# IMPACT: Blending Civil Construction with ICT for Cost Effective Transparency

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## ABSTRACT

*Haryana PWD (B&R) is responsible for construction, up-gradation and maintenance of about 4,200 ongoing civil works, located throughout Haryana, costing to Rs. 3,600 Crores. IMPACT (Integrated Monitoring of PWD Activities), a workflow based Web Enabled System of monitoring the works systematically, was established with the technical support of NIC-Haryana. The database contains complete information on 8,500 works of PWD. The IMPACT also helps in extensive data analysis through pie charts, bar charts, line graphs etc. This kind of analysis is helping the government in pinpointing the bottlenecks and to take all-important decisions. The system has emerged as a highly effective tool for enhancing the efficiency, bringing transparency and cost effectiveness in the department.*

***Keywords:*** PWD, MIS, LOC, Civil Engineering, IMPACT, NIC.

## 1. Situation before IMPACT

Haryana PWD (B&R) is responsible for construction, up-gradation and maintenance of about 4,200 ongoing civil works costing to Rs. 3,600 Crores presently. At present, these are This is distributed among 57 divisions and 13 circles located throughout Haryana. IMPACT *(Integrated Monitoring of PWD ACTivities)*, a web enabled work flow application is a first step for governing these works electronically. Currently G2G, the application has wide scope of expansion, LOC computerization being the first in series. The first such work done for any Public Works Department in India, IMPACT has involvement of whole PWD for continuously building up database. It is being used by government for taking up all important decisions. IMPACT has capability of analyzing data based on 15 parameters. These works have importance In this era of e-Governance, the induction of ICT in PWD was need of the hour. To monitor various aspects of works systematically and to bring transparency in the working of the department, a workflow based Web Enabled System of monitoring all the works was established with the technical support of NIC-Haryana State Centre. The situation before the implementation of this e-Governance system was paper based, inefficient and lacked authenticity as there was no methodology available to know the exact status of a large number of works being implemented by the department on various locations spread over all over the State. The only source of information was papers and files. Further, the release of funds by way of LOC (Letter Of Credit) is one of the most cumbersome financial processes in the department involving enormous much paper and telephonic transaction resulting in adhocism, delays, etc.

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## 2. Strategy Adopted

To monitor various aspects of works systematically and to bring transparency in the working of the department, a need was felt to establish a workflow based Web Enabled System of monitoring the sanctioned and on-going works. The responsibility of developing, hosting, training & implementation of such a system was assigned to NIC-HRSC. Basic requirement in automation was to give a unique Id to each work, which earlier used to be identified by work name only. Automatically generated work code contains the year and circle in which it was started. Secondly, three major levels of department viz. Government (Principal Secretary), Head Office (E-in-C, Chief Engineers) and Field Offices (SEs and Executive Engineers) were given different privileges to access the system depending upon their job profile.

The biggest challenge was the formulation of Heads of Accounts that could cater both financial and administrative requirements of department. This was a long iterative process solved with the categorization of all works in newly formulated categories. Requirement of standardizing the constituent activities leading towards the final construction of Building, Bridge or Roads was felt. Each of the wholesome process was divided into 10 constituent activities. System was then devised for monitoring at even constituent level. Considering the political and administrative importance of PWD works, the Assembly Constituency and location was also attached with each work. As a first step, system study was carried out and different kinds of works were analyzed. Based on the requirement of system, a single page Performa for each work was designed and circulated to all divisions. Manual data of 3000 works was thus collected. Whole data was entered through raw data entry forms with limited report features. This was done to give a feel of computerization to the department. This was the time when department accepted the model for first time and signaled for going ahead. Software was refined and made user friendly afterwards. Several meetings were held with departmental officers for tuning of software. Based on opinions and requirements, General Query System was also developed. At the later stage, the status of work was distinctly defined as

- Work not approved administratively
- Work Administratively approved but not tendered yet
- Work in Tender/Allocation formalities
- Work in Physical Progress
- Work Physically completed but financial liabilities pending
- Work Physically and Financially completed

This categorization played a vital role in identification of works running beyond schedule. Since the proper data entry from field level was key to success of the system, all the officers of SE and Executive Engineers levels were involved in implementation. Approximately 100 newly purchased computers were inducted into service. Data entry operators were taken on contract basis at circle levels. Training of about 70 officials in IMPACT and general operation of computers was held at state level training centre and other locations throughout the state during first year of implementation. Since the IMPACT system is completely web based, Internet connectivity was provided at all the field locations. Uniform email addresses and groups were created on http://hry.nic.in server for all the officers of PWD (B&R) of the rank of Executive Engineers and above. In LOC module, the workflow approach was adopted between Divisions, SEs and CEs.

## 3. Overview of IMPACT System

The IMPACT system is an important step in the direction of total e-Governance in the department. All the officials at PWD's Head Office are using the system on daily basis for monitoring of works and collection of data and information. Data is being fed from field offices regularly. At present, the database contains complete information about 5,500 works being executed by PWD. Expenditure figures of all past months are also available on the Internet. Overall system contains two basic modules viz PWD Works Monitoring System & LOC Control System

### *3.1 PWD Works Monitoring System*

New work initiated in PWD after getting administrative approval is entered by circle offices. All parameters are entered by them (Figure 1) and a unique Work ID is automatically generated.

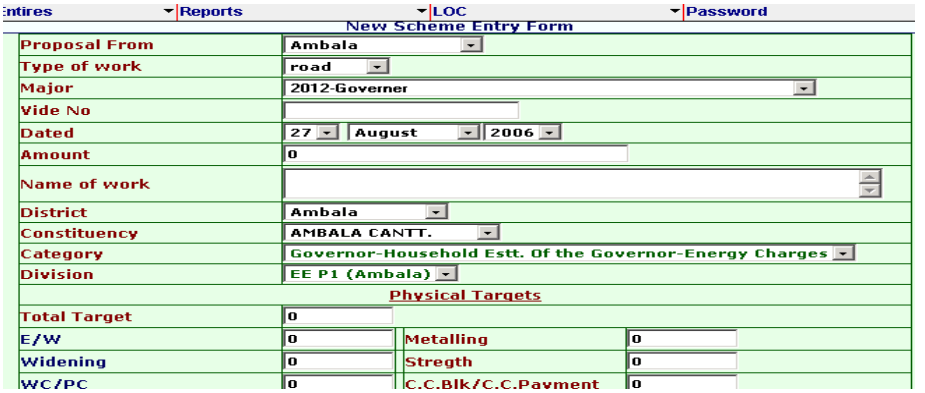



**Figure 1:** New Work Entry

Divisions enter the expenditure figures (Figure 2) of all works for previous month. Physical progress is also entered from password protected division levels.

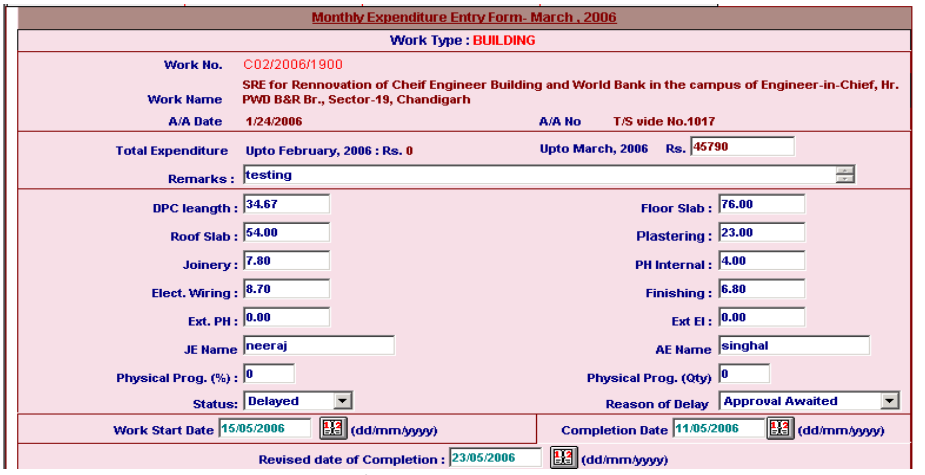



**Figure 2:** MPR Entry

A general query system (Figure 3) based on all parameters has been developed. It is accessible from all levels and generates reports (Figure 4) in various pre-defined formats. System Administrator controls various aspects of password maintenance and data management. In order to reduce the burden of monthly progress entry an automated data carryover facility has been introduced.

### *3.2 LOC Control System*

This module basically deals with demand of funds from divisions, Recommendations from concerned SEs and final Approval by Chief Engineer or E-in-C. The Work flow based LOC system takes care of all existing manual rules and regulations while dealing with complex and time consuming process of funds release. At the beginning of any month, all divisions enter the figures corresponding to funds required for each work during that month. Once entered, SE gets the information of all demands online and is able to

recommend the amount to higher authorities. CEs can approve or disapprove the amount based on their decision. Up to date expenditure and LOC figures are visible at all the three levels all the time.

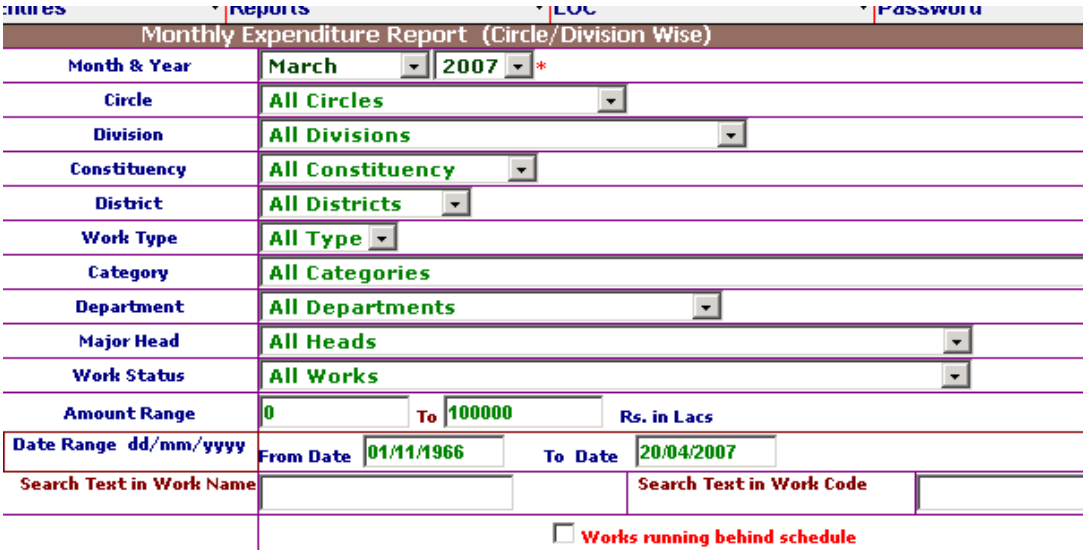
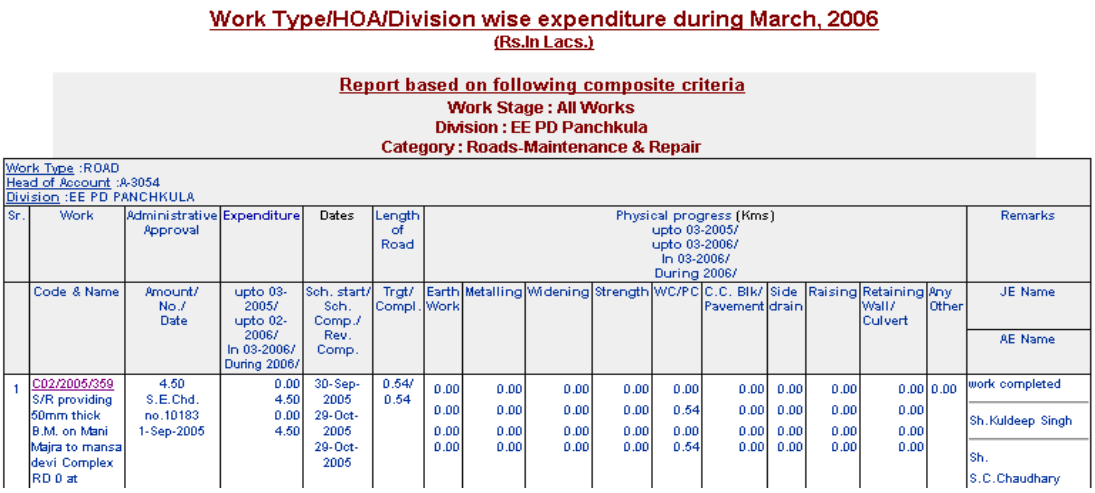



**Figure 3:** General Query Form



Work Type/HOA/Division wise expenditure during March, 2006
(Rs.In Lacs.)

Report based on following composite criteria
Work Stage : All Works
Division : EE PD Panchkula
Category : Roads-Maintenance & Repair

Work Type :ROAD
Head of Account :A-3054
Division :EE PD PANCHKULA

| Sr. | Work | Administrative Approval | Expenditure | Dates | Length of Road | Physical progress (Kms) upto 03-2005/ upto 03-2006/ In 03-2006/ During 2006/ | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Code & Name | Amount/ No./ Date | upto 03-2005/ upto 02-2006/ In 03-2006/ During 2006/ | Sch. start/ Sch. Comp./ Rev. Comp. | Trgt/ Compl. | Earth Work | Metalling | Widening | Strength | WC/PC | C.C. Blk/ Pavement | Side drain | Raising | Retaining Wall/ Culvert | Any Other | JE Name / AE Name |
| 1 | C02/2005/359 S/R providing 50mm thick B.M. on Mani Majra to mansa devi Complex RD 0 at | 4.50 S.E.Chd. no.10183 1-Sep-2005 | 0.00 4.50 0.00 4.50 | 30-Sep-2005 29-Oct-2005 29-Oct-2005 | 0.54/ 0.54 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 0.54 0.00 0.54 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 0.00 0.00 0.00 | 0.00 | work completed / Sh.Kuldeep Singh / Sh. S.C.Chaudhary |

**Figure 4a:** Sample Report

System has facility for raising successive LOCs in a single month. Also there is prohibition on overlapped LOC demands.

## 4. Data Analysis

One of the main objectives of creating any MIS is to facilitate the management for viewing various trends and tallies at a glance. Based on this, the management can see bottlenecks and take all-important decisions. Keeping the same in mind, a large database has been created to accommodate various attributes associated

with any PWD work. Here is a sample how various statistical tables and graphs based on the database can be used to draw inferences.

**LOC Entry For the Month - March,2006**

| Sno | Work Name | Amount in Lacs | | | LOC (Rs.) | | | |
|---|---|---|---|---|---|---|---|---|
| | | Estimated Amount / Balance LOC Admissible | Total Expenditure (Till Date) | Total LOC Released (Till Date) | Demanded (Division) | Remarks | MBno/Page no | Total LOC Admissible |
| 1 | C02/2005/1<br>L/R Thapli to Barisher via Tipra<br>MAJOR Head : 5054 | 325.55 | 301.29 | 0.00 | 0 | | | |
| 2 | C02/2005/2<br>L/r from Jia to M.S.Thathar<br>MAJOR Head : 5054 | 48.13 | 3.42 | 0.00 | 0 | | | |
| 3 | C02/2005/3<br>L/R from village Gobindpur to Thathar<br>MAJOR Head : 5054 | 188.09 | 0.00 | 0.00 | 0 | | | |

**Figure 4b:** LOC entry form

### *4.1 Work Load Imbalance*

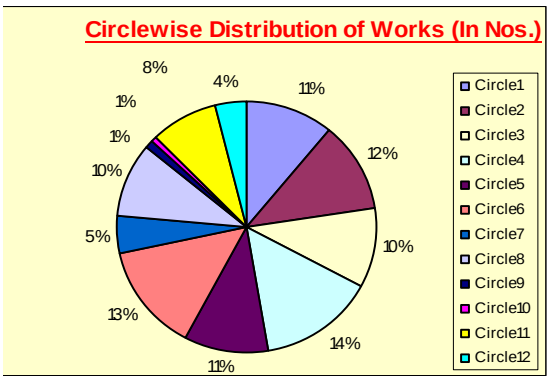



**Figure 5 :** Circle wise Distribution of Works (By Nos)

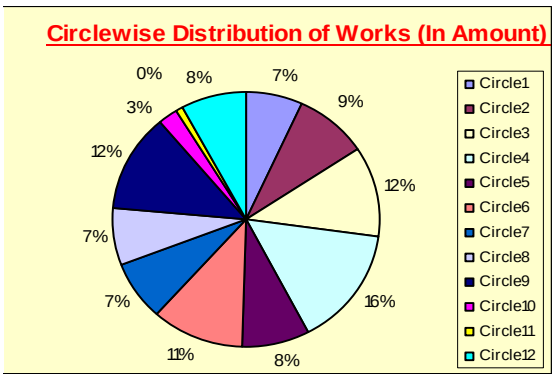



**Figure 6:** Circlewise Distribution of Works (By Cost)

**Table 1:** Circle wise Distribution of Works

| Circle | Total | | Road Works | | | Building Works | | | Bridge Works | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Amt (Rs. In Crore) | Number | Amt (Rs. In Crore) | Avg. Amt. in Crore | Number | Amt. (Rs. In Crore) | Avg. Amt. in Crore | Number | Amt. (Rs. In Crore) | Avg. Amt. in Crore |
| Circle1 | 603 | 253.97 | 333 | 135.93 | 0.41 | 242 | 45.98 | 0.19 | 28 | 72.06 | 2.57 |
| Circle2 | 628 | 310.13 | 394 | 146.48 | 0.37 | 169 | 99.09 | 0.59 | 65 | 64.56 | 0.99 |
| Circle3 | 549 | 417.71 | 226 | 237.10 | 1.05 | 315 | 101.85 | 0.32 | 8 | 78.76 | 9.85 |
| Circle4 | 794 | 540.55 | 231 | 220.01 | 0.95 | 557 | 213.94 | 0.38 | 6 | 106.60 | 17.77 |
| Circle5 | 574 | 305.63 | 318 | 181.20 | 0.57 | 251 | 75.29 | 0.30 | 5 | 49.14 | 9.83 |
| Circle6 | 759 | 399.97 | 409 | 265.20 | 0.65 | 340 | 97.36 | 0.29 | 10 | 37.41 | 3.74 |
| Circle7 | 262 | 268.54 | 154 | 206.74 | 1.34 | 104 | 47.71 | 0.46 | 4 | 14.09 | 3.52 |
| Circle8 | 526 | 257.65 | 295 | 137.08 | 0.46 | 224 | 56.45 | 0.25 | 7 | 64.12 | 9.16 |
| Circle9 | 49 | 450.78 | 40 | 398.08 | 9.95 | 0 | 0.00 | 0.00 | 9 | 52.70 | 5.86 |
| Circle10 | 47 | 94.25 | 25 | 72.44 | 2.90 | 3 | 7.35 | 2.45 | 19 | 14.46 | 0.76 |
| Circle11 | 454 | 14.18 | 0 | 0.00 | 0.00 | 454 | 14.18 | 0.03 | 0 | 0.00 | 0.00 |
| Circle12 | 208 | 293.82 | 113 | 173.05 | 1.53 | 91 | 66.32 | 0.73 | 4 | 54.45 | 13.61 |
| Total | 5453 | 3607.18 | 2538 | 2173.31 | 0.86 | 2750 | 825.52 | 0.30 | 165 | 608.35 | 3.69 |

On comparing the Fig 5 and Fig 6, based on Numbers and Cost of works in various Circles, it can be seen that Circle9 having only 1% of works, accounts for 12% in terms of Cost. Similarly, circle12 accounts for 8% of total Cost for only 4% of overall works. On the other hand Circle11 has reverse trend with almost 8% works accounting for just 0% Cost.

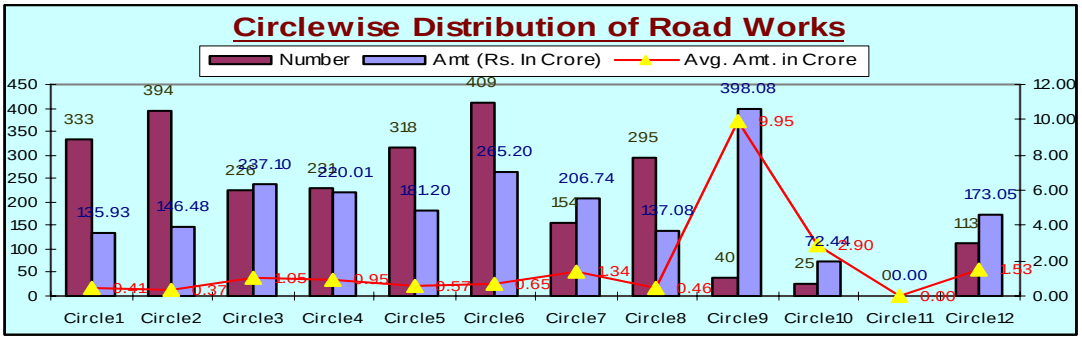



**Figure 7:** (above) Circle wise Distribution of Road Works

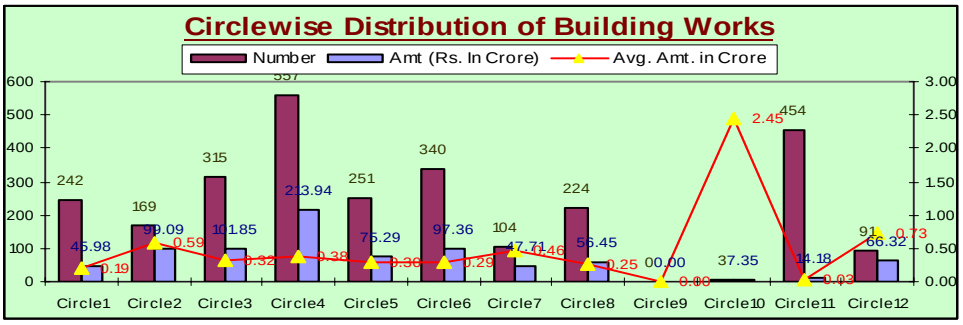



**Figure 8:** Circle wise Distribution of Building Works

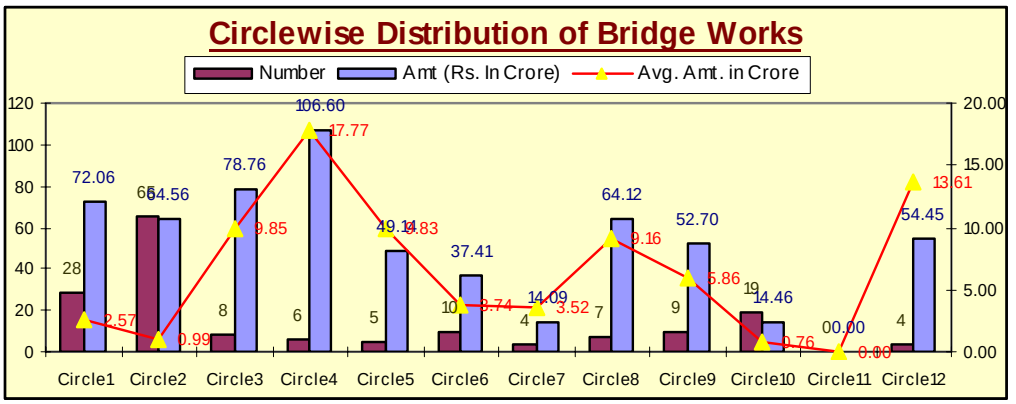



**Figure 9:** Circle wise Distribution of Bridge Works

### *4.2 Circle Wise Distribution of Works*

It is evident from Fig 7, Fig 8 and Fig 9 that main reason for this is extremely high average cost of Roads (9.95 Crore) and Bridges (5.86 Crore) works allocated to circle9. This average is much higher than the state averages of 0.86 Crore for Roads and 3.69 Crore for Bridge works. Circle11, an electrical circle is basically involved in building works with very small cost fraction as compared to their civil counterpart. Since the average cost per building in Electrical Circle is very small but their involvement is in too many buildings, the Works Number %age is more than the Work Cost %age in Circle11. Average cost of 2.45 crore in case of buildings of Circle10 is highly critical if compared to state average of just 30 lacs. Similarly the bridge of Circle4 (17.77 Crore) is another item requiring management's attention.

### *4.3 Distribution of Works as a Factor of Cost*

On analyzing the distribution of works on the basis of approved cost, overall works tally of works can be categorized in two classes. Higher range consists of works of more than 50 Lacs and the lower range has works below 50 Lacs. It can be graphically seen that among the works in higher range (Fig 10), majority of works (73%) are upto 3 Crore marks. Very few (64) works are beyond the limit of 10 Crore.

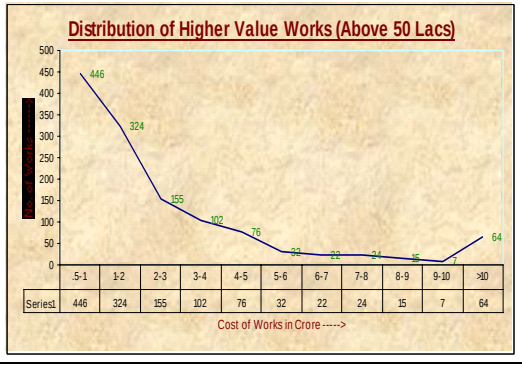



**Figure 10:** Distribution of Higher value works

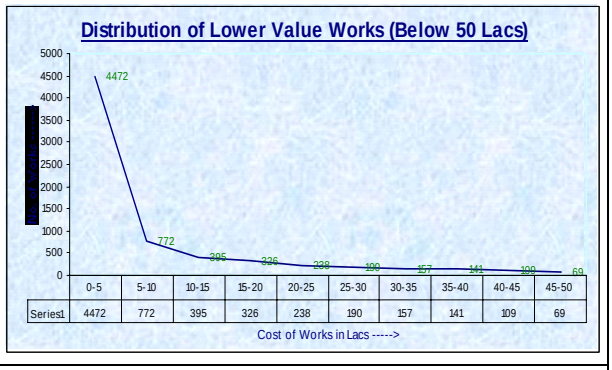



**Figure 11:** Distribution of Lower value works

Same is the trend in Lower range (Fig 11) works wherein almost 65% of works are of less than 5 lacs. These works are considered as very small in terms of works taken by PWD. Resources can be accordingly allocated so that the higher end works, although less in numbers, be given due care.

### *4.4 Works running behind schedule*

One of the most important parameters required by the management or Government is the identification of circles/division that have tendency to ignore the deadlines set for completion of works.

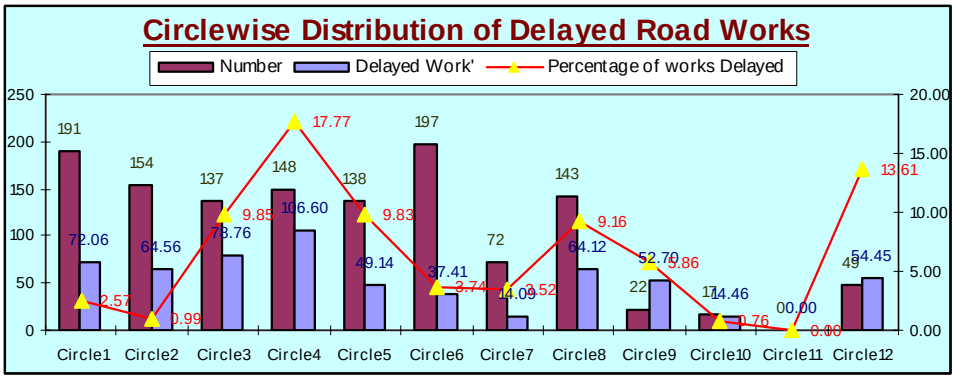



**Figure 12:** Circle wise Distribution of Delayed Road Works

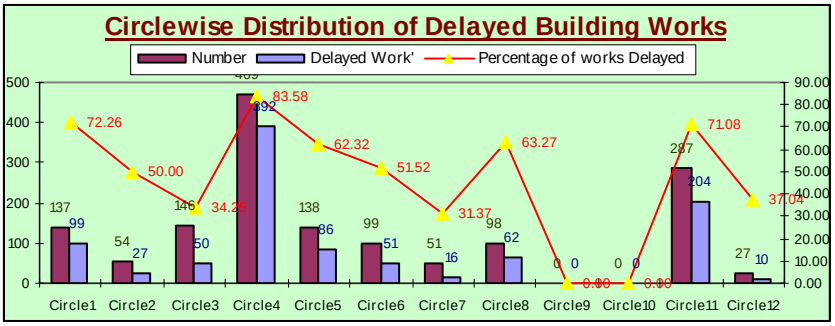



**Figure 13:** Circle wise Distribution of Delayed Building Works

With the introduction of discrete work stages, it is now possible to surface out individual works and their executers that have crossed the deadlines. Considering the data taken for 2854 works approved during 2006-07 in table 2, it can be seen that delay percentage is between 25% and 80%. Also there seems to be close association between numbers of works allotted to number of works delayed. From the individual graphs of roads, buildings and bridges in Fig 12, Fig 13 and Fig 14, it can be seen that Circle4 has the tendency of delaying in all the three compartments viz Roads, Buildings and Bridges. With the exception of Circle4, the delay pattern of road works is more or less similar. Building works are delaying more and almost all the bridge works get delayed. Management can act balance its attention accordingly as delay is always a matter of concern.

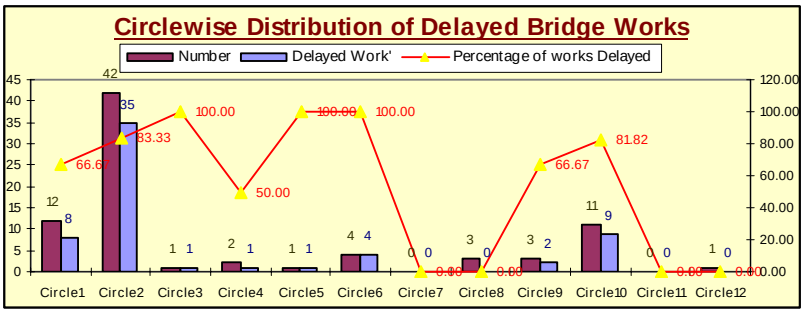



**Figure 14:** Circle wise Distribution of Delayed Bridge Works

**Table 2:** Circle wise Distribution of Delayed Works

**Circle wise Scenario of Delayed Works (Works Approved during 2006-07)**

| | All Works | | | Road Works | | | Building Works | | | Bridge Works | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circle | Total | Delayed | %age | Total | Delayed | %age | Total | Delayed | %age | Total | Delayed | %age |
| Circle1 | 340 | 219 | 64.41 | 191 | 112 | 58.64 | 137 | 99 | 72.26 | 12 | 8 | 66.67 |
| Circle2 | 250 | 171 | 68.40 | 154 | 109 | 70.78 | 54 | 27 | 50.00 | 42 | 35 | 83.33 |
| Circle3 | 284 | 114 | 40.14 | 137 | 63 | 45.99 | 146 | 50 | 34.25 | 1 | 1 | 100.00 |
| Circle4 | 619 | 493 | 79.64 | 148 | 100 | 67.57 | 469 | 392 | 83.58 | 2 | 1 | 50.00 |
| Circle5 | 277 | 174 | 62.82 | 138 | 87 | 63.04 | 138 | 86 | 62.32 | 1 | 1 | 100.00 |
| Circle6 | 300 | 185 | 61.67 | 197 | 130 | 65.99 | 99 | 51 | 51.52 | 4 | 4 | 100.00 |
| Circle7 | 123 | 43 | 34.96 | 72 | 27 | 37.50 | 51 | 16 | 31.37 | 0 | 0 | 0.00 |
| Circle8 | 244 | 141 | 57.79 | 143 | 79 | 55.24 | 98 | 62 | 63.27 | 3 | 0 | 0.00 |
| Circle9 | 25 | 6 | 24.00 | 22 | 4 | 18.18 | 0 | 0 | 0.00 | 3 | 2 | 66.67 |
| Circle10 | 28 | 19 | 67.86 | 17 | 10 | 58.82 | 0 | 0 | 0.00 | 11 | 9 | 81.82 |
| Circle11 | 287 | 204 | 71.08 | 0 | 0 | 0.00 | 287 | 204 | 71.08 | 0 | 0 | 0.00 |
| Circle12 | 77 | 22 | 28.57 | 49 | 12 | 24.49 | 27 | 10 | 37.04 | 1 | 0 | 0.00 |
| Total | 2854 | 1791 | 62.75 | 1268 | 733 | 57.81 | 1506 | 997 | 66.20 | 80 | 61 | 76.25 |

## 5. Challenges and Benefits Accrued from project

The level of computerization in the department was limited to elementary applications such as typing, data processing on stand alone basis. Broadly, the following problems were faced while implementing the system.

- The major issue was the formulation of Head of Accounts. Since inception of the department, there was no organized way of accounting. Different levels of Head of Accounts proposed by Finance department were being haphazardly used.
- The acceptance of system in view of total transparency was another problem. There was reluctance in acceptance as the new system demands for time bound reporting of physical and financial progress of any month.
- Computer illiteracy at different levels was another source of problem.

Through the passage of time, system has emerged as highly successful tool for monitoring in department.

- Authenticated data is now available everywhere, any time to everyone. Earlier different figures used to pour from different sources.
- Major part of reporting to state government is being done through this system.
- After tremendous success with in department, Query system with limited features is being opened for public as a part of total transparency in department.
- During the initial part of study in the department, it was observed that major part on manpower is being wasted in generation of various reports required by management and Government. Now all important reports are available through few key strokes.

- Although not fully implemented as yet, the LOC system has potential of reducing cost incurred on postage and telephones and in speeding up the process of LOC delivery.
- At present the database contains complete information about 4300 works being executed by PWD. Expenditure figures of all past months are also available on the net.

IMPACT helps in taking important decisions at top level. A large database has been created to accommodate various attributes associated with any PWD work. The IMPACT system helps in extensive data analysis through pie charts, bar charts, line graphs etc showing various trends and tallies at a glance. This kind of analysis is helping the government in pinpointing the bottlenecks and to take all-important decisions.

The system has emerged as a highly effective tool for enhancing the efficiency, bringing transparency and cost effectiveness in the department. After achieving tremendous success in G2G domain, the on-line query system with requisite features has now been prepared for access to public (G2C interface) as a part of total transparency in the department. This case study gives an overview of IMPACT system implementation in PWD (B&R) Haryana along with analysis of data.

- As IMPACT has become an integral part of PWD activities, the system is being used by all the circles and divisions for data entry purpose.
- All the officials at PWD HO and at field level are using the system on daily basis for monitoring of works. Now the latest status of each individual project is available to decision makers on anytime anywhere basis.
- Going by the success of system in the department, Hafed, HSIDC, PWD Public Health and PWD Irrigation department have shown interest in extending the system to their offices.
- The system has capacity to sustain for long time, even if there are changes in govt policies regarding execution of PWD works, as technical support of NIC is available on long term basis.
- Extensive data analyses capabilities has helped the decision makers to take corrective measures about abnormalities in terms of excessive cost & speed of execution of works.

## 6. Looking Forward

IMPACT is a first step towards the goal of total e-Governance in the department. On the basis of its success, the IT Plan of the department was approved by the state government. Several milestones still need to be achieved before final goal is achieved. Some of them are given below.

- LOC release system has already been developed and integrated with Works Monitoring module, is ready for implementation. The efforts would be made to use the module in the next phase of computerization.
- Computerization of basic accounts at division level and its integration with IMPACT.
- Development of Personnel Information System for large workforce of the department.
- Development of a system to manage material and stores distributed at distant locations throughout the state.
- Separate system for management of Contractors and its integration with IMPACT.
- Work of digitization of all roads of Haryana is already underway.
- One of the most time consuming work in the department is preparation of estimates. Work has already been started to computerize this activity.
- Making read-only access to the latest status of individual works to general public through the web.
- Budget and expenditure control through integration of IMPACT with LOC Control System and finally with Online Treasuries Information System.

IMPACT is just the beginning. After its successful implementation, the department's officials are encouraged to use ICT on a wider scale.