavy rains in kilometers 13 and 14. Even though the contractor had deployed his labor and machinery within the permissible response time, the forest department did not allow the contractor to take the earth from the adjoining land and also forced the contractor to remove his machinery from the worksite since the ownership of the land was that of the forest department. After numerous failed efforts to resolve the issue, the PIU had to suspend the item of maintaining shoulders in the affected stretch from the contract till the matter was resolved.

In another instance, the contractor had the challenge of keeping the side drains and shoulders clear on a stretch of road that was passing through a thickly inhabited area where the local inhabitants kept dumping garbage, cow-dung etc. that kept blocking the drains.

The norms of trimming of grass was taken once a year in the estimate during planning state. However, it was seen that cutting of grass was required at least thrice a year owing to higher vegetation growth in hilly reaches, especially during monsoon.

The PBMC being new to the environment, a need was felt that a two-day workshop be held to impart necessary knowledge to the concerned engineers and contractors covering the complete details of performance indicators, quality control, measurements, inspection, submission of bill etc. The clarity about the deduction of the payments that are

required to be affected for non-conformance is to be understood clearly by both the engineers and the contractors to avoid any misinterpretation of verification of performance indicators on the part of either party. The training will also help both department and the contractor in unequivocal understanding their respective roles and responsibilities.

7. Financial feasibility of PBMC

A number of agencies are skeptical regarding a valid basis for cost comparisons between force account work and PBMC by private firms as making cost comparisons is complex (Hyman, 2009). While the length and duration of the pilot do not permit any conclusive deductions regarding financial viability, it definitely has the potential to allay any apprehensions in the minds of road maintenance agencies and contractors that it might be inordinately expensive and might not be workable.

A major handicap in cost comparison of PBMC with commonly practiced BoQ contract is the duration of the pilot. The BoQ maintenance contract covers mostly the Period-1 maintenance if the contract is executed in the beginning of the year. If the BoQ maintenance contract is executed towards the end of the year, the cost is comparable to the sum of costs of Period-1 and Period-2. However, in the first case, the road will develop defects after the BoQ contract is executed and the road will be up for routine maintenance at the beginning of the next year again. In the second case, the road will be in a good condition at the beginning of the next year, but the road users would have faced hardships of an unmaintained road through the year. In contrast, the PBMC would have afforded a well maintained road throughout the year and leaves as it had been at the beginning of the next year.

Comparison of cost of Period-2 of PBMC with that of maintenance during the defect liability period (DLP) of PMGSY roads will make better sense since both cover the cost of keeping the road in a predetermined condition. As shown in Figure 3, the average cost of maintenance under PBMC is only 27% of the cost of maintenance of PMGSY roads under DLP. It may also be noted that the cost of maintenance under DLP only covers repair of potholes while that under PBMC includes several other works of road maintenance too.

Figure 3 also gives the routine maintenance norms prevailing in the state which can be compared with the cost of Period-2 of PBMC from the second year onwards. It can be seen that the cost under PBMC is only 68% of that of the norms prevalent in the state.

While it is acknowledged that the above comparison might not qualify all PBMCs as more economical than the conventional maintenance contracts or the DLP of PMGSY roads keeping in view the length and duration of pilot, it is encouraging for other agencies to try it in their respective jurisdictions and evaluate for themselves. The per-km costs of Period-2 maintenance of pilots simultaneously carried out on six roads in Himachal Pradesh are also given in Figure 3 for cost comparison. There is a likelihood of reduction of costs once the packages of roads and the duration of contract in each contract increase (Anastasopoulos et al., 2009), as also with the executives and the contractors becoming more familiar with the PBMC procedures.

8. Conclusion

PMGSY, with assistance from the World Bank and International Labour Organization, has ushered in a culture of asset management to alleviate the sagging condition of rural roads in India. In order to have an effective asset management of vast rural road network of the country, there is a need for a contracting system that reduces the burden on the road maintenance agencies and gives more autonomy to the contractors while providing a good quality road throughout the contract period for which PBMC is an ideal choice.

The pilot project undertaken by URRDA in Uttarakhand has shown that PBMC has the potential to meet the maintenance requirements within the permissible budget and it reduces the burden on the already overburdened executives of the road maintenance agencies while providing quality road network for the users. An increased involvement and

initiative of the contractor have also been encouraging indicators in support of the argument for PBMC.

The road agencies should take up the PBMC on bigger road networks for longer durations that have the capacity to precipitate larger benefits in order to continue the momentum that has been initiated by PMGSY.

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