

## “Optimizing Construction Resources Using ERP”

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### Abstract

Enterprise Resource Planning is (ERP) is now becoming are to integrate the process of operations. The implementation of ERP in Construction industry has always raised questions whether it is feasible or not as in construction Project each Project is unique in its own sense. This research is a case study for a mid-sized construction firm whose analysis for Material Management showed the effect on resources with the processes without ERP and after implementation of ERP. This dissertation gives an overview of a system working for a Company so as to run an organization efficiently. The Systems, Applications and Products in data processing (SAP) is a integrated ERP which is highly effective solution to run a organization as and when its customization is done as per Company's profile and requirements.. The manual processes carried out in the non-SAP using Company to complete the Project was done. The analysis for non-SAP using Company was done to compare its effect on resources after implementation of ERP system. The decision making authorities were clearly defined to employees who kept a transparency in communication between employees within the organization.

### 1. Introduction

Systems, Applications and Products in data processing (SAP). The application is integrated Enterprise Resource Planning (ERP) software manufactured by SAP AG that targets business software requirements of midsize and large organizations in all industries and sectors. It allows for open communication within and between all company functions. It is the World's largest business software and third highest revenue independent software provider.

SAP focuses on six industry sectors:

Process industries, discrete industries, Consumer industries, Service industries, financial services, Public services.

Service Industry –

The service industry is an industry where services are provided to get some product or work done with the help of various resources. The Construction industry is service based industry which serves the various types of Construction work carried out by work break down structure, transportation of materials, number of resources for each activity and all the resources

required to commence and complete the construction work.

## 2. Training on SAP ERP system in a Construction Industry:

The training to learn about the implementation of SAP system had taken in Highbar Technologies Ltd. (Hindustan Construction Company Group) who was running over 50 sites all over India with SAP System. The various departments in a Company were working simultaneously. But due to implementation of SAP it was possible that each activity was getting updated into the system, henceforth the entire report of project was possible to overview at any instance. The project work was carried out as per actual resources used and the quantity of survey pre-planned. This definitely allowed a company to produce the actual cost on project in a precise manner. The process and role of SAP system in large scale construction industry was studied with the help of Concept presentation at the Company.

### 2.1 Holistic concept of ERP:

The figure 1.1 shows island in which five parameters are separated which denotes quality, costs, materials, resources and revenues. While the ERP system offers the integrated solution which link all those five parameters together.

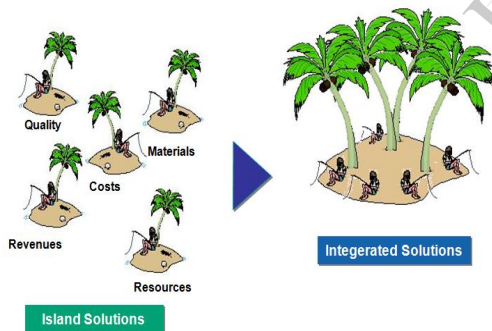


Fig. 1.1: Concept of ERP

The figure 1.2 shows the data of all modules in HCC was stored in the central server at head office of the company. It also denotes at the Projects located in remote places the access for server can be given through Satellite.

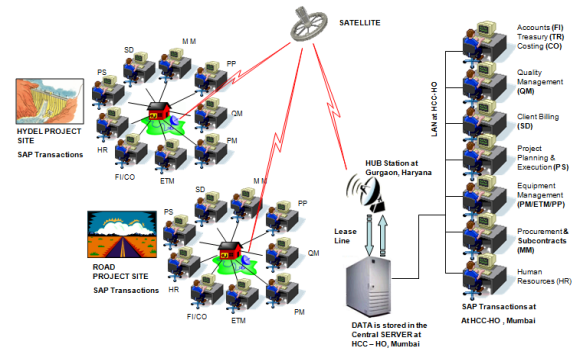


Fig. 1.2: Working of SAP

### 2.2 About ERP

This is integrated Software as against earlier island systems SAP is a readymade software which can be customized suiting to specific industry requirement.

1. Company's Processes had been mapped in to the system.
2. The data kept was online – moment a record was saved as common data – anybody accessing was able to see the data as secured.
3. Data viewing was controlled through Authorization.
4. Accounting & Costing Entries were flowed as & when different transactions were carried out.
5. Data was consistent as same data flowed across modules.

### 2.3 Common terminology and Overview:

The fig. 1.3 shows module wise functions of SAP system so that the specific department in the company served assigned functions under the modules.

Modules in SAP	Functions
Project systems (PS)	Planning & Execution
Material Management (MM)	Stores- Sub Contracting -QSS
Equipment Tools Mgmt (ETM)	Equipment
Plant Maintenance (PM)	Equipment
Production Planning (PP)	Production plants at site
Quality Management (QM)	Quality Control
Sales and Distribution (SD)	QSS
Finance (FI)	Accounts
Controlling (CO)	Costing

Fig.1.3: Module wise functions of SAP

### 2.4 Equipment mobilization and operation-

The fig. 1.5 shows whether the equipment to hire or purchase as per requirement for operations on site. If the equipment is purchased a new log card is created as it becomes an asset to the company.

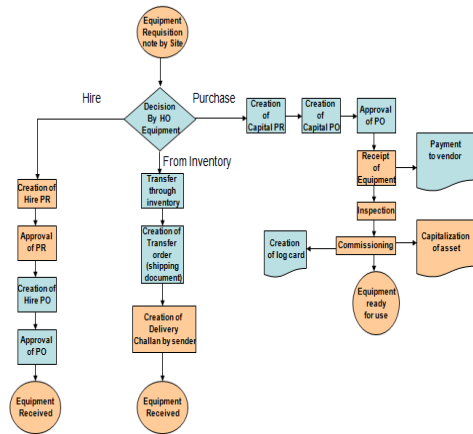


Fig. 1.5: Equipment mobilization

The operation of equipment done has various fields according to the type of equipment and all the costs are booked into equipment log card as shown in fig. 1.6

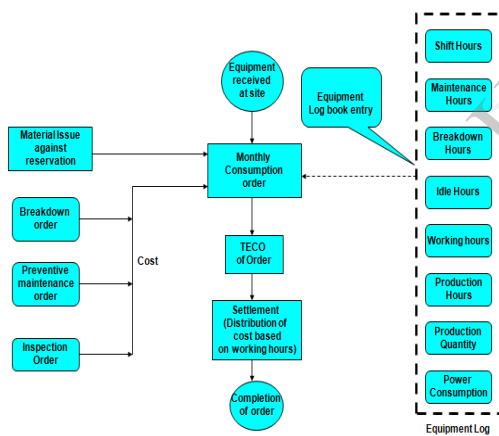


Fig. 1.6: Equipment operation

The flow chart in figure 1.7 denotes the purpose of equipment in particular activity.

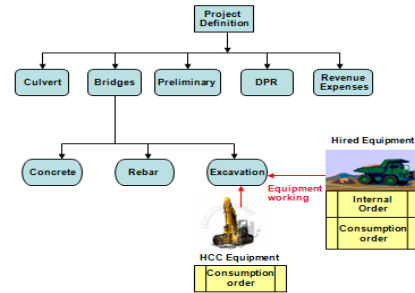


Fig. 1.7: Equipment operation WBS

### 2.5 Production Process –

While the process of production in execution the Material Requirement Planning was done as per the quantity of concrete to be produced shown in fig. 1.8

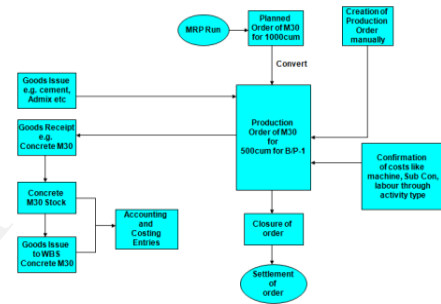


Fig. 1.8: Production Process – In house

The type of material denoted by short forms which consist of material group and material as shown in fig. 1.8

-Material Types		
-BLDG	(Building Material)	
-COAS	(Consumable Accessories)	
-CONA	(Construction Aids)	
-FUEL	(Fuel & Oils)	
-GENS	(General Stores)	
-MSE	(Miscellaneous Equipments)	
-NVAL	(Non valued Items)	
-SFGD	(Semi finished Goods)	
-SPRS	(Spares)	

Material Type	Material Group	Material
Building Material	Reinforcement Steel	
	Structural steel	ISMC 125
		Plate 10 mm

Fig. 1.9: Material Cycle – Material Master

As and when the demand for material was done the manual purchase requisition was created which was later put into the system. Further the system checked the availability of the material as per the material requirement planning initially done. The PR was approved or rejected as per the planned order as in fig. 1.10

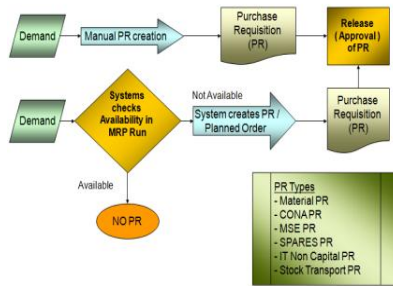


Fig. 1.10: Material Cycle – Purchase Indent

The material from one project to another was able to transfer as in fig.1.11

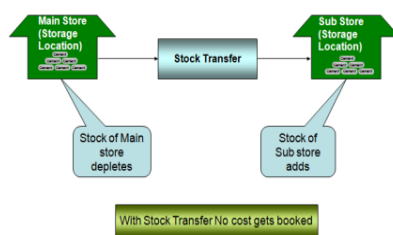


Fig. 1.11: Material Cycle – Stock Transfer

### 3. A Case Study on Conventional system for Material management

For analysis site is selected in Kolhapur city. For comparison with ERP first upon conventional process (non ERP) for material management is studied.

#### 3.1 Material Management –

The area is concerned with following aspects;

1. Purchase Requisition
2. Purchase Order
3. Material inward/ Outward
4. Purchase Receipt
5. Vendor Billing

**3.1.1 Purchase requisition** – As per the stock required of a material to be ordered the concerned Engineers report to the store Clerk. The store Clerk checks the existing stock and releases PR from the name of concerned Engineer to the head office. The Managing Director approves or denies the PR and further it is released to site office. The Purchase Requisition slip in fig 2.1 is shown at company which shows item

description, item code, quantity, unit, total quantity and sign or remark by stores clerk.



Fig. 2.1: Material Requisition slip

**3.1.2 Purchase order** – After once PR is approved the Store Clerk prepares a Purchase Order from the name of a Vendor consisting Unit, rate, quantity, etc and takes the PO to head office. Here the director signs the PO and further it is carried out to the vendor. The fig 2.2 shows the PO slip from the company.



Fig. 2.2: Purchase Order slip

**3.1.3 Material Inward/ Outward** – After the PO is given to the vendor, the vendor provides the material at the site. The inward material is issued by the store clerk. The issued material is recorded into the register as per the bill no., date, Vendor, Vehicle no., Unit, quantity, rate, etc.

**3.1.4 Purchase receipt** – Once the material is issued at the site a receipt is given to the vendor. A copy of receipt is kept at site office and another copy is sent to head office to tally with the PO released from head office.

**3.1.5 Billing** – When the PO from head office matches the copy of receipt a payment to the Vendor/Supplier is made within the prescribed duration. Bill invoice is recorded into the excel sheet of head office.

#### 3.2 Material Requirement Planning for Conventional system:

The quantities of material required for Construction of Compound wall was as shown in table 2.1

**Table 2.1:** Estimated quantities of material required

Sr.no/Item	Quantity (Cu.m)	Concrete Grade	Cement(Bags)	Sand(Cu.m)	Aggregate(Cu.m)	12mm 8mm	6mm Bricks (4')	Steel(Kg)	
1 Pile no P1 to P170	54 Cu.m	M25	405	33	49	3080	4000		
2 Pile cap P1 to P170	54 Cu.m	M25	405	33	49	2100	1140		
3 P.C.C	28 Cu.m	M10	112	17	26		1100		
4 Corun Beams B1 to B170	73 Cu.m	M20	475	44	66	2260	1760		
5 R.C.C Columns C1 to C170	18 Cu.m	M20	117	11	17	1360	850		
6 R.C.C Curb	145 Cu.m	M20	943	87	130				
7 R.C.C Coving	52 Cu.m	M20	338	32	47	1100	390		
8 B.B.M (4')	191 Cu.m	(1:6)	240	50				6700	
9 Plastering	2054 Sq.m	(1:6)	205	21					
			3240	328	384	9610	9650	1490	67000 No.

The actual dates of PR creation and PO approval are shown in table 2.2 and the duration required for approval of each Purchase order.

**Table 2.2:** Approval duration for PR to PO

Sr. no.	Material	Unit	Specification	Company	Quantity	PR Date	PO Approved Date	Approval duration(Days)
1	Cement	Bag (50 Kg)	43 Grade	Ultratech	1000	02-03-2012	07-03-2012	5
2	Cement	Bag (50 Kg)	43 Grade	Ultratech	1000	15-03-2012	20-03-2012	5
3	Cement	Bag (50 Kg)	43 Grade	Ultratech	1240	27-03-2012	02-04-2012	6
4	Sand	Cu.m	River Sand	NA	28.3	02-03-2012	07-03-2012	5
5	Sand	Cu.m	River Sand	NA	21	02-03-2012	07-03-2012	5
6	Sand	Cu.m	River Sand	NA	35.4	02-03-2012	07-03-2012	5
7	Sand	Cu.m	River Sand	NA	34	15-03-2012	20-03-2012	5
8	Sand	Cu.m	River Sand	NA	28.3	15-03-2012	20-03-2012	5
9	Sand	Cu.m	River Sand	NA	28.1	15-03-2012	20-03-2012	5
10	Sand	Cu.m	River Sand	NA	35.4	27-03-2012	02-04-2012	6
11	Sand	Cu.m	River Sand	NA	21	27-03-2012	02-04-2012	6
12	Sand	Cu.m	River Sand	NA	19.8	27-03-2012	02-04-2012	6
13	Sand	Cu.m	River Sand	NA	28	14-05-2012	22-05-2012	8
14	Sand	Cu.m	River Sand	NA	35.2	14-05-2012	22-05-2012	8
15	Sand	Cu.m	River Sand	NA	28.3	14-05-2012	22-05-2012	8

The average approval duration from Purchase Requisition to Purchase Order was 6 days

#### 4. Application of ERP on selected site:-

The material management module in ERP has following objectives;

- 1) Purchase of goods and services
  - i. Create Purchase Requisition
  - ii. Approval of Purchase Requisition
  - iii. Create Purchase Order
  - iv. Approval of Purchase Order
  - v. Receipt of goods and services

2) Manage inventory

3) Manage incoming materials

For the analysis of material management the requirement for following items are considered;

1. Brickwork = 20 Cu.m
2. External Plaster = 87 Sq. m
3. Internal Plaster – 87 Sq.m

4. Columns =  $(0.23 \times 0.6 \times 4.5) \times 10$  no. = 6.21 Cu.m

5. Flooring = 250 Sq.m

The requirement of material for above items as cement, steel, bricks, sand, aggregate and tiles were ordered from the system. The fig. shows the list of purchase requisition created for material required to carry out five activities as brickwork, internal and external plastering, Column casting and flooring.

Project name	Material	PR No.	Qty	Unit	Date
Court Building	Bricks	PR/138	7500	Nos	04/01/2013
Court Building	Cement	PR/139	132	Nos	04/01/2013
Court Building	Sand	PR/140	26	Cum	04/01/2013
Court Building	Aggregate	PR/141	5.60	Cum	04/01/2013
Court Building	Steel 16mm	PR/142	580	Kg	04/01/2013
Court Building	Steel 8mm	PR/143	206	Kg	04/01/2013
Court Building	Tiles	PR/144	1120	Nos	04/01/2013

**Fig. 3.1:** PR created for various materials

The screen in fig. 3.2 shows PR status generated from Head office.

**Fig. 3.2:** PR status

The fig. 3.3 shows the PO login for particular supplier with his PO no.

**Fig. 3.3:** PO login

A typical PO of vendor shown in screen 3.4

**Fig. 3.4:** PO of Vendor

When the PO is approved and the material was supplied the receipt voucher was created with the help of PO no. of same supplier. The receipt voucher login is shown in fig. 3.5

**Fig. 3.5:** Receipt voucher login

The receipt voucher from the name of company was generated and stored into the system as in fig. 3.6

**Fig. 3.6:** Receipt voucher of vendor

The duration required to get approval for stock from Purchase Requisition to Purchase Order by using ERP was 1 day.

## 5. Conclusions

- A conventional case study represents the duration for approval of Purchase order as 6 days which was reduced to 1 day with the help of Enterprise Resource Planning system.
- The Material Management module provided the distinct authorities to approve the Purchase Order.
- The requirement of material on the specific site is verified and processed within 24 hours from the manual creation of purchase requisition.
- The consumption of material is exactly identified to keep control on wastage and prepare a Material Requirement Planning.
- The material management played very important role as the work break down structure of project is related to material issued to particular WBS.
- It became easy to approve, reject or keep pending the purchase requisition and purchase order as per the demand from site was generated.



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