

[DOI: 10.20472/IAC.2015.015.166](https://doi.org/10.20472/IAC.2015.015.166)

DASHARATHRAJ K SHETTY

Manipal Institute of Technology, India

AVINASH KUMAR SINGH

Manipal Institute of Technology, India

SRIKANTH PRABHU

Manipal Institute of Technology, India

RAMAKRISHNA NAYAK

Manipal Institute of Technology, India

LEWLYN L.R. RODRIGUES

Manipal Institute of Technology, India

CRITICAL FACTOR CONCEPTUAL MODEL FOR ERP ADAPTION IN PRINT INDUSTRY

Abstract:

Enterprise resource planning (ERP) is a suite of integrated software applications. Over the years ERP has aided the Organizations around the world to improve their operational efficiency, deliver superior customer service and bring in profitable growth. Print industry needs fundamental ERP capabilities for estimating, material control, job and product structuring, and scheduling. ERP solution also should have the capability to integrate with third party Customer Relationship Management (CRM) and Supply Chain Management (SCM) applications. This paper attempts to present a Critical Factor Conceptual Model to aid the Print Industry in Pre and Post ERP Adaption /Implementation. A set of 17 Critical factors were finalized by referring to the secondary data sources and by conducting semi structured interview of the Industry Experts. A Convenient Sampling survey of Experts and ERP Customers were carried out in Pre and Post ERP implementation stages. The study conducted helped in evolving a Conceptual model to understand the significance of ERP in Print Industry in terms of Wastage Analysis (WA), Cost Estimation (CE) and Accounting (CEA) and Performance Changes before and after ERP implementation.

Keywords:

ERP, Print Industry, Conceptual Model, Wastage Analysis (WA), Cost Estimation (CE) and Accounting (CEA), Performance Changes

JEL Classification: O39, M15

1. Introduction

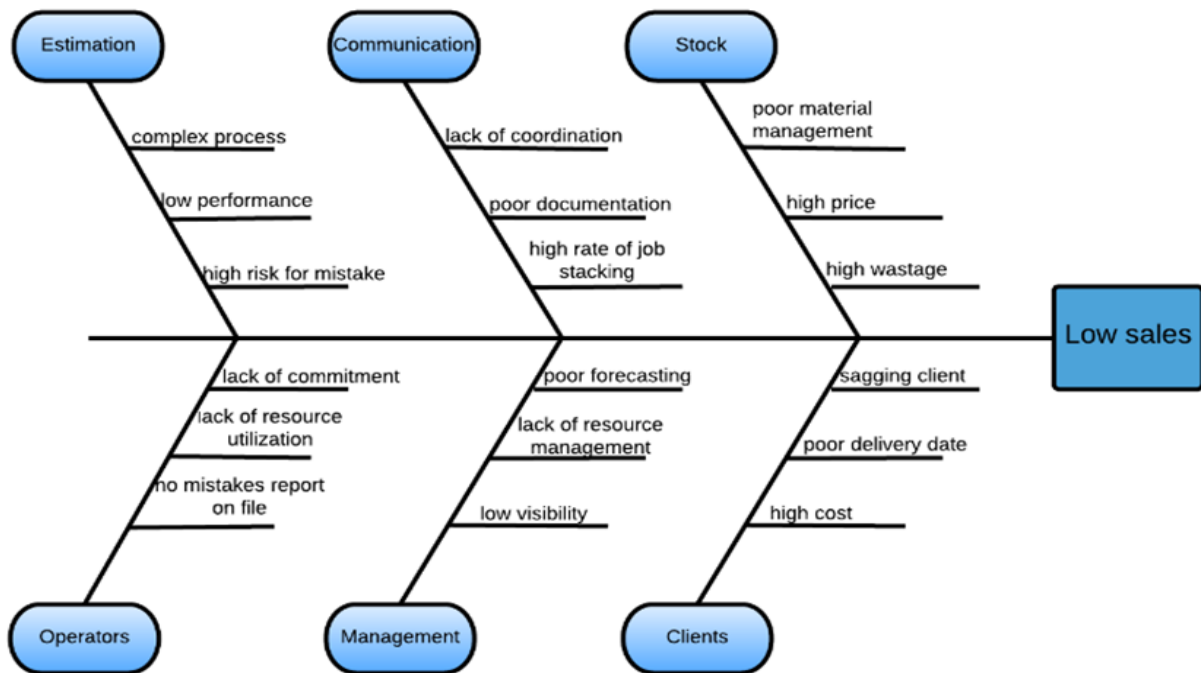
Enterprise Resource Planning(ERP) is software product that integrates the entire processes of an Organization. It helps to provide a flexible communication between the departments. Printing industry needs ERP for streamlining Print Workflow, Managing Costs, Managing Waste & Inventory and to centralize control system management. ERP solutions provide support right from estimating to full shop floor management. ERP is integration of softwares across all the functions of organization. ERP helps in automating the corporate business process and management systems. Hence, ERP integrates all facets of the business.

Table 1: Comparison of Print ERPs in India

Print ERP Solution Providers in India	Accounting function	Computer scheduling	Interface with third party software	Gang job	Multiple Quote
FEC	No	Yes	No	No	Yes
EFICC	Limited	Yes	No	Yes	Yes
HUSA	Yes	No	No	Yes	Yes
HPH	No	Yes	Yes	No	Yes
PMIS	No	No	Yes	No	No
EPS	No	No	Yes	No	Yes
AS	Limited	Yes	No	Yes	Yes

Source: Compiled after interviewing the experts-Names have been changed-actual names will be presented in conference

In India, there are only three major Print ERP vendors. A Comparative study shows that each individual of these ERP products fail to provide a complete solution. In the Print ERP domain the service provider EFICC(name changed) is a major player. Even though EFICC provides complete solution they have limited clients in India due to its high cost. A cost comparison could not be provided as the price is offered by the service provider after negotiating with the specific customers. A Comparison of the various Print ERPs in India is shown in Table 1.

Figure1. Cause and effect diagram depicting the of Printing Industry without ERP

Source: Prepared by the Authors

There are more than 5000 printing presses of various sizes all over the country out of which less than 500 printing presses have ERP Systems deployed to keep track of the efficiency of the press (The Economist, Volume 3, 2014). Implementation of the ERP increases the efficiency of the Printing Industry drastically. Figure 1 shows the various causes for low sales. ERP implementation in the Print Industry helps in proper estimation, communication, stock keeping, operations, management and handling of clients. Print Industry has two main Workflows Estimation Workflow and Production Workflows.

2. Objective

The objective of this study is to design a Critical Factor Conceptual Model to aid the Print Industry in Pre and Post ERP Adaption /Implementation. The Conceptual model should help in understanding the significance of ERP in Print Industry in terms of Wastage Analysis (WA), Cost Estimation and Accounting (CEA) and Performance Changes before and after ERP implementation.

3. Methodology

A Convenient Survey of Experts and ERP Customers were carried out in Pre and Post ERP implementation using convenient mode of sampling. Survey was conducted in two phases.

Phase I(Pre-implementation phase): A set of 17 Critical factors were identified by conducting a literature survey and by obtaining opinion from the IT experts and printing experts with the help of semi structured questionnaires.

- IT Experts – 15 Employees of the IT Company
- Printing Experts –15 Employees of the Printing Industry

Phase II(Post-implementation Phase) : A Study was conducted in the press to study the significance of ERP for Wastage Analysis (WA) and Cost Estimation(CE). The analysis carried out by comparing the results obtained by manual operations and results obtained with the help of the Print ERP.

4. Results and Analysis

4.1 Phase I(Pre-implementation phase)

Hypothesis:

H₀ (null):The factors do not influence the ERP Implementation

H_a (alternative):The factors influence the ERP Implementation

Degree of freedom= (15-1) + (15-1)=28, Table t-value=2.05,p=0.95,1-p=0.05

H₀ (null): Factor is rejected if the calculated t-Value is higher than the Table t-value else H₀ is accepted. H_a (alternate): Factor is accepted if the calculated t-Value is higher than the Table t-value else H_a is rejected.

Table 2: t-Test Results

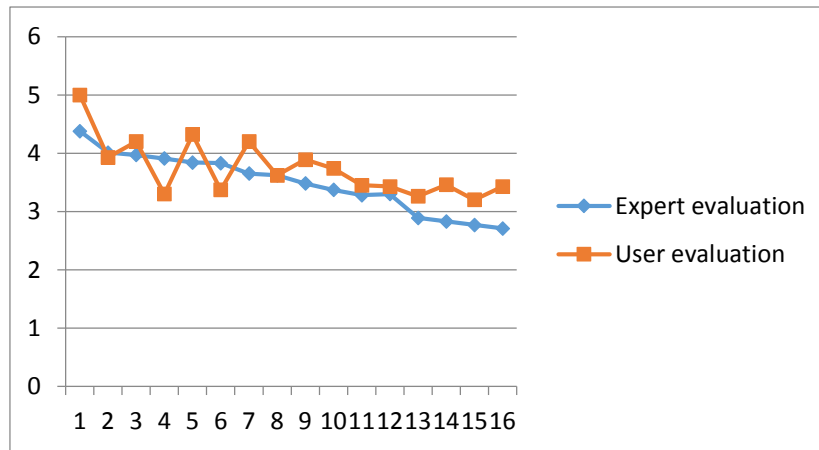
Critical Factors analyzed		CASE A (Set 1) N=15 IT Experts	CASE B (Set 2) N=15 Printing Experts	Null Hypothesis H₀ Accepted If mean <2.05
		Mean	Mean	
IT challenges				
1	Goals of the project	4.38	5	H _a
2	Project management	3.99	3.93	H _a
3	Software Requirement specification	3.97	4.20	H _a
4	Staffs involvement in project	3.91	3.30	H _a
5	Project team	3.84	3.43	H _a
6	Minimum Customization	3.83	3.37	H _a
7	R&D team to conduct real time scenario	3.65	3.30	H _a
8	Organization change management	2.93	3.36	H _a
Printing challenges				
9	Existing system drawbacks & ERP requirement	3.62	3.90	H _a
10	Acceptance of ERP & familiarity	3.58	3.89	H _a
11	Business process re-organization	4.01	4.32	H _a
12	Budget allocation for IT Business solution	3.47	3.45	H _a
13	Exiting ERP attempts & result	3.38	3.74	H _a
14	Data accuracy	3.02	3.1	H _a
15	Training of user	2.99	3.46	H _a
External Factors				

16	Co-operation of external supplier	2.87	3.33	H _a
17	External consultants	2.71	3.20	H _a
	Average Mean	M _a =3.49	M _b =3.656	
	Standard Deviation	S _a =0.45	S _b =0.36	

Source: Compiled by the Authors

Correlation coefficient between CASE A and CASE B evaluation is statistically significant (R=0.642) that means the opinion of the Experts from IT department & Experts from printing Department has positive linear correlation. Hence, all the factors play a significant role. The same is shown in Figure 2.

Figure 2: Differences in CASE A(Expert evaluation) and CASE B(User evaluation)



Source: Compiled by the Authors

4.2 Phase II (Post-implementation phase)

In this a comparative study was conducted in the press to study the impact of Print ERP in Wastage Analysis (WA).The study considered the case of Poster, Magazine1, Magazine2 and Supplement for WS. Study considered Letterhead, Index cards, Newsprint, Flyers and Memos for Wastage Analysis.

4.2.1 Cost Analysis

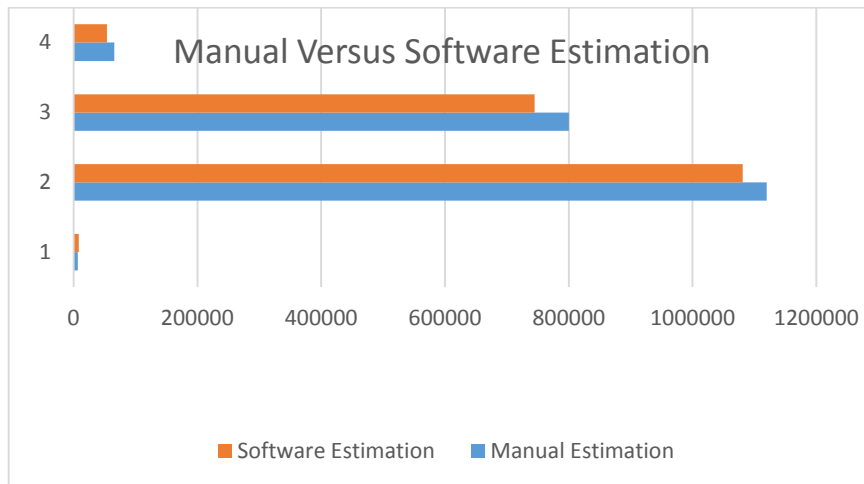
Table 3: Shows the Cost analysis -Manual Versus Software

	Poster	Magazine1	Magazine2	Supplement
Copies	2000	40000	20000	25000
Machine	Mitsubishi Daiya	Lithrone	Cover in Lithrone & inside in Heatset	Heatset
Finishing Size	22.83 inch X 17.21 inch	8.26 inch x 11.02 inch	7.28inch x 9.84inch	21.06inch X 13.77inch
Feeding Size	23.03 inch X 35.82 inch	23.03 inch X 35.82 inch (for cover & inside)	Print in 20.07 inch X 29.93 inch sheet size for cover / 29.92 inch reel for Inside	27.55 inch reel
Pages & Paper	Single side 4 color printing &100 gsm Maplitho Paper	Cover: 4 page 4 color on 130 gsm Art Paper Inside: 64 pages 4 color on 80 gsm Art Paper	Cover: 4 page 4 color on 130 gsm Art Paper Inside: 64 pages 4 color on 80 gsm Art Paper	4 page 4 color & 65 gsm LWC Reel
Manual Estimated Cost(Rs.)	7000	11,20,000	8,00,000	66,000
Software Estimated Cost(Rs.)	8560	10,97,756	7,84,800	63,420
Error	1560	22,224	15,200	2580
Percentage Error(1)	22	1.986	1.90	3.9

Source: Compiled by the Authors

Percent Error: $(| \text{theoretical} - \text{actual} | / \text{theoretical}) \times 100$ (same as 100 - % yield) (1)

Figure 3: Differences in Cost Estimation -Manual Versus with help of Print ERP



Source: Compiled by the Authors

There is considerable gap in Manual estimation and using Print ERP. Hence, ERP helps in increasing the efficiency of Cost Estimation.

4.2.2 Waste analysis

Table 4: Shows the Cost analysis- Manual Versus Software

	Letterhead	Index cards	Newsprint	Flyers	Memo
Size Sheet	8.5×11	6×10	7×10	24×36	8.5×13
Parent Sheet	17×22	25.5×30.5	24×36	25×38	17×22
Copies	28,000	12,000	9,000	1,406	21,000
Number of Forms	7,000	1,000	818	1,406	7,000
Cost of Paper	16500	6630	3250	10140	22165
Paper Waste Percentage (2)	0	7.43	10.88	9.05	11.36

Source: Compiled by the Authors

Paper waste percentage = $\{1 - (\text{Area of sheet used in sq. in.} \div \text{Total area of sheet in sq. in.})\} \times 100$ (2)

As shown in Table 4 the Wastage in the manual selection of sheets in the printing press is enormous and therefore cannot be avoided. To solve this issue, Print ERP should have a provision to gang jobs into single sheet and plan the jobs accordingly. Presses are not planning jobs into single sheet due to its complex planning analysis which results in great amount of paper wastage. No software vendor in India is offering Gang job facility in their Print ERP.

To test the significance of job preferences (Gang jobs in sequence) and planning, Chi-Square test for independence (Job preference versus Planning) was conducted. In a press a random three job were taken. Jobs were classified by sheet sizes (Feeding sheet & Forms) and by job preference (Leaflet, Flyer, or Brochure) as shown in Table 5.

Table 5: Job Preference & Planning

Job Preference				
	Leaflet	Flyer	Brochure	Row total
No. of Forms	63	125	250	438
No. of Copies	500	1000	1000	2500
Column total	563	1125	1250	2938

Source: Compiled by the Authors

H₀: Planning (Sheet Size & No. of Copies) and Jobs preferences are independent.

H₁: Planning (Sheet Size & No. of Copies) and Jobs preferences are not independent.

A Significance level of 0.05 was taken. Chi-square test for independence of sample data was conducted.

$$\text{Degree of Freedom} = (\text{row} - 1) \times (\text{column} - 1) = (2 - 1) \times (3 - 1) = 2 \quad (3)$$

$$E_{\text{row, column}} = (n_{\text{row}} \times n_{\text{column}}) / n \quad (4)$$

In (4) $E_{\text{row, column}}$ is the expected frequency and $O_{\text{row, column}}$ is the observed frequency.

Using (4) we get $E_{1,1}=83.9$, $E_{1,2}=167.7$, $E_{1,3}=186.3$, $E_{2,1}=479$, $E_{2,2}=957.2$, $E_{2,3}=1063.6$,

$$X^2 = \sum [(O_{\text{row, column}} - E_{\text{row, column}})^2 / E_{\text{row, column}}] \quad (5)$$

Using (5) we get $X^2 = (63 - 83.9)^2/83.9 + (125 - 167.7)^2/167.7 + (250 - 186.3)^2/186.3 + (500 - 479)^2/479 + (1000 - 957.2)^2/957.2 + (1000 - 1063.6)^2/1063.6=36.40$

The P value is the probability with 2 degree of freedom. Hence, $P(x^2 > 36.49) = 0.0002$
The p value (0.0002) is less than the significance level (0.05), we accept the alternative hypothesis. Thus, it can be said that there is a relationship between Copies, Forms and Job preference.

5. Performance Testing

A survey of 30 print industry employees was carried out to compare the Press efficiency before and after Print ERP adoption.

Table 6: Comparison of Efficiency-before and after ERP adoption

	Average Mean (Manual)	Percentile Ranking (Manual)	Average Mean (Print ERP)	Percentile Ranking (Print ERP)
Cost Accuracy	4.4	88	4.8	96
Sale analysis & marketing	3.26	65	3.96	79
Shop Floor Control	2.11	42	3.87	77
Master Production Scheduling	2.9	58	4.63	93
Job Card/Quote processing	3.6	72	4.7	94
Customer Relationship Management	3.6	72	4	80

Costing & Invoicing	2.9	58	4.53	91
Delivery Control	3.2	64	4.3	86
Report Writer	3.28	66	4.39	88
Stock control	1.98	40	3.39	68

Source: Compiled by the Authors

From table 6 it can be concluded that the effectiveness of ERP in the printing press can increase the productivity

6. Conclusion

We can define a conceptual model as a model that comprises of factors that help the people to know, understand and simulate the various factors of a subject in question. At pre-implementation level we have conducted a survey on 17 critical factors and tested their significance using t- test and at post implementation level, we have taken various jobs (e.g. book, magazine) and compared the cost using manual estimation and with Print ERP. We have also come up with the wastage analysis solution which is yet to be practiced in Indian Printing Industry. It can be concluded that the effectiveness of ERP in the printing press can increase the productivity which in other words means that ROI on Print ERP will be within one year for small to medium scale industry.

Limitations:

1. The opinion expressed by experts and end-users may be biased, as it is based on their own personal experiences and their work environments.
2. The sample size is limited to 15 members from each category which is a small number and study conducted with higher number may yield better precession.