



## Role of Manpower in IT Companies

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### Abstract

*The importance of manpower employed in IT companies is discussed and this factor is compared IT Companies and in non IT companies. Data for ten years (from 2001 to 2010) has been collected and an analysis between Profit after Tax (PAT), number of employees and compensation paid per employee has been analyzed and the values of the correlation coefficient for each company has been collected. The statistical package SPSS16 has been utilized for this purpose. An analysis of PAT verses manpower employed and compensation per employee has also been done and the value of the correlation coefficient for this analysis has been obtained. Thereafter, Data Envelopment Analysis between manpower and Profits has been done. The profitability / efficiency ratios have been calculated these figures have been compared and it has been shown that the number of employees has a very significant effect on profitability in IT companies, also using Wilcoxon-Mann-Whitney test for obtaining Rank-Sum.*

**Keywords:** Profitability, Correlation Analysis, Regression Analysis, Data Envelopment Analysis, Rank-Sum-Test.

### Introduction

Profitability is invariably the main spark of any economic activity. An analysis of profitability for several companies, including some Information Technology companies and a comparison between the functioning of manufacturing companies and Information

Technology companies do provide some interesting results. Of course, one must first decide the measure to test profitability. In the annual reports provided by various companies, there are several heads under which performance can be measured. These are: 'Profit after Tax' (PAT), 'Profit before Tax (PBT) and Assets created. Of these measures, there is no major difference between Profit-before-Tax and Profit-after-Tax since they both indicate the same measure of profitability. Assets created, on the other hand, may be another measure of the health of the company and the increase in assets may be a measure of the health of the company. However, assets are not normally increased in preference to increase in profit before tax or profit after tax except in very special condition which may be tax related. Therefore either may be selected. In our present case we shall select "Profit after Taxes" in case of companies in India and "Profit" as reported by companies in the U.S.

It is being hypothesized that the manpower strength of an organisation indicates its health. Since different companies have different levels of manpower requirements, the comparison between the increase in profitability and the increase in manpower annually, is the best way to test this hypothesis. Data for a large number of companies was collected and some twelve large companies in India, were selected. Of these four were Information Technology companies, the rest being manufacturing companies or financial companies, including banks. Similarly, ten large companies from the U.S. were selected. Of these, five were Information Technology companies.

In order to test this hypothesis, a regression analysis was done between 'profit-after-tax' (PAT) (or "Profit" in case of companies from the U.S.) as the dependent variable and total manpower along with compensation per person on manpower as the two independent variables. This test was performed for Indian companies only, since compensation per employee was not available for U.S. companies. The analysis indicates that compensation per person has very little effect on PAT, or profit. Accordingly, linear regression analysis was done, taking PAT (or profit) as the 'y' variable and the total manpower as the 'x' variable. Not surprisingly, the value of R and R<sup>2</sup> are very high in most cases. The analyses of the reports from various companies shows the very interesting results discussed below.

The data on which the analysis has been done has been obtained from the annual financial report published by each company<sup>1</sup> over the last ten years and hence may be treated as authentic. Data for some 200 companies were collected. Of these, data from two sets of companies has been selected. Set one consists of some non Information Technology companies consisting of the following eight companies from India and five companies from the U.S. This set consists of companies that do not have Information Technology as their core business or are 'Non IT companies'.

1. ACC
2. ICICI
3. RANBAXY
4. Siemens
5. State Bank of India
6. Steel Authority of India Ltd.

7. Tata Motors
8. Tata Steel
9. Bank of America
10. Boeing
11. Pfizer
12. Proctor and Gamble
13. Walmart

Set two consists of IT companies that have Information Technology as their core business, that is, the following companies:

1. HCL
2. Infosys
3. TCS
4. WIPRO
5. CISCO
6. DELL
7. Microsoft
8. Google
9. ORACLE

The financial and manpower related figures for the last ten years have been realized and the reasons for taking – or ignoring- the data from that company has been explained. Thereafter the figures from the two sets of firms have been compared and conclusions have been drawn.

### **Selection of IT Companies**

It has been mentioned before that Strategic Planning in Information Technology is required for:

- (a) companies for whom Information Technology is their prime business;
- (b) Large companies that extensively use Information Technology as it affects their costs and profits;
- (c) NGOs and Government Organizations that extensively use information Technology but which do not have profitability as their prime motive.

It is difficult to get data from a large number of companies where Information Technology helps heavily in the bottom line as well as from NGOs and Government departments since their accounting is not profitability oriented. In any case the concepts of strategic planning

will be valid for all organizations. Therefore, companies that deal in Information Technology have been taken as examples as they form the bulk of organisations for whom this analysis is important. However, as the following discussions will show, some of the companies selected in group one are heavy users of Information Technology. The companies mentioned in this group have been selected keeping the following issues in mind:

- the main activity of the company is not related to information technology
- the company was sufficiently large and well known
- the companies selected covered different segment of activities
- the data for the last several years- upto 10 years- was available.

The firms selected in this group fulfill all these conditions. We can now describe the statistical analysis and the results obtained for each firm separately.

### **Scope of the Study and the Procedures Adopted**

It is being postulated that in Information Technology organizations, manpower is probably the largest single strategic factor in development and profitability of the organization.

In order to prove this postulate, data for a large number of companies have been collected from their annual reports in India and from Form 10 in the U.S. Thereafter, regression analysis has been done on the data provided by these companies. This data indicates the high value of the correlation coefficient  $R$  – and hence  $R^2$  – for Information Technology organizations.

In the next step, Data Envelopment Analysis has been done for all these companies and the value of profitability or efficiency ratio is obtained for each year. The average of these ratios is calculated for each company. These averages for Information Technology companies are invariably high- very close to one.

In the third analysis Wilcoxon-Mann-Whitney “Rank-Sum-Test” is performed between various companies (one from the “IT group” verses one from the “Non IT group”). This comparison is carried out for several pairs of companies. This test checks the null hypothesis whether the two groups belong to the same population group or not. While this information may not be of great interest to us, the statistic suggested in this test will certainly point out the distinct dependence of profitability on manpower strength in IT companies, in comparison to that in non IT companies.

It is being postulated that while manpower and its regular increase indicates that the health of the company is good in case of all companies, it is definitely a crucial indicator in case of Information Technology companies. On this basis the following table has been created:

**TABLE 1**

S. No.	Company Name	R in PAT vs. Emp. Num	R in PAT vs. Emp.Num & Comp. per Emp
1	ACC	0.046	0.929
2	ICICI	0.979	0.995
3	Ranbaxy	0.164	0.406
4	Siemens	0.802	0.985
5	State Bank of India	0.404	0.903
6	Steel Authority of India	0.821	0.877
7	Tata Steel	0.978	0.979
8	Tata Motors	0.813	0.840
9	Bank of America	0.488	
10.	Boeing	0.100	
11.	Pfizer	0.156	
12.	Proctor & Gamble	0.840	
13.	Walmart	0.892	
<b>Average for Group 1</b>		<b>0.576</b>	<b>0.864</b>
14.	HCL	0.899	0.903
15.	Infosys	0.994	0.994
16.	TCS	0.997	1.000
17.	WIPRO	0.908	0.958
18.	Apple	0.959	
19.	CISCO	0.752	
20.	DELL	0.527	
21.	Google	0.849	
22.	Microsoft	0.946	
23.	ORACLE	0.984	
<b>Average for Group 2</b>		<b>0.882</b>	<b>0.964</b>

We can discuss the above table and draw the appropriate conclusions. It is obvious from the figures displayed in the above table that manpower plays an extremely important role in the profitability of IT companies- worldwide and that its importance is less in “non IT” companies and that compensation per employee does not seriously affect profitability.

We will now use Data Envelopment Analysis to find out whether the above conclusion is reinforced by applying the techniques suggested by Data Envelopment Analysis. In order to do this, we consider the data for each company. For most companies, this data refers to annual manpower and profits for a period of ten years. Data for each company will be treated as one group. Data Envelopment Analysis is run for each company, the output one gets consists of the profitability/ efficiency ratio of 1 in case of the result in the most efficient year; the results for the other years are expressed as fractions of this efficiency standard. We can conclude that if the average of this ratio for all years is high then it can be implied that manpower was effective over the entire period for which the data is analyzed. In addition to this statistic, if we can compare this conclusion with the conclusions obtained from non IT company then the conclusions will be reinforced. This analysis has been performed and the details are given below.

### Efficiency Ratio for ACC

**TABLE 2: DEA Analysis for ACC**

Year	PAT	Number of Employees	Efficiency Ratio
2001	57.17	9000	0.081177
2002	130.43	9000	0.064659
2003	103.89	9000	0.124626
2004	200.24	9000	0.235503
2005	378.39	8000	0.381024
2006	544.18	9000	0.766675
2007	1231.84	9000	0.895353
2008	1438.59	10000	0.679337
2009	1212.79	9000	1
<b>Average</b>			<b>0.469817</b>

**Associated Cement Company:** This is a manufacturing company that manufactures cement. This company clearly indicates that there is no significant change in manpower in the analysis period from 2000-2001 to 2009-2010. The DEA analysis also indicates that the profitability/ efficiency ratio is quite poor. This analysis is based on the data shown in the above table. These figures are obtained from data published by ACC.

**Efficiency Ratio for ICICI**

**TABLE 3: DEA Analysis for ICICI**

<b>Year</b>	<b>PAT</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2001	161.1	4000	0.600617
2002	258.3	7000	0.326646
2003	1206.18	10000	0.963225
2004	1637.11	13000	1
2005	2005.20	18000	0.896692
2006	2540.47	25000	0.929947
2007	3110.22	33000	0.935511
<b>Average</b>			<b>0.807520</b>

**ICICI:** This is a financial company and it is indeed performing very well. The regression analysis of the profitability verses the manpower employed is very high and has remained high for a very long time, indicating that the manpower practices of the company are good and that the company is peacefully improving its business activities. The DEA analysis, as depicted in the table above, indicates that the profitability or efficiency ratio is fairly high, indicating that the manpower practices of the company are good.

**Efficiency Ratio for Ranbaxy**

**TABLE 4: DEA Analysis for Ranbaxy**

<b>Year</b>	<b>PAT</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2001	180.61	6000	0.147099
2002	262.43	6000	0.330196
2003	478.47	6000	0.602023
2004	794.77	6000	1
2005	527.52	7000	0.568919
2006	212.04	7000	0.228681
2007	395.12	8000	0.372863
2008	617.72	8000	0.582923
2009	-1044.80	8000	0.479787
<b>Average</b>			<b>0.532475</b>

**Ranbaxy:** This company shows very low correlation between Profit after Tax (PAT) and manpower employed. The correlation between PAT and manpower employed plus compensation per unit of manpower is also not very good. The profit or efficiency ratio is also not very high. It can, therefore be concluded that significant changes in manpower do not present serious issues in profitability in this company.

### Efficiency Ratio for Siemens

**TABLE 5: DEA Analysis for Siemens**

Year	PAT	Number of Employees	Efficiency Ratio
2001	64.00	4000	0.141314
2002	68.72	4000	0.115608
2003	86.56	3000	0.292415
2004	139.38	3000	0.476353
2005	151.37	4000	0.254651
2006	245.75	4000	0.428568
2007	360.11	5000	0.413583
2008	596.54	6000	0.570934
2009	593.33	6000	0.567861
2010	1044.85	6000	1
<b>Average</b>			<b>0.425129</b>

**Siemens:** The correlation coefficient between PAT and Manpower employed for this company is high and with the inclusion of compensation per unit of manpower, it becomes even higher. But it may be seen that while there is no large scale changes in manpower with increasing profitability, the compensation per employee has increased considerably. However, DEA analysis indicates that profitability or efficiency ratio is not high. This may indicate that the chief reason for good correlation between PAT and number of Employees is compensation per employee being good.

### Efficiency Ratio for State Bank of India

**TABLE 6: DEA Analysis for State Bank of India**

Year	PAT	Number of Employees	Efficiency Ratio
2001	1604.25	214000	0.163571



2002	2431.62	209000	0.253861
2003	3105.00	208000	0.325721
2004	3681.00	207000	0.38801
2005	4304.52	205000	0.458161
2006	4406.67	198000	0.485616
2007	4541.31	185000	0.53562
2008	6729.12	179000	0.820262
2009	9121.23	205000	0.970838
2010	9166.05	200000	1
<b>Average</b>			<b>0.540166</b>

**State Bank of India:** This is a financial organization that has a very large manpower base. An analysis of PAT against the manpower trend reveals that the correlation coefficient R for PAT verses Manpower employed is fairly low at 0.404 but increases significantly to 0.903 for when both manpower employed and compensation paid per employee are taken as independent variables. Therefore, manpower *per se* does not have any significant effect on profitability. This mixed conclusion is also indicated by the profitability or efficiency.

#### Efficiency Ratio for Steel Authority of India

**TABLE 6: DEA Analysis for SAIL**

Year	PAT	Number of Employees	Efficiency Ratio
2005	6816.97	126000	0.325676
2006	4012.97	138000	0.918851
2007	6202.29	132000	0.493868
2008	7536.78	128000	0.79786
2009	6170.40	121000	1
2010	6754.37	116000	0.988897
Average			0.754213

**Steel Authority of India Ltd.:** SAIL, as this company is normally referred to, employs a fairly large volume of manpower. This company has been trying to reduce manpower as improved technology is being utilized. However, a regression coefficient value of 0.821 does not effectively imply that the manpower has a very significant role in improving profitability. The

fact that manpower has some effect on profitability is demonstrated by moderately good profitability or efficiency ratio.

### Efficiency Ratio for Tata Motors

**TABLE 7: DEA Analysis for Tata Motors**

Year	PAT	Number of Employees	Efficiency Ratio
2003	300.11	20000	0.160767
2004	810.34	21000	0.413424
2005	1236.95	22000	0.602389
2006	1528.88	22000	0.744558
2007	1913.46	22000	0.931847
2008	2028.92	23000	0.945115
2009	1016.55	23000	0.474464
2010	2240.08	24000	1
<b>Average</b>			<b>0.527256</b>

**Tata Motors:** A study of the regression analysis of the data for the last eight years for Tata Motors shows a reasonable but not high correlation between the annual profitability and the manpower utilized. While the manpower growth has not been substantial, the profitability has increased rapidly and also decreased rapidly in one case, tending to enforce the conclusion that manpower and change in it is not a significant factor in profitability. The correlation coefficient for Profit after Tax versus Number of Employees and Compensation per employee is also marginally higher than correlation between Profit after Tax and Number of Employees rising from 0.813 to 0.840. The obvious conclusion is that the significance of manpower in profitability is nominal. There is, therefore, some dichotomy and this is reflected by an intermediate value of profitability/efficiency ratio.

### Efficiency Ratio for Tata Steel

**TABLE 8: DEA Analysis for Tata Steel**

Year	PAT	Number of Employees	Efficiency Ratio
2001	553.44	48000	0.07264
2002	204.90	46000	0.029115
2003	1012.31	43000	0.153878

2004	1746.22	42000	0.271757
2005	3474.16	39000	0.582258
2006	3506.38	38000	0.603123
2007	4222.15	37000	0.745868
2008	1904.45	35000	0.875306
2009	2375.29	34000	1
2010	2470.22	34000	0.970214
Average			0.5304520

**Tata Steel:** Like SAIL, Tata Steel has also gone in for manpower reduction by seriously improving technology, but unlike SAIL it has had greater success in reducing manpower while at the same time keeping its retained manpower relevant. The value of correlation coefficient being very high at 0.978 would seem to indicate high relevance of manpower on profitability. However, a look at the fitted straight line indicates that there is sharp reduction in manpower on a regular basis. The dependence of profitability on manpower can be considered to be incidental or peripheral. This conclusion is reinforced by the profitability / efficiency ratio.

#### Efficiency Ratio for Bank of America

**TABLE 9: DEA Analysis for Bank of America**

Year	Profit	Number of Employees	Efficiency Ratio
2001	7499	142274	0.540709
2002	9553	142670	0.686904
2003	10762	133549	0.855902
2004	13947	175742	0.763921
2005	16465	176638	0.8989
2006	21133	203425	1
2007	14982	210000	0.686742
2008	4008	243000	0.158769
2009	6276	284000	0.21272
<b>Average</b>			<b>0.644952</b>

**Bank of America:** Bank of America is a non IT company that has a reasonably high profitability ratio but a low correlation coefficient. Neither of the two figures show high dependence of profitability on manpower. One would say that neither of the two figures gives any definite answers.

### Efficiency Ratio for Boeing

**TABLE 10: DEA Analysis for Boeing**

Year	Profit	Number of Employees	Efficiency Ratio
2001	2827	188000	0.290673
2002	492	166000	0.419364
2003	718	157000	0.49952
2004	1872	159000	0.63921
2005	2572	153000	0.785634
2006	2215	154000	1
2007	4074	159300	0.685352
2008	2672	162200	0.180068
2009	1312	157100	0.291116
<b>Average</b>			<b>0.532326</b>

**Boeing:** The correlation coefficient for Boeing is very low, while the profitability / efficiency ratio is also fairly low. In case of Boeing, this is understandable because the job volume fluctuates and therefore the dependence of profitability on manpower is not high.

### Efficiency Ratio for Pfizer

**TABLE 11: DEA Analysis for Pfizer**

Year	PAT	Number of Employees	Efficiency Ratio
2001	7788	90000	0.438551
2002	9126	98000	0,471945
2003	3910	122000	0.162425
2004	11361	115000	0.500675
2005	8085	106000	0.388555
2006	19337	98000	1
2007	8144	86600	0.476603

2008	8104	81800	0.502092
2009	8635	116500	0.375641
2010	8257	116500	0.037836
<b>Average</b>			<b>0.435432</b>

**Pfizer:** This company may be doing well as well as a profitable concern but its performance in terms of dependence of profitability on manpower is poor as indicated by very low correlation coefficient as well as profitability / efficiency ratio.

### Efficiency Ratio for Proctor & Gamble

**TABLE 12: DEA Analysis for Proctor & Gamble**

Year	PAT	Number of Employees	Efficiency Ratio
2001	2922	106000	0.270818
2002	4352	102000	0,424801
2003	5186	98000	0.560554
2004	6481	110000	0.578833
2005	7257	107000	0.666311
2006	8684	136000	0.627314
2007	10340	135000	0.752473
2008	12075	135000	0.878734
2009	13436	132000	1
2010	12736	127000	0.98522
<b>Average</b>			<b>0.8080208</b>

**Proctor & Gamble:** The values of both correlation coefficient are high and indicate that the performance of the manpower has been effective in contributing to profitability.

### Efficiency Ratio for Walmart

**TABLE 12: DEA Analysis for Walmart**

Year	PAT	Number of Employees	Efficiency Ratio
2001	6295	1244000	0.683256

2002	6671	1383000	0,638824
2003	7955	1400000	0.2671
2004	9054	1500000	0.705032
2005	10267	1700000	0.442705
2006	11234	1800000	1
2007	11284	1900000	0.398995
2008	12731	2100000	0.359223
2009	13400	2100000	0.38276
2010	14335	2100000	0.0386
<b>Average</b>			<b>04916495</b>

**Walmart:** Unlike Proctor & Gamble the correlation coefficient, which is very good, the profitability / efficiency ratio is quite low. Perhaps Wilcoxon-Mann-Whitney test will throw some light on the issue of profitability and its dependence on manpower.

Having seen the values for the regression coefficients for all the non-IT companies discussed above, we may safely conclude that manpower and its changes do not seriously affect the profitability of these companies. Obviously, manpower increase may be essential in most cases where production capabilities are increased to a certain higher level, but at the same time, as SAIL and Tata Steel have shown, the attempt to cut down on the flab as well as to upgrade technology may be a method of managing manpower so that profitability is not seriously affected by manpower increase. We can now look at the similar analysis in case of companies in Group 2, that is in IT companies.

### Selection of “IT” Companies

These consist of those companies that have Information Technology as their core business. There were four such large companies from India and five companies from the U.S. The performance of these are analyzed below.

### Efficiency Ratio for HCL

**TABLE 13: DEA Analysis for HCL Infotech**

Year	PAT	Number of Employees	Efficiency Ratio
2001	199.91	--	--
2002	426.78	3000	1
2003	401.95	4000	0.706365
2004	312.47	5000	0.439294
2005	325.72	8000	0.286201
2006	329.27	12000	0.19288
2007	638.29	17000	0.530595
2008	1101.76	32000	0.904148

2009	780.64	37000	0.40903
2010	997.16	38000	0.643123
<b>Average</b>			<b>0.571793</b>

**HCL Infotech:** HCL computers is one of the oldest IT companies in India This is one of the four large IT companies in India whose data has been considered for analysis. One look at the following table immediately strikes one that this is a company whose growth is reflected in the continuous rise in its Profit after Tax (PAT) from 199.91 in 2001 to 997.16 in 2010 along with the continuous rise in its manpower from 3000 in 2002 to 38000 in 2010. The value of the correlation coefficient calculated over this period is 0.899. It is interesting to note that in case this regression analysis is done with two input variables that is, manpower utilized and compensation per employee, this correlation coefficient increases marginally to 0.903, thereby indicating that the compensation given to the employees is adequate and it does not seriously affect the regression coefficient.

### Efficiency Ratio for Infosys

**TABLE 14: DEA Analysis for Infosys**

Year	PAT	Number of Employees	Efficiency Ratio
2001	628.81	9000	0.98792
2002	807.96	10000	1
2003	957.93	15000	0.79041
2004	1243.47	23000	0.69998
2005	1904.00	32000	0.812057
2006	2421.00	44000	0.766449
2007	3782.00	59000	0.916844
2008	4470.00	73000	0.882069
2009	5819.00	85000	0.995076
2010	5803.00	92000	0.916761
<b>Average</b>			<b>0.876757</b>

**Infosys:** Infosys is perhaps the internationally most famous IT Company from India. The figures shown in the table below show the fact of dependence of PAT on manpower increase very clearly. The fact that the value of the regression coefficient of the regression analysis between PAT and Manpower employed is very high - 0.994 is clearly indicative of the fact that profitability is almost directly dependant on the manpower strength. This is further enforced by the fact that when profitability as measured by PAT is correlated against both manpower strength

and compensation paid to the manpower, the correlation coefficient still remains at 0.994. Clearly, the employees do not find the compensation paid to them in any way to be inadequate.

### Efficiency Ratio for TCS

**TABLE 15: DEA Analysis for Tata Consultancy Services**

Year	PAT	Number of Employees	Efficiency Ratio
2005	1831.42	40000	0.994849
2006	2716.87	62000	0.945241
2007	3757.29	85000	0.950978
2008	4508.76	97000	1
<b>Average</b>			<b>0.972767</b>

**Tata Consultancy Services:** Tata Consultancy Services or TCS is the largest IT Company from India. The company is of recent origin since it was earlier operating as a unit of Tata Sons and had a fairly large international presence then. However, it became a full fledged company in its own right much later. Therefore, the data available is only of recent years and therefore, somewhat inadequate. Therefore, the average values for the regression coefficient for all companies in Group2 have been calculated with as well as without TCS. In either case, the average is very high. The average coefficient of correlation of IT companies with TCS is 0.952 and without TCS it is 0.934. The coefficient of correlation for TCS with a single variable – Employee Number- is 0.997 and with two independent variables – Employee Number and Compensation to Employees- is 1.00. The significance of Employee strength in enhancing profitability is very high.

### Efficiency Ratio for WIPRO

**TABLE 16: DEA Analysis for WIPRO**

Year	PAT	Number of Employees	Efficiency Ratio
2005	1494.82	41000	0.922292
2006	2020.50	53000	0.900968
2007	2842.10	67000	0.96486
2008	3063.30	82000	0.828419
2009	2973.80	97000	0.675997
2010	4898.00	108000	1
<b>Average</b>			<b>0.882089</b>



**WIPRO:** Wipro is one of the four major IT companies in India and the results of the regression analysis between Profit after Tax (PAT) and Number of employees over the years indicates that the coefficient of correlation between these two is extremely high at 0.908 and that the coefficient of correlation between PAT and two inputs – Number of Employees and Compensation per employee – at 0.958 is slightly better. The meaning of this is that while Number of employees is a distinctly important and that Compensation per employee is reasonably good but at the same time leaves some room for improvement.

**Efficiency Ratio for Apple**

**TABLE 17: DEA Analysis for Apple**

<b>Year</b>	<b>Profit</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2002	65	10211	0.059027
2003	69	10912	0.047217
2004	276	11695	0.1481
2005	1328	14800	0.383947
2006	1989	17787	0.398327
2007	3495	21600	0.502709
2008	6119	32000	0.497667
2009	8235	34300	0.61104
2010	14013	46600	1
<b>Average</b>			<b>0.405337</b>

**Apple:** This is a company that was formed in the 70’s, but started doing extremely well from 2002 and its profitability has since been gradually improving. However, the fact that manpower has been a prime mover in profitability is not illustrated dramatically by the average of the profitability/efficiency index. This is because the improvement in profitability has been gradual. The slow increase in profitability in the earlier years under discussion shows the problems associated with considering averages of the profitability ratios.

**Efficiency Ratio for CISCO**

**TABLE 18: DEA Analysis for CISCO**

<b>Year</b>	<b>Profit</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2002	1893	36000	0.351835
2003	3578	34000	0.704129
2004	4401	34000	0.86609

2005	5741	38413	1
2006	5580	49926	0.747822
2007	7333	61535	0.835592
2008	8052	66129	0.90794
2009	6134	65550	0.626126
2010	7767	70000	0.808902
<b>Average</b>			<b>0.760928</b>

**CISCO:** While the productivity/ efficiency ratio is reasonably good and inline with our reasoning that manpower has definite effects on profit, the analysis mentioned in case of Apple is further strengthened; the low increase of profitability in the earlier years is reducing the average of this ratio; nevertheless, it is reasonably high.

#### Efficiency Ratio for DELL

**TABLE 19: DEA Analysis for DELL**

Year	PAT	Number of Employees	Efficiency Ratio
2001	2177	40000	0.471969
2002	1246	34000	0.42705
2003	2122	39100	0.489404
2004	2625	65200	0.223763
2005	3018	65200	0.257263
2006	3602	65200	0.307045
2007	2583	90500	0.146054
2008	2947	88200	0.170982
2009	2478	78900	0.160717
2010	1433	96000	1
<b>Average</b>			<b>0.371765</b>

**DELL:** The profitability/ efficiency ratio is rather low. For an IT company, this is unusual. The value of the correlation coefficient in regression analysis is also not high. The chief reason for these two facts is probably that DELL has stepped out from being a purely IT company and has gone into manufacturing and marketing. This shifting of focus away from IT has resulted in lower profitability / efficiency ratio.

**Efficiency Ratio for Google**

**TABLE 20: DEA Analysis for Google**

<b>Year</b>	<b>PAT</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2004	399	3021	0.710703
2005	1465	5680	0.928638
2006	3077	10674	0.915506
2007	4204	16805	0.760939
2008	4227	20222	0.635841
2009	6520	19835	1
2010	8505	24400	0.507909
<b>Average</b>			<b>0.779934</b>

**Google:** The origin and development of this company is like a fairy-tale. Both, the correlation coefficient and profitability / efficiency ratio are high, pointing out that manpower has built this company and is providing the profitability. The figures shown above are totally in line with the postulate that manpower is an important strategic asset of an IT company.

**Efficiency Ratio for Microsoft**

**TABLE 21: DEA Analysis for Microsoft**

<b>Year</b>	<b>PAT</b>	<b>Number of Employees</b>	<b>Efficiency Ratio</b>
2001	7346	47000	0.800901
2002	5355	50000	0.531143
2003	7531	55000	0.669791
2004	8168	57000	0.697611
2005	12251	61000	0.969619
2006	12599	71000	0.842093
2007	14065	79000	0.844636
2008	17681	89000	0.942484
2009	14659	89000	0.781930
2010	18760	89000	1
<b>Average</b>			<b>0.808021</b>

**Microsoft:** The success of Microsoft is another success story like Google and proves the postulate that we have stated.

### Efficiency Ratio for ORACLE

**TABLE 22: DEA Analysis for ORACLE**

Year	PAT	Number of Employees	Efficiency Ratio
2001	2561	42927	1
2002	2224	42006	0.803948
2003	2307	40650	0.861771
2004	2681	41658	0.977244
2005	2886	40872	0.878707
2006	3381	56133	0.914601
2007	4274	74674	0.870847
2008	5521	84233	0.999007
2009	5593	86000	0.991317
2010	6135	105000	0.891082
<b>Average</b>			<b>0.918838</b>

The analysis of the average values of profitability/efficiency ratio for each company clearly shows the dependence of profitability on manpower in IT organizations. For ‘non IT companies’ the relationship between manpower and profitability is not very clear. After this in the next analysis “Whitney-Mann-Wilcoxon” Rank-Sum-Test will be utilized to compare companies in groups of two. Each group will consist of one IT company and one ‘non IT company’. This should further reinforce the conclusions arrived from the earlier two tests.

### Rank-Sum-Test

This test, devised by Whitney, Mann and Wilcox, is a non parametric test that compares independent data belonging to two groups to test the hypothesis that the two groups belong to the same population. While the statistic for each group will indicate whether there is any significant difference between the two members, the test devised by Wilcoxon need not be extended since the statistic will directly show the ranking. The results of the test carried out on various groups are described below.

In this test between two groups say G1 and G2, assume that G1 has  $m$  members and G2 has  $n$  members. We then merge the two groups and get a new group say M. In this group we rank the members in descending order, while keeping the identity of the original group (that is, whether the data belongs to group G1 or G2). This new group M will then have  $m+n$  elements. We then rank these elements and if there is a tie, we then use the midrank value for both

observations. Thus, in the ranking if there are two values of 1, two values of 1.5 will be recorded and no value of 2. The list of ranking using in the combined set is thus created. Thereafter, the statistics for the rankings are created for group G1 by adding all the ranks for G1 and similarly for G2. We can compare these two and decide the ranking, as long as the values of  $m$  and  $n$  are equal. We are thus avoiding further computation, since we are aware that they both belong to the same group and we are only concerned with the comparative ranks.

This test is carried out between Walmart and CISCO, as follows:  
The data for Walmart is as follows:

0.638824, 0.2671, 0.705032, 0.442705, 1, 0.398995, 0.359223, 0.38276, 0.0386

In this case, the data for Walmart has been reduced to 2002 to 2010 from 2001 to 2010. This has been done by dropping the data for 2001. The reason for this is that the usable data for CISCO is available only for 2002 to 2010. The data for CISCO is:

0.381835, 0.04129, 0.86609, 1, 0.747882, .835592, 0.90794, 0.26126, 0.808902.

When these are ranked and the rankings summed up company wise, the statistics that we get are:  $S = 115.5$  for Walmart and  $S = 63.5$  for CISCO

Further computation of normalization etc. is not required since these figures clearly indicate that the rank of CISCO is considerably above that of Walmart. Similarly, we can try this comparison between DELL and Walmart. The data for DELL (also for 2002 to 2010) is:

0.471969, 0.42705, 0.489404, 0.223763, 0.257263, 0.307045, 0.146054, 0.170982, 0.160717, 1

When these are ranked along with the data for Walmart, the statistics that we get are:  $S = 74.5$  for Walmart and  $S = 97.5$  for DELL. This does show that ranking wise, Walmart, a non IT company, is ranked above DELL an IT company. Similar comparisons have been done between other IT companies and non IT companies. In all cases IT companies have ranked better than non IT companies.

A word about the 'Rank-Sum-Test' is in order. The test as suggested by Wilcoxon, Mann and Whitney has not been utilised in full; rather a modification of the test has been utilised. The test as suggested by them is to test whether the two groups belong to the same population or not. In the present case the groups belong to the same population by design; we only need to test the ranking of each group with respect to the other. This may, therefore, be considered a modified 'Rank-Sum-Test'

## **Conclusions**

The comparative study between companies whose products are not Information Technology related and companies whose products are IT related clearly demonstrates that while manpower increase is related to increase in profitability for 'non-IT' companies, it is not a deciding factor by itself. The examples of this fact are numerous; the case of Tata Steel and SAIL are classic cases where manpower has not been increased substantially but profitability has

increased. In fact, in the case of Tata Steel, manpower has been drastically reduced over the ten year period, whereas the profitability has increased sharply. Other examples of non-IT companies where increased profitability is related to increased manpower. We may safely conclude, therefore, that for 'non-IT companies' the increase in manpower is not a very serious factor in increasing profitability. This is amply indicated by the average value of significance of correlation of 0.626 for this group.

For companies whose products are IT related, however, manpower and its continuous increase is a very significant factor in the increase in profitability of the company. The average value of the correlation coefficient of 0.950 for 'IT companies' amply indicates this dependence. Also, the difference between the correlation coefficients of PAT verses number of employees and PAT verses number of employees and compensation per employee is a mere 0.014 ( the difference between 0.950 and 0.964) indicating that employee satisfaction is very good at the present rate of compensation per employee for IT companies. In fact it may be concluded that one of the most important assets – if not the most important asset- of an IT company is its manpower. This fact can be utilized in long term strategic planning. The factors that are required to retain the organization's most significant assets- the employees- can be analyzed. These facts may be utilized in deciding the extent, timing and composition of the training to be employed for the employees. It is a suggestion that companies should report the "attrition" rate of employees every year- subject to certain constraints: for example, the number of employees who have quit the organization after, say 3 years. The percentage of such employees out of the total employee strength will be a firm indicator of the health of the company.

To summarize the conclusions, the use of regression analysis and Data Envelopment Analysis indicates that manpower is a critical strategic asset for an IT organization. The fact that it appears to be a critical asset for some companies merely indicates that the manpower practices of these companies are very good; for IT companies, on the other hand manpower is a critical strategic asset. This factor must be kept in mind and given important consideration in both recruitment and training.

All the tests mentioned in this paper have been carried out. These include regression analysis, Data Envelopment Analysis and 'Rank-Sum-Test'. These are not being enclosed with this paper to reduce the size. They are available with the authors.

In the appendix the total details of the statistical analysis for one company – Infosys- has been shown: results, similar to those of Infosys are available for all other companies and can be shown. For regression analysis, the software package used is SPSS16 and for Data Envelopment Analysis, the software package MaxDEA5 developed by Cheng Gang and Qian Zhenhua has been used.

## References

1. Cooper, Seiford and Tone, "Introduction to Data Envelopment Analysis"
2. Cheng Gang and Qian Zhenhua, "MaxDEA5 and manuals"
3. P.L.Brockett and B.Golany "Using Rank Statistics for Determining Programmativ Efficiency Differences in Data Envelopment Analysis"
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5. Andersen, P., Petersen, N.C.A., 1993. Procedure for ranking efficient units in Data Envelopment Analysis. *Management Science* 39 (10), 1261–1264.
6. Charnes, A., Cooper, W.W., Rhodes, E., 1978. Measuring efficiency of decision making units, *European Journal of Operations Research* 2, 429–441.
7. Chen, Y., 2003. Measuring super-efficiency in DEA in the presence of infeasibility, *European Journal of Operations Research* 161, 545–551.
8. Cooper, W.W., Seiford, L.M., Tone, K., 2000. *Data Envelopment Analysis*. Kluwer Academic Publishers., USA. pp. 42–46.
9. Haritha Saranga. 2009. The Indian auto component industry – Estimation of operational efficiency and its determinants using DEA ,*European Journal of Operational Research* 196 (2009) 707–718.
10. Zhu, J., 2003. *Quantitative Models for Performance Evaluation and Benchmarking*. Kluwer Academic Publishers, USA.

## APPENDIX

### INFOSYS

#### Regression

#### Notes

Output Created		23-Jul-2011 15:53:15
Comments		
Input	Data	G:\INFOSYS.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
Missing Handling	Value Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT VAR00001 /METHOD=ENTER VAR00003.
Resources	Processor Time	00:00:00.078
	Elapsed Time	00:00:00.078
	Memory Required	1452 bytes
	Additional Memory Required for Residual Plots	0 bytes



[DataSet1] G:\INFOSYS.sav

**Variables Entered/Removed<sup>b</sup>**

Model	Variables Entered	Variables Removed	Method
1	EmpNum <sup>a</sup>	.	Enter

a. All requested variables entered.

b. Dependent Variable: PAT

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.994 <sup>a</sup>	.988	.986	238.69940

a. Predictors: (Constant), EmpNum

**ANOVA<sup>b</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.649E7	1	3.649E7	640.483	.000 <sup>a</sup>
	Residual	455819.214	8	56977.402		
	Total	3.695E7	9			

a. Predictors: (Constant), EmpNum

b. Dependent Variable: PAT

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
-------	-----------------------------	---------------------------	---	------

		B	Std. Error	Beta		
1	(Constant)	-44.392	135.147		-.328	.751
	EmpNum	.064	.003	.994	25.308	.000

a. Dependent Variable: PAT

\* Curve Estimation.

TSET NEWVAR=NONE.

CURVEFIT

/VARIABLES=VAR00001 WITH VAR00003

/CONSTANT

/MODEL=LINEAR

/PLOT FIT.

### Curve Fit

#### Notes

Output Created		23-Jul-2011 15:53:55
Comments		
Input	Data	G:\INFOSYS.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Cases with a missing value in any variable are not used in the analysis.

Syntax		CURVEFIT /VARIABLES=VAR00001 WITH VAR00003 /CONSTANT /MODEL=LINEAR /PLOT FIT.
Resources	Processor Time	00:00:00.953
	Elapsed Time	00:00:00.969
Use	From	First observation
	To	Last observation
Predict	From	First Observation following the use period
	To	Last observation
Time Series Settings (TSET)	Amount of Output	PRINT = DEFAULT
	Saving New Variables	NEWVAR = NONE
	Maximum Number of Lags in Autocorrelation or Partial Autocorrelation Plots	MXAUTO = 16
	Maximum Number of Lags Per Cross- Correlation Plots	MXCROSS = 7
	Maximum Number of New Variables Generated Per Procedure	MXNEWVAR = 60
	Maximum Number of New Cases Per Procedure	MXPREDICT = 1000

Treatment of User-Missing Values	MISSING = EXCLUDE
Confidence Interval Percentage Value	CIN = 95
Tolerance for Entering Variables in Regression Equations	TOLER = .0001
Maximum Iterative Parameter Change	CNVERGE = .001
Method of Calculating Std. Errors for Autocorrelations	ACFSE = IND
Length of Seasonal Period	Unspecified
Variable Whose Values Label Observations in Plots	Unspecified
Equations Include	CONSTANT

[DataSet1] G:\INFOSYS.sav

### Model Description

Model Name	MOD_1
Dependent Variable 1	PAT
Equation 1	Linear
Independent Variable	EmpNum
Constant	Included
Variable Whose Values Label Observations in Plots	Unspecified

### Case Processing Summary

	N
Total Cases	10
Excluded Cases <sup>a</sup>	0
Forecasted Cases	0
Newly Created Cases	0

a. Cases with a missing value in any variable are excluded from the analysis.

### Variable Processing Summary

	Variables	
	Dependent	Independent
	PAT	EmpNum
Number of Positive Values	10	10
Number of Zeros	0	0
Number of Negative Values	0	0
Number of Missing User-Missing Values	0	0
System-Missing	0	0

### Model Summary and Parameter Estimates

Dependent Variable: PAT

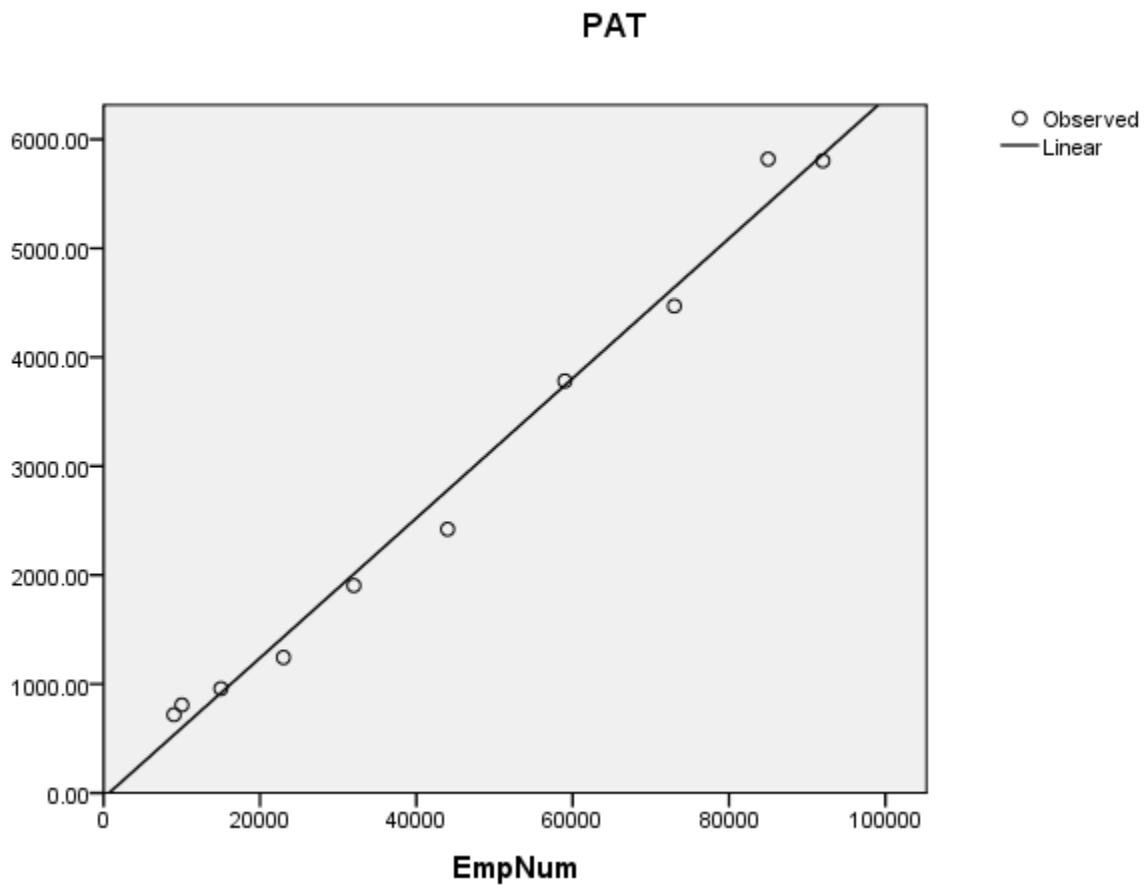
Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.988	640.483	1	8	.000	-44.392	.064

## Model Summary and Parameter Estimates

Dependent Variable: PAT

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	.988	640.483	1	8	.000	-44.392	.064

The independent variable is EmpNum.



## Regression

### Notes

Output Created		23-Jul-2011 15:54:33
Comments		
Input	Data	G:\INFOSYS.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	10
Missing Handling	Value Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT VAR00001 /METHOD=ENTER VAR00003 VAR00004.
Resources	Processor Time	00:00:00.359

Elapsed Time	00:00:00.375
Memory Required	1708 bytes
Additional Memory Required for Residual Plots	0 bytes

### Variables Entered/Removed<sup>b</sup>

Model	Variables Entered	Variables Removed	Method
1	CompperEmp, EmpNum <sup>a</sup>	.	Enter

a. All requested variables entered.

b. Dependent Variable: PAT

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.994 <sup>a</sup>	.988	.984	252.65091

a. Predictors: (Constant), CompperEmp, EmpNum

### ANOVA<sup>b</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.650E7	2	1.825E7	285.921	.000 <sup>a</sup>
	Residual	446827.381	7	63832.483		
	Total	3.695E7	9			

a. Predictors: (Constant), CompperEmp, EmpNum



**ANOVA<sup>b</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.650E7	2	1.825E7	285.921	.000 <sup>a</sup>
	Residual	446827.381	7	63832.483		
	Total	3.695E7	9			

b. Dependent Variable: PAT

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-350.612	828.331		-.423	.685
	EmpNum	.063	.003	.982	18.969	.000
	CompperEmp	33.197	88.450	.019	.375	.719

a. Dependent Variable: PAT