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# "OVERCOMING THE CHALLENGE OF INTEGRATING CONNECTED VEHICLES AND INTELLIGENT TRANSPORTATION"

**Rishikesh Paitwar[1], Tushar Pimpalshende[2], Anikhil Paspunurwar[3], Prof. S.R. Khot[4]**
Department of Civil Engineering Sinhgad Academy Of Engineering, Kondhawa,Pune-44

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**Abstract: Intelligent transport systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitor applications, such as security CCTV systems, and automatic incident detection or stopped vehicle detection systems; to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance.**

**Information systems; weather information; bridge de-icing systems; Intelligent Transport Systems or ITS, are increasingly being used globally to improve road safety, reduce travel times and help improve decision making by road users by providing relevant and timely data. Broadly, the ITS applications for road safety can be divided into three operational areas Data collection, Information exchange and emergency response & Enforcement. The scenario is beginning to unfurl as the government has now recognized road safety as a major issue and has resolved to reduce accidents. Therefore, the implementation of Intelligent Transportation System along major urban corridors can resolve many traffic management safety issues, while creating a smart urban environment. And achieving the objectives with help of effective utilization of ITS.**

**Keywords:** *Intelligent Transport System, Vehicular Traffic; Emergency Vehicle; Stolen Vehicle; Congestion; Traffic Light.*

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## I INTRODUCTION

Vehicular traffic is one of the major problems to be addressed in a country, especially in major cities. The effects are worst in the case of emergency vehicles such as ambulance, fire engines etc. when they are struck in congestion. It may even lead to loss of lives of a few to many. Congestion occurs mainly due to two reasons, one is due to traffic lights and other is due to incidents such as accidents, vehicle breakdown etc. Congestion results in various problems such as increased average waiting time, decreased average distance travelled, increased pollution, increased fuel consumption etc. which in turn results in intolerance of drivers which may even lead to accident.


Though there are many solutions to overcome the traffic problem. One is to build new roads and widen existing roads. Another is to make effective and efficient utilization of the available ones. First one is very costly and needs more time. It also creates a lot of disturbance in the public. In some cases it can be said that first solution is literally impossible, whereas, the second solution is comparably easier to implement without disturbing the available infrastructures. Building new roads may be the permanent solution to some extent. But, without effectively utilizing the available ones, if we build new ones it is mere waste of resources and time. So by going for second solution i.e. by building an intelligent traffic management system we can make effective and efficient utilization of the available resources.

The objective of the project was to minimize time and cost by leveling the resources and this was done by taking three cases to compare the optimized results. In Case 1 the entire project was considered to be done in the same order of WBS without breaking it into parts and the cost incurred by the utilization of resources is calculated. In Case 2 the entire project was divided into two parts and the cost incurred by the utilization of resources is calculated. In Case 3 the entire project was divided into three parts and the cost incurred by the utilization of resources is calculated.

- Vehicular Traffic Management
- Traffic Light Control
- Rerouting
- Emergency Vehicle Management
- Traffic Light Control
- Rerouting
- Stolen Vehicle Management
- Defining "Intelligent Transport Systems"
- Traffic Management
- Economic Value
- Designing Master Plans And Formulating Standards
- Challenges Of The System

Planning and scheduling is an integral part required for efficient execution of construction activities. Project management software's are trending for helping the manager's for better handling of time and other resources. Microsoft Project is one such software aiding in increasing the overall project efficiency. In Road Construction, Equipment's play a major role as they manage more than 50 % of the work, so their Costs and Productivity play a major role in making the Project profitable to the company. In this work a Case Study of two Road or Pavement Construction sites is carried out. Efforts are taken to improve the Productivity of

Equipment's by using Project Management Techniques which in turn helps to cut down the Costs incurred.

Resource Planning Construction Equipment: Production task needing equipment include excavating, handling, transporting, filling, compacting, grading, hoisting, concreting, pre-casting, plastering, finishing, trenching, and laying of pipes and cables. The supporting equipment at project site consists of generators, transmission lines, pumping sets, other utility services equipment. Construction equipment is indispensable in execution of modern high-cost, timebound massive construction projects. It produces output with an accelerated speed in a limited time. It saves manpower, which is becoming ever more costly and demanding. It improves productivity, quality and safety and also adds a sense of urgency. Acquisition of equipment mass involves initial heavy investment but, on the whole, its ads to profitability by reducing the overall costs, provided it is properly planned, economically procured and effectively managed.

Productivity means the ability to produce. The term 'productivity', as commonly understood, implies the ratio of output to input. The input and output can be measured in physical quantities, monetary terms or a combination of both. Many link productivity to mean of workers' output capability; they express productivity as work quantity produced per man-hours of input. Productivity is also defined as monitory value of output per man-hour of input. Some consider productivity as performance output in rupees for every rupees of input. In the narrower sense of controlling project resources, the productivity concept is used to measure the performance of resources.

## Problem Statement

"Provide highway and transit agencies with creative and innovative solutions that meet their transportation objectives. Our Intelligent Transport Services provides expertise in the planning, design, implementation, and operation of solutions that focus on maximizing system performance."

## Literature review

**Study On Resource Planning in Highway Construction Projects, K Swarna Kumari, J vikranth**

In this paper they studied the resource planning and productivity can, thus help in good resource planning, better monitoring and overall controlling of the project. For the better understand they were taken a case study on B.R.T.S. project at Vishakhapatanam. At the site location they collected data in which the data wise requirement of project manpower, costly equipment, production costs, sales or earned value of work done and expected income. After collection of data they have done resource planning in that Planning of construction work force, planning of construction material, planning of construction equipment. The most general objective of planning is to improve to provide a link between the establishment of an effective productivity measurement system and the human task of improving organizational performance by means of changes in all or several elements of the organization-the people, structure, culture and technology. They observed that in highway projects, the same resource is often used for different activities and the productivity of that resource being different for different activities; it becomes inevitable to know the correct norms for correct estimation, planning and monitoring.

Equipment cost for any project comprises of mainly 20-30% of project cost plus additional cost for maintenance, repair and operation. Cost of equipment has to be controlled properly by efficient allocation of equipment for different phases of work. So for using equipment effectively and efficiently equipment becomes necessary. Equipment procurement is done after measuring productivity of every equipment. Material cost for any project which is more or less invariable, it depend mainly on type of project work to be performed. Material planning is done to achieve requirement of project at different phases of construction work and it also reduces excessive wastage of material. Manpower Planning is the process by which an organization ensures that it has the right number and right kind of people, at the right place, at the right time, capable of effectively and efficiently completing those tasks that will help the organization achieve its overall objectives. In any project, most of the activities are done ―team-wise‖ and productivity of individual labour cannot be determined. Also teams productivity is depend on driving equipment such as grader, roller, paver etc…

The Planning of BRTS Road Project by using Microsoft Project 2007 for 013 KMS and Existing Carriage indicate poor planning of resources. Also equipment assign for total project is less as compared to required number. From the planning of BRTS highway project after allocating resources to various activities, we come to know if Equipment and manpower is provided as per required data which is analyze by using Microsoft Project-2007 as compare to actual used on site. It will help to complete project on time with specified duration as per contract.

**Resource Optimization in Road Construction Projects[2]**
**K sriBindu, U. Jayasanthosh Kumar**

In this paper they studied in highway projects, the same resource is often used for different activities and the productivity of that resource being different for different activities, it becomes inevitable to know the correct norms for correct estimation, planning and monitoring. For the detailed study they taken three cases study and plan their resources by understanding productivity of each of the resource and its use for a particular activity using Microsoft project. They used MSP software for resourced planning, scheduling and allocation. In order to optimize the cost and duration in construction projects resource optimization is required. This may be used for the expansion of M.G Road from Patamata to Machilipatnam (NH-9).

The objective of the project was to minimize time and cost by levelling the resources and this was done by taking three cases to compare the optimized results. In Case 1 the entire project was considered to be done in the same order of WBS without breaking it into parts and the cost incurred by the utilization of resources is calculated. In Case 2 the entire project was divided into two parts and the cost incurred by the utilization of resources is calculated. In Case 3 the entire project was divided into three parts and the cost incurred by the utilization of resources is calculated.

Overall they concluded that by scheduling the project in three different types, three different time schedules are obtained and the respective resource allocations are also achieved. From the resource allocations and the time schedule of the three cases the optimal resource utilization is identified by the cost comparison. By performing the resource leveling the cost of the project has been reduced by Rs 9,27,474.72. From the above analysis conducted, the optimal solution is Case 2 with the reduction of cost to Rs 9,27,474.72 where the total cost is Rs 16, 70,59,530.3 which is the least cost of the three cases due to the reduction in duration.

**Optimization of Resources in Highway Construction[3]**
**Vishnuraj RG, Vishak MS**

The project is carried out to have a study about resource Management in highway constructions and its implementation. In recent year's project management software systems like MS Project, Primavera etc. have been improving continuously and recent versions have exhibited better interfaces, integrated planning and control features, and Internet capabilities. Yet, basic project management functions such as resource allocation, resource leveling, and time cost trade-off analysis have been the least improved. The Construction projects, especially the highway construction projects, uses huge amount of resources on and off the field in various forms of resources viz., materials, plants, equipment's and human resources along with money, time and space.. Production and operation sequence management is the process of controlling production and services the main objective of which is to match efforts with application of resources and equipment's in order to best produce and serve. Effort is made to use available resource and time in a desirable way and prevent resource and equipment waste. Data collection is done by questionnaire survey and it is used to find Benefits of resource management, causes of failure of resource management and causes of resource fluctuation etc.. Project management software primavera is used in order to complete the project on time under

budget.

They concluded the visit to highway project site and study of available database in the project site reveals that the construction companies in India have neither yet realize the necessity of detail study of their own resources nor have develop their accounting system for research and development purpose has evident from the lack of useful and relevant data from the site. The present construction practices in India is still adopt the methodology of as and when required,, resource management. Lack of professionalism leading to lack of detailed and meticulous planning and irrational decision making as per site management is concerned leading to underutilization of resources to a great extent. Till now project resource planning is only limited to planning and scheduling with time but resource mobilization and usage planning according to their capacity and availability, ahead of time in the planning stage, is still nobody's concern. Equipment cost for any project comprises of mainly 20-30% of project cost plus additional cost for maintenance, repair and operation. Cost of equipment has to be controlled properly by efficient allocation of equipment for different phases of work. So for using equipment effectively and efficiently equipment becomes necessary. Equipment procurement is done after measuring productivity of every equipment. Material cost for any project which is more or less invariable, it depend mainly on type of project work to be performed.

**Productivity Escalation and Cost Optimization of Equipment's used in Pavement Construction[4]**

Pankaj Suresh Rayamane, Amey A. Kelkar

In this paper they studied cost optimization of equipment used in pavement construction. The aim of this work is to highlight the importance of Productivity of Equipment's used in Pavement Construction and its Cost. In construction, some tasks are labour-intensive, some predominantly employ equipment and some use a combination of both, i.e., labour and equipment. In big infrastructure projects like Road or Pavement projects, equipment's and the plants play a crucial role in the production process. While the actual work done and the associated labour is accounted for by the foreman concerned, the equipment productivity control is undertaken to determine its employment time, the output achieved and its productivity at the site. The main purpose of equipment productivity control is to minimize the wastage in utilization and to minimize the Costs.

Planning and scheduling is an integral part required for efficient execution of construction activities. Project management software's are trending for helping the manager's for better handling of time and other resources. Microsoft Project is one such software aiding in increasing the overall project efficiency.

In Road Construction, Equipment's play a major role as they manage more than 50 % of the work, so their Costs and Productivity play a major role in making the Project profitable to the company. In this work a Case Study of two Road or Pavement Construction sites is carried out. Efforts are taken to improve the Productivity of Equipment's by using Project Management Techniques which in turn helps to cut down the Costs incurred.

**A productivity management of road construction in Thailand**

**Wisoot Jiradamkerng**

This research's objectives were to conduct a work study of sub base course of road construction and implement productivity analysis with EZ Strobe simulation system. The study had divided construction process into 3 parts. Each part of the process was simulated with EZ Strobe to find optimum construction team members with minimum unit cost. These optimum team members were used in simulation model of each part to determine basic time with 95% confident interval and 5% limit of error. Then, the standard time and productivity of each construction team was calculated in various units; production per hour (cu.m./hr., sq.m./hr.), daily production (cu.m./day, sq.m./day, m. of road/day), and number of hour required per section of sub base course construction (200 m. in length). After that, the overall process simulation model including Part1 to Part3 was created, representing for all 26 sections of sub base course construction.

The analysis results showed that optimum team combination of Team1, Team2 and Team3 for the minimum unit cost of sub base construction was 2-1-2; and for the minimum duration of construction was 3-2-3. The outcomes of this research pointed out that, with EZ Strobe simulation system, the productivity management could be done effectively by conducting work study at project site and simulating for alternative resources management plan to determine for optimum construction teams according to the desired project goals.

## AIM

Based on various literatures available, the problems are identified they are logically placed in three Clusters:

- Lack of Traffic Management System
- Homeland Security System and Vehicles Operation
- Vehicle to Vehicle Co-ordination and implementation of new technologies

## OBJECTIVES

- To improve traffic safety
- To relieve traffic congestion
- To improve transportation efficiency
- To reduce air pollution
- To increase the energy efficiency
- To promote the development of related industries

## Methodology

The main objective of our thesis work was to measure the resource productivity of a highway project; finding out the factors affecting the productivity of the resources; establishing interrelations of the factors and finally formulation of a system to estimate the productivity of the resources in different environmental and site conditions.

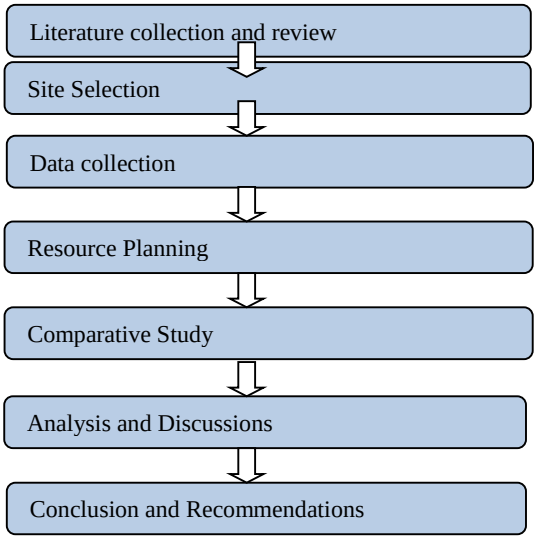
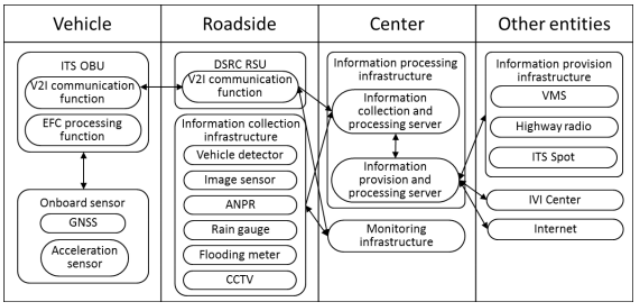



**Fig: Flowchart of Methodology**

For this thesis, relevant data was collected from selected highway project sites of Pune-Nashik National highway (NH50) constructing by IRB infrastructure developer's ltd through pre-designed questionnaire and collated for analysis.

Configuration of Traffic Control System A traffic control system largely consists of (i) information collection infrastructure, (ii) information-processing infrastructure, (iii) information provision infrastructure, (iv) communications infrastructure, and (v) monitoring infrastructure. In addition to the above infrastructures, disaster prevention infrastructure may be included if there are structures that need to be monitored, such as tunnels.




The Architecture can be defined as a basic system organisation consisting of crucial components, their relations and connections to environment, as well as principles for system design and development during the whole lifecycle.

In order to enable development and upgrades, complex systems have to include additional characteristics such as: Compatibility, Expandability, Interoperability, Integrability, Standard ability.

Lack of architecture can result in difficulties because of incompatible components, higher cost for updates and complications in introducing or Faculty of Transport and Traffic Sciences Intelligent Transport Systems adjusting new technologies. ITS architecture provides a general framework for planning, designing and implementing integrated system in a given period and geographical area. An ITS Architecture is important for a number of reasons:

- It ensures an open market for services and equipment, because there are "standard" interfaces between components;
- An open market permits economies of scale in production and distribution, thus reducing the price of products and services;
- It ensures consistency of information delivered to end-users; o it encourages investment in ITS since compatibility is ensured;
- it ensures inter-operability between components, even when they are produced by different manufacturers, which is also good for SMEs (Small and Medium sized Enterprises);
- It permits an appropriate level of technology independence and allows new technologies to be incorporated easily;
- It provides the basis for a common understanding of the purpose and functions of the ITS, thus avoiding conflicting assumptions.
  Based on the content and mandatory use, three main type of ITS Architecture are defined:

  - Framework ITS Architecture;
  - Mandated ITS Architecture;
  - Service ITS Architecture,

Attributes:

| | |
|---|---|
| 1 | Lack of surveillance |
| 2 | Failure of contributors to instantly handle changes |
| 3 | variations in legislation and guidelines |
| 4 | Lack of understanding |
| 5 | Incompetent designer |
| 6 | Poor communications among project contributors |
| 7 | Lack of cooperation among contributors |
| 8 | Indistinct contract documents |
| 9 | Impracticable expectations by the parties |
| 10 | The impact of local culture. |
| 11 | Misinterpretation of contracts |
| 12 | Lack of resources |
| 13 | Poor communication and documentation |
| 14 | Late involvement of lawyers in the construction projects |
| 15 | Tendency of lower price offer |
| 16 | Working relations and Supervision |
| 17 | Circumstances produces a model based on project uncertainty |
| 18 | Dispute in construction contracts: Alterations |
| 19 | Lack of effective communication among project contributors |
| 20 | Delayed payments |
| 21 | Design insufficiency |
| 22 | Lack of necessary proficiency and experience |
| 23 | Poor site management |
| 24 | Poor planning and programming |
| 25 | Project hampers health of people and damage the natural setting of flora |
| 26 | Disputes with subcontractors |
| 27 | Late imbursement to subcontractors |
| 28 | Harmonization of subcontractors |
| 29 | Alterations to standard conditions of contract |
| 30 | People seeking more benefit from the project |
| 31 | Inappropriate contract type |
| 32 | Accident due to moving traffic adjacent to project site |
| 33 | Disputes due to discrepancy in contract document |
| 34 | Lack of professionalism of participants |
| 35 | Weather Conditions |
| 36 | Availability of health and safety training |
| 37 | Inappropriate in salary, poor wages, Lack of Financial motivations |
| 38 | Inaccurate design information and incomplete tender Information |
| 39 | Inappropriate Contractor Selection |
| 40 | Lack of training sessions, lack of labour recognitions programs, lack of place for eating & relaxation, Lack of team spirit |
| 41 | Decisiveness of the agreement |
| 42 | The location and implementation of work |
| 43 | Minimized costs in attaining settlement |
| 44 | Sustained business relations |
| 45 | Control of the result and procedure |

## DATA COLLECTION & EXPERIMENTATION

The primary objectives of this field experiment were to

- Determine whether the WRITE system is feasible for measuring construction productivity and
- Identify the advantages and limitations of this system by conducting a case study.

To accomplish the objective, productivity data were collected simultaneously by using the different methods and the WRITE system.
The stopwatch method is a classic productivity measurement method develops. The method uses a stopwatch to record the time spent on each human movement to complete an operation and categorizes each movement as direct work, supportive work, or nonworking. The productivity is computed on the basis of the percentages of direct work, supportive work, and nonworking within certain duration. Results from the stopwatch method and the WRITE system were compared by using statistical methods to determine whether there was a significant difference. Figure shows a data collection form for this project and a sample data set that was used for statistical analysis. The field experiment was conducted at three asphalt paving projects and one bridge reconstruction project. Hot-mix asphalt overlay project and two hot-in-place recycling projects were selected as equipment-intensive projects, and the bridge reconstruction project was deemed to be a labour-intensive project.


Resource productivity as well as labour and capital productivity is indicators that reflect both the development of the economy and the environment. However, the interrelationships between socio-economic and environmental processes are highly complex and available information, judgment of experts and public awareness are often controversial. Therefore, the criterion of policy relevance from this study refers to a reduction of this complexity rather than to a full understanding. In other words, it refers to the capacity of reducing this complexity and providing relevant and useful information for decision making and public discourse.

This scoping study provides evidence that data availability and quality is essential for assessing the impacts of resource productivity on employment.

In recent years, decision makers asked for establishing RMC as the lead indicator for the EU resource efficiency strategy. For this purpose it is important to supplement figures on a country level34. Recently, Eurostat has published the 'Country RME tool' for compiling RME-related estimates at the country level. Since RMC/RME-based estimates at the country level are challenging, calculating RME of product flows at sectoral levels for all EU Member States would be rather difficult. However, examining resource productivity at the sectoral level is of great importance as each sector shows different material use patterns.

A feasible solution might be to focus on some sectors for representative countries. Still, constructing a time series might turn out to be resource and time consuming. Another option includes case studies on individual country experiences which could prove to be useful for other Member States. For example, the construction sector is one of the most important sectors in the European Union. It generates about 10% of GDP and positively influences the growth of employment in other related economic activities. Furthermore, the Netherlands could be an interesting country to study for its high resource productivity in the agricultural and the construction sector.

An already well-established and regularly updated project is the Exiobase36 - a global, detailed Multi-regional Environmentally Extended Supply and Use / Input Output (MR EE SUT/IOT) database. Version 3 will comprise 200 sectors in 44 countries and 5 rests of the world regions. According to involved partners, sectoral data will possibly be available in 2016.

Another approach is to use just direct extraction all over the world data in primarily monetary models and estimate the impact of policies on the extraction in relation to growth and employment effects. Even if this does not explicitly deliver figures for productivity, it reveals the relative effects on labour, capital and resources on regional and global levels, which can be used to further analyze the productivities in question.

In addition, there is a lack of adequately measuring the quality of labour inputs, accounting for skills, gender, education and employment status of the workers. Eurostat, in collaboration with the JRC-IPTS, is currently running a project that aims at improving labour productivity indices by disseminating time series of productivity indicators for Member States. The first dataset will be available in spring for the years to. Data on capital productivity should follow later.

Another way forward would be the development of a more comprehensive econometric analysis that would allow a better understanding of the relationship between potential drivers such as R&D and energy demand. As the examined variables show a significant relationship with resource productivity, going on a sector-by-sector analysis would provide insights as for example to which sectors are receiving more R&D and in which countries R&D is having the most impact on productivity. Accommodating or systematically examining more potential drivers is an integral aspect of a future econometric analysis.

The empirical part of our analysis – as of many other studies - was based on describing correlations rather than the causalities. This is due to the fact that the identification of causal relationships is a difficult task in terms of methodology and goes beyond the scope of this study. Finding causalities was left to the literature review, where we described the results of some comprehensive modelling efforts that show the interlink ages between resource productivity improvements and social, environmental and economic indicators.

In conclusion, the empirical part of this scoping study was not only an exercise to provide a preliminary statistical and empirical analysis of resource, labour and capital productivity, but also to open up possibilities for further investigation, once data will be available. Some topics that could possibly be explored through future analyses comprise:

- Investigation of sectors which would be most affected by job losses due to resource efficiency policies or, in general, the transition towards a more resource efficient economy in the EU

- Analysis of whom within the labour force would be most susceptible to shifts in employment (which skill level, age group).

- Studying of sectors that show high levels of capital investment and whether those sectors are the most/least resource/labour productive. A question to look at is whether labour is being replaced by capital in these most/least resource productive sectors.

- Understanding of the effects of R&D on resource productivity on a sector level, comparing between Member States and establishing reasons for differences, if there are some

## DATA ANALYSIS & EXPERIMENTATION

The questionnaire were distributed over large construction as well as small construction projects including the group of workers including site engineers, Painter, steel binder, Plasterer, Meson Brickwork, Carpenter, Gardener for Landscaping and many more.

One of the most important stages was to collect accurate data, the total number of questionnaires sent was and the number of responses received and validated. This figure is greater than the required sample size, so the data obtained satisfies the quality requirements. The results of the survey were synthesized by the author and evaluated the impact, which are divided into seven groups of factors affecting the labour productivity of construction workers on sites in as follows.

**Ranking of factors on workers themselves**

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Experience of workers | 4.29 | Very high | 5 |
| Labour Discipline | 4.12 | Very high | 5 |
| Physical ability | 4.01 | High | 4 |
| Psychophysiology ability | 3.78 | High | 4 |
| Labour Intensity | 3.52 | Mid | 3 |
| Age | 3.41 | Low | 2 |
| Gender | 3.19 | Extreme Low | 1 |
| Level of training | 3.09 | Extreme Low | 1 |

The lower the labour intensity, the lower the labour productivity, the physiological psychological problems of people will affect the efficiency of work thus affecting the labour productivity. The higher the age, the more accumulated experience, but the physical strength can be reduced, thus greatly affecting labour productivity.

**Ranking of operational and managerial factors**

| Factors | RII | Impact | Rank |
|---|---|---|---|
| Ability to organize Production | 4.23 | Very high | 5 |
| Construction supervision | 4.20 | High | 4 |
| Application of technology | 3.92 | Mid | 3 |
| Workers' arrangement | 3.73 | Low | 2 |
| Labours Communication | 2.89 | Extreme low | 1 |

## Ranking of factors that motivate employees

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Types of salary payment | 4.27 | Very high | 5 |
| Staff Support | 4.05 | High | 4 |
| Reward Mechanism | 3.69 | High | 4 |
| Spiritual Life | 3.58 | Mid | 3 |
| Training and improving skills | 3.32 | Low | 2 |
| Initiative at work | 3.18 | Extreme low | 1 |

Professional training, skills upgrading and innovations in labour are factors that have high impact on labour productivity. These factors directly influence the motivation of employees, bring satisfaction and sense of responsibility of construction workers to the work

High-impact factor is the complexity of the work with RII = 3.78 and factor of material transport methods with RII = 3.22. These factors affect the performance of the work that will also affect labour productivity as reported. In order to ensure the achievement and growth of labour productivity, organizations need to utilize machines, equipment and tools which must be suitable with products and technologies; ensure routine readiness and operation throughout the working shift; ensure raw materials, semi-finished products putting into production must have evident origin and qualification.

## Ranking of natural environmental factors

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Weather conditions | 4.82 | Very High | 5 |
| Regulations, | 3.42 | High | 4 |
| Geological and | 3.27 | Mid | 3 |
| hydrological conditions | 3.12 | Low | 2 |
| laws on construction | 3.02 | Extreme Low | 1 |

Weather factor is a factor that has a high impact on labour productivity and is ranked first with RII of 3.82. Most construction works are built in natural spaces, where are affected directly by the weather. The weather not supporting or sometimes becoming **Ranking of factors of working tools and object**

severe has a not small impact on labour productivity. The role of natural conditions for labour productivity is objective and unavoidable. Therefore, to ensure the achievement and increase productivity, construction firms need to anticipate the difficulties arising due to natural environment conditions to mitigate risks in the production process. The second most influential factor is the factor of regulations on construction with RII = 3.42. Regulations and national policies that influence the goals and direction of the production of the construction firms, affecting the organizational policies for workers on wages, investment in science and technology, so on, thus affecting productivity.

## TESTING RESULTS& DISCUSSION

**Experimental Determination of material properties**

Various tests will be carried out on the materials used in Waste tyre rubber bitumen. The following tests will be carried out on materials:

1) Bitumen with Partial Replacement with Waste Plastic

- Standard Penetration Test [IS: 73 (1950-62-92)]
- Softening Point Test [IS: 73 (1950-62-92)]

| Factors | RII | Impact | Ranking |
|---|---|---|---|
| Quality of materials | 4.25 | Very High | 5 |
| Quality of working tools | 4.01 | High | 4 |
| Complexity of works | 3.72 | Low | 2 |
| Material transport methods | 3.02 | Extreme Low | 1 |

- Ductility Test [IS: 73 (1950-62-92)]
- Stripping Value Test [IS: 73 (1950-62-92)]
- Marshall Stability Test [IS: 73 (1950-62-92)] (For bituminous mix containing both Waste plastic and Reclaimed Asphalt Pavement)

2) Fine Aggregate and Coarse Aggregate with Partial Replacement of Reclaimed Asphalt Pavement

- Flakiness Index [IS 2386]
- Elongation Index [IS 2386]
- Impact Value [IS 2386]
- Sieve size analysis [IS 2386]
- Specific Gravity [IS 2386]
- Water Absorption Test (%) [IS 2386]

These all testing will be done for all the design mix to determine the mechanical properties and durability of the specimens and Results will be find out for all the tests of all design mix and it will be compare.

**Properties of Bitumen**

| Properties | Bitumen Grade 60/70 |
|---|---|
| Penetration | 63 |
| Softening Point | 62 C |
| Ductility | 64.5 mm |

**1. For various Tests for Bitumen Replaced by Waste Plastic**

| Waste Plastic in Percentage of Weight of bitumen | 0% | 5% | 10% | 15% | 20% | 25% | Total No. of Samples |
|---|---|---|---|---|---|---|---|
| Standard Penetration Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Softening Point Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Ductility Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |

**2. For various Tests for NA Replaced by Reclaimed Asphalt Pavement**

| Weight of RAP in percentage of weight of Natural aggregate | 0% | 10% | 20% | 30% | 40% | 50% | Total No. of Samples |
|---|---|---|---|---|---|---|---|
| Flakiness and Elongation Index | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Sieve Analysis | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Specific Gravity | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Water Absorption Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Impact Value Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| Crushing Value Test | 1 | 1 | 1 | 1 | 1 | 1 | 5 |

### 3. For Marshall Stability Test

| Waste Plastic | 0% | 5% | 10% | 15% | 20% | 25% |
|---|---|---|---|---|---|---|
| RAP | No. of Samples | | | | | |
| 0% | 3 | 3 | 3 | 3 | 3 | 3 |
| 10% | 3 | 3 | 3 | 3 | 3 | 3 |
| 20% | 3 | 3 | 3 | 3 | 3 | 3 |
| 30% | 3 | 3 | 3 | 3 | 3 | 3 |
| 40% | 3 | 3 | 3 | 3 | 3 | 3 |
| 50% | 3 | 3 | 3 | 3 | 3 | 3 |

| (Plastic Content , RAP Content )(%) | Wt. of Sample | | Bulk Sp. Gr. Of Sample | VMA (%) | VFB (%) | Viscosity grade | | Modified Bitumen – Hot Climate | | Modified Bitumen – Cold Climate | | Marshall stability (KN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air (gm.) | Water (gm.) | | | | Avg MS | Avg Flow | Avg MS | Avg Flow | Avg MS | Avg Flow | |
| (0,0) | 1201.7 | 755.9 | 3.46 | 12.86 | 63.92 | 3.29 | 3.59 | 22.1 | 3.28 | 18.6 | 5.4 | 11.67 |
| (0,10) | 1273.8 | 776.3 | 2.63 | 12.76 | 59.44 | 3.58 | 3.19 | 20.1 | 3.48 | 16.5 | 5.1 | 11.22 |
| (0,20) | 1273.7 | 741.8 | 2.34 | 10.81 | 59.04 | 2.56 | 2.82 | 16.8 | 3.28 | 10.9 | 4.7 | 10.54 |
| (00,30) | 1281.6 | 726.6 | 2.89 | 7.25 | 58.83 | 3.96 | 3.30 | 18.8 | 4.40 | 12.3 | 5.2 | 10.01 |
| (0,40) | 1260.0 | 708.4 | 2.71 | 6.69 | 57.57 | 2.42 | 2.99 | 13.6 | 3.58 | 13.1 | 3.9 | 9.85 |
| (0,50) | 1209.1 | 753.0 | 3.17 | 6.11 | 57.45 | 3.51 | 2.51 | 23.8 | 3.72 | 17.4 | 3.9 | 9.57 |

**Observation Table & Test Results:**

Test Results & Minimum Requirements For Paving Grades (IS 73: 2013)

| Sr.No | Name of the test | Test results | VG 10 | VG 20 | VG 30 | VG 40 | Test Method |
|---|---|---|---|---|---|---|---|
| 1 | Specific Gravity | "--" | - | - | - | - | IS 1202- 1978 |
| 2 | Penetration at 25 Deg C in 1/10 of mm | 53 | 80 | 60 | 45 | 35 | IS 1203- 1978 |
| 3 | Absolute viscosity at 60 Deg C in Poises | "--" | 800-1200 | 1600-2400 | 2400-3600 | 3200-4800 | IS 1206 (P2) |
| 4 | Kinematic viscosity at 135 Deg C in cSt | "--" | 250 | 300 | 350 | 400 | IS 1206 (P3) |
| 5 | *Flash Point (Cleveland open cup) in Deg C | "--" | 220 | 220 | 220 | 220 | IS 1448 Part 69 |
| 6 | Softening point(R & B) in Deg C | 47 | 40 | 45 | 47 | 50 | IS 1205 -1978 |
| 7 | Ductility at 25 Deg C in cm | 100 | 75 | 50 | 40 | 25 | IS 1208- 1978 |
| 8 | *Loss on heating in percentage | "--" | - | - | - | - | IS 1212-1978 |

**Observation Table & Test Results:**

| Sieve Analysis of Fine Aggregate as per IS2386, P-1 2016 | | | Percentage passing as per IS 383-2016 | | | |
|---|---|---|---|---|---|---|
| Sr. No. | Sieve Size -mm | Percentage passing- % | Grading Zone I | Grading Zone II | Grading Zone III | Grading Zone IV |
| 1 | 10 | 100.0 | 100 | 100 | 100 | 100 |
| 2 | 4.75 | 98.8 | 90-100 | 90-100 | 90-100 | 95-100 |
| 3 | 2.36 | 88.1 | 60-95 | 75-100 | 85-100 | 95-100 |
| 4 | 1.18 | 51.7 | 30-70 | 55-90 | 75-100 | 90-100 |
| 5 | 0.6 | 34.5 | 15-34 | 35-59 | 60-79 | 80-100 |
| 6 | 0.3 | 25.7 | 5-20 | 8-30 | 12-40 | 15-50 |
| 7 | 0.15 | 18.2 | 0-10 | 0-10 | 0-10 | 0-15 |
| Fineness Modulus - % | | 2.83 | | | | |
| Sand Confirming as per clause no. 4.3 of IS 383-2016 | | "I" | | | | |

| Test Particular | Unit | Test results | Test Method | Specified limit |
|---|---|---|---|---|
| Specific Gravity | - | 2.64 | IS 2386 P3 - 2016 | - |
| Water absorption | % | 3.48 | IS 2386 P3 - 2016 | - |

**Observation Table & Test Results:**

Sieve analysis of coarse aggregate and specified percentage passing as per IS-383:1970 ( RA ) 2016

| Sr.No | Sieve Size in mm | Percent Passing | 10mm-Single Size | 20mm-Single size | 20mm-Graded size | 40mm -Single size | 40mm Graded size |
|---|---|---|---|---|---|---|---|
| 1 | 40 | 100.0 | - | 100 | 100 | 85-100 | 95-100 |
| 2 | 25 | 100.0 | - | - | - | - | - |
| 3 | 20 | 98.8 | - | 85-100 | 95-100 | 0-20 | 30-70 |
| 4 | 16 | 48.1 | - | - | - | - | - |
| 5 | 12.5 | 8.9 | 100 | - | - | - | - |
| 6 | 10 | 0.6 | 85-100 | 0-20 | 25-55 | 0-5 | 10-35 |
| 7 | 4.75 | 0.0 | 0-20 | 0-5 | 0-10 | - | 0-5 |
| 8 | 2.36 | 0.0 | 0-5 | - | - | - | - |

| Test Particular | Unit | Test Result | Test method | Specified Limit |
|---|---|---|---|---|
| Sp. Gravity | - | 2.9 | IS 2386 P: 3-2016 | - |
| Water Absorption | % | 0.99 | IS 2386 P: 3-2016 | - |
| Aggregate Crushing value | % | 16.96 | IS 2386 P 4 - 2016 | Max 45% Non wearing surface Max. 30% - Wearing surface |
| Flakiness Index | % | 3.52 | IS 2386 P1:2016 | - |
| Elongation Index | % | 3.47 | IS 2386 P 1-2016 | - |
| Aggregate Impact value | % | 15.03 | IS 2386 P 4 -2016 | Max 45% Non wearing surface Max. 30% - Wearing surface |

## CASE STUDY

**SOLAPUR – DHULE Highway Project**

4-Laning of Solapur-Dhule 211 (New NH-52) from 00.000 KM to 453.000 KM in the state of Maharashtra to be executed as BOT (Toll) on DBFOT Pattern under NHDP.

This route is one of the major high density traffic highways in India. Poor existing pavement condition, unhealthy condition of several cross drainage structures and increasing traffic volume levels on this road indicated an urgent need to improve and augment the capacity of the road Infrastructure. The project consists of up gradation and strengthening of the existing 2 lane carriageway and widening the same to 4 lane dual carriageway, improving and rehabilitation or reconstruction of cross drainage structures between Solapur-Dhule sections of NH-211. The project is being done through Public Private Participation (PPP) on Build Operate Transfer (BOT) basis. The concessionaire/Operator's scope include Designing, Constructing, Maintaining and Operating the project corridor for a period of 29 years and then will transfer the project operations in hands of NHAI.

**SALIENT FEATURES**

| | |
|---|---|
| **Name of Project** | "Four Laning of Solapur to Yedeshi Section of NH-211 from Km 0.000 to Km 100.000 (Design Length - 98.717 Km) in the State of Maharashtra to be executed as BOT (Toll) on DBFOT Pattern under NHDP Phase - IV" |
| **Total Length of Project** | 98.717 Km |
| **Contract / Phase** | Phase NHDP Phase – IV |
| **Client / Authority** | National Highways Authority of India. (Ministry of Shipping, Road Transport & Highways). |
| **Concessionaire** | M/s. Solapur Yedeshi Toll way Private Limited |

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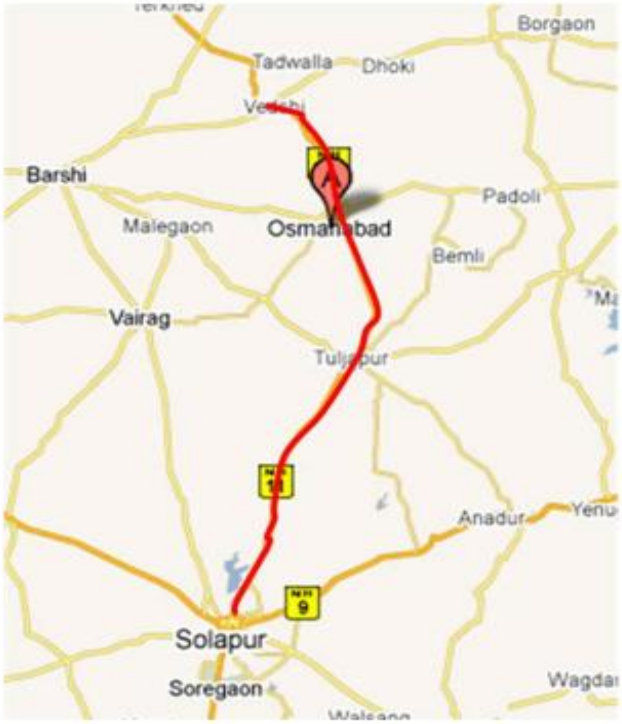
| | |
|---|---|
| **Independent Engineer** | M/s. SA Infrastructure Consultants Pvt. Ltd. In Association with Dhruv Consultancy Services Pvt.Ltd. |
| **Project Management Assistant** | M/s. Sowil Limited |
| **EPC Contractor** | M/s. IRB / MRM Pvt. Ltd. Design |
| **Consultant** | M/s. STUP Consultants Private Limited |
| **Bankers** | IDBI Bank |
| **Total Project Cost** | INR 972.50 Crore. |
| **Date of Signing of Concession Agreement** | 03rd March 2014 |
| **Appointed date** | 21st January 2015 |
| **Scheduled Four-Laning Date** | 910th (nine hundred and tenth) day from the Appointed date (18.07.2017). |
| **Concession Period** | 29 Years Commencing from the Appointed Date. |




| SR.NO. | TYPES OF STRUCTURES | NO. OF STRUCTURES |
|---|---|---|
| 1 | Major Bridges | 2 |
| 2 | Minor Bridges | 24 |
| 3 | ROB | 1 |
| 4 | Pipe Culverts | 115 |
| 5 | Slab Culverts/Box Culverts | 6 |
| 6 | Vehicular Overpasses | 1 |
| 7 | Vehicular and Non-Vehicular Underpasses | 1 |

**Following are the Proposed Structures in the Project Site:**

| SR.NO. | TYPES OF STRUCTURES | No. of Struct. |
|---|---|---|
| 1 | Major Bridges | 2 |
| 2 | Minor Bridges | 25 |
| 3 | ROB | 1 |
| 4 | Flyover / Vehicular Underpasses | 7 |
| 5 | Pedestrian / Cattle Underpasses | 11 |
| 6 | Box Culverts | 11 |
| 7 | Pipe Culverts | 123 |

## RESULT & DISCUSSION

### R-II Method Results

| Sr. No. | Questions | YES(1) | No(2) | CANT SAY(3 | Total | | |
|---|---|---|---|---|---|---|---|
| 1 | Have you heard about Construction Waste management? | 80 | 20 | 0 | 100 | percent | 0.33 |
| 2 | Are you aware of waste management in your area? | 70 | 25 | 5 | 100 | percent | 0.35 |
| 3 | Do you ever noticed Construction waste in the road, public area and Land? | 97.5 | 0 | 2.5 | 100 | percent | 0.37 |
| 4 | In India, Do you thing Construction waste management is good? | 42.5 | 42.5 | 15 | 100 | percent | 0.4 |
| 5 | Do you know India recycle just one per cent of its construction and demolition waste? | 60 | 40 | 0 | 100 | percent | 0.4 |
| 6 | Do you thing Construction waste management is necessary? | 90 | 0 | 10 | 100 | percent | 0.4 |
| 7 | Will you know construction waste management rule is mention from ministry of environment? | 25 | 67.5 | 7.5 | 100 | percent | 0.41 |
| 8 | Have you ever heard about the importance of recycling in construction industry? | 40 | 47.5 | 12.5 | 100 | percent | 0.42 |
| 9 | Do you use construction waste management system on your site? | 35 | 52.5 | 12.5 | 100 | percent | 0.42 |
| 10 | Have you use any method for waste disposal or Recycling material? | 60 | 32.5 | 7.5 | 100 | percent | 0.42 |
| 11 | Does it effect on quality using recycled material? | 40 | 55 | 5 | 100 | percent | 0.43 |
| 12 | Does cost-benefit analysis affect the project cost? | 92.5 | 5 | 2.5 | 100 | percent | 0.43 |
| 13 | Do you think there is enough information about the environmental impact due to Construction waste? | 20 | 70 | 10 | 100 | percent | 0.45 |
| 14 | Do you think Construction and demolishing waste management has impact on sustainable development? | 87.5 | 0 | 12.5 | 100 | percent | 0.47 |
| 15 | Can you say that to increase project productivity by reducing and eliminating the wastes? | 82.5 | 12.5 | 5 | 100 | percent | 0.48 |
| 16 | Do you think by decreasing waste we can decrease the project cost? | 82.5 | 10 | 7.5 | 100 | percent | 0.48 |
| 17 | Do you think using recycle material benefit the total project cost? | 85 | 0 | 15 | 100 | percent | 0.48 |
| 18 | Have construction waste management have effect on project cost? | 65 | 22.5 | 12.5 | 100 | percent | 0.49 |
| 19 | Do you think most environmental issues in India could be minimized if Construction Waste is managed properly? | 80 | 15 | 5 | 100 | percent | 0.49 |
| 20 | Do you think Cost benefits analysis should be done before starting construction? | 42.5 | 45 | 12.5 | 100 | percent | 0.5 |
| 21 | Do you think by using automation technique wastages of material is decreased? | 67.5 | 22.5 | 10 | 100 | percent | 0.51 |
| 22 | Do you use new technology for construction of building? | 42.5 | 55 | 2.5 | 100 | percent | 0.53 |
| 23 | Is that affect in reducing wastages? | 80 | 20 | 0 | 100 | percent | 0.54 |
| 24 | By giving proper training to mason increase the productivity of work and decreases the wastages of material? | 62.5 | 25 | 12.5 | 100 | percent | 0.55 |
| 25 | Not following construction step induced rework and that also increase construction waste? | 62.5 | 12.5 | 25 | 100 | percent | 0.57 |
| 26 | Does electrical and plumbing work increase the rework? | 67.5 | 20 | 12.5 | 100 | percent | 0.58 |
| 27 | By proper storage of material on site reduced the wastages of material? | 80 | 10 | 10 | 100 | percent | 0.58 |
| 28 | Do you think main reason of steel waste is because of irresponsible beam reinforcement and fabrication cutting? | 72.5 | 10 | 17.5 | 100 | percent | 0.59 |
| 29 | Do you think using RMC over traditional method decreased the waste of material? | 60 | 27.5 | 12.5 | 100 | percent | 0.61 |
| 30 | Now, do you use Construction waste management system on your site to increase the productivity and decreasing the cost of project? | 100 | 0 | 0 | 100 | percent | 0.63 |

| Sr. No. | Questions | YES(1) | No(2) | Other(3) | Total | Total Number(N) | A=N | RII | Ranks | MEAN | std. Deviation | Variance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Have you heard about Construction Waste management? | 80 | 40 | 0 | 120 | 100 | 300 | 0.4 | 4 | 1.2 | 0.4915 | 0.1164 |
| 2 | Are you aware of waste management in your area? | 70 | 50 | 15 | 135 | 100 | 300 | 0.45 | 8 | 1.4 | 0.5160 | 0.3336 |
| 3 | Do you ever noticed Construction waste in the road, public area and Land? | 97.5 | 0 | 7.5 | 105 | 100 | 300 | 0.35 | 2 | 1.1 | 0.3161 | 0.1000 |
| 4 | In India, Do you thing Construction waste management is good? | 42.5 | 85 | 45 | 172.5 | 100 | 300 | 0.58 | 18 | 1.7 | 0.7161 | 0.5132 |
| 5 | Do you know India recycle just one per cent of its construction and demolition waste? | 60 | 80 | 0 | 140 | 100 | 300 | 0.47 | 3 | 1.4 | 0.4965 | 0.2465 |
| 6 | Do you thing Construction waste management is necessary? | 90 | 0 | 30 | 120 | 100 | 300 | 0.4 | 4 | 1.2 | 0.6183 | 0.3889 |
| 7 | Will you know construction waste management rule is mention from ministry of environment? | 25 | 135 | 22.5 | 182.5 | 100 | 300 | 0.61 | 20 | 1.8 | 0.5545 | 0.3102 |
| 8 | Have you ever heard about the importance of recycling in construction industry? | 40 | 95 | 37.5 | 172.5 | 100 | 300 | 0.58 | 18 | 1.7 | 0.6179 | 0.4451 |
| 9 | Do you use construction waste management system on your site? | 35 | 105 | 37.5 | 177.5 | 100 | 300 | 0.59 | 19 | 1.8 | 0.6160 | 0.4435 |
| 10 | Have you use any method for waste disposal or Recycling material? | 60 | 85 | 22.5 | 167.5 | 100 | 300 | 0.49 | 11 | 1.5 | 0.6401 | 0.4101 |
| 11 | Does it effect on quality using recycled material? | 40 | 110 | 15 | 165 | 100 | 300 | 0.55 | 16 | 1.7 | 0.5160 | 0.3336 |
| 12 | Does cost-benefit analysis affect the project cost? | 92.5 | 10 | 7.5 | 110 | 100 | 300 | 0.37 | 3 | 1.1 | 0.3791 | 0.1441 |
| 13 | Do you think there is enough information about the environmental impact due to Construction waste? | 20 | 140 | 30 | 190 | 100 | 300 | 0.63 | 21 | 1.9 | 0.5451 | 0.2971 |
| 14 | Do you think Construction and demolishing waste management has impact on sustainable development? | 87.5 | 0 | 37.5 | 125 | 100 | 300 | 0.42 | 6 | 1.3 | 0.6701 | 0.4491 |
| 15 | Can you say that to increase project productivity by reducing and eliminating the wastes? | 82.5 | 25 | 15 | 122.5 | 100 | 300 | 0.41 | 5 | 1.2 | 0.5301 | 0.2811 |
| 16 | Do you think by decreasing waste we can decrease the project cost? | 82.5 | 20 | 22.5 | 125 | 100 | 300 | 0.42 | 6 | 1.3 | 0.5981 | 0.3481 |
| 17 | Do you think using recycle material benefit the total project cost? | 85 | 0 | 45 | 130 | 100 | 300 | 0.43 | 7 | 1.3 | 0.7231 | 0.5231 |
| 18 | Have construction waste management have effect on project cost? | 65 | 45 | 37.5 | 147.5 | 100 | 300 | 0.49 | 11 | 1.5 | 0.7161 | 0.5132 |
| 19 | Do you think most environmental issues in India could be minimized if Construction Waste is managed properly? | 80 | 30 | 15 | 125 | 100 | 300 | 0.42 | 6 | 1.3 | 0.5431 | 0.2951 |
| 20 | Do you think Cost benefits analysis should be done before starting construction? | 42.5 | 90 | 37.5 | 170 | 100 | 300 | 0.57 | 17 | 1.7 | 0.6871 | 0.4721 |
| 21 | Do you think by using automation technique wastages of material is decreased? | 67.5 | 45 | 30 | 142.5 | 100 | 300 | 0.48 | 10 | 1.4 | 0.6751 | 0.4559 |
| 22 | Do you use new technology for construction of building? | 42.5 | 110 | 7.5 | 160 | 100 | 300 | 0.53 | 14 | 1.6 | 0.5451 | 0.2971 |
| 23 | Is that affect in reducing wastages? | 80 | 40 | 0 | 120 | 100 | 300 | 0.4 | 4 | 1.2 | 0.4915 | 0.1164 |
| 24 | By giving proper training to mason increase the productivity of work and decreases the wastages of material? | 62.5 | 50 | 37.5 | 150 | 100 | 300 | 0.5 | 12 | 1.5 | 0.7161 | 0.5132 |
| 25 | Not following construction step induced rework and that also increase construction waste? | 62.5 | 25 | 75 | 162.5 | 100 | 300 | 0.54 | 15 | 1.6 | 0.8881 | 0.7892 |
| 26 | Does electrical and plumbing work increase the rework? | 67.5 | 40 | 37.5 | 145 | 100 | 300 | 0.48 | 10 | 1.5 | 0.7741 | 0.5992 |
| 27 | By proper storage of material on site reduced the wastages of material? | 80 | 20 | 30 | 130 | 100 | 300 | 0.43 | 7 | 1.3 | 0.6481 | 0.4201 |
| 28 | Do you think main reason of steel waste is because of irresponsible beam reinforcement and fabrication cutting? | 72.5 | 20 | 52.5 | 145 | 100 | 300 | 0.48 | 10 | 1.5 | 0.7831 | 0.6131 |
| 29 | Do you think using RMC over traditional method decreased the waste of material? | 60 | 55 | 37.5 | 152.5 | 100 | 300 | 0.51 | 13 | 1.5 | 0.7161 | 0.5132 |
| 30 | Now, do you use Construction waste management system on your site to increase the productivity and decreasing the cost | 100 | 0 | 0 | 100 | 100 | 300 | 0.33 | 1 | 1.0 | 0.0000 | 0.0000 |

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| Sr. No. | Questions | N | Min | Max | Mean | Standard deviation | Variance |
|---|---|---|---|---|---|---|---|
| 1 | Have you heard about Construction Waste management? | 40 | 1 | 2 | 12 | 0.405 | 0.164 |
| 2 | Are you aware of waste management in your area? | 40 | 1 | 3 | 14 | 0.580 | 0.336 |
| 3 | Do you ever noticed Construction waste in the road, public area and Land? | 40 | 1 | 3 | 11 | 0.316 | 0.1 |
| 4 | In India, Do you thing Construction waste management is good? | 40 | 1 | 3 | 17 | 0.716 | 0.512 |
| 5 | Do you know India recycle just one per cent of its construction and demolition waste? | 40 | 1 | 2 | 14 | 0.496 | 0.246 |
| 6 | Do you thing Construction waste management is necessary? | 40 | 1 | 3 | 12 | 0.608 | 0.369 |
| 7 | Will you know construction waste management rule is mention from ministry of environment? | 40 | 1 | 3 | 18 | 0.549 | 0.302 |
| 8 | Have you ever heard about the importance of recycling in construction industry? | 40 | 1 | 3 | 17 | 0.679 | 0.461 |
| 9 | Do you use construction waste management system on your site? | 40 | 1 | 3 | 18 | 0.660 | 0.435 |
| 10 | Have you use any method for waste disposal or Recycling material? | 40 | 1 | 3 | 15 | 0.640 | 0.41 |
| 11 | Does it effect on quality using recycled material? | 40 | 1 | 3 | 17 | 0.580 | 0.336 |
| 12 | Does cost-benefit analysis affect the project cost? | 40 | 1 | 3 | 11 | 0.379 | 0.144 |
| 13 | Do you think there is enough information about the environmental impact due to Construction waste? | 40 | 1 | 3 | 13 | 0.545 | 0.297 |
| 14 | Do you think Construction and demolishing waste management has impact on sustainable development? | 40 | 1 | 3 | 13 | 0.670 | 0.449 |
| 15 | Can you say that to increase project productivity by reducing and eliminating the wastes? | 40 | 1 | 3 | 12 | 0.530 | 0.281 |
| 16 | Do you think by decreasing waste we can decrease the project cost? | 40 | 1 | 3 | 13 | 0.588 | 0.346 |
| 17 | Do you think using recycle material benefit the total project cost? | 40 | 1 | 3 | 13 | 0.723 | 0.523 |
| 18 | Have construction waste management have effect on project cost? | 40 | 1 | 3 | 15 | 0.716 | 0.512 |
| 19 | Do you think most environmental issues in India could be minimized if Construction Waste is managed properly? | 40 | 1 | 3 | 13 | 0.543 | 0.295 |
| 20 | Do you think Cost benefits analysis should be done before starting construction? | 40 | 1 | 3 | 17 | 0.687 | 0.472 |
| 21 | Do you think by using automation technique wastages of material is decreased? | 40 | 1 | 3 | 14 | 0.675 | 0.456 |
| 22 | Do you use new technology for construction of building? | 40 | 1 | 3 | 16 | 0.545 | 0.297 |
| 23 | Is that affect in reducing wastages? | 40 | 1 | 2 | 12 | 0.405 | 0.164 |
| 24 | By giving proper training to mason increase the productivity of work and decreases the wastages of material? | 40 | 1 | 3 | 15 | 0.716 | 0.513 |
| 25 | Not following construction step induced rework and that also increase construction waste? | 40 | 1 | 3 | 16 | 0.888 | 0.753 |
| 26 | Does electrical and plumbing work increase the rework? | 40 | 1 | 3 | 15 | 0.714 | 0.51 |
| 27 | By proper storage of material on site reduced the wastages of material? | 40 | 1 | 3 | 13 | 0.648 | 0.421 |
| 28 | Do you think main reason of steel waste is because of irresponsible beam reinforcement and fabrication cutting? | 40 | 1 | 3 | 15 | 0.783 | 0.613 |
| 29 | Do you think using RMC over traditional method decreased the waste of material? | 40 | 1 | 3 | 15 | 0.716 | 0.512 |
| 30 | Nov, do you use Construction waste management system on your site to increase the productivity and decreasing the cost | 40 | 1 | 1 | 10 | 0.000 | 0 |

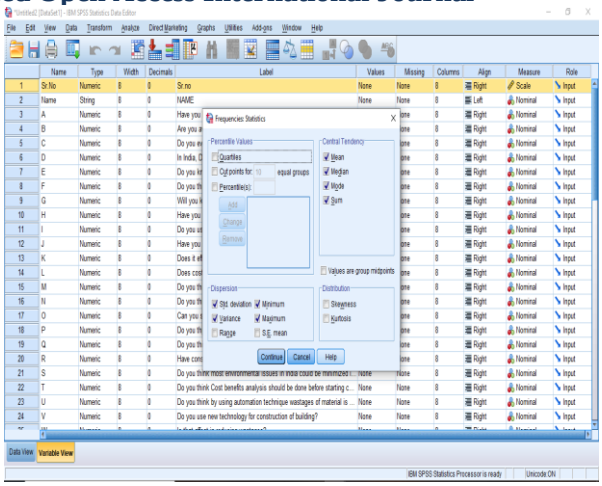

Fig: Mean & Deviation

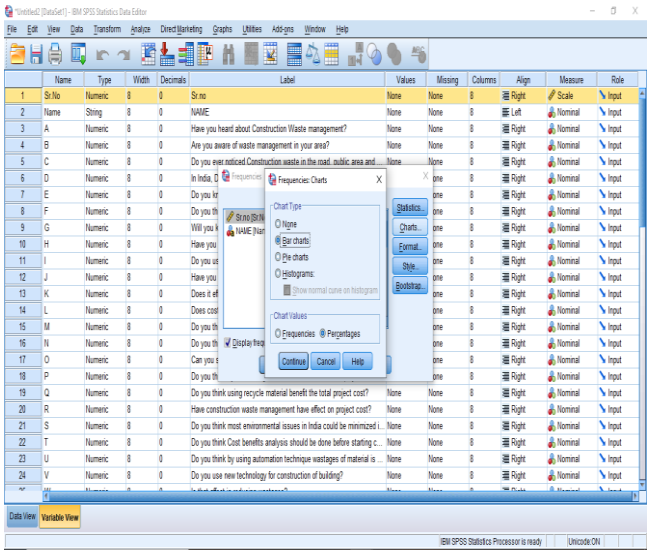

Figure: BAR Chart

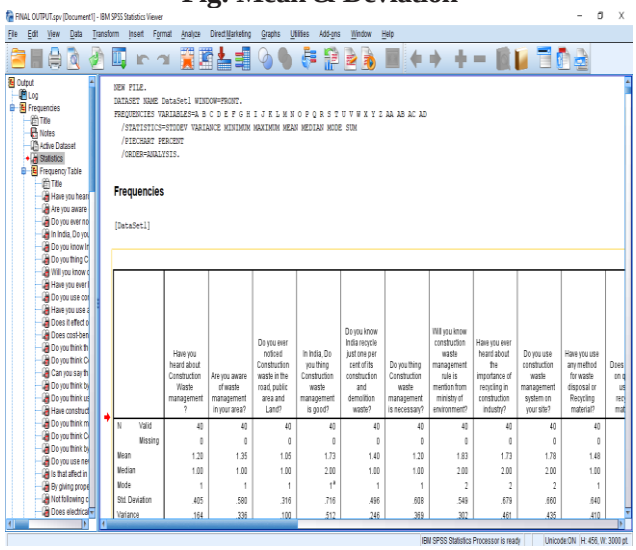

Figure: Output File

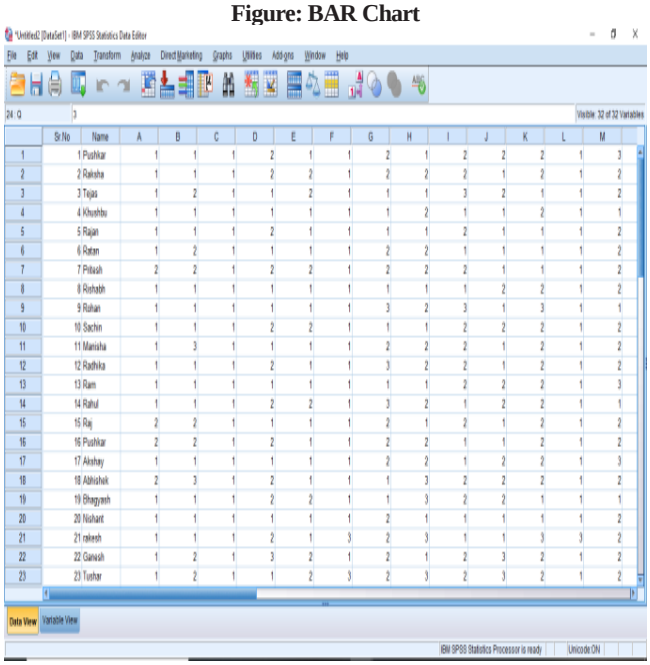

Figure: Data View

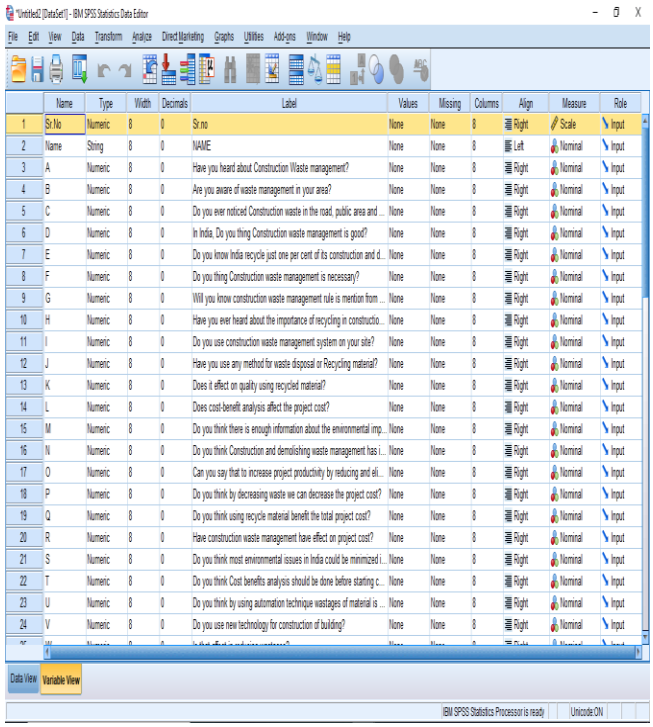

Figure: Variable View

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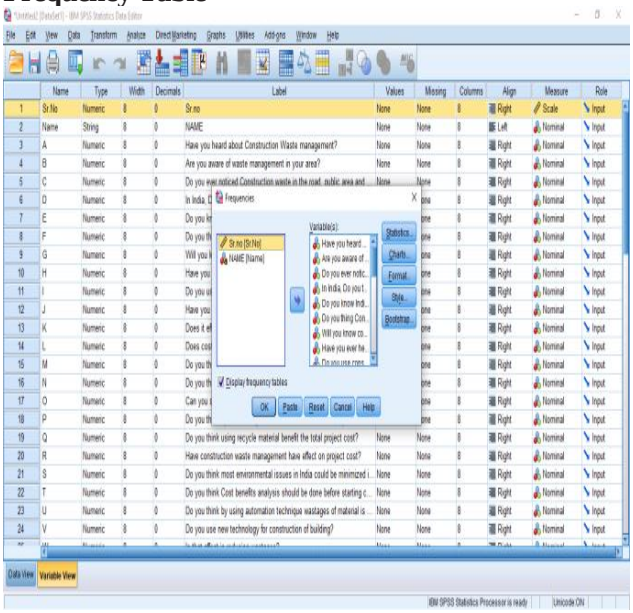
## Frequency Table



Have you heard about Construction Waste management?

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 32 | 80.0 | 80.0 | 80.0 |
| | 2 | 8 | 20.0 | 20.0 | 100.0 |
| | Total | 40 | 100.0 | 100.0 | |

Are you aware of waste management in your area?

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 28 | 70.0 | 70.0 | 70.0 |
| | 2 | 10 | 25.0 | 25.0 | 95.0 |
| | 3 | 2 | 5.0 | 5.0 | 100.0 |
| | Total | 40 | 100.0 | 100.0 | |

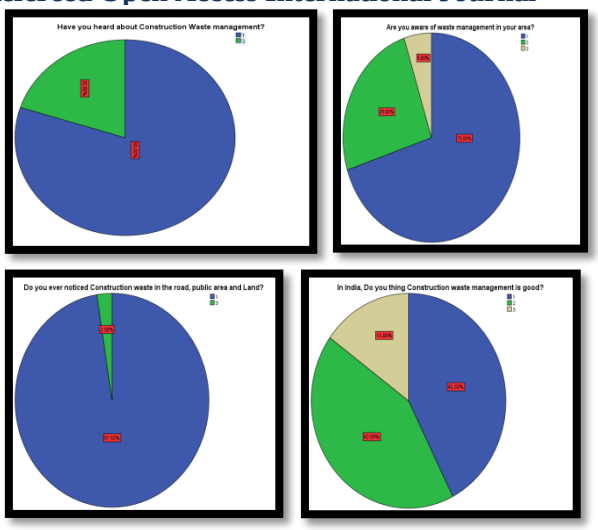
Do you ever noticed Construction waste in the road, public area and Land?

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 39 | 97.5 | 97.5 | 97.5 |
| | 3 | 1 | 2.5 | 2.5 | 100.0 |
| | Total | 40 | 100.0 | 100.0 | |

In India, Do you thing Construction waste management is good?

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1 | 17 | 42.5 | 42.5 | 42.5 |
| | 2 | 17 | 42.5 | 42.5 | 85.0 |
| | 3 | 6 | 15.0 | 15.0 | 100.0 |
| | Total | 40 | 100.0 | 100.0 | |

## Pie Chart




## CONCLUSION

ITS development based on the recognition of ITS advantages and need for harmonized development. The main reasons for ITS introduction are: improving safety, improving efficiency, reducing pollution and enabling interoperability between different systems.
To achieve the full potential of ITS, a careful systematic approach is required in the design and planning, development and implementation, which addresses the problems of user needs and benefits, system architecture and integration issues while at the same time giving due attention to other national and international medium and long-term objectives related to such issues as land use and regional planning, infrastructure design, transportation system management, and many other important areas that are directly or indirectly influenced as a result of ITS implementation.

The great potential offered by technologically and economically viable Intelligent Transportation System was quickly recognized as an efficient way to resolve many simple and complex transportation problems. Recent expectations in relation to this potential have suggested, for example, that ITS will lead to a reduction in road fatalities; a reduction in travel time; a reduction in traffic delays; and a reduction in city pollution.

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