Assessing the Yield of IT Projects in Developing Nations: Aggregated Models Are Not Sufficient

Stephen Ruth, Bhaskar Choudhury

School of Public Policy, George Mason University, 4400 University Drive, MSN 3C6, Fairfax, VA 22030 USA

ABSTRACT

Determination of the outcome of an IT project in a developing nation is often based on sectoral models and highly aggregated data. This paper offers an example of a replicable methodology to go to the grass roots—the user level—to obtain valuable insights from the individual and group data that are masked by the aggregate statistics.

EXTENDED SUMMARY

This paper offers an example of a methodology and a process that can enable better policy choices in IT diffusion in developing nations. It updates and refocuses an earlier report by Ruth [19]. There are literally dozens of conceptual frameworks aimed at describing the diffusion of IT in developing nations but no unified approach to determining the micro-level data that underpins the aggregate data. Internet hosts per thousand population, for example, is an interesting summary number in a developing country but gives no clear vision of the individual and group issues—access limits, training approaches, gender roles, etc.-- that cause each host site's inclusion or exclusion. A comprehensive model of the diffusion process for Internet must be able to describe specific approaches to measuring at the micro level—not just aggregations of statistics at the regional or national level. We offer a small step in that direction by demonstrating that these micro level statistics *can* be obtained with precision, enabling inferences about individual and group performance. The example we use is an Internet course for professors in Romania's capital, Bucharest. Training of this type is an integral step in Internet diffusion in any developing nation and the variables that emerge can be used in many other micro-level studies of other Internet-related issues. The importance of training is reiterated in a study conducted by the World Bank in which connectivity and education are identified as critical factors in ensuring the reduction of the "digital divide" [25]. In this demonstration case significant effects are demonstrated in both descriptive statistics and ANOVA results based on gender, academic specialty, computer skills, age, and research productivity. The approach in Romania is robust and replicable and we feel that by using this realistic individual data as an exemplar for other micro level studies, it can be possible to integrate more realism into the rich array of macro-level models that already exist.

1. THE PROBLEM OF TOO MUCH SUMMARY DATA: MACRO LEVEL APPROACHES FOR EXPLAINING THE DIFFUSION OF INTERNET TECHNOLOGY IN DEVELOPING NATIONS

The number of aggregate or macro level statistics proposed for measuring of Internet diffusion in developing nations is steadily increasing. A group of experts developed over seventy criteria for studying the effects of Internet in developing countries [22, section 4]. Examples of these criteria are:

a. Number (percentage) of chambers of commerce with Internet access
b. Rate of change in the value of a firm's exports since acquiring Internet access
c. Number of ministries/departments with e-mail reply addresses on the Web
d. Percentage of total public information made available through the Internet
e. Number of Web server hits or requests fulfilled per month from domestic versus regional versus international sources

For those who follow this literature the number of macro level frameworks for Internet diffusion in developing nations can be daunting—numbering in the dozens. Abramson [1] and Goodman et al [7], among others, provide summaries of many of them. Each of these approaches is an attempt to establish a series of criteria or predictor variables that can assist in evaluation of the process by which Internet technology deployment takes place. Incidentally, one finding that none of these studies contests is that Internet connectivity in developing nations is tragically low. Internet Hosts in millions in the top five nations, the USA, Japan, Canada, UK, and Germany are 65.9, 4.3, 3.9, 3.2, and 2.7 respectively. The comparable numbers for Africa, China, and India, where nearly half the world population is concentrated, are 0.24, 0.11, and 0.05 respectively [20]. The twenty developed nations of the world use about 95 percent of the Internet capacity [12,25].

Typical of the approaches for integrating macro indicators for Internet diffusion in developing nations is a group of periodic reports, many appearing in the *Communications of the Association for Computing Machinery*, prepared by researchers who make field visits and interview Internet Service Providers (ISP), government officials, Postal, Telephone & Telegraph (PTT) managers, and other Internet policy planners. Typically, they examine either a group of countries like the United Arab Emirates [2] or South America

[6]; or individual countries like Bangladesh [16], Nepal [11], Israel [5], Turkey [23], Cuba [15]; or a region like Greater South China [9]. Their reports emphasize descriptive statistics based on Internet hosts, usage ratios among population segments and other summary data.[24]

Another generalized approach to characterizing the dynamics of the Internet diffusion process was developed by John Daly and is shown in Figure 1 [4]. An essential characteristic of this framework is the interaction among Internet penetration, utilization and results (impacts) for workgroups, organizations and markets. Internet penetration is dependent on such factors as availability of bandwidth, quality and quantity of content transmitted, infrastructure (electrical and telephony), and the policy environment (prices, taxes, etc.). Utilization is about variables that affect the ability to take advantage of Internet: training, quality of use, hours of use, and the like. Impacts are measured as a cluster of results that can be achieved, like improved education, changes in Gross Domestic Product in Internet services, and individual benefits in health, government, commerce, industry, etc. Again, the inputs and outputs in this framework are highly aggregated data, summaries of summaries in many cases.

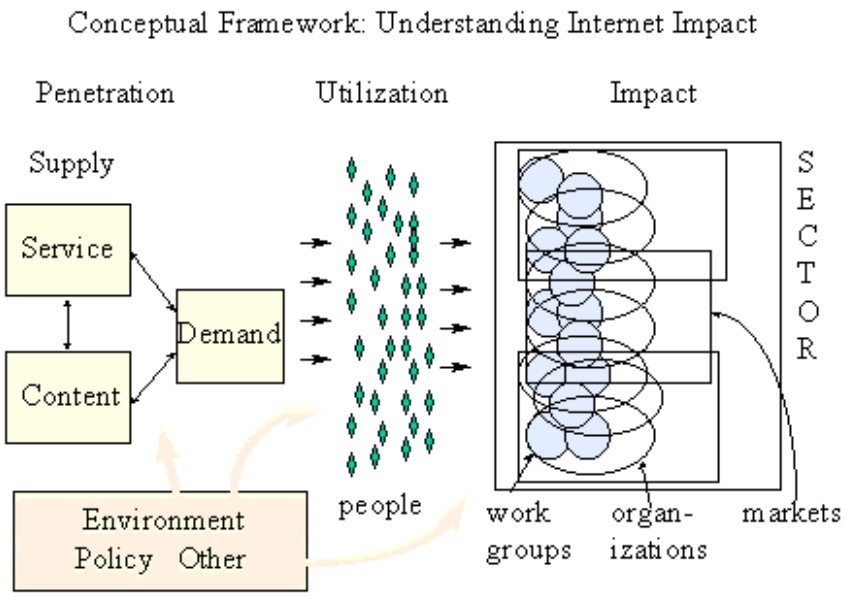

Figure 1

Conceptual Framework for Evaluating Internet Diffusion in Developing Nations (J. Daly)

Perhaps the most detailed and tested aggregate approach to examining Internet diffusion in developing nations is the GDI (Global Diffusion of the Internet) studies. Figure 2 describes the GDI conceptual framework. GDI methodology analyzes six characteristics of Internet connectivity at the country level: Pervasiveness, Geographical Dispersion, Sectoral Absorption, Connectivity Infrastructure, Organizational Infrastructure, and Sophistication of Use. Through a standardized approach to these six aggregate indicators, GDI practitioners are able to develop a summary for each country, portrayed in the hexagonal format shown in Figure 2, which shows the Internet in Cuba for 1994-1997 [15].

Dimension	Value
Pervasiveness	1
Geographic Dispersion	1
Sectoral Absorption	1
Connectivity Infrastructure	1
Organizational Infrastructure	2
Sophistication of Use	1

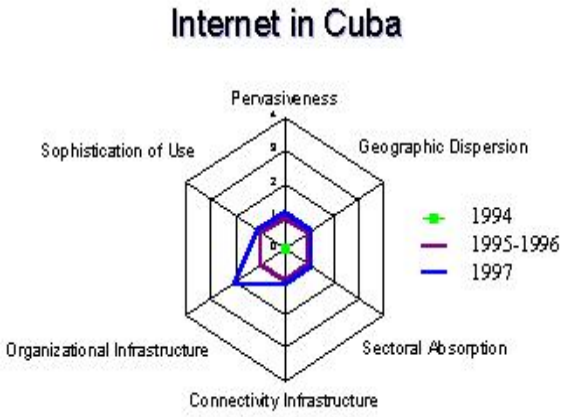

Figure 2

GDI Analysis of Cuba, 1994-1997 (L. Press)

2. AGGREGATE DATA IS NOT ENOUGH: A REPLICABLE APPROACH TO OBTAINING INDIVIDUAL GRASS ROOTS RESULTS OF INTERNET DIFFUSION

The dozens of aggregate approaches to characterizing, classifying and conceptualizing Internet diffusion in developing nations can lead to interesting results, as briefly described above, but at the heart of any analysis must be data from individuals and groups. For example, knowing the number of Internet hosts, ISP's or aggregate bandwidth by city or region is simply not sufficient to determine the crucial policy issues that underlie the summaries. For example, in the city of Kampala, Uganda, one of the authors has spent considerable time assisting in the installation of a wireless Internet connection for the Institute of Public Health at Makerere University, one of Africa's largest PhD-granting institutions. The aggregate data for Kampala – less than one hundred Internet hosts, about a dozen ISP's, and aggregate bandwidth (for the entire city) of about 3 to 5 megabits per second [14] -- does not begin to describe the situation in

that city with respect to Internet connectivity. Are there any differences in access related to wealth, status, gender, education, academic specialty, etc. [18]? What are the characteristics of a "typical" user in different sectors of the economy [10,17]? What predictors of success for using networks from home, office or schools have emerged [8, 19]? These questions are impossible to answer without data gathered at much more down-to-earth levels than those required for models based on aggregated countrywide summaries.

3. FOCUS OF THE STUDY: THREE-DAY INTERNET TRAINING COURSE AT THE ROMANIAN ACADEMY OF SCIENCE

The focus of this exploratory study is a rigorous three-day Internet training course offered from 1996-2000 to researchers affiliated with the Romanian Academy of Sciences in Bucharest. The Andrew W. Mellon Foundation, the Soros Foundations and Sun Microsystems, Incorporated, funded the training. The aim of this program was to establish a long term Internet training capacity, staffed by local experts and supporting a major research effort in the country. The study population is a group of professors and lecturers affiliated with the Romanian Academy of Science, a large, multifaceted alliance of academics representing all fields of study, from drama to engineering, and centered in Bucharest, Romania's capital, with regional branches throughout the country.

4. MODEL FOR EVALUATION: KIRKPATRICK'S FOUR STEP APPROACH

The study aimed to capitalize on some of the successful, non-traditional evaluation approaches now widely used in the corporate world and gradually being adopted by multilateral organizations like the World Bank and the United Nations: the Kirkpatrick Model [13]. This approach focuses on long-term effects, not simply immediate reactions. As shown in Figure 3, Kirkpatrick categorizes four evaluation levels for institutional training programs:

1. **Reaction**--assessing immediate results and perceptions of the training environment and the participant's satisfaction with the learning experience. In terms of Internet training, particularly in developing nations, this evaluation level, if measured at all, is often the only indicator available.

2. **Learning**--determining the degree to which the learning experience has been responsible for changing attitudes, increasing knowledge, or improving skills. The emphasis on changing attitudes is important in this dimension, since many specialists feel that attitude modification is the only valid measure of a training experience [13, p.20]. In Internet training situations in developing nations, this dimension can highlight the true value of a donor's investment by indicating that the result was not simply acquisition of a new skill but a positive modification of previously held attitude about the milieu surrounding that skill.
3. **Behavior**--this is often referred to as "transfer of training" and involves longer-term changes in job behavior attributable to the training experience. While a donor could be satisfied with attitude change alone (learning) in an Internet course, it would be hoped that the result of the change in attitude could also be specific, measurable changes in the ability to use Internet to increase productivity at office, production site, or factory.
4. **Results**--Kirkpatrick describes this level as "the final results that occurred because the participants attended the program…increased production, improved quality, decreased costs, reduced frequency or severity of accidents, reduced turnover, higher profits, etc." [13, p 23]. In our context the training would have institution-wide results, for instance, by reducing backlogs or improving communications speed and accuracy, etc; however, the measurement problems are considerable.

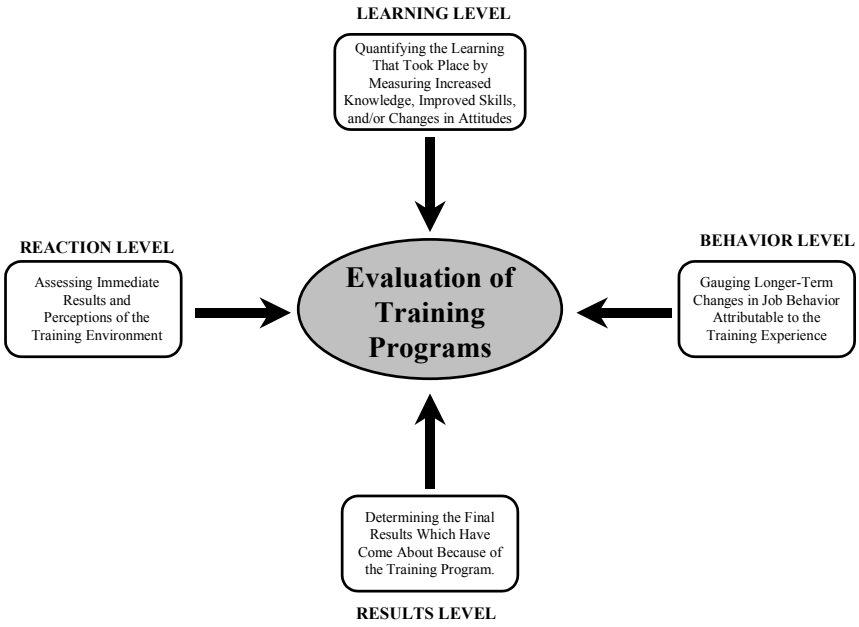

Figure 3

The Kirkpatrick Approach to Measuring the Long Term Results of a Training Event

There are several advantages that can be obtained through use of this four level evaluation methodology. First, it provides a more careful measurement of the return on investment for training. Second, it opens research opportunities into some of the demographics of training, specifically, the effects of age, gender, regional and cultural differences, equipment utilization, bandwidth, instructional methods, distance learning and the like. With longitudinal data covering a several year period after the training took place, it is possible to examine many variables that impact an individual's response to technology-based training. Third, the Kirkpatrick methodology is directly linked to the process of improving the training process. When the organization is committed to measuring impacts at each of the four levels, it becomes possible to determine training improvement opportunities at each phase of the evaluation process.

5. METHODOLOGY

The focus of this preliminary study was primarily on Kirkpatrick's third level of analysis and aimed at perceptions of actual changes in behavior that could be attributed to the training event. A detailed questionnaire was developed aimed at determining the effects of Internet training on life-style, research productivity, earning power, management style, teaching and other factors. Fifteen questions were used to

determine predictor or impact variables. These are shown in Table 1. It was expected that competency in World Wide Web use would be associated with perceptions of success in doing research and two questions probed this issue. Second, three questions asked about the effect of Internet use on organization and management. Since Internet skills can be used in the classroom, three questions were included to determine this effect, if any. We were particularly interested in the possible impact of Internet on the development and maintenance of teamwork structures in organizations and included four questions on that subject. Finally, there were four questions that asked about personal variables like the relationship between Internet and changes in job skills, earning power and quality of life.

The questionnaire was sent by email to 521 persons who had completed the three-day course and 207 usable responses were received. A sampling of the non-respondents indicated that there was no noticeable bias involved in the decision not to respond. These non-respondents were relatively proportional to the respondents according to age, academic discipline and gender. A response rate of nearly 40 percent for a questionnaire that requires over twenty minutes to complete is considered excellent. This significantly exceeds the 20 percent response rate recommended for surveys of this type sent by mail [26] and the 6 percent rate for email studies reported by Tse [21].

Table 2 summarizes the population according to five individual variables: age, gender, research productivity, computer skills, and academic discipline. Two thirds of the respondents are women, mirroring the demographics of the group that attended the Internet Academy courses.

TABLE 1

RESEARCH PRODUCTIVITY AND COMPUTER SKILLS OF RESPONDENTS BY GENDER AND ACADEMIC DISCIPLINE FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 RESEARCH PRODUCTIVITY/ (COMPUTER SKILLS) RATINGS

	Low	Moderate	High	Total
Gender				
Male	33 (9)	25 (19)	13 (41)	71
Female	66 (18)	34 (51)	36 (67)	136
				207
Discipline Group				
Engineering/Technical	17 (3)	17 (9)	11 (33)	45
Mathematics	12 (3)	2 (7)	8 (12)	22
Arts/Engineering/Law	70 (20)	40 (51)	30 (79)	140
				207

Note: Research productivity rankings are based on assessment (quantitative and qualitative) of reported activity in professional journals, conference proceedings, reports, etc. Computer skills scores are based on self-assessment. The Mathematics group was merged with Engineering/Technical for subsequent data analysis.

TABLE 2

RESPONSE SUMMARY: FIFTEEN IMPACT QUESTIONS FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 WITH POPULATION GRAND MEANS (N=207]

Question	**Topic**	**Mean (1-6 scale)**
1. I feel no constraints from managers or colleagues on my use of Internet and WWW	Management	5.02
2. Internet and WWW have improved the way I am able to communicate with my colleagues outside Romania	Relationships	4.94
3. Internet and WWW have improved the opportunities to stay current with my academic discipline	Research	4.90
4. Internet and WWW have improved my ability to do the research required in my field	Research	4.70
5. Internet and WWW make it possible to do better on my job	Personal	4.62
6. My supervisors and superiors understand and encourage the use of Internet and WWW	Management	4.49
7. I am now more open to new ideas since I can communicate more freely on WWW	Relationships	4.49
8. Internet and WWW have made me more open to be willing to be open to the opinions of others	Relationships	4.22
9. The use of Internet and WWW have changed the way I approach my daily work	Personal	4.19
10. I am now better able to work on team projects where the same team members are connected to Internet or WWW	Relationships	4.07
11. My manager (or dean or chairman] actively supports the use of Internet and WWW	Management	4.05
12. Learning to use the Internet and WWW has improved my ability to earn a living	Personal	3.42
13. Internet and WWW have improved the way I am able to communicate with my colleagues in Romania	Relationships	2.98
14. Internet and WWW seem to be very helpful for my students too	Pedagogy	2.00
15. I regularly use Internet and WWW in helping my students	Pedagogy	1.39

6. ANALYSIS OF AGGREGATE RESULTS: DESCRIPTIVE STATISTICS

The fourteen impact questions were presented to respondents on a 1-6 Likert scale. Results are shown in Table 1. The means arrayed from 1.39 to 5.02 and showed some interesting clusters. The top half, with scores of 4.49 to 5.02, indicates a very positive feeling for social issues associated with Internet proficiency. Four of the seven top positives have to do with individual comfort about Internet-mediated work place (no constraints from managers/colleagues, improved communication outside Romania, more open to new ideas, supervisors encourage). Three have to do with the job itself (do a better job, stay current with my discipline, improve research ability).

In the bottom seven, among the negatives the two lowest scores 1.39 and 2.00 on the 1-6 scale, have to do with using the Internet to help students. These very low scores on the pedagogy questions could be interpreted as being an indication of low levels of Internet training for college students, resulting in professors being doubtful of its efficacy in teaching. But alternative explanations are also possible. For example, in some universities, students tend to be more successful Internet users than faculty, so the low pedagogy ratings may simply reflect that the students are ahead of faculty, not the reverse.

6.1 Analysis of Variance Comparisons --Humanities/Arts and Engineering/Mathematics

Analysis of variance computations allow a deeper level of analysis. Table 3 arrays the questions in terms of differences between the two broad categories of academic discipline: Humanities and Arts and Engineering and Mathematics. These aggregations were used because of the sample size requirements and the relative homogeneity of the backgrounds in each group. Three significant differences appear. First, the Engineering/Mathematics group is significantly more positive about the use of Internet to communicate with colleagues. Second, the Engineering/Mathematics group is significantly more positive about using Internet for teamwork applications. Third, the Engineering/Mathematics group reports significantly more management support for using Internet in their work. These findings probably reflect the normal technology diffusion process in a university environment where "hard science" researchers often start using IT tools before other groups.

TABLE 3

ANALYSIS OF VARIANCE FOR RESPONSES TO FIFTEEN IMPACT QUESTIONS, BY ACADEMIC DISCIPLINE (AGGREGATED), FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 (N=207)

		N	Mean	SD	SE	F	Sig.
Internet Changes	Humanities/Art	139	4.09	2.74	.232	.687	.408
Work Approach	Engineering/Math	66	4.39	1.54	.190		
Improves Ability To	Humanities/Art	139	3.27	1.79	.152	2.41	.122
Earn A Living	Engineering/Math	67	3.70	1.68	.206		
Better Linkages	Humanities/Art	139	4.73	1.50	.127	7.67	.006**
Outside Romania	Engineering/Math	67	5.34	1.30	.159		
Better Linkages	Humanities/Art	139	3.02	1.76	.149	.262	.610
In Romania	Engineering/Math	66	2.89	1.72	.210		
Supervisors And Superiors	Humanities/Art	139	4.43	1.63	.138	.656	.419
Encourage Use	Engineering/Math	67	4.62	1.58	.193		
Stay Current With	Humanities/Art	139	4.86	1.25	.106	.497	.481
Academic Discipline	Engineering/Math	66	5.00	1.39	.170		
Internet Helpful For	Humanities/Art	139	1.80	2.41	.204	2.54	.112
Students	Engineering/Math	67	2.40	2.72	.332		
Internet Helps Me To Be	Humanities/Art	139	4.51	1.40	.119	2.47	.117
Better On My Job	Engineering/Math	66	4.85	1.45	.178		
More Open To New	Humanities/Art	139	4.37	1.52	.129	1.74	.189
Ideas Due To Internet	Engineering/Math	67	4.67	1.49	.182		
More Open Now To	Humanities/Art	139	4.24	1.48	.126	.052	.821
Other's Opinions	Engineering/Math	67	4.19	1.66	.203		
Help Students By	Humanities/Art	139	1.23	1.84	.156	3.02	.083
Using Internet	Engineering/Math	67	1.74	2.27	.276		
Work Better Now On	Humanities/Art	139	3.76	1.68	.142	14.7	.000**
Team Projects	Engineering/Math	66	4.73	1.71	.210		
Manager (Or Dean]	Humanities/Art	139	3.82	1.91	.162	6.20	.014*
Actively Supports	Engineering/Math	67	4.52	1.80	.220		
Improve Research	Humanities/Art	139	4.38	1.61	.136	1.92.167	.167
Ability	Engineering/Math	67	4.71	1.53	.187		
Feel no constraints	Humanities/Art	139	4.98	1.49	.127	.349	.555
To Internet use	Engineering/Math	65	5.11	1.57	.192		

Note: ** significance .01 level or less; * significance at .05 level or less. Small changes in sample size for individual questions are due to incorrect or incomplete response.

6.2 Analysis of Variance Comparisons—Gender

Table 4 examines differences that can be attributed to gender—with two significant results. Women are significantly more willing than men to attribute Internet as being responsible for making them more open to new ideas and are also significantly less likely to use the World Wide Web in helping their students, although, as indicated in the aggregate data, both women and men use WWW relatively rarely in teaching students. There is no obvious explanation for this result beyond the fact that women outnumber men in this study and particularly so in the non-quantitative disciplines. For them, the more recent experience with Internet may have been particularly significant in opening a wider world of colleagues and idea sharing. The more interesting interpretation, however, is that of fourteen questions, only two showed significant gender-related differences.

TABLE 4

ANALYSIS OF VARIANCE FOR RESPONSES TO FIFTEEN IMPACT QUESTIONS, BY GENDER, FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999

		N	Mean	SD	SE	F	Sig.
Internet Changes Work Approach	Male	69	4.34	3.52	.424	.439	.508
	Female	136	4.11	1.60	.137		
Improves Ability To Earn A Living	Male	70	3.44	1.75	.210	.008	.927
	Female	136	3.41	1.77	.152		
Better Linkages Outside Romania	Male	70	4.8	1.56	.187	.630	.428
	Female	136	5.00	1.41	.121		
Better Linkages In Romania	Male	69	2.98	1.79	.214	.000	.999
	Female	136	2.96	1.72	.148		
Supervisors And Superiors Encourage Use	Male	69	4.44	1.53	.183	.110	.740
	Female	136	4.42	1.66	.142		
Stay Current With Academic Discipline	Male	70	4.97	1.17	.140	.253	.616
	Female	136	4.87	1.36	.116		
Internet Helpful For Students	Male	70	2.34	2.48	.296	1.963	.163
	Female	136	1.82	2.53	.217		
Internet Helps Me To Be Better On My Job	Male	69	4.48	1.47	.175	1.026	.312
	Female	136	4.69	1.40	.120		
More Open To New Ideas Due To Internet	Male	69	4.38	1.51	.181	.332	.565
	Female	136	4.51	1.52	.130		
More Open Now To Other's Opinions	Male	70	3.90	1.62	.194	4.92	.028*
	Female	136	4.40	1.47	.127		
Help Students By Using Internet	Male	70	1.82	2.05	.205	4.98	.027*
	Female	136	1.17	1.94	.167		
Work Better Now On Team Projects	Male	69	4.10	1.67	.200	.017	.892
	Female	136	4.06	1.79	.153		
Manager (Or Dean] Actively Supports	Male	69	3.92	1.84	.220	.456	.500
	Female	136	4.11	1.93	.165		
Improve Research Ability	Male	70	4.22	1.79	.214	3.002	.085
	Female	136	4.63	1.46	.125		
Feel No Constraints To Internet Use	Male	70	4.75	1.62	.194	3.434	.065
	Female	136	5.16	1.44	.124		

Note: * significance at .05 level or less. Small changes in sample size for individual questions are due to incorrect or incomplete response

6.3 Analysis of Variance Comparisons--Research Productivity

Analysis of variance for the research productivity data, in Table 5, shows a significant difference among the groups along three variables (only statistically significant relationships are shown). First, the most productive researchers show significantly higher scores for Internet use than the less productive group. Second, they indicate significantly higher use of Internet in teaching, probably because they have skills comparable or greater than their peers and students. Finally, the more productive researchers also indicate a significantly higher degree of management support for their work. These three findings are indicators of the expected benefits of Internet for researchers and especially for highly productive ones. It is not surprising that the most productive researchers are also the ones who are most likely to use the newest research capabilities of the Internet and WWW. What is surprising is that only three of the fourteen

questions would result in findings that the high research productivity population was different from the less productive groups.

TABLE 5

ANALYSIS OF VARIANCE FOR RESPONSES TO FIFTEEN IMPACT QUESTIONS, BY RESEARCH PRODUCTIVITY RANKING [1], FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 –STATISTICALLY SIGNIFICANT RESULTS ONLY

		N	Mean	SD	SE	F	Sig.
Internet Helpful For Students	Low	96	1.50	2.29	.233	3.46	.033*
	Moderate	57	2.50	2.71	.360		
	High	45	2.37	2.59	.387		
Help Students By Using Internet	Low	96	.969	1.71	.174	4.229	.016*
	Moderate	57	1.75	2.10	.279		
	High	45	1.80	2.22	.331		
Manager (Or Dean] Actively Supports	Low	96	4.21	1.82	.184	3.677	.027*
	Moderate	57	4.26	1.77	.235		
	High	45	4.37	2.05	.307		

Note: * significance at .05 level or less. Small changes in sample size for individual questions are due to inability to incorrect or incomplete response

6.4 Analysis of Variance Comparisons—Age

Table 6 describes the differences across age groups (only statistically significant results are shown). In general, the younger respondents were more positive in their responses than the older, but the only significant differences were found with respect to supervisors' support and management support, where older employees were significantly less positive. There is relatively little information to predict the effect of reported age on technology interventions. In fact, in about half the responses the oldest and youngest groups arrayed similarly in satisfaction order. Possibly this is because many younger researchers enter the automation milieu with the same initial tendencies of anxiety and fear that are often attributed to older workers.

Table 6

ANALYSIS OF VARIANCE OF RESPONSES TO FIFTEEN IMPACT QUESTIONS, BY REPORTED AGE, FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 -- STATISTICALLY SIGNIFICANT RESULTS ONLY

		N	Mean	SD	SE	F	Sig.
Supervisors And Superiors Encourage Use	Age 20-30	87	4.87	1.27	.136	4.38	.014*
	Age 31-50	93	4.25	1.72	.178		
	Age over 50	25	4.07	2.01	.395		
Manager (Or Dean] Actively Supports	Age 20-30	87	4.47	1.63	.175	3.753	.025*
	Age 31-50	93	3.76	1.96	.204		
	Age over 50	25	3.69	2.25	.430		

Note: * significance at .05 level or less. Small changes in sample size for individual questions are due to inability to incorrect or incomplete response

[1] Research productivity rankings are based on assessment (quantitative and qualitative] of reported activity in professional journals, conference proceedings, reports, etc

7. ANALYSIS OF VARIANCE FINDINGS – COMPUTER SKILLS

As shown in Table 7 there was a close relationship between computer skills and teaming and also a weaker but noticeable relationship with management (or the dean's support). Three levels of self-assessed computer proficiency were allowed and half the population assigned themselves the highest proficiency score of 3 (108), with 70 assigning 2 and only 27 considering themselves at the lowest proficiency level, 1.

TABLE 7

ANALYSIS OF VARIANCE FOR RESPONSES TO FIFTEEN IMPACT QUESTIONS, BY COMPUTER PROFICIENCY RANKING, FOR SURVEY OF INTERNET COURSES TAUGHT AT THE ROMANIAN ACADEMY OF SCIENCES 1996-1999 – SELECTED SIGNIFICANT RESULTS ONLY

		N	Mean	SD	SE	F	Sig.
Work Better Now On Team Projects	Low	27	3.78	1.89	.328	6.48	.002*
	Moderate	70	3.57	1.81	.204		
	High	109	4.48	1.59	.163		
Manager (Or Dean) Actively Supports	Low	27	3.85	1.66	.363	2.742	.067
	Moderate	70	3.69	2.12	.225		
	High	109	4.34	1.77	.181		

Note: Small changes in sample size for individual questions are due to inability to incorrect or incomplete response

8. SUMMARY: GRASS ROOTS DATA MUST UNDERPIN AGGREGATIONS USED TO SUMMARIZE INTERNET PROGRESS IN DEVELOPING NATIONS

The aim of this preliminary study was to demonstrate an example of a replicable approach to the development of useful micro-level data about Internet usage in a developing nation. The activity selected was Internet training, one of dozens that could be used to determine individual and group results at a level of aggregation far below that used currently in examining Internet results in developing nations. Other activities that could be subjected to the same approach could be work site analysis in business and government, reviews of non-traditional loci for Internet activity, like Internet cafes and government centers, ISP surveys and web site analysis on a user-by-user basis. We feel that the value of the approach is its ability to shed light in areas left dark by the countless aggregate models now available. It would be impossible for any of the aggregate models to show that there is apparently no age differentiation in Internet use in the Romanian scientific community; or that engineers feel more empowered by Internet than non-engineers; or that Internet's value as an adjunct to teaching is low or that women show no difference from men on most Internet-related variables.

There are several clear advantages to these micro-level findings. First of all, they can lead to policy decisions that are completely obscured by the macro data. Using only this pilot study's results it is clear that Romanian researchers who are not engineers should be given more attention in Internet training—more preliminary training and follow-up, greater access to research data bases, for example, than others. Second, if data of this type are gathered systematically across a region, in this case Romania, it is possible to pool the results and obtain greater certainty about other necessary decisions. For example, a relatively small increase in Internet availability or convenience, could lead to disproportionate improvements in satisfaction and utility. Third, these grass roots data can be used as part of a system of checks and balances to insights from the macro models. For example, the Daly or GDI data (described above) indicate that if sectoral absorption is poor, the micro data could be used to indicate areas where the potential for most productive investment would lie.

9. AGENDA FOR THE FUTURE -- THREE ACTION STEPS

There are three insights from this micro-level study that could be considered for action in any developing nation and by donor nations and multilaterals. First, since it is clearly possible to accomplish a replicable study of this type almost anywhere in the world, there should be greater emphasis on gathering this type of data, even at the expense of the aggregate studies. Second, a comprehensive collection of lower level studies of this type needs to be assembled to determine public policy options that may already be justified. Stephen Denning of the World Bank has pioneered a process of sharing information organization-wide. He found that by sharing "stories" about successful implementation ideas learned in one location, he could apply them to other countries around the world [3]. It is quite likely that these results in Romania could assist in Internet deployment plans in Eastern Europe or beyond. Finally, with respect to Internet training, and any other training done in developing nations, this study applies a model (Kirkpatrick's) that is widely used in business and hardly at all in development studies. The latter normally assumes that an inventory or questionnaire immediately following the training event is sufficient. We believe that the assessments of changes in attitude and behavior, all of which occur long after the training, are crucial metrics. They not

only track more significant, work-related results more accurately, but also allow much more sophisticated review of findings.

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