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Rourkela steel plant automation: A case study

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Abstract- In order to improve product quality, reduce cost, increase customer satisfaction and to sustain the global competition, automation in the existing infrastructure of the steel industry is essential. After liberalization started in the steel sector in India, a large number of steel plants have come up with most advanced technology. In this paper automation process in Integrated material management system (IMMS), Electronic Procurement system (EPS), Product Planning and Control System (PPCS) are discussed and possibility of implementation of ERP and GPS based transportation system is discussed for automation)

Keywords-Integrated material management system , ERP,GPS Tracking;productivity;automation; (key words)

I. INTRODUCTION

Steel Authority of India Limited (SAIL) is the leading steel making company in India. It is a fully integrated iron and steel maker, producing both basic and special steel for domestic use like construction, engineering, power, railway, automotive, FMGC and defense industries and for sale in export markets. Rourkela Steel Plant (RSP) is one of the integrated steel plants of SAIL producing mainly flat products. SAIL achieved profit after Tax (PAT) of Rs.6754 crores (12.3 million tons) for the year 2009-10. As on date, RSP has an installed capacity of 2.0 MT of Hot metal, 1.9 MT of crude steel and 1.67 MT of saleable steel. The Plant is undertaken Expansion Program. By the year 2012 the total saleable steel will be increased to around 3.9 MT.

Automation in iron & steel industry started from Second World War. Without Automation in the manufacturing industry, it is not possible to ensure progress in the national economy and thus improvement in the living standards of the people in the country. Through Automation in the process industry, manifold objectives of business like improvement in the working condition for the Employees at the work place, Productivity in the shops as well as quality of Products are achieved.

It is observed that due to automation introduced in blast furnace, Steel Melting shops and Re heating furnaces the output has increased by about 8-10% and has resulted in high amount of saving in fuel consumption. Automation in the rolling mill has contributed to about 15% increase in the output.

The working condition of the employees has improved drastically. The operating personal strength is reduced by 25% and the overall production cost is reduced by 20% [1].

An integrated steel plant has many Departments operating in an interdependent fashion to produce steel products. There are production Departments, Services

Departments and other non works departments like human resources development, materials management, finance, personnel, marketing and computer &IT. Among other departments, production planning & control (PPC) Department is one of the important departments in the service category.

Production departments are Ore Bedding & blending, coke ovens, sinter plants, blast furnace, steel melting shop and various rolling mills. All these departments have their individual roles to play in keeping the plant operation smooth & sound. They depend on each other from time to time for day to day transaction and information flow.

The top management also needs information regarding functioning of the plant in the form of management information system (MIS) from time to time and plant performance parameters on a real time basis. Apart from these, customer also needs information regarding the status of his order. All of these activities and information should flow very fast within the organization so as to bring efficiency & competitiveness in the system.

Most of the integrated steel plants across the globe have implemented ERP and realized the benefits both in the form of operational efficiency as well as working capital reduction. ERP products for steel industry come along with industry best practices and specific task features. Most of the private players in the steel industry across the globe including India like Arcelor Mittal, TISCO CORUS, Jindal Steel, POSCO, ISPAT, VoestAlpine etc. have already implemented ERP. The public sector metal industries like SAIL, RINL, NALCO, HINDUSTAN Copper etc are currently in the process of implementing ERP.

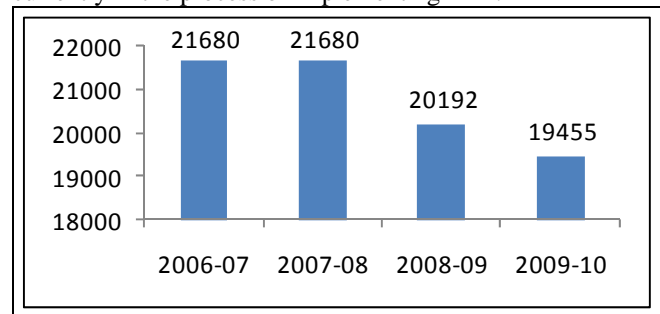


Figure: 1 Rightsizing manpower by automation.

ERP helps in ensuring smooth flow of information while facilitating multiple and multi user transactions across the entire supply chain of the Organsiation. The supply chain includes all the activities, the function and the facilities

involved in producing and delivering a product from supplier to the customer. The SCM (supply chain management) is optimizing each components of production, operation management. Various models such as Just in time (JIT), Inventory management model, Vendor managed inventory (VMI) model, Zero inventory model (ZI), Total Quality Management Model (TQM) are already in place. These models are focused toward optimization of supply chain in isolation. But the SCM leads optimization of the full chain.

II. AUTOMATION IN STEEL INDUSTRIES

The automation is a very important factor in steel industries. Automation can be done in Drives (AC/DC) & through programmable logic controller. By automation the industry can achieve Reduction in hard ware required, Very fast fault detection, Easy maintenance, High level of efficiency, Energy conservation and other benefits. Automation units in RSP are: Hot Strip Mill, Steel Melting Shop-2, Steel Melting Shop-1, ERW pipe Plant, Supervisory Load Control Center, Coke Ovens, Energy Management, Secondary Steel Stock Yard, Weigh Bridges, Env.n. Monitoring Info. Systems. The level of automation can be discussed under four levels. [1]

TABLE:1 LEVELS OF AUTOMATION.

SL NO.	TYPE	LIMITATION
1	LEVEL-1	Only one station, No networking control of individual machine
2	LEVEL-2	Networking possible, Data logging, MMI. Communication through Only one control room.
3	LEVEL-3	Data logging to user, Remote operation I/C can view all the data, Multiclient operation, client server technology, ERP implementation is possible in production, planning & control by the package. Maintenance, analysis of data is possible. It is a total integration automation system
4	LEVEL-4	Like level 3, Control by satellite from a remote area is possible.

III. INTEGRATED MATERIAL MANAGEMENT SYSTEM(IMMS)

At present RSP is having IMMS with in-house built software. It handles the requirement of 145 indenting Departments with a cumulative stock master base of 178456 items. Annually it generates 4500 indents. Integration with various modules like financial accounting, sales invoicing, costing, cmms systems and e-procurement module is done. On-line Integrated Material Management system(IMMS) covers all the areas of Material Management like cataloging, material planning, purchase order placement, inspection activities, material receipts, stores transactions & inventory management, payment modules etc. IMMS provides a homogenous environment of software and hardware facilities across the organization. The various modules are fully integrated to ensure effective way of working resulting in reduction of lead-time, increase in labor productivity, better decision making and cost control. Implementation of electronic procurement module through metal junction in the web adds competitive edge to Material Management functions in the Steel plant.

Salient Features of the System

- The entire system was designed & built internally
- The Govt. Paraphonia for procurement, audit requirement elaborate integrity checks and maximum security features to meet with purchase procedure is available.
- Validation and updating of data is done at point of origin.
- It takes into account all the material management function.
- Tacking of procured materials starting from entry point to industry.
- It deals with on line budget control and clearance.
- It deals with multiple options based on deep cascading query facilities.
- It deals inventory Analysis, Surplus/Obsolete, and Non-moving identification.
- Processing of bills and generation of ledger are done on line.

Benefits from the System

- Improvement of labor productivity at various stages.
- Paper movement time and its consumption. are minimized
- Vendor service through e-procurement system is improved.
- Updated and reliable data is available
- Indent, Order & GARN (good acceptance receipt note), lead time is reduced.
- Cost is reduced through rate contract & vendor selection

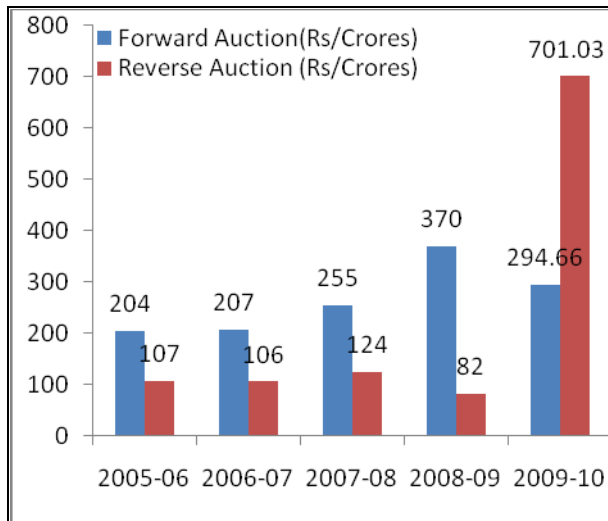


Figure : 4 Forward & Reverse Auction by EPS

V. PPC AUTOMATION

The AIM of On-line Production Planning and Control System (PPCS) is to execute the Customer orders effectively on time. The customer order is electronically integrated with Planning, Manufacturing, Quality and Dispatch functions.

The Operational areas covered under this computerization are Blast Furnace, Continuous Casting Mills I & II, Plate Mill, Hot Strip Mill, Cold Rolling Mill, Silicon Steel Mill, ERWPP and Spiral Weld Pipe Plant. The service departments like PPC, Research & Control Laboratory, Traffic, and Finance are also covered to carry out their functions respectively. To meet these requirements a computer network comprising of latest network equipments & 40 kms of Optical Fiber was commissioned. The package is configured for high availability and redundancy.

Benefits from the System.

- Planning is done as per orders that excess/short material processing is avoided.
- Storage and retrieval of materials from yards became systematic.
- The records of chemical and physical tests on metal to provide assistant in tracking quality control information up to heat making stage is maintained.
- It maintains the record of finished inventory analysis and control, Inter process inventory analysis and control.
- Dimensional data of Slabs and HR Coils through instruments is recorded.
- On-line weighment data of HR Coils/Plates, GP/GC Sheets, and CR Coils/Sheets from weigh bridge controller is recorded.
- Order Analysis is done deeply.

- Introducing Systems and Procedures to bring in disciplined work culture.

The Computerized PPC System follows a unified coding structure with respect to Product, Grade, Technical delivery condition, Customer, Destination, Branch, and Stockyard etc. This coding structure is developed and adopted jointly by CMO and all the Integrated Steel Plants for exchange of information. Thus the PPC System can be easily interfaced with Production and Financial modules of ERP.

VI. CURRENT PLANT STATUS SYSTEM

This is an On-line system to provide information of all major plant units i.e. the mill status, current shift and day's production and breakdown status. To show status of plant units like running units, units under breakdown condition, units idling and units under shutdown / capital repair. The system also provides production history, power distribution to all major units, details of Energy consumption, Personnel data for all employees, Costing data of all major products, Personnel circulars, Option Quarter circulars, Vigilance manual, Purchase procedure manual and maintenance related information in many background pages.

This is a single window for Management information and decision support. It works as a freely available information system for many employees. It runs on 3 tier architecture and is freely accessible round-the-clock to all workstations connected in the intranet.

The automation the Steel Plant is now introducing is ERP (Enterprise resources Planning) system. ERP enables free flow of data from one source to the other. It ensures no duplicity of data in the system. This is an efficient and a faster system. Another advantage of ERP is the total networking of all the business units of the Organization located at different geographical locations.

VII. ERP AT RSP

RSP can implement ERP in the Organization. On the face of a strong competition from the other steel plants in the National and International level, the company has to provide better service to business partners as well as minimize the production cost of the Products. Flow of information is key to this. Management information should be available on the desktop for faster decision making. ERP can also help in reduction in day to day efforts in managing business transactions in the long run.

The current information systems at RSP cover critical areas like Finance, Materials, Marketing, Payroll, Employee Service Record information, Maintenance, Production planning & control (SMS to mills coverage), System to raise DA/TC etc and is based on Sun computer and Oracle 7 database. Business information is transferred between in-house developed online PPC system, from new Sun system using Oracle 10G and separate MES systems. The software

functionality in E3K has been in wide use, yet the main E3K/oracle-7 system has some problems;

- To maintain increasing business needs of RSP there is a problem of scalability.
- Proper disaster recovery/backup systems is lacking. So in case of major breakdown of these computers both business system and production system of RSP is hampering.
- The software is mostly discrete in functionality and support only the mapped process/function without much enterprise level integration. This results in duplication of data and effort and inappropriate mapping of functional requirement.
- The existing system does not support streamlined business processes.
- This system requires continuous involvement of programmers for day to day business transaction.
- There is risk of obsolescence/unavailable components for replacements.

Thus, the objective was to replace E3K system. Present application software of E3K will not be compatible with any latest computer that offers Oracle 10G database. Hence, complete re-engineering of all E3K software is required and major investment in terms of both money and several man years of software work is due.

ERP can also transform RSP from discrete island of information to business data warehouse where the user can get the right information at right time from right source for strategic and operational decision making on real time basis. It also introduces best business practices and prepares RSP to compete better in future.

Current IT Scenario

The present software in use has been developed in-house by Computer and information Technology Department at RSP(C&IT). The back-end data servers are on RISC platform running Solaris 2.5 as the Operating system. The majority of the applications have been built using COBOL, C,Pro*C and Pro*COBOL and are Oracle 7.0. C&IT department also has the ppc system using a different RISC server and Oracle 10G .

The above applications are integrated by a central TCP/IP/Ethernet network backbone having 1 Gbps and 100 Mbps fiber optic links across many locations in

plant and township. There are about 1650 nodes in this network where 1380 workstations/desktops,180 dumb terminals and 30 servers in business , PPC, MES etc are connected across various departments in RSP.

Figure:5 Present status of IT in RSP

Few users in RSP get internet connectivity through dialed up and broadband. Antivirus deployed for network

connectivity layer2 and layer3 switches for inter connectivity is used. There is control by net sight atlas All All servers are interconnected and PPC/MES data flows to E3K business server. The current high-level application map is depicted in the following diagram.

Which is an Enterasys Network Management System. It also has connectivity through CISCO routers and RAS.

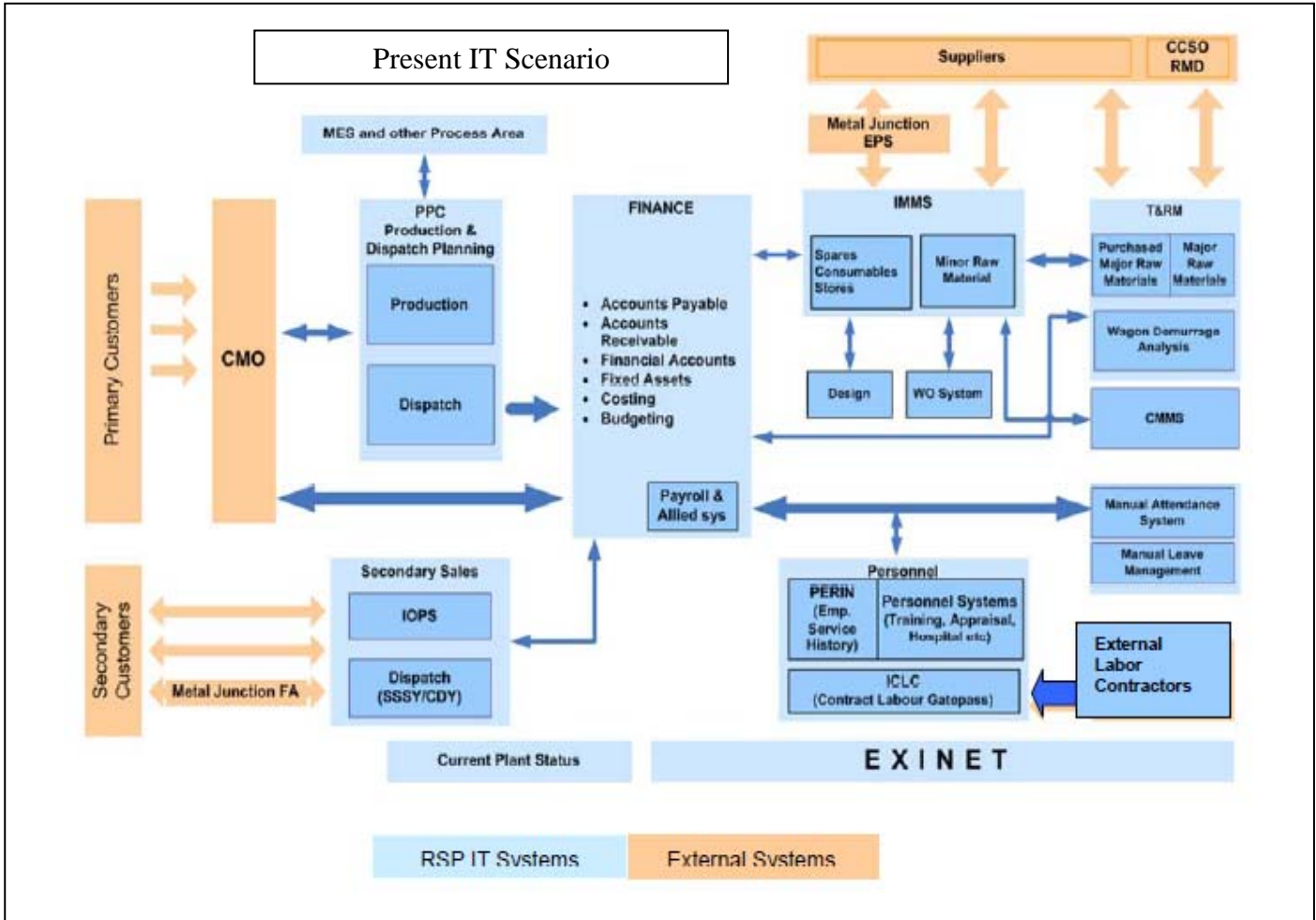
This network can be used by ERP, and a snapshot of the network backbone is given in this diagram below.

Choice of ERP functionality

All the business processes of RSP from the angle of ERP implementation and proper investment planning has been studied. RSP Finance and Materials are fully computerized by legacy systems and are tightly linked with RSP's other on-line computerized systems in Dispatching, Personnel, Production etc. As all existing applications are mission critical, seamless implementation without any break of service anywhere, has been the prime consideration in selecting the areas.

connectivity to ERP. The scaling of servers will be done based on future scalability.

ERP will introduce major change in the work culture among the Employees. The areas which are already automated will also get the benefit. By this redistribution of work among various departments is possible. This is the secret behind the success for an industry.



ost-ERP Implementation

All major processes related to the functions of Finance, Materials Management, Sales & Distribution, Production planning and execution, Plant Maintenance and Quality Management. Can be configured and customized for RSP in the ERP system. There would be requirements for interfacing with additional systems to capture data related to the above mentioned functions.

In the hardware aspect, the server solution can be segregated into inner and outer DMZ (De-militarized Zone) for enhanced security options. Employees can access the system from outside plant through secured Internet

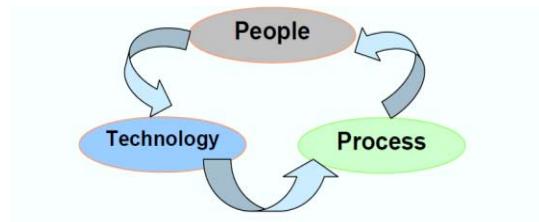


Figure:6 integration of people, process and technology

Benefits from the system

- ERP has industry best practices embedded which improves business processes.
- ERP brings with it the capability to provide automated controls and ERP enabled practices.
- Capturing data at source will help to improve transparency.
-

SN	Module	Current Function	Approach to ERP
1	Finance	As per rules of SAIL accounting standard to generate the financial statement of company for the given period	To cover current computerized /non computerized financial statements for different period .System should integrate collect from all the areas which are controlled by ERP and enter data manually where no ERP.
2	Sales & distribution	Initiate and complete sales for primary and secondary products dispatch process interface with quality management update of inventory	RSP marketing for secondary sales and PPC for coordinating sales through CMO. The primary sale is an addition in the revised scope.
3	Plant maintenance	At present the CMMS system which is used centrally for planning and tracking plant maintenance activity	The SAP PM module will provide functionalities to plan for preventive maintenance, capital repair plan, breakdown maintenance and condition based maintenance.
4	Quality Management	All quality interfaces with purchase and dispatch of materials/products ,inspection, tests, analysis (physical, chemical, mechanical and generate test certificates)	Inspection and test analyses in coming material intermediate product and final product. Other department can also use the QM at intermediate stages.
5	Material management	The enter purchase cycle interface with quality management ,management of store at various location issue of material for internal consumption, stock transfer, material classification and inventory valuation .	This carries out current using system/manually along with process under taken by TRM for raw material purchase. It covers inventory tracking and vendor site.
6	Production planning and execution	Annual, long term, monthly, weekly, daily production planning, scheduling in different department tracking of production order consumption at each stage production at shift end other support process supporting operation.	Along with the current operation additional departments like OBBP,CO,CCD,SP I, SP II, RF Power Generation, Power Distribution, EMD, Top etc. Within scope to track daily/shift wise production and materials consumption.

TABLE:2 PRESENT STATUS AND FUTURE TARGET OF VARIOUS MODULES.

Better decision support and up-to-the minute information.

VIII. GPS BASED TRANSPORTATION CONTROL

Global positioning system is a satellite control radio detection system. Position, Velocity and time can be detected of the target . Tracking of the locomotives can be controlled using the system for raw material handling , hot metal , laddle movement , dispatch of finish product of a steel industry . In the present sinario integrated steel plant depends on road transport of goods inside the plant. Particularly for transportation of slabs , slugs, HR coil and

other goods , fleet, wagons and other locomotives are used, this transport network covers the entire plant premises connecting all major shops and stockyard. The traffic management of this locomotives in very important . These traffic management is one of the important parameter in the productivity of the industry.[8]

At present 50 Nos. of locomotives are running inside the plant. They are used for transportation purpose. The locomotives carry steel slabs blast furnace to sms. Slug to

dump yard and other places. Similarly the other department also depend on locomotive for their transportation So as to say the internal transportation is heavily dependent on these locomotives material tracking and fleet management of locomotives is a major challenge.

Each group of locomotives is controlled by a separate control room. This control room is normally situated near the area of operation.

In RSP there are 4 blast furnaces at present 40nos. locomotives are used 24x7x365 Within a interval of 8 hours hot metal and liquid slug is being tapped out. At present walky-talky is the medium of communication medium by the operator and the control room. To optimize fleet sizes increase in productivity and reduction in locomotive run our a GPS based vehicle tracking system can be implemented in this system the GPS provide the data to locate the locomotive.

Vehicle Tracking System

This technology can be suggested for vehicle tracking system the GPS will provide the data to locate the object in 3D space the data's can be transmitted to computer network. The transmission of data may be real time and passive time. In a passive tracking a GPS data logger to be installed the data logger transmit the data which can be downloaded by computer present in the control room. Data is recorded in a predetermined time interval. In a real time vehicle tracking system a communication module and GPS receiver is present. In the locomotive control room same type of communication module is hooked up to a computer having vehicle tracking software. Each locomotive reports its position the control room.

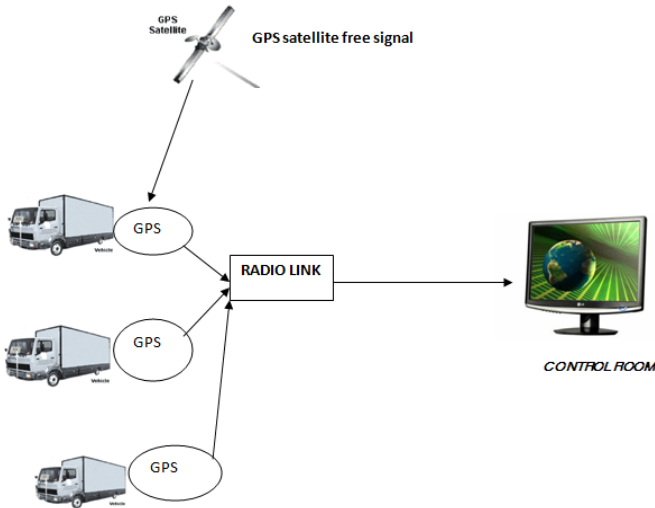


Figure:7 GPS based tracking system.

The most important part is the data communication between locomotive in the control room. The communication medium used may be VHF based radio or satellite communication normally VHF radio are highly preferable because the surrounding in a steel plant is suitable for VHF. The satellite communication may create EMI and EMC problem . The VHF radio will operate in the same

frequency in simplex mode . A two channel trunking system requires four frequencies where the simplex system requires only one frequency . A VHF radio with 25watt RF output has a range of 25 km with suitable antenna. In a continuous set up mobile units transmit a report to the central station on a regular basis . The various position report can be available in the central station at any time.[9]

Bokaro steel plant had already implemented the system in its blast Furnaces area it has a capacity of five blast Furnaces, 50 slag ladle this implementation of GPS system not only increase productivity but also reduced cost.

IX. CONCLUSION:

The existing automation can be upgraded further in terms of ERP and GPS transportation system. ERP can be implemented in all most all the sections and build architecture can be upgraded so that it will be compatible with implementation of ERP. TISCO, POSCO, MITAL Group of industries are implemented ERP .There is wider scope for implementation of GPS based tracking system for transport system in RSP. BOKARO steel plant has also implemented the GPS based electronics transport system. The present study suggests Rourkela Steel plant to implement ERP and GPS based transport system. Which will further help in its automation.

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