

ICT in universities of the Western Himalayan Region in India: Performance analysis

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ABSTRACT

The paper presents a comparative analysis of a case study carried out to understand the performance and impact of ICT initiatives taken by the Universities located in the Western Himalayan Region of India. A basic four- tier framework has been used to carry out this study. Accordingly, a pre- structured questionnaire on ICT initiatives, status and accomplishments, containing 117 questions divided in 18 groups, was prepared and given to the Head of the Department (HOD) of ICT in the Universities, who along with his technical team, supplied the feedback on a five- point scale. In each of the groups, at least one question was related to performance (as performance indicator) which was identified and thus another special group 'S' was created. In order to assess the respective performance and impact, a standard statistical analysis was carried out in terms of the weighted mean and the correlation (Pearson's) coefficients (CC) validated by t-test. The finding of the study are (i) a dynamic academic leadership and a properly trained skilled human resource yield better performance and impact leading to effective problem solving capability, research output and actual placements. This aspect is being implemented in most of the universities effectively and the performance is found to vary from one to another university (ii) For most of the groups the CC, with the 'S' group, was found to be significant, indicating a positive ICT- based performance in the universities (iii) The universities, to a greater extent, have been found to act as nuclei towards creating skilled professionals with enhanced core competence.

Keywords: *Information and Communication Technology (ICT), Initiative, Status, assessment, performance, efficiency, Impact of ICT.*

1.INTRODUCTION

During the past decade, Information and Communication Technology (ICT) has taken rapid strides in the field of higher education, in various Universities and Institutions of higher learning across the length and breadth of India. Such a transformation was triggered by the developments in microwaves communication followed by powerful computer systems, VSAT/ internet connectivity and optical fiber communication. Broadband communication which consists of technologies and equipments required to deliver packet- based digital voice, video and data services on-line and at high speed, has facilitated progress in this direction so as to provide even virtual environment of work places to end users. The bandwidth problem is being addressed successfully. These developments have further resulted in the integration of various technologies, which could not have been imagined earlier. In the context of Indian higher education, the pace of development was accelerated by various initiatives of Government of India through UGC- INFONET program to connect various institutes and universities. Its pervasiveness has made inroads both in laboratories and classrooms.

The impetus at the national level was set in motion by the recommendations of Task Force 'Technology Information Forecasting and Assessment Council' (TIFAC), for Technology Vision 2020. One of the important pilot documents "India 2020, A Vision for the New Millennium" (1998) prepared by TIFAC, under the leadership of Dr. A.P.J. Kalam, provided a blueprint of the Technology Vision for India. According to this document, ICT can enhance skills in critical thinking, information handling, level of perception, problem solving capability and adding value to research in higher educational institutions. This document particularly underlined the importance of higher educational institutions/ universities as agents to take prompt and appropriate initiatives in this direction. It also gave further direction for planning ICT strategies in which the role of higher educational institutions in India can be networked to achieve criticality. The document further emphasized that the Indian human resource has great learning capabilities which, with a core competence in technology, can lead to spirit of entrepreneurship and competitiveness. It strongly advocated the synergy between development of human resource cadre (Sadagopan 1998) and the role of higher educational institutions, a cornerstone of knowledge economy and technological advancement.

This document prompted the Government of India to take a major ICT initiative to lay down the ICT policy for the country. This is reflected in the planning and implementation of ICT in the field of higher education by the Ministry of Human Resource Development (MHRD), Government of India, at various levels since 1998. Simultaneously, at the national level, it is being implemented vigorously in the form of e-governance, being coordinated by National Informatics Centers (NIC). Latest telecommunication guidelines, (Tandon, 2007), have been extremely helpful in implementing this ICT policy. At the institutional level, University Grants Commission (UGC), All India Council of Technical Education (AICTE), Department of Science & Technology (DST), Department of Atomic Energy (DAE), Indian Council of Agricultural Research (ICAR), all are encouraging higher educational institutions to move in this direction.

In Jan. 2009, the Cabinet Committee on Economic Affairs, Government of India, approved a new scheme 'National Mission on Education through Information and Communication Technology' (NMEICT), submitted by the Ministry of HRD for the 11th Five Year Plan. This mission has envisaged to raise the potential of ICT by providing high quality modules (personalized and interactive), for all the learners as one- stop solution in 'any time any where mode'. It has to ensure an effective on- line access to all the ICT resources viz. connectivity, e-content in the form of digital lectures, static documentation and availability of virtual laboratories for exploration, to more than 18,000 colleges and 425 Universities of the country. Effort of the mission is to bridge the digital divide between the haves and have-nots.

There has been another apex body, National Association of Software and Services Companies (NASSCOM), in the field of ICT, dealing with the ICT infrastructure, research & development and trade since 1988. In its recent report (Strategic Review, 2009), it has been emphasized that availability of skilled and employable talent is the responsibility of universities and higher educational institutions. In order to achieve this, concentrated efforts to elevate talent and quality are needed from all the concerned quarters namely the government, the academia and the industry. The role of academia is supposed to be very critical at the level of implementation of these programs including the upgradation of research laboratories. Specific initiatives like faculty development program, upgrading the curriculum, launching internship programs and academia-industry collaboration have been proposed which would help to bridge the gap towards the development of talent. It is being felt that this has resulted in enhancing the reach of all the stakeholders to knowledge resources which in turn is likely to have an impact on creation of knowledge as well. This body is a partner with the Government of India and various State Governments of the country to encourage percolation of ICT. It has also played a crucial role in the formulation of ICT policies which endeavors to narrow down the digital divide in the country and has paved the way for

all citizens to enjoy the benefits of ICT. NASSCOM has been particularly interested in the ICT-business process outsourcing (ICT-BPO) industry in India, which has become a major job provider and has led to growing economy of the country. It provided a feedback to Government of India to modulate the ICT policies and programs from time to time.

At the International level, UNESCO (2007- 08) has prepared a document for Asia- Pacific countries, for the implementation of ICT programs (Roy and Raitt 2003) through the higher educational/ research institutions. In this document, various ICT strategies supporting the core areas viz. learning, teaching (Kulik and Kulik, 1991 and Resta, 2002), training programs and research, driving the higher education towards excellence, have been suggested. Very recently, special issue of International Journal of Education and Development using ICT, brought out an editorial by Dirckinck- Holmfeld (2009), on innovation of 'Problem Based Learning' (PBL) through ICT, which emphasized on the ICT based transformation within a framework of three core themes: PBL & pedagogical principles, inquiry based learning characteristics of ICT and intercultural perspectives. The theme of PBL and Problem Oriented Project Pedagogy (POPP) have a long tradition within a university system in teaching & learning alongwith international collaboration. This theme provides a direction for critical pedagogy and research oriented approaches where students have to undergo through different stages of systematic investigations. This approach further supports the development of skills and competencies towards interdisciplinary thinking and solving serious problems. ICT has supported PBL approach in new ways leading to some interesting and dramatic consequences.

All these innovative ideas could diffuse using the framework provided by ICT. It seems that diffusion and adoption of the latest ICT are making all the difference particularly in the universities and the educational environment. During the last decade there have been several attempts to understand information technology diffusion. The concept of diffusion, at the empirical level, was reviewed by Fichman in 1992. He dwelled upon innovation diffusion theory and, in particular, how to improve technology assessment, adoption and implementation. A framework was discussed in terms of classical diffusion which was adopted by individuals and organizations. For the latter, Fichman discussed achieving a critical mass beyond which the innovation is self- sustained and universally adopted. Many other important scientific works exist on the diffusion of innovation and its adoption, given by Attewell (1992), Rogers (1995), Farquhar & Surry (1994), Anderson et al (1998), Fichman (2000) and Wilson et al (2000). Attewell (1992) classified the work on diffusion in two categories: (a) Adoption studies and (b) Macro diffusion studies. The former is primarily concerned with understanding of innovations and its assimilation during a time of adoption. The latter is concerned with pattern of technology adoption. This type of work was understood in terms of mathematical models of the diffusion process by Mahajan & Peterson (1985) and Mahajan et al. (1990). Rogers (1995), in his book on Innovation Diffusion, has presented a significant general frame work which became the basis for the later work. Another mathematical approach for this innovation diffusion was developed by Karmeshu & Pathria (1980), Lal et al (1988), Karmeshu et al (1992) and by Karmeshu & Jain (1995).

In recent years, in the context of ICT, a very significant work on 'Global Diffusion of the Internet' by Wolcott and Goodman (2003) appeared in Indian context. They presented a vision of new India as a measure of IT power, fully integrated with global economy. The key to this vision was obviously the internet for enabling the technology based changes. They provided an analytical framework which broadly consisted of dimensions and determinants. Dimensions contained six variables namely organizational infrastructure, geographic dispersion, connectivity infrastructure, pervasiveness, sectoral absorption and sophistication of use. These variables are supposed to capture the state of internet and hence ICT within a country at a given point of time. Each of these variables was judged on five point scale. Determinants represent various factors to understand the observation of the 'state'. They further elaborated on distinctive features of the internet in India for a continued dynamic growth in three steps: (a) The government policy (b) The nature of relationship

between the government, the state-owned & private telecommunications service providers as a critical variable (c) The policy makers try to strike a balance between the interest of individuals and those of the society. Later, this framework was applied usefully to understand the initiative, status and performance in Ghana by Foster et al (2004), in Togo by Bernstein and Goodman (2005), and in Kenya by Ochara et al (2008).

In view of the above ICT- based initiatives, most of the universities and higher educational institutions have adopted the latest technology and implemented it productively, for the development of skilled human resource in respective area of specialization, as part of their responsibility. These programs have been going on for the last decade or so. At this stage, one feels like asking a question: how much efficient, performance wise, the university system has become using the ICT facilities as compared to the that without the ICT technology decade ago?

Particularly in this context, an assessment of the overall performance and efficiency based on ICT infrastructure/ activities, seems essential for deciding the future ICT strategies at the respective levels. Essentially, it became the basis of motivation to undertake a comparative study of the ICT vision and planning, infrastructure, activities and academic accomplishments in various universities of the western Himalayan region of the country, using standard statistical methods on primary data.

At the national level, the University Grants Commission (UGC), New Delhi, took steps to establish an autonomous institution, National Assessment and Accreditation Council (NAAC), to undertake comprehensive assessment of various universities in this region and to rank them. NAAC (2007) has developed a framework for higher education based on the promotion and sustenance of quality of teaching- learning, research and training programs. Their most significant core value is quest for excellence/ innovations using the latest technological trends and fostering global competence among students. They have devised seven assessment criteria namely, curricular, teaching-learning, research and application, innovation, infrastructure, student support and leadership/ governance aspects to capture the micro- level quality indicators by using differential weightages. Times of India group (TOI, 2007) also tried to assess independently various agriculture, horticulture and technical institutions. Their recommendations and respective gradations are available at the national level. This information may be utilized for comparison with the findings of this paper in the context of ICT. However, their emphasis has been an overall assessment of the educational institution for categorization, not the efficiency, performance and impact of ICT alone which we address in this paper.

Recently, Mokhtar et al (2007) gave a framework for assessment (academic computing) of Malaysian colleges in respect of ICT- based accomplishments, within which they tried to answer three fundamental questions regarding (a) the indicators for assessment, (b) the characteristics of performance and (c) the academic performance. They adopted a value chain concept originally proposed by Porter (1985). This framework had two parts as primary and support activities. The primary activities included ICT- based learning, teaching, research and training as the core service and then enhancing the value in each. It further included remote access to data, faster and precise data processing, simulation of complex systems, collaboration between research groups. The support activities were linked with primary activities to improve the ICT- based efficiency and standards. Their finding was the moderate to high ICT- based academic performance in Malaysian colleges, which was corroborated later by Bakar & Mohamed (2008). This study was having some limitations as it was carried out for Malaysian colleges only and not for the universities and higher educational institutions of training and research. However, the work provided the inspiration to authors to devise a suitable framework for universities/ higher educational institutions and undertake the task of assessment in such institutions..

This framework takes into consideration, in a logical sequence, all the components present in universities/ higher educational Institutions which are primarily the centres of research where knowledge is created, shared and disseminated. The Figure 1 containing the basic constituents of ICT, placed in the appropriate tiers, depict the different academic components of ICT and the related activities of a university.

Using this framework, a questionnaire comprising 117 questions divided in 18 groups (A-R) were created to assess the initiative, status, activities and accomplishment of the universities under investigation in accordance to the areas delineated in Figure 1. The items in the questionnaire are shown in Appendix A.

Further, in each group the last question is related to the performance, but the group R has two questions related to performance. All these performance related questions (19) are placed in another group, S, which are presented in Table 1.

Table 1. *Various Groups of ICT Components in an Institution*

S.No.	Group	ICT details at University level	Performance Indicators	No. of Questions	Tier in Framework
1.	A	ICT Vision	Implementation	03	Tier-I
2.	B	ICT Initiatives	Execution	04	
3.	C	ICT Planning	Achievement	06	
4.	D	ICT Infrastructure	Utilization	13	Tier -II
5.	E	Local Area Networks Facility	Users	16	
6.	F	Internet, Network Security	Speed	10	
7.	G	Mobile Computing access	Access 24x7 basis	04	
8.	H	System Applications S/W	Overall user's Satisfaction	11	
9.	I	Web site and information systems	Online communication	09	
10.	J	Teaching Display Technologies	Availability	05	
11.	K	ICT Technical Staff	Trouble Shooting	05	
12.	L	ICT Budget allocation	Utilization	04	
13.	M	E- Library	Availability	04	
14.	N	E-Placement/Alumni Portal	Alumni Portal	03	
15.	O	ICT based Teaching and learning	Effective use of ICT	04	Tier III
16.	P	ICT Based research	Satisfaction level	07	
17.	Q	ICT Training programs	No. of programs organized	04	
18.	R	Accomplishments	Placement /Research	04	Tier IV
19.	S	Performance	Success rate	19	

3. METHODOLOGY:

The universities located in the western Himalayan region are those spreading over the state of Himachal Pradesh and Jammu & Kashmir. There are mainly 7 universities located in the western Himalayan Region of India, out of which six ICT based universities have been selected purposely as per details given in Table 2.:

Table 2.: Six ICT based Universities of western Himalayan region of India.

University	Abbreviation	State	Founded Year	Ownership	Website
Jammu University, Jammu	J.U.Jammu	Jammu and Kashmir	1969	State Government	http://www.jammuniversity.in/
H.P University, Shimla	H.P.U, Shimla	Himachal Pradesh	1970	State Government	http://www.hpuniv.gov.in
C.S.K Agriculture University, Palampur	C.S.K.U Palampur	Himachal Pradesh	1978	State Government	http://hillagric.ernet.in
Y.S.Parmar University Nauni, Solan	Y.S.P.U. Nauni	Himachal Pradesh	1985	State Government.	http://www.yspuniversity.ac.in/
National Institute of Technology (Deemed University) Hamirpur.	NIT, Hamirpur	Himachal Pradesh	1986	Central Govt. of India.	http://www.nitham.ac.in
J.P.University of Information Technology, Solan, H.P.	J.P.U, Solan	Himachal Pradesh	2002	Private	http://www.juit.ac.in

In order to gain information regarding ICT vision & initiative, status, activities and accomplishment in each university, the questionnaire was given to the concerned Head of the Department (HOD) of ICT/ IT/ Computer Science in the institution/ University. Though the person chosen was deemed to have the full knowledge regarding the development of ICT program, right from its inception, The HOD together with his technical team gave the feedback which was later verified and doubly ensured for the correctness of the information, by the first author at the time of collecting the information, personally.

In the structured questionnaire, the feedback (binary) to various queries was on five point scale arranged in a particular order that revealed the natural flow from the lowest level to the highest level of sophistication in technology. That is why it was thought reasonable to give a weightage of 1 to 5 respectively to each level in increasing order. The relevant statistical quantities were obtained as follows.

a. Weighted mean:

Standard statistical tools were used to analyse the data, groupwise, to find the Weighted Mean, Standard Deviation and Coefficient of Variation (CV) keeping in view the weight of the respective

level. The CV indicates the variation around its weighted mean in the series, the lesser is the CV, more consistent and stable is the series. However, the weighted mean was found to be a better measure as compared to CV, to understand the trend in a particular group. The use of median was another alternative but in view of the limitations of this method, weighted mean was logically preferred.

In view of the fact that queries were replied (in binary form) on a five point scale, The weighted mean (WM) of each group was calculated, followed by an overall mean in the respective tier. For the weighted mean, a weight factor ($w_i / \sum w_i$) was assigned for the response (1) in a particular level i , where w_i represents the weight 1,2,3,4,5 for the levels ($i= 1,2,3,4,5$) respectively. After this, an overall mean was found for different groups and then for different universities. Thus a simple tabular analysis was carried out to find results which are presented in Table 3.

b. Performance:

Performance may be defined as the active (not the passive) part of the process/ item. For example, take any item in either of the four tiers. As long as it remains in the mind or on the paper it is passive and it is not performance. The moment it is converted into action and becomes functional/ fruitful/ output oriented, that implies performance.

The performance was assessed as follows:

- (i) A performance related question, (PI), was identified from each of the first 18 groups. But from the group R two questions were identified for this. These 19 questions formed the nineteenth group 'S'.
- (ii) For each of the university, a statistical mean of the weighted values of 19 PIs was calculated.
- (iii) These mean values, given in the last row of Table 3, belonging to group S are shown in Figure 6a for different universities, depicting a performance analysis in Section 4.

c. Correlation Coefficients:

Another statistical quantity (Pearson) 'Coefficient of Correlation' (CC) of various 18 groups (A to R) with the group S was obtained and given in the last column of Table 3 and displayed in Figure.6b of Section 4. A t- test was conducted to ascertain the significance level (upto 5% level, showing $t_{0.05} = 2.12$ from the statistical table) of CC, using the formula,

$$t = r \cdot (n-2)^{1/2} / (1-r^2)^{1/2},$$

where r represents the CC and n denotes the degrees of freedom (18 in the present context). It provided confidence in planning proper groupings incorporated in the structure of the questionnaire, as the correlation coefficients for most of the groups were found to be significant.

Table 3: Weighted Mean and Pearson's Correlation Coefficients of various groups with Group S.

The t- test validated the Significance level of CCs from all the groups (but one 'O' group, which was found Not Significant 'NS')

Tier		J.P.U Solan	NIT Hamirpur	CSK.U Palampur	J.U. Jammu	Y.S.P.U. Nauni	H.P.U, Shimla	Correlation coefficient
Tier I	Group A	0.3	0.33	0.17	0.3	0.27	0.33	0.60
	Group B	0.27	0.27	0.2	0.22	0.18	0.28	0.70
	Group C	0.29	0.28	0.21	0.21	0.24	0.32	0.48
Weighted. Mean		0.29	0.30	0.19	0.24	0.23	0.31	
Tier II	Group D	0.33	0.33	0.28	0.22	0.22	0.3	0.70
	Group E	0.32	0.33	0.21	0.23	0.24	0.2	0.93
	Group F	0.27	0.28	0.23	0.26	0.19	0.28	0.64
	Group G	0.2	0.29	0.23	0.24	0.17	0.17	0.60
	Group H	0.07	0.33	0.07	0.27	0.16	0.07	0.49
	Group I	0.24	0.24	0.16	0.18	0.19	0.19	0.93
	Group J	0.15	0.27	0.15	0.14	0.07	0.12	0.80
	Group K	0.24	0.33	0.18	0.16	0.13	0.18	0.92
	Group L	0.33	0.27	0.2	0.2	0.09	0.11	0.77
	Group M	0.23	0.33	0.23	0.2	0.23	0.17	0.71
	Group N	0.31	0.27	0.13	0.17	0.23	0.17	0.79
Weighted Mean		0.24	0.30	0.10	0.20	0.17	0.18	
Tier III	Group O	0.27	0.27	0.25	0.2	0.26	0.15	0.38 (NS)

	Group P	0.2	0.27	0.07	0.18	0.07	0.23	0.95
	Group Q	0.2	0.2	0.09	0.12	0.07	0.08	0.91
Weighted Mean		0.22	0.25	0.14	0.17	0.13	0.15	
Tier IV (WM)	Group R	0.3	0.32	0.17	0.23	0.15	0.22	0.63
Performance Indicator(W	Group							

4. RESULTS AND DISCUSSION:

This section will be presented in two subsections as below:

4.1 Comparative Status of different Tiers (I-IV):

The weighted mean for Tier I, vision, initiative and planning, for different universities has been presented in Figure.2, which depicts a comparative view among the universities.

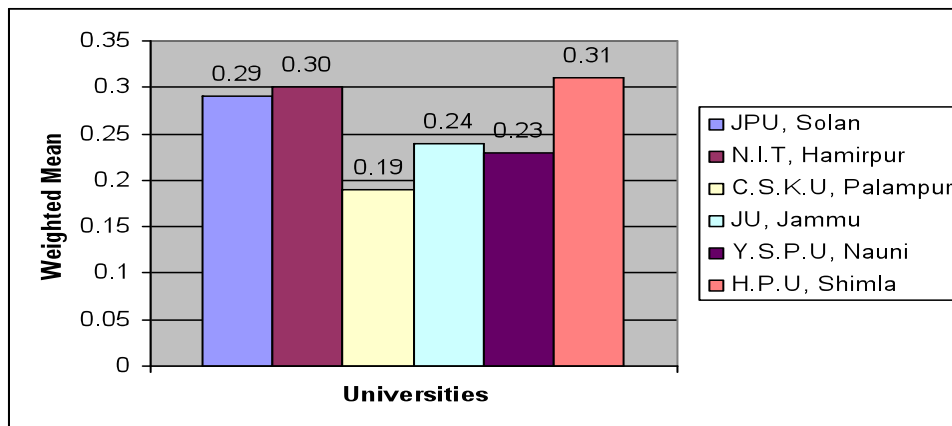


Figure 2 (Tier I.) Status of ICT Vision, Initiative and Planning among different Universities.

Actually, at the level of Tier I, all the universities think big with a minor difference. It is only a matter of earlier or later ICT technologies adopted by the universities which normally makes a difference. Figure 2 shows that there is not much difference corresponding to the constituents of Tier I, among the three Universities viz. JP University, NIT and H.P.University. The other universities might have lagged behind due to earlier adoption of the technology, proper initiative or the vision in fixing the priorities in respective universities. The standard deviation and the coefficient of variation (CV) was also calculated for Tier I. CV (%) was found to be 14.54%, 15.13%, 18.04%, 24.05, 32.66% and 39.44% respectively for H.P.University, J.P.University, NIT, Nauni University, Jammu University and Palampur University. It reveals that first three universities are having more consistency in ICT vision, initiative and planning than the later three universities.

Next, the weighted mean of all the different groups in Tier II, dealing with the overall ICT infrastructure among different Universities in the region, has been presented in Figure. 3.

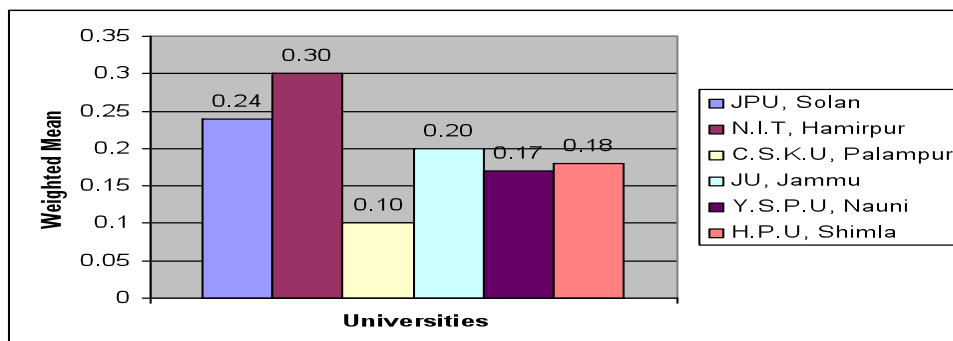


Figure. 3. (Tier II) Status of ICT Infrastructure among different Universities.

From this diagram, it may be seen that NIT Hamirpur is having the largest ICT infrastructure followed by J.P. University, Jammu University, H.P.University, Palampur University and Nauni University. This difference may be mainly attributed to advanced ICT facilities available in NIT, like Local Area Network with facilities of large bandwidth, Video- conferencing, Mobile (Wi-Fi) computing, IP telephony and assured access of the digital tools/ resources to all the users on the campus along-with a prompt maintenance management. These facilities are also available to students in the hostels and to faculty members at their official accommodation. At the same time, NIT has a functional & effective web site along-with the information system, better University-industry interaction. From all these counts, NIT has an edge over other universities. Other contributing factors are the effectiveness of ICT training programs, organized for the faculty, students and professionals as the drive for human resource development. Finally, the placement of outgoing professionals in reputed establishments add much more weightage in this direction. J.P.University (a private university) closely follow the NIT Hamirpur due to the availability of sufficient resources as per their priority.

This figure further reveals a small difference between Jammu University and Himachal Pradesh University, particularly because of the fact that Jammu university is having higher internet bandwidth, better mobile computing facilities, video-conferencing facility alongwith e-library as compared to those available in Himachal Pradesh University. The difference may be attributed to the limitation of funding and technical faculty.

Tier III, is concerned with the IC- based academic activities which can be further divided into primary activities of teaching and learning, and advanced activities like sophisticated training programs with an orientation of actual problem solving & quality research for developing professional skills. These are displayed in Figure 4.

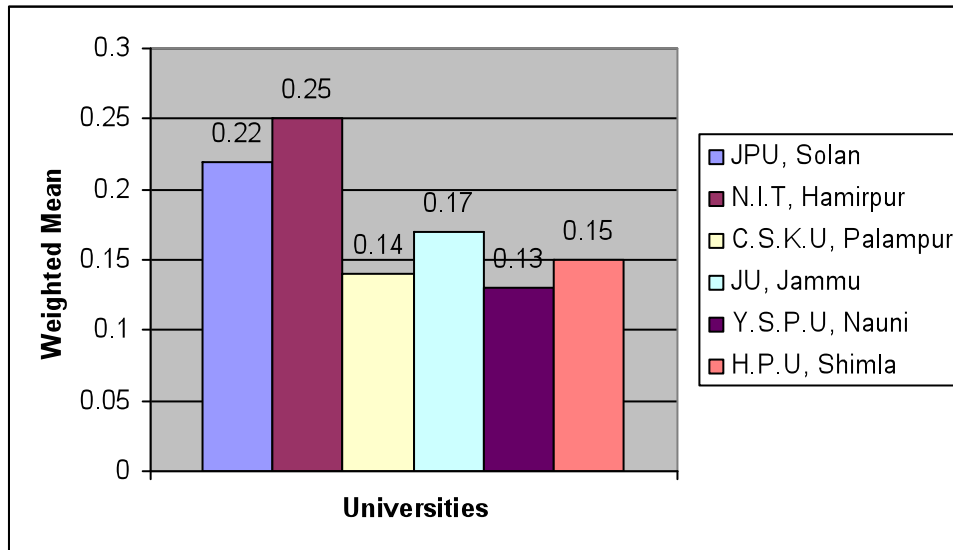


Figure.4 (Tier III.) Status of ICT based activities Teaching/Learning/Research/Training among different universities

The use of ICT- based tools is one of the effective approaches in organizing various academic activities. E-journals and internet resource have become the lifeline for the quality research work and for conducting the advanced training programs in the university system. In this respect, NIT Hamirpur has established superiority over others in Tier III also, followed by J.P.University, Jammu University, H.P.University, Palampur university and Nauni university.

The accomplishments leading to performance and impact of various universities at the local (societal) level, national and international level, falls under Tier IV. The performance & impact are reflected mainly through two components. One is the outstanding research supported with patents for the fruitful activities and for the benefit of mankind. Another is the placement of outgoing students trained in professional courses, to reputed universities, institutes, industries and other organizations. The accomplishment/ impact factor has been shown in Figure. 5

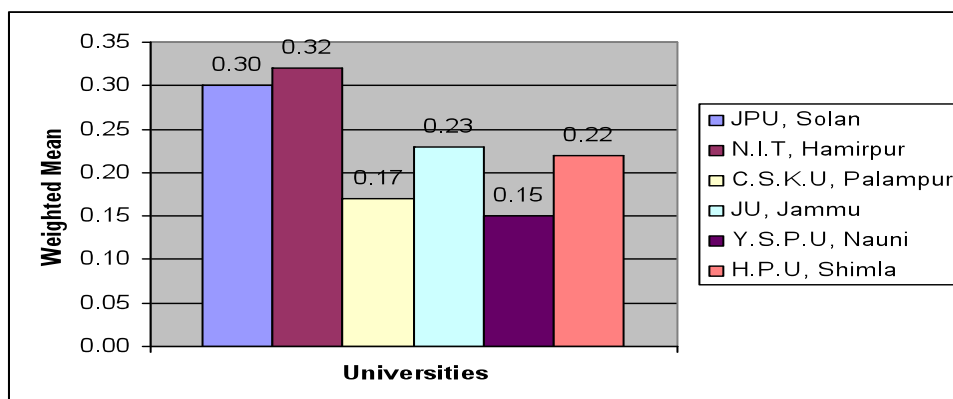


Figure 5. (Tier IV) Status of ICT based accomplishment(Placement/Research)

This figure reveals that NIT Hamirpur is again having an edge over other universities in the western Himalayan region of India, followed by J.P.University, Jammu University and Himachal Pradesh University. The main reason for this variation is the value addition through adoption of innovations in the field of research, particularly supported by the advanced ICT-based facilities. Further, quality research publications per year, along with successful collaborative research work also becomes an important factor for the superiority of one university over the other. In addition, actual placement contributes the most to Tier IV in the form of linkages of the professionals with industries.

Impact may be judged by either of the two methods: (i) Present and past approach (ii) With and without approach. In this study, we try to judge the accomplishment by 'Present and past approach'. Earlier, one could not imagine the accessibility of most of the relevant journals to the academic community, particularly in the universities of this region having rough and difficult terrain with less resources, but now with the availability of the ICT- technology the e- material and e- journals have become readily available, through the courtesy of University Grants Commission. With this, the academic interaction/ communication and exposure of students & faculty members in the universities increased leaps and bounds which got reflected through quality publications in research and better placements of outgoing professionals.

In general, an output of a concern is judged by its quality and its demand (at the local and global level). These two aspects decide the impact of the concern. Adopting this analogy here, quality comes from, in addition to the development of skilled professionals, the enquiry- based learning & research based on problem solving. After all, the basic purpose of education is actual problem solving. This is how humanity progressed and survived. Further, the demand has its manifestation in placements of the outgoing students in reputed Indian/ multinational concerns including the software development sector.

There are other factors also that are indirectly responsible for the accomplishment, performance and impact of an institution, like increase in the number of universities/ higher educational institutions where innumerable programmes having better employability are being offered. All this became possible due to the revolution in the field of solid state devices (from the micro to nano), digitization of information and internet technology. Earlier, in the absence of ICT- programs, only a few higher educational institutions/ universities could be counted as centres of excellence but in the post- ICT scenario, one can appreciate the presence of many such excellent higher educational institutions at the Global level.

4.2. Performance:

This section would be further subdivided as follows.

- **ICT based Performance Analysis:** Going back to Table 3, last row, group S, the weighted mean of the performance has been plotted in Figure. 6a. Here it may be noted that the maximum value of the weight corresponding to the level 5 (in the feedback), is 1/3. Now the figure reveals that NIT Hamirpur is very near to this maximum, followed by J.P.University with the performance in the range between 80 to 95%. Then comes the two general multifaculty universities namely Jammu University and H.P. University, having the performance in the range 60 to 70%, followed by the Agri- Horticulture universities having the performance in the range 50 to 60 %.

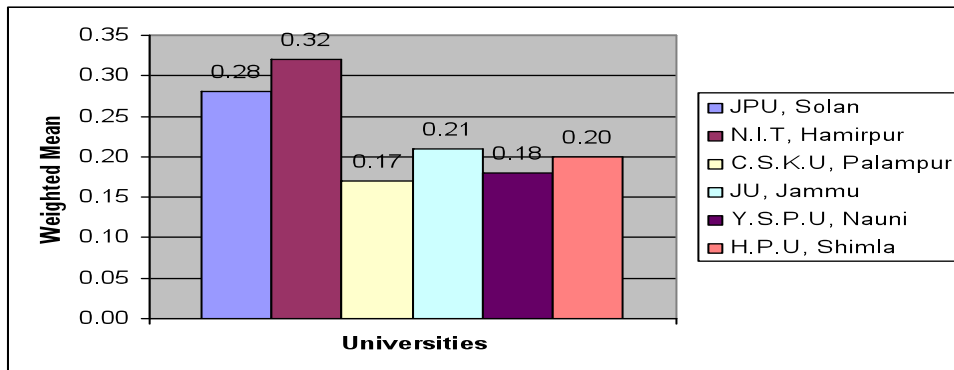


Figure 6 a. Performance Analysis

- Correlation Coefficients:** Towards the end, it was thought reasonable to compare Coefficient of Correlation of different groups, (with the group S indicating the performance). These Correlation Coefficients have been given in the last column of Table 3 and displayed in Figure. 6 b.

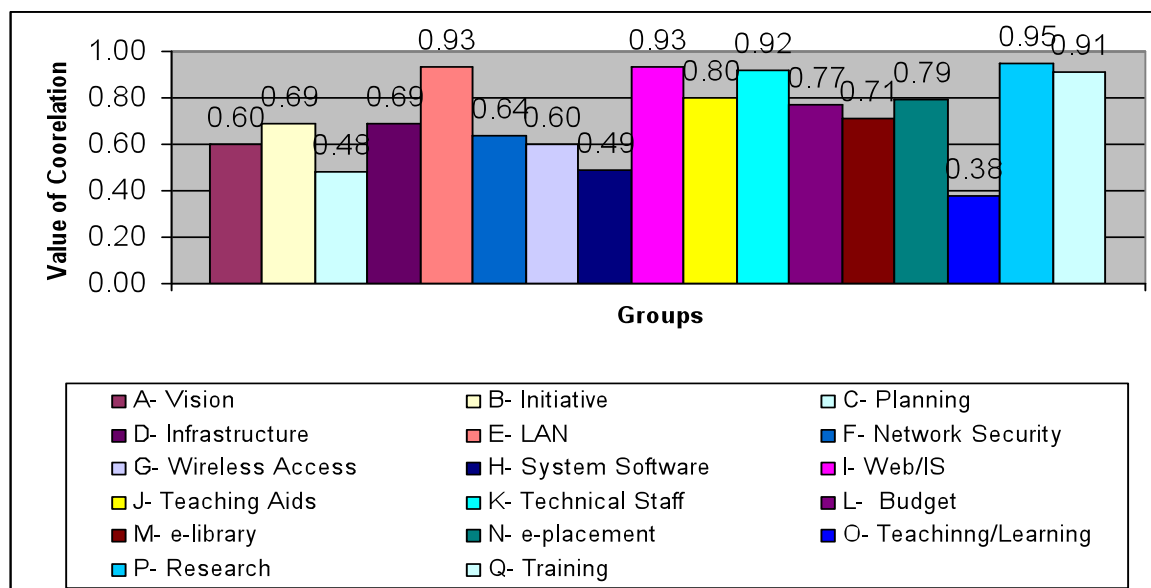


Figure. 6b. Groupwise Correlation with performance indicator Group S

On its perusal, the CCs are found to have values, lying between 0.38 and 0.95. The values of CCs from 11 groups, lying above 0.70 are found, validated by the t-test, to be most significant. The most significant level CC groups are: B- ICT initiative, D- ICT Infrastructure, E- LAN, I- Website and Information System, J- Teaching Display Technologies, K- technical staff, L- ICT Budget Allocation, M- e-Library and N- Alumni portal and placement, P- ICT based Research, and Q- ICT Training programs. The other CCs from 6 groups lying between 0.48 to 0.70 are found significant. These are related to A- ICT vision, C- ICT planning, F- internet & network security, G- mobile computing

facility, H- system application software and R- accomplishments of ICT. This analysis is found quite consistent with the analysis presented in Section 4.1 above.

However, the only Non- Significant (NS) CC was found to be from the 'O' group which was related to the ICT- based primary activities (conventional classroom teaching and learning, an extremely important pillar of education system). It appears to be a depressing factor where the universities of this region could not pick up with the pace of revolution in the ICT field.

5. SUMMARY AND CONCLUSION

This section will be presented in two subsections.

5.1 Summary:

In this study we have presented an assessment and analysis of ICT vision & planning, status of ICT infrastructure, ICT based academic activities and corresponding performance/ success of six universities in the western Himalayan region. The focus was on the integration of ICT with the academic curricula of an institution. The analysis was based on the primary data gathered as feedback to a questionnaire which had 117 questions divided into 18 different relevant groups within a four- tier framework. Statistical inferences were drawn from the weighted mean of various responses. Performance indicator of each of the groups was carefully identified to gauge the success of respective ICT initiative at different stages of the framework.

The Tier I covered vision, planning and implementation which initially become the basis for decision- making and respective strategies. These are always driven by a visionary at the highest level in the university system with full support from the government along with a small but dynamic team at the local level. It may also be emphasized that a good academic curriculum and better faculty are the most essential requirements for imparting the quality education in the field of ICT. The present analysis showed H.P. University to have an edge over others followed by NIT Hamirpur and J.P. University among the first three Universities.

It further requires superior infrastructure (Tier II) with an efficient and fast network to access the internet system along with a large bandwidth and good technical support for maintenance. This aspect in functional form gets reflected subsequently on the performance level of the university system. The analysis revealed that the technical support and redundancy problem was not taken care of in general with the exception of NIT Hamirpur and JP University.

After all, the universities are meant (Tier III) to create knowledge by the professionally skilled dedicated manpower. The professional spirit of a person is always gauged on a scale of how much busy his academic schedule remains for assimilating knowledge towards actual problem solving. The findings of the analysis in respect of this category, are that

- Communication between students and faculty members using the ICT facility, is still not widespread in many of the universities except NIT Hamirpur and partly in Jammu University. Such a communication enables flexible learning by the students.
- On the research front, most of the faculty and students are able to utilize ICT facilities in accessing the literature and submitting the research papers online to respective journals. Even organization of conferences and workshops has become a lot easier due to the availability of such a facility.

- Interaction among the researchers' community is becoming more and more efficient within the universities and research institutions at the global level.
- Though the online facility is available through the websites of respective universities and students try to access information, but in case of any query posed by them, they remain disappointed in general at the institutional level. NIT Hamirpur and J.P. University have been found better in this direction.
- Further, most of the universities have shown good results in spreading ICT awareness alongwith specialized training in this field, through organizing extension programs on regular basis. In this category, NIT Hamirpur is found to be at the top followed by J.P.University, Jammu University, H.P. University and the two agro- horticulture universities.

The better performance in ICT field always results in sound impact (Tier IV) at the national and international level in terms of outstanding research publications in the fields of relevance and actual placements. ICT plays a significant role in driving the universities towards excellence by virtue of performance. It also facilitates doing experiments in virtual laboratories and establishes close collaboration between research groups from national to global level. In this respect also, once again, NIT Hamirpur is found to have an edge over others, followed by J.P.University, H.P. University and Jammu University.

5.2. Conclusions:

Important conclusions may be described as below.

- In view of the difficult terrain of western Himalayan region and the struggle of the people, the present study has become more relevant and significant so as to appreciate the ICT penetration in different universities of the region.
- Integration of ICT with various academic programs to develop the problem- solving skill, has helped significantly in enhancing the quality research and better placements. This aspect is being implemented in most of the universities effectively.
- The significant level of coefficients of correlation (CC), using t-test, of most of the groups (but one) provided confidence in the conceptualization of groups presented in the questionnaire. The eleven groups , the most significant ones, are found to be dominating the ICT-based performance in the university system. However, the depressing factor remains with the ICT-based class room teaching and learning, where actual problem- solving skill ought to be promoted.
- On the basis of overall ICT status, activities and performance, the present analysis is found to match with the reported ranking submitted by NAAC and other agencies. It may be recalled that quality has remained the most important defining element with the NAAC.
- The universities, to a greater extent, have been found to act as nuclei towards creating skilled professionals with enhanced core competence

6. FUTURE STRATEGIES:

The pattern revealed in this paper through various aspects of ICT development, points towards future strategies as follows:

- The first and the foremost attention should be paid to the class room teaching and learning so far as the benefit of ICT facilities is concerned, where the initial seed of 'problem solving' skill be sown in the mental field and then nurtured upto a critical level.
- Although ICT initiatives in different universities are quite encouraging, their extension must be envisaged in all the universities/ higher educational institutions of the country. It must include the advanced training programs to prepare professionally skilled manpower specially in problem solving skills for enhancing the core competence of scientists and making these programs more meaningful.
- The universities with highly skilled professionals in the field of ICT should function as nucleus to generate more and more skilled human resource. At the same time, these professionals must plan with dedication & determination to solve the real problems and remove the sufferings of humanity. Only then it will fulfill the objectives of 'Transforming the Society' as envisaged in the Kothari Commission report of 1966 and the Technology Vision 2020 document prepared by TIFAC for India.
- Different courses in the form of e-content inclusive of video, in Indian universities be made available as freeware similar to those of MIT open courseware, as envisioned by NMEICT. It will have an effective long term sustainable impact on society by way of advanced ICT enabled education and empowerment of people in the western Himalayan region of the country.

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Appendix A

Questionnaire

	ICT Components	Levels of Performances				
S.no	ICT Vision	Level I (Lowest) (a)	Level II (b)	Level III (Middle) (c)	Level IV (d)	Level V (highest) (e)
TIER I						
Group A –ICT Vision						
1.	Source of vision	Enthusiastic students	Level 1+ ICT specialists.	Level II + Directors/Deans/HOD	Level III+ Registrar	Level IV + Vice-Chancellor
2	Logical conclusion of the vision.	0-20%	20%-40%	40-60%	60-80%	80% and above.
3.	Success rate of Implementation	0-20%	20%-40%	40-60%	60-80%	80% and above.
Group B - ICT Initiatives						
1.	ICT infrastructure	Enthusiastic students	Level 1+ ICT specialists.	Level II + Directors/Deans/HOD	Level III+ Registrar	Level IV + Vice-Chancellor
2.	ICT Learning/ Awareness.	Enthusiastic students	Level 1+ ICT specialists.	Level II + Directors/Deans/HOD	Level III+ Registrar	Level IV + Vice-Chancellor
3.	Complete ICT automation	Enthusiastic students	Level 1+ ICT specialists.	Level II + Directors/Deans/HOD	Level III+ Registrar	Level IV + Vice-Chancellor
4.	Execution of Initiatives	<20%	20 -40%	40-60%	60-80%	80% and above
Group C - ICT Planning						
1.	The scope of ICT planning	Purchase of HW/SW only	Level I+ Data entry and printing.	Level II+ e-resources & data base archive.	Level III+ Teaching/ e-content	Level IV + research /automation
2.	Participation level	Enthusiastic students	Level 1+ ICT specialists.	Level II + Directors/Deans/HOD	Level III+ Registrar	Level IV + Vice-Chancellor
3.	Funding for ICT development.	No Funding	Limited to department/S elf Financing	University level funding	State Govt	Central Govt
4.	Implementation and its monitoring	Chairman Department Level	Dean Faculty level	Level I+II+ ICT specialists	University committee	Level IV+ Audit, Vice Chancellor
5.	Curricula	Updated 5 year or more	Updated 4 year or more	Updated 3 year or more	Updated 2 year or more	Updated 1 year or more
6.	Plan achieved.	<20%	20 -40%	40-60%	60-80%	>80%

Group D- ICT Infrastructure						
S.No	ICT Infrastructure	Level I (Lowest) (a)	Level II (b)	Level III (Middle) (c)	Level IV (d)	Level V (highest) (e)
1.	Availability of computers to the students (Ratio)	1:10 or more	1: 0 to 1:8	1:6 to 1:4	1:4 to 1:2	1:2 to 1:1
2	Internet enabled computers to students.	1:10 or more	1: 0 to 1:8	1:6 to 1:4	1:4 to 1:2	1:2 to 1:1
3.	Availability of computers to the faculty members.	1:5 or more	1:4	1:3	1:2	1:1
4.	Computers out of order available to students	15% or more	10% or more	6% or more	4% or more	2% or less.
6.	Working computers vs out of order computers	5%	4%	3%	2%	1% or less
7.	AMC Engineer and time	No.	3 days or	2-3 days or more	1-2 days	Less than 10

	frame for troubleshooting		more			hours.
8.	Availability of spare parts	No	10%	=40%	70%	90% or more.
9.	Internet enabled Laptops with faculty.	1:5 or more	1:4	1:3	1:2	1:1
10.	EPBAX facility in all the rooms/ offices	Not available	10% -25 % coverage	25 %-50% coverage	50%-75% coverage	75% -100% coverage.
11.	Availability of IP based telephony.	Not available	10% -25 % coverage	25 %-50% coverage	50%-75% coverage	75% -100% coverage.
12.	Availability of Video Conferencing.	NO	In one faculty only	Common facility	More than one faculty.	With all the faculties.
13	Utilisation	Not Available	10-25 %	25-50%	50-75%	75-100%
Group E – Local Area Network Facility						
1.	Campus Wide LAN	No	25%-40%	40%-60%	60%-90%	90% or more.
2.	Backbone within campus	No	Cat5/5 e backbone	Cat6 backbone only.	OFC backbone + Cat6.	OFC backbone +Cat7e
3.	Redundancy feature on campus backbone	No	Covers 25%	Covers 50%	Covers 75%	Covers 100%
4.	Type of Network switches (central switch)	No switch	Layer II	Layer II/ Manageable	Layer II+III Manageable	Multi layer Chassis switch
5.	Number of hubs / Layer II (Non Manageable)	More than 40%	30%-40%	20%-30%	10%-20%	No hub available.
6.	Number of Layer II (Manageable)	NO	10%-20%	20%-30%	30%-40%	More than 40%
7.	Number of Layer III (Manageable)	NO	10%-20%	20%-30%	30%-40%	More than 40%
8.	Campus structured cabling done?	Not done	Upto 40%	40-70% done	70-95% done	95% or more
9.	Capacity of end user connection available	No patch cords.	Less then cat5 (10 Mbps)	CAT5e (100 Mbps)	CAT 6(Giga)	CAT 7e
10.	% of 10 Mbps Ethernet available in systems	80% or more	50%-80% done	20%-50%	05%-20%	Less than 5%.
11	% of 100 Mbps Ethernet available in systems	Less than 5%.	05%-20%	20%-50%	50%-80% done	80% or more
12.	% of 1 Gbps Ethernet available in systems	Less than 5%.	05%-20%	20%-50%	50%-80% done	80% or more
13.	% of 10 Gbps Ethernet available in systems	None	Upto 20%	20%-50%	50%-80% done	80% or more
14.	Uptime of LAN	40%	40-60%	60-80%	80-97%	More than 97%
15.	Availability of network.	1 building	2-10 buildings	11-20 buildings	Campus with all the hostels	Level IV+ Staff Residence
16.	No of Internet users in the campus.	100 -200 users	201 -400	401-600 users	601-800 users	801 or higher
Group F – Internet, Network Security.						
1	User Authentication	Not done	0%-20%	20%-50%	50-90%	90% or above
2	User -Mac Address Binding available	Not done	0%-20%	20%-50%	50-90%	90% or above
3	User -IP address Binding done in your campus	Not done	0%-20%	20%-50%	50-90%	90% or above
4	User-Mac address-IP address binding	Not done	0%-20%	20%-50%	50-90%	90% or above
5	Internet facility with VSAT	Not available	512 kbps- 1 Mbps	1 Mbps (1:1)	2 Mbps	2 Mbps(1:1) or higher
6	Internet facility through leased line on copper	Not available	1 Mbps or 1 Mbps (1:1)	2 Mbps	2 Mbps(1:1)	More than 2 Mbps (1:1)
7	Internet facility through leased line on OFC	1 Mbps -2 Mbps	1-2 Mbps (1:1) ratio	4 Mbps	4 Mbps (1:1) ratio	More than 4 (1:1) ratio
8	No of leased line available.	1	2	3	4	5

8	No of leased line available.	1	2	3	4	5
9	Uptime of internet leased line link	<40%	40-60%	60-80%	80-97%	> 97%
10	Internet performance (Speed)	not reliable	always Slow	Slow only in peak hours	Smooth with little delay.	Smooth w/o any delay.

TIER II

Group G- Mobile Computing Access Facilities						
1.	Is your campus networked with secured Wi-Fi.	One building	2-10 buildings	11-20 buildings (without hostels)	20-30 builds + hostels	IV+ teachers residences
2.	Is internet available via mobile computing .	not reliable	Always Slow	Slow only in peak hours	Smooth with little delay	Smooth without delay
3.	Access to digital tools, through Wi-Fi	Not available	20%	20-50%	50-80%	>80%
4.	Wi-Fi Enabled Internet Access 24x7 bases	not reliable	Always Slow	Slow only in peak hours	Smooth with little delay.	Smooth w/o any delay.
Group H - System, Application software.						
1.	Operating Systems in use MS windows 98	Not available	20%	20-50%	50-80%	80% or higher
2	Microsoft windows2000	Not available	20%	20-50%	50-80%	80% or higher
3	MS windows 2003	Not available	20%	20-50%	50-80%	80% or higher
4	Microsoft windows 2007 or higher	Not available	20%	20-50%	50-80%	80% or higher
5	Open source	Not available	20%	20-50%	50-80%	80% or higher
6.	Unix	Not available	20%	20-50%	50-80%	80% or higher
7.	Solaris	Not available	20%	20-50%	50-80%	80% or higher
8.	Office Applications	Not available	20%	20-50%	50-80%	80% or higher
9	Groupware software is in use	Not available	20%	20-50%	50-80%	80% or higher
10.	Scientific software like simulations tools in use	Not available	20%	20-50%	50-80%	80% or higher
11.	Overall user Performance/Satisfaction	None	25%	25-50%	51-80%	80% or higher
Group I - Web Site and Information systems.						
1.	Academic information available on intranet	Not available	20%	20-50%	50-80%	80% or higher
2.	E content/ Lecture notes available via Web Server	Not available	20%	20-50%	50-80%	80% or higher
3.	Online attendance, Marks, examination schedule, etc	No Information	20% information	20-50% information	50-80% information	80% or higher information
4.	Encouragement by teachers for online submission of assignments	No	20% Faculty	20-50% Faculty	50-80% Faculty	80% or higher Faculty
5.	e- communication within departments	No	20%	20-50%	50-80%	> 80%
6.	Online test/Exams of teaching courses conducted	No.	25%	25%-50% Test /Exams	50-80% Test /Exams	>80%
7.	Entrance exam to various courses conducted online	No.	25%	25%-50%	50-80%	>80%
8.	Entrance exam is conducted through OMR/OCR System	No. Only manual	25%	25%-50%	50-80%	>80%
9.	Performance due to online communication	None	0-25%	25-50%	50-75%	>75
Group J – Teaching Display Technologies						
1.	Peripherals available in your campus	No	Dot Matrix, inkjet Printer	Laser printers, scanners	III + Network laser printers,	IV + printing management
2.	LCD display class room teaching	No	25%	25-50%	50-75%	>75%
3.	Storage of teaching material via digital board	No	25%	25-50%	50-75%	>75%
4.	Video Storage of lectures	No	25%	25-50%	50-75%	>75%
5.	Availability of teaching	No	25%	25-50%	50-75%	>75%

	display technology.					
Group K- ICT Technical Staff						
1.	Ratio of technical staff to 30 computer in labs.	No Tech. Staff	1-2	2-4	4-6	>6
2.	Confidence level of solving tech. problems	<20%	20-40%	40-60%	60-80%	80-100%
3.	Are Technical staff motivated?	<20%	20-40%	40-60%	60-80%	80-100%
4.	Job Satisfaction of ICT staff.	<20%	20-40%	40-60%	60-80%	80-100%
5.	Troubleshooting	Less than 10%	10%-40%	40-70%	70-80%	80%-100%
Group L - ICT Budget						
1	During 2006-07 in INR.	Upto 5 Million	5-10 Million	10-20 Million	20-30 Million	Above 30 Million
2	During 2007-08 in INR	Upto 5 Million INR	5-10 Million	10-20 Million	20-30 Million	Above 30 Million
3	During 2008-09 in INR	Upto 5 Million INR	5-10 Million	10-20 Million	20-30 Million	Above 30 Million
4	Utilisation of budget in INR	Upto 5 Million INR	5-10 Million	10-20 Million	20-30 Million	Above 30 Million

Group M – E-Library System						
1	Facility of E-Catalogs available	None	Upto 25%	25%-50%	50%-75%	> 75%
2	E-thesis/dissertation submission available.	None	Through CD/DVD	Online through Campus LAN.	through LAN WAN	IV + Online Feedback/stat us.
3	Extension Services available.	None	Upto 25%	25%-50%	50%-75%	> 75%
4	Availability of e content via Intranet/Internet	No	<25%	25%-50%	50%-75%	>75%
Group N- E-Placement/Alumni Portal						
1.	Is E-placement with online resume, test, etc.	Manual work	Done electronically	Done online within intranet	III+ Internet.	IV + linkage with industries online.
2.	E- Discussions with industries & students	Manual work	Done electronically	Done online within intranet	III+ Internet.	IV + linkage with industries online.
3.	Online alumni portal.	No.	Manual work	Online Registration	With updated database (DB)	Dynamic Data Base.

TIER III

Group O- Integration of ICT in Teaching and Learning.						
1.	Approach of delivering lecturers using ICT i.e. ppt, etc	<20% use ICT	20-40%	40-60%	60-80	>80.
2.	Approach of delivering lecturers using ICT and video.	<20% use ICT	20-40%	40-60%	60-80%	>80%
3.	To make subject interesting using simulations models, etc.	<20% use ICT	20-40%	40-60%	60-80%	>80%
4.	Online Counseling	<20% use ICT	20-40%	40-60%	60-80%	>80%
5.	Effective use of ICT tools for teaching and learnin	<20% use ICT	20-40%	40-60%	60-80%	>80%
Group P- Research using ICT						
1.	Using Internet and open e-resources	<20%	20 -40%	40-60%	60-80%	>80%
2.	Availability of . subscribed E-journals	<100	<500	<1000	<2000	Above 2000
3.	No. of e-journals (used per person)	<5	<10	<15	<20	Above 20
4.	Full text availability of desired e journals	<20%	20 -40%	40-60%	60-80%	>80%
5	Frequently of usage for e- journals?	Once in a month	Once in three weeks	Once in two weeks	Once in one week	Every day

6.	Reasons for subscribing e-journals if subscribed by the university.	Not available	Economy	Solves theft , mutilation problems.	Easy to Archive	Easy Distribution over network
7.	Satisfaction Level with e-journals with full text.	<20%	20 -40%	40-60%	60-80%	>80%
Group Q- ICT training Programs						
1.	ICT Support for training to lecturers available	No such facility	Upto 20%	20-50%	50-80%	80% or above.
2.	ICT awareness program conducted annually	None	1	2	3	4 or more
3.	Advanced ICT training program conducted annually	None	1	2	3	4 or more
4.	No. of programs Organised	None	1	2	3	4 or more

TIER IV

Group R – Accomplishment (Research/ Actual Placement)						
1	No of research publications per annum per 100 faculty members.	<10	10-20	20-30	30-50	>50
2	Research collaboration using facility of (Email/Online)	Nil	Once a month	Once a fortnight	Once a week	Every day.
3	Institute Industry Interaction (3i) Program for students	Nil	Once a year	Once in 9 month	Once in 6 month	Once in 3 Month.
4	On campus placement annually in percentage	Nil	Upto 30%	30-60%	60-90%	More than 90%

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