

Meta Analytic Approach to Compare Competence Indices of an Automobile Company

R. Chakrabarty, S. K. Basu and N. Mazumdar
Department of Business Management
University of Calcutta, Kolkata 700001, India

Abstract

Big or small companies and organizations put much effort on “human capital” and its development. They know that internal competences are able to give a distinctive identity for the company, and that the knowledge of their human competence index has become the common practice to all human resource development researchers. Various definitions and resources represents the primary wealth of the organization. They therefore develop and implement tools and methods to manage, transfer and capitalise competence, and to define standards for their evaluation and validation. As an indicator to the growth of an organisation the estimation of human resource index or methods are used for such estimation by these development practitioners with their own different perceptions on the concept of competence level. Authors in this paper have made an effort to compare four such estimation methods (Analytic Hierarchy Process (AHP), Human Development Index(HDI), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and FUZZY) using the Human Resource (HR) indices for 8 departments with 4 types of managers. Finally a comparison on different methods using the concept of META Analysis has been made and the best method has been identified.

Key Words

META Analysis, Analytic Hierarchic Process, TOPSIS Method, HDI, FUZZY method

Introduction

In all business operations the three most important words are people, product and profit. Of these people i.e Human resource is the most important pillar because unless there is a team of good people not much be done with the other two. For this reason large or small companies and organizations, invest much effort on “human capital” and its development. They know that internal competences are able to impress a distinctive feature on the company, and that the knowledge of their human resources represents the primary wealth of the organization. They therefore develop and implement tools and methods to manage, transfer and capitalise competence, and define standards for their evaluation and validation. Competence combines three aspects, knowledge, know-how, attitudes and resources. It is known that any analysis of competence has to be contextualised to the typology of product, service and organization. A study was under taken in an automobile unit as it wanted to enhance the performance of its employees. The Unit was feeling a serious need for proper judgement of its people for drawing a relationship between the competency and performance at different levels and departments. In this paper the ranking of different Departments of the automobile unit by different methods on the basis of competence of the managers has been presented first and then the meta analysis was carried out to choose the best method.

Case Study

A reputed veteran automobile organization, in spite of having all its required technological resources, infra-structural support and human resources, has not been able to make profit for the last few years. The corporate body of the organization has made a very specific vision statement and set goals for the organization. In order to achieve each of the goals, all departmental heads were asked to identify critical key result oriented parameters from their day to day departmental activities. The departments work on the parameters and monitor the results in strict manner. However expected results were not happening. The corporate management of the organization then organised a brain storming session for a week with all the departmental heads to find out the root cause of the failure. After the one week session, they noted certain critical observations in various areas of activities. Then with these key parameters they tried:

- a) To estimate Human Resource (HR) indices using different methods for different groups of managers,
- b) For different departments,

c) To compare the methods of estimation of HR indices, to identify the best method to be used by the organization for evaluation of assessment system

Organization

There are 8 main departments in the organization namely, i) Personal and Human Resource (HR), ii) Finance and Audit, iii) Systems, iv) Quality, v) Manufacturing and maintenance, vi) Marketing, vii) President's office and viii) Purchase and store. There are 109 managers in the organization who are responsible for all managerial activities and working in the above departments. These managers are categorised into 4 grades according to their different level of responsibilities.

Competence Indices

Four different MCDM (Multi criteria Decision Making) methods were used to estimate the HR indices for different departments, group of managers and of the whole organisation. The methods were Analytic Hierarchy Process (AHP), Human Development Index (HDI), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and FUZZY. For each grade of manager, six competency skills were – i) Meet commitment, ii) Anticipation, iii) Problem solving, iv) Perception skills, v) Teamwork and vi) Job performance and knowledge. Using these criteria Competence indices were calculated for the different departments and are presented below:

Table 1. Competence Index and Ranking for different departments by different methods

	Estimate of HR Index				Rank w.r.t estimate of Dept. HR Index			
	AHP	HDI	TOPSIS	FUZZY	AHP	HDI	TOPSIS	FUZZY
Department								
Personal and HR	0.1270	0.4315	0.4379	0.1218	5	5	5	4
Finance and Audit	0.1433	0.4414	0.4509	0.1604	3	4	4	3
Systems	0.1713	0.5594	0.5495	0.1946	2	2	2	2
Quality	0.2077	0.4686	0.4756	0.0899	1	3	3	6
Manufacturing and Maintenance	0.1012	0.4044	0.4220	0.1043	6	6	6	5
Marketing	0.0862	0.3638	0.3677	0.0713	7	7	8	7
President office	0.0324	0.3263	0.3738	0.0624	8	8	7	8
Purchase and Store	0.1310	0.5631	0.5588	0.1954	4	1	1	1

With respect to HR index, by AHP method the rank of quality department is at the top, next is system department. The 8th position is of manufacturing and the position of purchase department is 4th. The rank of purchase department for the 3 methods HDI, TOPSIS and FUZZY is at the 1st position. The position of system department is consistent at 2nd with other methods also. Quality department is ranked 3rd by HDI and TOPSIS and 6th by FUZZY. The manufacturing department is at 6th position by HDI and TOPSIS and having 5th rank by Fuzzy. Similarly the ranks of the other departments are different with different methods. This leads to the questions in mind: What is the justification of using different methods to estimate the same thing? Thus the concept of META Analysis comes into consideration in our present study.

META Analysis: Comparing Different Estimates of Development Indices:

The natural queries might come in mind that:

- Why different methods of estimation for HR indices should be used?
- Which method is better than the other and why?
- Can a single index of development be worked out combining different indices?

META Analysis: Correlation Test Method

Table 2: The results of correlation test between different methods are given in the following table

	Standard normal at 1 per cent level = 2.576 at 5 per cent level = 1.960		Level test at 1 per cent					Level test at 5 per cent			
			Hypothesis accepted if Abs(N) < 2.576					Hypothesis accepted if Abs(N) < 1.960			
			Between	r	ξ	ϵ	1- ϵ	N	Inference	ϵ	1- ϵ
1	AHP, TOPSIS	0.8095	1.1256	0.03	0.97	2.162	Acc	0.04	0.96	1.834	Acc
				0.02	0.98	2.621	Rej	0.03	0.97	2.162	Rej
2	AHP, HDI	0.8333	1.1988	0.02	0.98	2.457	Acc	0.04	0.96	1.671	Acc
				0.01	0.99	3.237	Rej	0.03	0.97	1.998	Rej
3	AHP, FUZZY	0.5714	0.6496	0.06	0.94	2.434	Acc	0.1	0.9	1.839	Acc
				0.05	0.95	2.643	Rej	0.09	0.91	1.963	Rej
4	TOPSIS HDI	0.9762	2.2096	0.21	0.79	2.545	Acc	0.13	0.87	1.960	Acc
				0.22	0.78	2.603	Rej	0.14	0.86	2.049	Rej
5	TOPSIS, FUZZY	0.8333	1.1988	0.02	0.98	2.457	Acc	0.04	0.96	1.671	Acc
				0.01	0.99	3.237	Rej	0.03	0.97	1.998	Rej
6	HDI, FUZZY	0.8571	1.2823	0.02	0.98	2.270	Acc	0.03	0.97	1.811	Acc
				0.01	0.99	3.051	Rej	0.02	0.98	2.270	Rej

Correlation vector of maximum value for which null hypothesis was accepted at 1 per cent level of significance : For AHP , (97, 98, 94) i.e. Average is 96, TOPSIS, (97, 79, 98) i.e. Average is 91, HDI, (98, 79, 98) i.e. Average is 92, FUZZY, (94, 98, 98) i.e. Average is 96

At 5 per cent level of significance : For AHP , (96, 96, 90) i.e. Average is 94, TOPSIS, (96, 87, 96) i.e. Average is 93, HDI, (96, 87, 97) i.e. Average is 93, FUZZY, (90, 96, 97) i.e. Average is 94

For AHP and FUZZY, the average is higher than those of HDI and TOPSIS methods and hence AHP and FUZZY may be considered as jointly the better method.

META Analysis: Compliance Test Method

Another method of comparing & combining estimates from different methods has been suggested here. The ranks of the states with respect to the HR indices are divided into two groups i.e. Group 1 - 1 to 4 , and Group 2 - 5 to 8. By one method say AHP, departments are grouped according to ranks into two groups. It is to see that using another method say TOPSIS, how many departments from group 1 of AHP is also present in group 1 using TOPSIS i.e the level of compliance (per cent) between 2 methods. Similar result would also be seen between each pair of methods. This way of testing the compliance per cent of ranking between pair of methods, is named as compliance test on HR indices. A method is said to pass the compliance test if the average compliance per cent for a method for all three groups is reasonably high and the method with highest compliance per cent would be considered as the best method among all with respect to this test.

Consider the compliance vector for AHP , ($P^a(1)$, $P^a(2)$)

TOPSIS , ($P^t(1)$, $P^t(2)$) , HDI , ($P^h(1)$, $P^h(2)$) , FUZZY, ($P^f(1)$, $P^f(2)$)

The K^{th} method will be called as better method than L^{th} method if

$P^K(i) \geq P^L(i)$, for maximum no. of i 's where $i=1, 2$ and K, L are a , t , h , f

Table 3: Rank identity of different departments using TOPSIS, HDI AND FUZZY with respect to AHP

GROUP								
	AHP		TOPSIS		HDI		FUZZY	
1 (Rank 1 to 4)	A1	Quality	A4	Purchase	A4	Purchase	A4	Purchase
	A2	Systems	A2	Systems	A2	Systems	A2	Systems
	A3	Finance	A1	Quality	A1	Quality	A3	Finance
	A4	Purchase	A3	Finance	A3	Finance	A5	Personal
2 (Rank 5 to 8)	A5	Personal	A5	Personal	A5	Personal	A6	Manufacturing
	A6	Manufacturing	A6	Manufacturing	A6	Manufacturing	A1	Quality
	A7	Marketing	A8	President office	A7	Marketing	A7	Marketing
	A8	President office	A7	Marketing	A8	President office	A8	President office

Average compliance with AHP, Group 1 – $(100+100+75) / 3 = 92$
 Group 2 – $(100+100+75) / 3 = 92$
 Average compliance with TOPSIS, Group 1 – $(100+100+75) / 3 = 92$
 Group 2 – $(100+100+75) / 3 = 92$
 Average compliance with HDI, Group 1 – $(100+100+75) / 3 = 92$
 Group 2 – $(100+100+75) / 3 = 92$

Average compliance with FUZZY, Group 1 – $(75+75+75) / 3 = 75$
 Group 2 – $(75+75+75) / 3 = 75$

We see here, with AHP the compliance vector is (92, 92)
 TOPSIS the compliance vector is (92, 92)
 HDI the compliance vector is (92, 92)
 FUZZY the compliance vector is (75, 75)

All the components with AHP, TOPSIS & HDI are greater than those of Fuzzy and hence AHP, TOPSIS & HDI may be considered here as jointly the stronger method than FUZZY method.

META Analysis: Pareto Ordering

We have also in this study tried Pareto ordering to compare the department's HR indices using different methods.

Pareto ordering is defined as an ordering $R(X) = xRy$

Thus a department 'x' have better HR index than the department 'y', if xRy i.e. the HR index for the department 'x' is greater than that of 'y'. This ordering avoids inter-HR indicator comparison and based on principal information but completely ordered set by this relation excludes drastically the elements of 'x'. This Pareto ordering of HR can be applied only to a limited no. of departments.

Pareto ordering may be modified to a k-component ordering

if $xRy = \{ (x,y) \in R / x_{pi} \leq y_{pi} \text{ for } i= 1,2 \dots 5, ; p=1,2,\dots 5 \}$

Thus p_1 ordering is a complete ordering of our whole set x and p_k, p_r for k, r , if k and r runs through the same index.

A p_1 ordering by each of the methods (x_{pi}) on the ranking of HR index for the department are given as follows, arranged in structure of 'semantic differential'.

If A_i has better ranking than A_j , then $A_i > A_j$

Where $A1 = \text{Personal}$, $A2 = \text{Finance}$, $A3 = \text{System}$, $A4 = \text{Quality}$, $A5 = \text{Manufacturing}$,

$A6 = \text{Marketing}$, $A7 = \text{President dept}$, $A8 = \text{Purchase}$

Thus p_1 completely orders the whole of HR indices implying that if we take a single indicator we can have complete order of department according to HR ranking but as the no. of methods is increased completely ordered set is reduced in size. The p_2 ordering is generated from p_1 chains and p_3 ordering is generated from p_2 chain and so on.

As the no. of methods increases, such procedure cracks down as the totally ordered chain approaches a null set.

Many orderings can be deduced from within the method and between the methods at different levels. However these orderings compare the states with respect to HR indices. But these do not compare methods.

A method can be formulated to compare the methods from Pareto orderings.

Let us define the Pareto order score for a state (POS) = the no. of departments having better Pareto ordering than this department or better HR index than this department.

$(POS)_i^j$ = Pareto order score of i^{th} department for j^{th} method

$(DST)_i^{jk}$ = Distance between Pareto order score of i^{th} department between j^{th} and k^{th} method
 $= ((POS)_i^j - (POS)_i^k)^2$

Sum of distance between j^{th} and k^{th} method = $(DST)^{jk} = \sum (DST)_i^{jk}$ for all i 's

Overall distance for j^{th} method = $(DST)^j = \sum (DST)^{jk}$ for all k 's, $k <> j$

Average overall distance for j^{th} method in our study = $(DST)^j / 3$ n^{th} method is said as the best method if $(DST)^n / 3$ is minimum of $(DST)^j / 3$

Here for AHP method,

Average overall distance from other methods = $(14+16+36)/3 = 22$

for TOPSIS method,

Average overall distance from other methods = $(16+2+14)/3 = 11$

for HDI method,

Average overall distance from other methods = $(14+2+12)/3 = 9$

for FUZZY method,

Average overall distance from other methods = $(36+12+14)/3 = 21$

Since for HDI method, average overall distance (9) is minimum, HDI method should be considered as best method in comparison to other methods.

Conclusion

The above analysis was done for an organization which was making loses for years. The management in addition to other issues of organizational activities had taken up the Human Resource Development HRD issue as they felt that there are assessment lapses which should be removed. To study the situation in the organization different assessment methods were used. Then to compare the different methods META Analysis was carried out. The Compliance Test Method of Meta analysis shows that the FUZZY method is not an appropriate method and Pareto Ordering method of META Analysis shows that HDI method is the best method. So HDI may be considered as the better method of assessment as it satisfies both Pareto method and the Compliance test Method of META Analysis but it does not satisfies correlation method of META Analysis.

References

1. Anand, S., and Sen, A., 1992, 'Human Development Index: Methodology and Measurement', background paper prepared for the *Human Development Report 1993*. New York: United Nations Development Programme.
2. Becker, B. J., 1994, "Combining significance levels". In *The Handbook of Research Synthesis*, Edited by Cooper and Hedges, 215-230. New York Russell Sage Foundation
3. Fleiss, J. L., 1994, "Measure of effect size for categorical data", In *The Handbook of Research Synthesis*. New York: Russell Sage foundation
4. Glass, G. V., 1976, 'Primary, Secondary and Meta Analysis': *Educational Researcher*, 5, 3-8
5. Glass, G. V., and McGaw, B., (1981) : *Meta Analysis in Social Research*, Beverly Hills, C A : Sage
6. Hedges, L. V., and Olkin, I., 1985, *Statistical Methods for Meta Analysis*, Academic press ; Boston
7. Hunter, J. E., and Schmidt, F. L., 1982, *Meta Analysis; Cumulative Research Finding across studies*, Beverly Hills, CA; Sage
8. Rosenthal, R., 1984, *Meta Analytic procedures for Social Research*, Beverly Hills, C A : Sage
9. Satty T. L., and Kearns, K. P., 1985, *Analytical Planning -The Organization of Systems*, Pergamon Press, Oxford.
10. Yoon, K., and Hwanh. C., 1981, *Multiple Attribute Decision Making-Methods and Applications*, Springer-Verlag, New York.