Annex

Annex I

Principal Component Analysis

The Principal Component Analysis is a multivariate choice method. This approach develops a composite index by defining a real valued function over the relevant variables objectively. Given a set of explanatory variables, if we have to select the most important variable or a limited number of variables from the set, Principal Component Analysis helps. The principle of this method lies in the fact that when different characteristics are observed about a set of events, the characteristic with more variation explains more of the variation in the dependent variable compared to a variable with lesser variation in it. Therefore, the issue is one of finding weights to be given to each of the concerned variables. Weight to be given to each of the variables is determined on the principle that the variation in the linear composite of these variables should be the maximum. Once the weight to be given to each of these variables is decided, we can focus on the important variables in order to reduce the noise in the data. A set of assumptions has been used in our method of construction of a composite index. These are:

- the condition of *weak pareto rule* demands that when a state registers values of indicators uniformly higher than those of the other - the former should have a higher ranking than the latter ones;
- the condition of *non-dictatorship* implies that no single indicator should be considered so significant as to determine the final ordering all by itself;
- the condition of *unrestricted domain* implies that the method should be capable of giving the final ranking for all possible data matrices;
- the final condition is that of *independence* from irrelevant alternatives, which demands that while ranking two , the decision must be guided by the values of the indicators for these units under study alone and not by any other irrelevant phenomenon

Given these general assumptions, the composite index is defined as,

$$C_i = W_1 x_{11} + W_2 x_{12} + W_3 x_{13} + \ldots\ldots\ldots\ldots + W_n x_{1n}$$

or, $C_i = \sum W_i x_{ij}$,

where C_i is the composite index for the i^{th} observation, W_j is the weight assigned to j^{th} indicator and x_{ij} is the observation value after elimination of the scale bias.

It is evident from the above formula that to compute the composite index two major components are to be known, i.e., the weights assigned to the indicators and the observation values after elimination of the scale bias for the available indicators. These two have been discussed below in detail.

Elimination of scale bias

Variables chosen for any analysis are usually measured in different units and are generally not additive. Hence, it is necessary to convert them in some standard comparable units such that the initial scale chosen for measuring them do not bias the results. The method adopted to standardise the variable is

$$x_{ij} = (X_{ij} - X_m / s)$$

where x_{ij} is the scale free observation, X_{ij} is the original observation and X_m is the mean of the series and s is the standard deviation.

The transformed series now would be scale free and would have a mean of zero and a standard deviation of unity.

Assigning weights objectively using Factor Analytic Model

Once the bias of measurement is removed from the observations, the crucial problem that remains is that of assigning appropriate weights to the selected indicators. If one has sufficient insight into the nature and magnitude of inter-relationships among the variables and their implications, one might choose to determine the weights on the basis of

independent judgement. This way of constructing an index stands exposed to subjectivity. Assigning equal weight (or no weight) would imply assumption of equal correlation of each indicator with the composite index of importance which would hardly be a realistic approach in this case. Therefore, in this analysis, the weights for individual indicators have been assigned on the basis of the factor analytic model.

Factor Analysis or Principal Component Analysis is a tool used to construct a composite index in such a way that the weights given maximise the sum of the squares of correlation (of the indicators with the composite index). The application of Factor Analysis in this specific case has been accepted in 'objective ranking' of the regions. This method enables one to determine a vector known as the first Principal Component or Factor, which is linearly dependent on the variables, having the maximum sum of squared correlation with the variables.

The weights given to the indicators are chosen in such a way so that the Principal Components satisfy two conditions:

a). The number of Principal Components are equal to the number of indicators and are uncorrelated or orthogonal in nature.

b). The first Principal Component or P_1 absorbs or accounts for the maximum possible proportion of variation in the set of the indicators. This is the reason why it serves as the ideal measure of composite index.

Method

Step 1 We start by taking the simple correlation coefficients of the *k* numbers of indicators. These correlation coefficients may be arranged in a table, which is called the correlation table. The elements of the diagonal would be unity as they are the self-correlated, i.e., the correlation of each X_i with itself ($r_{xi\ xi} = 1$ for all the *i*'s). The correlation matrix is symmetrical, i.e., the elements of each row are identical to the elements of the corresponding columns, since $r_{xi\ xj} = r_{xj\ \ xi}$.

Correlationt table of the set of K Variables

	X_1	X_2	X_3	X_k	$\Sigma^k_i r_{xi\ xj}$
X_1	$r_{x1\ x1}$	$r_{x1\ x2}$	..	$r_{x1\ xk}$	$\Sigma^k_i r_{x1\ xi}$
X_2	$r_{x2\ x1}$	$r_{x2\ x2}$	..	$r_{x2\ xk}$	
"	..	..	..	..	
"	..	..	..	..	
X_k	..	..	..	..	
"	$r_{xk\ x1}$	..	..	$r_{xk\ xk}$	
$\Sigma^k_i r_{x1\ xj}$	$\Sigma^k_i r_{xi\ x1}$	$\Sigma^k_i r_{xi\ x2}$	$\Sigma^k_i r_{xi\ x3}$	$\Sigma^k_i r_{xi\ xk}$	$\Sigma^k_i \Sigma^k_i r_{xi\ xj}$

Step 2 Sum of each column (or row) of the correlation table is computed, obtaining *k* number of sums of simple correlation coefficient.

$$S^k_i r_{xi\ xj} = S^k_i r_{xi\ xj}$$

Step 3 We compute the sum total of the column (or row) sums-

$$S^k_i S^k_j r_{xi\ xj}$$

and we take its square roots.

Step 4 Finally, we obtain the factor loadings for the first Principal Component P_1 by dividing each column (or row) sum by the square root of the grand total.

$$a_{ij} = (S^k_i r_{xi\ xj}) / (\sqrt{S^k_i S^k_i r_{xi\ xj}})$$

It should be clear that the loadings thus obtained are the correlation coefficients of the respective indicator with the composite index.

Step 5 The P_1 or the first Principal Component is constructed in the following way

$$P_1 = a_{11} x_1 + a_{12} x_2 + \ldots\ldots\ldots\ldots + a_{1k} x_k$$

Step 6 The sum of the squares of the loading of the Principal Component is called the latent root (or Eigen Value) of this component and are denoted by the Greek letter l with the subscript of the Principal Component to which it refers. For example, the latent root of the first Principal Component P_1 is

$$l_1 = [\text{latent root of } P_1]$$
$$= S^k_i \, l^2_1$$
$$= l^2_1 + l^2_2 + \ldots + l^2_k$$

The sum of the latent root of all the Principal Components would be equal to the number of indicators:

$S^k_i \, l_i = k$

The importance of the latent root or the eigen value lies in the fact that it expresses the percentage of variation in the set of indicators the Principal Component explains. If for example, $l_1 = 2.797$ and the number of variables are 8, then the P_1 expresses -

$l_1 / k = (2.797/8)*100 = 35\ \%$ of the variations of the set of 8 variables.

Tests of significance of the loadings: the loadings in our study have been tested based on the levels of significance of the Pearson Correlation coefficients.

Multi-Stage Principal Component Analysis

In this particular exercise, we have attempted a method of normal or single stage Principal Component Analysis as well as the multi-stage Principal Component Analysis. For performing the single stage Principal Component Analysis, all the indicators are taken together and the procedure discussed above is followed. In case of multi-stage Principal Component Analysis selected variables are divided into well-defined sub-groups depending on the nature of the indicators. Within a sub-group, they have a high degree of inter-correlation, while the canonical correlation between pairs of sub-groups is low on an average. The Principal Component Analysis has then been applied to each of these sub-groups of variables. The first Principal Components obtained from different sub-groups have been treated as a set of new variables and combined at a second stage to obtain the Final Composite Index. It has been argued that this method overcomes the necessity of taking more than one Principal Component in the analysis, since the correlation among the variables in a subgroup are generally high and consequently, the first Principal Component explains an 'adequate' proportion of the variation in the data matrix.

ANNEX - II

List of Indicators for State Level Assessment

A- 1: Indicators for Network Access

	Indicators	Source	Sub- Indicators
Network Access	Information Infrastructure	Secondary	• Teledensity
		Primary- MISH	• Percentage of households with phone
		Primary - MISH	• Percentage of households with cable TV connection
		DOT	• Cellular Phones per 100 fixed lines
		DOT	▪ Internet connections per 100 persons
		DOT	• Percentage of villages covered by VPTs
	Internet Affordability	State Governments	• Average Price per hour of Internet use in main cities
		COAI	• Number of cellular operators in the state
	Hardware and Software	Primary- MISH	• Hardware PC penetration-households (Nos.)
	Service and Support	DOT	• Telecom staff per 100 lines (Nos.)

A- 2: Indicators for Network Learning

	Indicators	Source	Sub- Indicators
Network Learning	Institution's Access to ICT (Educational Institutions)	State Governments	• Percentage of colleges having access to Internet
		State Governments	• Percentage of schools having access to Internet
		State Governments	• Percentage of schools with Computer labs
		State Governments	• Percentage of colleges with Computer Labs
		State Governments	• Percentage of Universities offering ICT Courses
		State Governments	• Percentage of Universities/ Institutes with online courses
		State Governments	• Percentage of colleges with websites
		State Governments	• Percentage of schools with websites
	Developing ICT at workforce	State Governments	• Number of Registered training centers in State
		State Governments	• Percentage of students passing out with ICT courses to total students (general and technical)
		State Governments	• Percentage of government employees covered under online training programs
		State Governments	• Percentage of IT qualified teachers to total teachers

A- 3: Indicators for Network Society

	Indicators	Source	Sub- Indicators
Network Society	People & Organisations online	Primary - MISH	• Households accessing internet as a % of households with computers
		State Governments	• Number of companies online (e-Commerce)
		Primary- MISH	• Households accessing internet as a % of households with phone
	Locally Relevant Content	State Governments	• Percentage of total websites in local language
		State Governments	• Number of government websites
		State Governments	• Does Local Language Interface exist?
	ICT in Everyday Life & workplace	Primary - MISH	• Households having PC, phone & Internet as a % of total households

A- 4: Indicators for Network Economy

	Indicators	Source	Sub- Indicators
Network Economy	ICT Employment Opportunities	State Governments	• Number of IT parks in the state
		State Governments	• Floor area of IT parks
		State Governments	• Turnover of companies in IT parks
		State Governments	• Employment in IT parks in state
		State Governments	• Number of jobs that require ICT skills
		State Governments	• Number of companies using facilities provided by IT parks

A-5: Indicators for Network Policy

	Indicators	Source	Sub- Indicators
Network Policy	Telecommunication Regulation, ICT Trade Policy	State Government	• Have the State level telecom issues been addressed?
		State Government	• Have taxation issues in E-Commerce been addressed?
		State Government	• Does an IT Policy Exist?
		State Government	• Is there a section on Enabling Policy?
		State Government	• Is there a section on Regulatory Policy?
		State Government	• Is there a section on Legal Policy?
		State Government	• Frequency of IT Policy revision
		State Government	• Is the issue of Intellectual Property Rights (IPR) addressed in ICT policy?
		State Government	• Have Sales Tax concessions been given to telecom/ ICT companies?
		State Government	• Is there any provision for deferred taxes?
		State Government	• Is there a dedicated infrastructure for ICT firms?
		State Government	• Do Cyber Laws exist?
		State Government	• Is recruitment of expert IT professionals feasible?
		State Government	• Are special rates available for internet access?
		State Government	• Are subsidised utilities provided to ICT firms?
		State Government	• Have incentives been given to software companies?
		State Government	• Number of initiatives taken for the telecom regulation, ICT trade policy

A- 6: Indicators for E-governance

	Indicators	Source	Sub- Indicators
E- Governance	Special Efforts	State Government	• Rural connectivity
		State Government	• Has there been application of ICT in the following areas A- Agriculture B- Health services C- Transportation D- Energy E- Trade
	Government Preparedness	State Government	• Has Government process reengineering been carried out?
		State Government	• Is there political stability in the state?
		State Government	• Does a PERT* chart for new ventures exist?
		State Government	• Have the government employees' records been computerised?
		State Government	• Number of e-governance projects successfully completed & in operation for 1 yr (Nos.)
	E-Services	State Government	• E- procurement in existence
		State Government	• Are the following facilities available online 1. Land registration 2. Stamp paper registration 3. Utilities billing 4. Crime registration 5. Municipality Administration
	Infrastructure	State Government	• Does a Government Intranet network exist?
	Data Systems	State Government	• Have the land records been computerised? (Yes/ No)
		State Government	• Number of movable property records (vehicles) computerised (Nos.)
	Leadership and Awareness	State Government	• Does a separate ministry for ICT exist?
		State Government	• Is Interest shown for ICT consultation by other departments?
		State Government	• Is there any computer-training programme for top Civil servants?
		State Government	• Total funds of HRD on computerisation

* Programme Evaluation Review Technique

ANNEX III

India State Profile (2001-02)

States/Union Territories	Population (2001)	Income per capita (1999-00)*	Rank- based on per capita income	Poverty (1999-2000)^		Total Literacy Rate	Rank- based on Total Literacy Rate	Female Literacy Rate	Rank- based on Female Literacy Rate
				Population below poverty line (%)	Rank- Based on population below poverty line				
Andaman & Nicobar Islands	356265	22880	-	20.99	17	81	7	75	6
Andhra Pradesh	75727541	14715	12	15.77	13	61	28	51	26
Arunachal Pradesh	1091117	14338	13	33.47	25	55	32	44	29
Assam	26638407	9612	22	36.09	28	64	24	56	23
Bihar	82878796	6328	24	42.6	31	48	35	34	35
Chandigarh	900914	46347	1	5.75	4	82	4	77	4
Chattisgarh	20795956	NA	-		-	65	23	52	25
Dadra & Nagar Haveli	220451	NA	-	17.14	14	60	30	43	31
Daman & Diu	158059	NA	-	4.44	3	81	7	70	9
Delhi	13782976	35705	2	8.3	7	82	4	75	6
Goa	1343998	24309	-	4.4	2	82	4	76	5
Gujarat	50596992	18625	8	14.07	10	70	15	59	21
Haryana	21082989	21114	6	8.74	8	69	18	56	23
Himachal Pradesh	6077248	15012	11	7.63	6	77	10	68	10
Jammu & Kashmir	10069917	12338	16	3.48	1	54	33	42	33
Jharkhand	26909428	NA	-		-	54	33	39	34
Karnataka	52733958	16343	10	20.04	16	67	21	57	22
Kerala	31838619	18262	9	12.72	9	91	1	88	1
Lakshadeep	60595	NA	-	15.6	12	88	2	82	3
Madhya Pradesh	60385118	10907	19	37.43	30	64	24	50	28
Maharashtra	96752247	23398	4	25.02	20	77	10	68	10
Manipur	2388634	11370	18	28.54	22	69	18	60	17
Meghalaya	2306069	11678	17	33.87	26	63	27	60	17
Mizoram	891058	12535	-	19.47	15	88	2	86	2
Nagaland	1988636	12408	-	32.67	24	67	21	62	15
Orissa	36706920	9162	23	47.15	32	64	24	51	26
Pondicherry	973829	30768	3	21.67	19	81	7	74	8
Punjab	24289296	23040	5	6.16	5	70	15	64	14
Rajasthan	56473122	12533	15	15.28	11	61	28	44	29
Sikkim	540493	13356	14	36.55	29	70	15	61	16
Tamil Nadu	62110839	19141	7	21.12	18	73	13	65	12
Tripura	3191168	10213	20	34.44	27	74	12	65	12
Uttar Pradesh	166052859	9765	21	31.15	23	57	31	43	31
Uttaranchal	8479562	NA	-		-	72	14	60	17
West Bengal	80221171	1559	25	27.02	21	69	18	60	17

ANNEX IV

E-Readiness: Statewise Status Chart

States	Network Access	Network Learning	Network Society	Network Policy	E-Governance	Network Economy	Categories
Andaman & Nicobar Islands	L 5	L 4	L 5	L 2	L 4	L 6	Below Average Achievers
Andhra Pradesh	L 4	L 2	L 2	L 2	L 1	L 4	Leaders
Arunachal Pradesh	L 6	L 6	L 5	L 6	L 5	L 6	Least Achievers
Assam	L 6	L 5	L 6	L 4	L 4	L 6	Least Achievers
Bihar	L 6	L 5	L 6	L 6	L 4	L 6	Least Achievers
Chandigarh	L 2	L 1	L 1	L 1	L 3	L 6	Aspiring Leaders
Chattisgarh	L 6	L 5	L 5	L 3	L 4	L 6	Below Average Achievers
Dadra & Nagar Haveli	L 6	L 5	L 6	L 6	L 6	L 6	Least Achievers
Daman & Diu	L 5	L 5	L 6	L 6	L 6	L 6	Below Average Achievers
Delhi	L 1	L 1	L 2	L 4	L 2	L 6	Aspiring Leaders
Goa	L 4	L 2	L 3	L 1	L 2	L 5	Aspiring Leaders
Gujarat	L 4	L 2	L 4	L 1	L 1	L 5	Aspiring Leaders
Haryana	L 4	L 4	L 5	L 3	L 3	L 6	Average Achievers
Himachal Pradesh	L 5	L 5	L 5	L 2	L 2	L 6	Below Average Achievers
Jammu & Kashmir	L 6	L 6	L 5	L 5	L 5	L 6	Least Achievers
Jharkhand	L 6	L 4	L 5	L 4	L 6	L 6	Least Achievers
Karnataka	L 3	L 1	L 1	L 1	L 1	L 4	Leaders
Kerala	L 4	L 3	L 4	L 2	L 2	L 5	Expectant
Lakshadweep	L 6	L 4	L 6	L 4	L 5	L 6	Least Achievers
Madhya Pradesh	L 5	L 3	L 4	L 2	L 2	L 6	Average Achiever
Maharashtra	L 4	L 1	L 3	L 1	L 2	L 1	Leader
Manipur	L 6	L 6	L 5	L 5	L 6	L 6	Least Achievers
Meghalaya	L 6	L 3	L 5	L 6	L 4	L 6	Below Average Achievers
Mizoram	L 6	L 5	L 5	L 3	L 5	L 6	Below Average Achievers
Nagaland	L 6	L 6	L 5	L 5	L 6	L 6	Least Achievers
Orissa	L 6	L 5	L 5	L 4	L 4	L 6	Below Average Achievers
Pondicherry	L 3	L 5	L 3	L 4	L 4	L 5	Average Achiever
Punjab	L 3	L 4	L 4	L 3	L 3	L 6	Average Achiever
Rajasthan	L 5	L 5	L 5	L 2	L 2	L 6	Average Achievers
Sikkim	L 6	L 5	L 4	L 5	L 5	L 6	Least Achievers
Tamil Nadu	L 4	L 1	L 3	L 1	L 1	L 2	Leader
Tripura	L 6	L 5	L 5	L 4	L 4	L 5	Below Average Achievers
Uttaranchal	L 6	L 3	L 5	L 6	L 2	L 6	Below Average Achievers
Uttar Pradesh	L 4	L 3	L 4	L 2	L 2	L 4	Expectant
West Bengal	L 4	L 3	L 3	L 2	L 3	L 5	Expectant

* L indicates the levels.

ANNEX V

List of Apex Committee Members

1. Shri Rajeeva Ratna Shah, Secretary, DIT
2. Shri S. Lakshminarayanan, Additional Secretary, DIT
3. Shri R. Chandrashekhar, Joint Secretary, DIT
4. Shri S.S. Grover, Senior Director, DIT
5. Shri J. Sathyanarayana, Principal Secretary IT&C, Govt. of Andhra Pradesh
6. Shri Vivek Kulkarni, Secretary IT, Govt. of Karnataka
7. Shri B.R. Bajaj, Secretary IT, Govt. of Punjab
8. Shri D.P. Patra, Secretary IT, Govt. of West Bengal
9. Shri Subash Chandra Das, Comm. & Secretary IT, Govt. of Assam
10. Shri Mukesh Kuller, Secretary IT, Govt. of Maharashtra
11. Dr. N. Vijayaditya, DG, National Informatics Centre
12. Shri N.K. Gupta, DDG(I)TEC, Deptt. of Communications
13. Shri K. Jayakumar, Director, Deptt. of AR&PG
14. Dr. B.H. Jajoo, Chairman, Computer Centre, IIM, Ahmedabad
15. Prof. P.G. Apte, Dean(Academics), IIM, Bangalore
16. Prof. V. Sridhar, Director, IIM, Lucknow
17. Shri Kiran Karnik, President, NASSCOM
18. Shri Vinnie Mehta, Director, MAIT
19. Shri Harish Krishnan, Director, CII
20. Smt. Madhabi Puri Buch, General Manager, ICICI Ltd.
21. Shri Shiv Kumar, Chief Executive (Agri Business), ITC Ltd
22. Shri Saurabh Srivasava, Executive Chairman, Xansa India Ltd.
23. Shri Nandan N. Nilekani, CEO, Infosys Technologies Ltd.
24. Shri Chetan Sharma, Executive Director, Datamation Consultant Pvt. Ltd.
25. Dr. Ashok Khosla, Founder, Development Alternatives
26. Shri Rahul Nainwal, Managing Director, MITRA, Technology Foundation Research Application
27. Shri Suresh Balakrishnan, Public Affairs Centre
28. Shri S. Ghosh, CEO & Managing Director, CMC Ltd.
29. Shri V.K. Neelakandhan, Executive Director, ER&DCI, Thiruvananthapuram

ANNEX VI

List of Steering Committee Members

1. Shri S.Ramakrishnan, Sr. Director, DIT
2. Shri S.S.Grover, Sr.Director, DIT
3. Shri S. Basu, Sr.Director, DIT
4. Shri. W. R. Deshpande, Sr Director, DIT
5. Smt. Renu Budhiraja, Addl Director, DIT
6. Shri Shashank Ojha, Informatics Advisory Service, South Asia Region, World Bank
7. Shri K. N. Gupta, Controller of Certifying Authority (CCA), DIT
8. Shri Harjit Singh, Advisor, Sustainable Development Networking Programme (SDNP), Ministry of Environment & Forests
9. Col Ramachandran, NASSCOM
10. Dr. N. Vijayaditya, Director General, NIC
11. Shri Vinnie Mehta, Director, MAIT
12. Shri A Murali Krishna, Dy General Manager, CMC
13. Shri J.K.Tyagi, DFA, DIT
14. Ms. Tulika, Joint Director, DIT