

# Infrastructural Challenges in Developing an Information Economy in Humboldt County, California

**Benjamin Yeo**

School of Information Sciences and Technology  
The Pennsylvania State University  
jby114@psu.edu

**Eileen Trauth**

School of Information Sciences and Technology  
The Pennsylvania State University  
etrauth@ist.psu.edu

**Perry Wong**

The Milken Institute  
pwong@milkeninstitute.org

## ABSTRACT

According to the United States Census Bureau, California's Humboldt County had a per capita income of US\$17,203, with 19.5 per cent of the population living below the poverty line, while the per capita income of California State was US\$22,711 in 1999. Humboldt County has since deployed economic development initiatives, which includes the development of an information economy. However, these are still in their initial stages, and there has been little evidence of success so far. Adapting Trauth's (2000) research framework and drawing parallels from the development of Ireland's information economy, we conducted face-to-face interviews in the summer of 2003 in Humboldt County, to analyze the relevant technological and human infrastructural challenges. The research leads to two policy recommendations to help the County develop better strategies for developing the information economy.

## Keywords

Information economy, Humboldt County, infrastructure, economic development, economic development policy.

## INTRODUCTION

The rise of Silicon Valley is an important case for considering the development of an information economy. In the 1950s, Silicon Valley was primarily dominated by agricultural and food processing industries. Today, the agrarian economy has been displaced by the information economy. In addition, Silicon Valley is currently the center of innovation and production for information technology (IT) industries globally (Benner 2002). Humboldt County, in California, has deployed similar economic development in attempting to leverage information technology (IT) to develop its industry clusters. However, despite similar agricultural roots with Silicon Valley, there has been little evidence of similar success in Humboldt County.

Humboldt County is located in Northwest California, sharing the northern geographic boundary with Del Norte County, the eastern boundary with Siskiyou and Trinity counties, and the southern boundary with Mendocino County. On the west of Humboldt County is the Pacific Ocean. The County covers 2.3 million acres of land, 80 percent of which are forestlands, protected redwoods and recreation areas ( Prosperity, the North Coast's Strategy Vol III 2003).

The Humboldt County Office of Economic Development and the CEDS (Comprehensive Economic Development Strategy) Committee were funded by the U.S. Department of Commerce economic Development Administration to carry out a study and devise a proposal to boost economic development in Humboldt County in 2000. These reports are collectively known as "Prosperity: The North Coast's Strategy."

According to the reports, the number of employing businesses in Humboldt County and the number of those employed has been slowly increasing for the past two decades. These figures are illustrated in Table 1 (Humboldt County Comprehensive 2003). However, unemployment rates are higher in the winter when labor intensive employers, like logging companies, bulb farms and construction related firms are experiencing their slow season (Humboldt County Comprehensive 2003). If the fluctuations from these employers can trigger significant fluctuations in the average unemployment rates, it suggests that the majority of the industries in Humboldt are still dependent on labor-intensive operations.

Labor Force	1985	1987	1990	1995	1998
Size of the labor force	47,900	49,700	58,100	60,200	60,700
Employed	42,800	45,900	53,600	55,200	56,300
Annual Unemployment Rate	10.65%	7.65%	7.75%	8.31%	7.25%

**Table 1. Employment in Humboldt County**

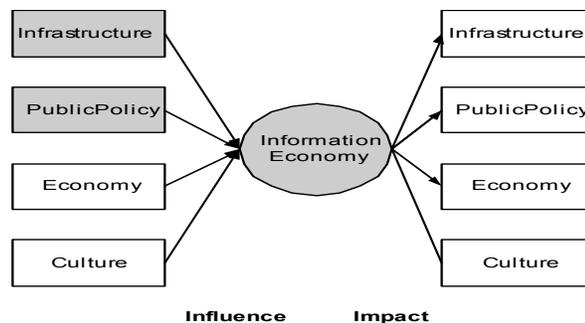
With the formation of the new global economy, information and knowledge now become directly productive forces. Information becomes the critical raw material from which social process and social organizations are made. Consequently material production, as well as services, becomes subordinate to the handling of information (Castells 1996). The histories of the development of Silicon Valley and Ireland’s transformation into an information economy show that rural regions do have potential to develop vibrant information sectors. These sectors are characterized by activities that engage in recording, processing or communicating information (Kling and Turner 1991). Locations such as Silicon Valley and Ireland have been held up as models of the new information economy in which e-business thrives. And in both of these locations, the development of information economies was influenced by technological infrastructure and societal factors (Benner 2002; Trauth2000). In a similar fashion, this paper considers the role of infrastructural and societal influences on Humboldt County’s capacity to develop an information economy, as an engine to its existing industry clusters.

This paper focuses on infrastructural factors in the development of an information economy from a societal level of analysis. Infrastructural factors include both telecommunication and human infrastructure. Human infrastructure refers to the facets of these human connections – the humans who will make use and give value to the technological infrastructure (Vojtek and Vojtek 1997). Specifically, this refers to human capital like labor and education (Trauth 2000). This paper has the following objectives:

1. To describe the current state of Humboldt County’s infrastructure
2. To analyze infrastructural factors that are influencing the development of an information economy in Humboldt County

**METHOD**

This research applies Trauth’s (2000) theoretical framework (see Figure 1) that was developed to study the influence of the societal context on the evolution of Ireland’s information economy. According to this framework, four factors comprise the societal context: infrastructure, public policy, economy, and culture. The shaded portions of the model represent our focus of this paper on the infrastructural factors that influence the development of an information economy in Humboldt County. The development of the Irish information economy is used as a benchmark for analysis due to their similar agricultural roots. For this paper, these infrastructural factors are analyzed in relation to existing policies to provide policy recommendations. We attempt to use the results to provide policy recommendations to the local Government of Humboldt County to facilitate the development of effective information economy development strategies.



**Figure 1: Influence-Impact Model**

Using this research framework as a guide, empirical data were collected in Humboldt County in the summer of 2003, through semi-structured in-depth interviews. The face-to-face interviews were conducted with members of the local population and local business development organizations. Participants in this study were identified by the North Coast Small Business

Development Center in Humboldt County. We triangulated the interviews with a review of documents related to policy and the regional economic well-being and participant observation. These included directors and managers of business development organizations, such as the North Coast Small Business Development Center. The interview questions, pertaining to the focus of this paper, were about economic development policy and initiatives, their effectiveness, telecommunications and human infrastructural development. The framework was used to guide data collection and analysis categories.

The next section describes Government initiatives, and the technological and human infrastructure in Humboldt County. These findings were consolidated from the interviews and verified by the reports that were recommended and provided by the interviewees. Subsequently, we discuss these findings to outline infrastructural issues influencing the development of an information economy in Humboldt County. In the conclusion, we provide policy recommendations using the Irish case as a benchmark.

## **FINDINGS**

### **Public Policy – Economic Development Strategy**

Policies pertaining to the development of an information economy in Humboldt County are not well-defined. However, there are documented initiatives aimed at developing the local economy. A substantial part of these initiatives are premised on the use of IT to achieve economic development goals.

“Prosperity - The North Coast Strategy” is the County's first ever comprehensive economic development strategy and is in the process of implementation since 2000. The strategy aims to achieve the following five goals:

1. Focus on growing the base of industry clusters
2. Support business growth and development
3. Enhance competitive edge
4. Invest in local businesses
5. Enhance regional quality of life

Specifically, the County Government is focusing its economic development efforts on the following nine industry groups that existed prior to the economic development initiatives:

1. Agricultural Services, Forestry and Fishing,
2. Construction,
3. Manufacturing,
4. Transportation and Public Utilities,
5. Wholesale Trade,
6. Retail Trade,
7. Financial, Insurance, and Real Estate Industries,
8. Service Industries, and
9. Government

In the strategy, the means to attain the goals involve the development and utilization of IT. For instance, the County aims to increase technology utilization and develop infrastructure to enhance the industries’ competitive edges and investments in local businesses respectively. However, the means by which the IT infrastructure can be leveraged requires more than simply constructing it. Thus, while the economic strategy is in its third phase and little success has been documented.

### **Infrastructure**

The cases of Silicon Valley and Ireland show that infrastructure is a significant factor in the development of an information economy. This is not restricted to physical infrastructure. It includes human infrastructure as well. The case of Humboldt County shows that there is viable telecommunication infrastructure. However, the residents and businesses are not poised to take advantage of the infrastructure for business and economic development. The local educational programs do not provide a facilitating environment for the development of skilled labor to support the IT industry.

#### *Telecommunications infrastructure – Inertia and lack of utility*

The One Gigabit Initiative was executed in California to deliver one gigabit broadband capabilities to all Californians – including Humboldt County. This was initiated partially to answer the demands of increased bandwidth usage. The initiative aims to transform Californians’ personal, professional, and civic lives, thus giving every person and every home the capacity

to be an information producer and information user. The Initiative promises to improve the quality of life of every resident, not merely the educated or affluent, through the new, information-centric, and constantly connected world ( Killer Apps: Proving the Need for One Gigabit 2003).

However, this initiative was halted for sometime in Humboldt County due to a lack of interest among the Government and local businesses. Subsequently, after much pressure from interest groups (including educational institutions) and stakeholders, the SBC finally agreed to resume the project to complete the laying of the last 21 miles of fiber optic cables (Nerat 2003). Thus high speed Internet services were only available shortly before the summer of 2003. Importantly, these interest groups and stakeholders constitute the minority of the Humboldt County population.

Integration of information systems is very beneficial to the economy. However, at present, IT systems in Humboldt County are incapable of inter-operability. Different companies subscribe to different services from different operators. This makes the transmission and the sharing of data difficult because information systems integration is difficult to achieve. In the healthcare industry for instance, telemedicine is an important service in Humboldt County. There is currently only one hospital serving the entire County. As such, telemedicine can provide basic consultation services to the local population without them having to leave the region. Unfortunately, the technological limitations pose a huge obstacle to the development of telemedicine. For example, ISDN lines are not affordable to the North Coast's Clinic Network at the moment. Considerable financial investments are needed to execute and manage this integration. In addition time is needed to plan and execute the project. In addition, there is insufficient expertise. As respondents pointed out in the interviews, the labor pool in Humboldt County is not qualified to set up a task force for the initiative at present. The issues pertaining to human infrastructure are considered in further depth in the section on human infrastructure.

#### *Lack of adequate support for human infrastructure development*

The North Coast School-to-Career Consortium, (NCSTCC) was established in 1999. It brings the local educational institutions into a dynamic, committed partnership with labor, business, industry, economic development, and community-based organizations with the aim of creating a region-wide K-12 and adult workforce development system to bring hope, growth, and productivity to north coast counties in California. Both Humboldt and Del Norte Counties are currently focused on providing students the skills and knowledge to succeed in the labor market. (Prosperity: The North Coast's Strategy, Vol. III 2003). The NCSTCC embraces the guiding principles of School-to-Career and pledges that:

- All students will have access to rigorous, meaningful, integrated curriculum in a seamless K-12 and adult continuum.
- All students will engage in school-based, work-based, and connecting activities.
- All students will have access to postsecondary learning opportunities.
- All students will meet rigorous standards as evidenced by authentic assessments and accountabilities.

(Prosperity: The North Coast's Strategy, Vol. III 2003)

Humboldt State University and the College of the Redwoods are two key tertiary educational institutions in the County. They play importantly economic development roles in the community. The students constitute labor that fills two economic niches: one is for low to medium skilled, low wage labor and medium skilled, mid-wage labor; the other is for professional service sector businesses. Many of the faculty members of these two schools participate in local organizations, providing expertise on a wide range of matters that add value to the local economy. This resource can be a strong factor in recruiting knowledge-based businesses to the community (Prosperity: The North Coast's Strategy, Vol. III 2003).

Pertaining to the educational and training programs, there are basically dichotomized views among the interviewees in terms of their potential to contribute to the development of information economy and economic development in general in the County. On the one hand, these education programs can quickly produce a pool of skilled labor for the region. In particular, the College of Redwoods has customized training programs that are very suitable for quick response to market demands for skilled labor. The interview data suggest that Humboldt County is competitively advantaged with a rich educational reserve from the competitive programs in the two universities. The President of Humboldt State University is community-oriented: He regularly participates in the Government initiatives to ensure the University's positive contribution to economic development.

However, the predominant faculties at the Humboldt State University are natural resources studies (which include Geographic Information Systems-related studies), timber-related studies, and arts and social sciences. There are insufficient programs in engineering and information science disciplines that are crucial to the information economy. In addition,

Humboldt State University is a teaching college rather than a research university. Consequently, there is a lack of activity on the campus during summer. A typical research-oriented university should have considerable number of research residents during the long summer vacation. A vibrant research culture is more likely to boost innovation. In order for the research culture to develop, the university needs to have a major revamp of its policies and its population.

Some respondents questioned the adequacy of the programs in preparing people for IT work. The result is a small pool of available to answer the market demands within a short span of time. In addition, students who graduate and remain in the region usually do not keep up their IT skills because there is little demand for these skills at present. The respondents suggested that there is a lack of skilled labor available to take on economic challenges in the region. Some of this could also be due to the inadequate programs, or the brain drain of skilled graduates to the coastal cities like San Francisco and Los Angeles where salaries are higher.

Participants also commented about the lack of progressive business practices among local businesses. An example was inertia to develop information systems and strategies to support business practices. The local businesses are not perceived as demanding high-end IT services that utilize the improved telecommunication infrastructure. On the other hand, the university programs are seen as unable to meet the needs of the County's bid to develop its economy.

## **DISCUSSION**

### **A Social Digital Divide**

A digital divide is defined as a phenomenon whereby people are divided into those who do and those who do not have access to and the capability to use IT (Katz and Rice 2002; Schement and Tate 2003). Economic development and digital divide issues are closely inter-related. Tools and skills to compete in the digital economy gives a distinct advantage to communities who can leverage existing IT infrastructures. Furthermore, a community with a well-educated, IT-literate population has a better chance to attract and sustain new businesses, which in turn continue to attract well-educated, technology-literate people into the area. In contrast, a community that lacks reliable access to IT and the literacy to leverage it has less potential to draw investments that could potentially serve as a catalyst to economic prosperity. In other words, if communities are to remain competitive in attracting, retaining and developing businesses in the economy of the 21<sup>st</sup> century, they must develop modern telecommunications facilities and cultivate a well-trained workforce (The Digital Divide Network; Economic Development, 2003).

A viable telecommunication infrastructure is one of the bases of an information economy. The U.S.A. is currently the center of Internet traffic because of higher bandwidth capacity. Although this is now changing as metropolitan areas are increasing their bandwidth capacity, information is still routed primarily through the metropolitan areas of the U.S.A. (Castells 2001), suggesting the importance of bandwidth capacity of an information economy.

A digital divide can also be perceived at the social level, as the gap between the information rich and poor within a region (Norris 2001). In Humboldt County, this divide is evident in the availability of IT services. It is relatively low compared to Silicon Valley. The data show that high-speed Internet access was only made available in 2003 after a long period of inertia. Also, access to IT is limited to the local minority who knows, understands, and uses IT in their business operations. Inertia is evidenced the lack of enthusiasm among the local population pertaining to the One Gigabit Initiative. This means that the information poor have little or no access to IT services made available from the IT infrastructure (the fiber optic cables).

It is perhaps due to this conception that some of the local population perceives the One Gigabit initiative as the key to rapid economic development. While telecommunications infrastructures are typically developed to support various economic activities (Lyon 1988), it is also important to take into account the context of these infrastructures. More importantly, there is neither demand nor supply of high-end IT services. The value of information systems depend on the users (Taylor 1996). Thus when there is no demand, even the greatest supply will not achieve significant results. In addition, there is a dominant perception that Humboldt County is still primarily using dial-up connections. This is because Humboldt County did not have access to cable internet until the summer of 2003. These diminish confidence in the region as a viable market for various industries, including an IT sector that is critical to the development of an information economy.

### **Leveraging Telecommunications Infrastructure**

Four inter-related factors – connectivity, capability, content, and context, are significant factors in analysis of digital divides in societies (Schement and Tate 2003). Connectivity refers to the limits and means to connect to the Internet. This covers issues like accessibility or cost of connection, and the quality of connectivity/connection. Capability refers to inherent

abilities of individuals to connect to the Internet. This pertains to issues of IT literacy. In rural regions, infrastructural issues may result in informational literacy being more difficult to attain and may not be compensated for in schools. Content refers to the ways users use the IT infrastructure to obtain information relevant to their work or business processes. In other words, the content that is accessed is dependent on its value attributed by the users themselves (Taylor 1996).

The residents of Humboldt County have access and can afford to connect to readily available high-end IT services. This is especially so after implementation of the fiber optic lines. However, in terms of capability, it remains questionable whether most of the users are able to fully utilize the capability of these technologies. In addition, local businesses do not seem to be incorporating IT in their business practices and processes. They say they cannot justify the benefits of IT in monetary terms. Therefore, in terms of content, there is limited information or services available. Businesses who have implemented IT in their operations are not fully leveraging its potential. However, a drive for constant innovation is necessary in the development of an information economy (Benner 2002). With intensified global competition, it is important for businesses to anticipate and create new market opportunities, encourage product innovation, and reconfigure production processes efficiently (Angel 1994).

### **Developing Human Infrastructure**

The development of an information economy depends largely on innovation in the development of information and communication technologies. However, this depends partially on effective investments in human capacity to utilize the infrastructure and effective policies that encourage research and innovation (Marburger 2003).

The interviewees commented that there is a lack of demand for IT-related labor. This in turn has contributed to the dominant view that the County is still dependent on dial-up networks. Looking at the Government initiatives, the efforts to develop employment opportunities that require skilled IT-work is unclear. This partially explains the outward migration of the local population once they have who received their education.

Beyond the common factors like demand and supply, flexible labor markets are also important factors (Benner 2002). Therefore, education becomes an important facet because it is the main driving force of skilled labor. However, there is a lack of human infrastructure in Humboldt County that is conducive to the development of an IT-based economy. As discussed earlier, an adequate labor pool is a vital factor in developing IT-based economies. However, in Humboldt County, there is no clear focus in the economic strategy aimed at developing educational programs to train the local population for IT-oriented employment. The NCSTCC has outlined goals to develop a viable labor force. At present, there is little evidence of success.

In Humboldt County, there has been little demand for IT labor. The outward migration of the local population is the result of this lack of demand. Furthermore, local businesses cannot afford to provide comparable employment conditions with the more developed areas.

The dynamism, knowledge-intensity, and creativity of IT-work require demand quick response from the industry to keep up with constant technological changes. Employment and work have to be flexible in reaction to the information economy (Benner 2002). Innovative thinking is necessary to support the continuous search for new products and services. Therefore information work and workers are increasingly faced with the ongoing challenge of keeping their skills and knowledge up-to-date, as life-long learning becomes more important (Hundley, Richard, Anderson, Bikson, and New 2003).

The local businesses in Humboldt County are focused on routine practices rather than less predictable urgent matters. The interview data also show that local businesses are not ready for high-end IT services like enterprise integration because of their lack of progressive thinking. These suggest that Humboldt County is not currently poised to attract investments in an IT sector.

With respect to educational infrastructure, while there has been some effort to change educational policies, there is little evidence of success. Most of the programs in the tertiary education institutions are still focused on non-IT subjects, suggesting the existing educational policies are not suitable for the development of an information economy presently.

### **CONCLUSION: POLICY RECOMMENDATIONS**

The Irish case offers some insights into ways in which human infrastructure can be adapted to an information economy. In Ireland, there was a need to create jobs requiring skilled IT labor (Trauth 2000). Thus, the industrial policy of Ireland was

shifted with the primary objective to create new employment opportunities. This shift was proven to be successful in the creation of its information economy (Trauth 1996). At the same time, IT Firms were attracted to Ireland partially because of their available pool of young labor (Trauth 2001). They were perceived to be open to new ideas and flexible to the changing environment (Trauth 2000).

Also, the challenge to change the existing educational infrastructure was acknowledged and successfully executed. Along with the new industrial policy to create new employment opportunities, Government training programs and adult learning programs provided technical training to the Irish. Between 1973 and 1993, this change in the educational infrastructure led to increased literacy nationwide and a shift in emphasis from arts subjects to science and technology subjects. In 1986, 25% of students who finished secondary education entered institutions of higher education, while 41% and 22% were studying science and commerce subjects respectively. These programs prepared the local population for IT-work, which supported the development of the information economy (Trauth 1993).

But employment and educational policies have to be coordinated. Not only must education programs be altered to suit the information economy, jobs must be created to support the employment of an increased supply of labor. This prevented the outward migration of skilled labor from Ireland (Trauth 2001; Trauth 1999). In addition, the industrial policy that developed the indigenous IT sector reversed the outward migration and opened up Ireland to foreign capital (Trauth 2000).

In contrast, Humboldt County lacks the coordination of employment and educational policies to create an information economy. Much of the efforts have not considered the dynamics of supply and demand of skilled labor. Importantly, while the educational institutions are taking active steps, the local businesses are not changing their business practices. This lack of coordination prevents the attraction of foreign capital.

This discussion has highlighted three major infrastructural problems that inhibit Humboldt County's attempt to develop an information economy. First, there is a social digital divide whereby a majority of the local population, especially local businesses, does not demand high-end IT services. In addition, they do not understand the merits of using the available IT infrastructure to support their businesses. While the One Gigabit Initiative is completed, there has been little use for it.

Second, the goals of *Prosperity* are partially aimed at increasing the use of IT to support businesses. However, there is no focus on developing an IT sector and thus creating employment. Tied to the first problem, it becomes difficult to increase the use of IT when there is little understanding of its merits. This may be improved with a vibrant IT sector to push the technological innovation and demand.

Third, the education programs should be changed to support the development of skilled labor along with the creation of the IT sector. While the NCSTCC seeks to develop additional training programs, the main programs in the educational institutions should change to provide technical training, similar to the Irish case.

Based on the preceding discussion, we have two policy recommendations to resolve the infrastructural problems. First, the local Government should take a leading role to promote the development and use of IT for common administrative services. This would increase the local population's understanding of IT and its use. In the long run, negative perceptions could be displaced by enthusiasm.

Second, pertaining to employment and education, policies should be implemented to create jobs and change the existing education infrastructure to encourage the supply of an IT workforce and demand for IT labor. These two initiatives would directly contribute to the development of an IT sector, and indirectly facilitate the development of an information economy to support its existing industry clusters.

The study is part of a larger study on California's rural regions. The data collection period for Humboldt County was considerably short. It is thus substantially limited a lack of quantitative and qualitative data pertaining to the local population, as well as actual businesses. Thus future research should seek to enrich the data with longer periods of immersion.

#### **ACKNOWLEDGMENTS**

We express our most sincere to the Milken Institute for their financial support. Without them, this research project would not have been possible.

## REFERENCES

1. Angel D. (1994) Restructuring for innovation: The remaking of the U.S. semiconductor industry. Guilford Press, New York.
2. Benner C. (2002) Work in the new economy. Flexible labor markets in Silicon Valley. Blackwell Publishers Ltd., USA, UK, Australia, Germany.
3. Castells M. (2001) The Internet galaxy. Reflections on the Internet, business, and society. Oxford University Press, Oxford, New York.
4. Castells M. (1996) The rise of the network society. Blackwell Publishers.
5. Humboldt county comprehensive. 2003. Accessed from [http://www.co.humboldt.ca.us/planning/ECONDEV/PROSPERITY/VOLIII/VOLIII.htm#\\_Toc464212233](http://www.co.humboldt.ca.us/planning/ECONDEV/PROSPERITY/VOLIII/VOLIII.htm#_Toc464212233) on Sept 26, 2003
6. Hundley, Richard O. Anderson R. H. Bikson T. K. and New C. R. The global course of the information revolution. Recurring themes and regional variations. 2003. Santa Monica, California, RAND.
7. Katz J.E. and Rice R.E. (2002) Social consequences of Internet use. Access, involvement, and interaction. MIT Press, Cambridge, Massachusetts.
8. Killer apps: Proving the need for One Ggabit. One Gigabit or bust. 2003. CENIC.
9. Kling R. and Turner C. (1991) The information labor force. In: Postsuburban California, The transformation of Orange County since World War II, Kling, Olin, and Poster (eds), University of California Press, U.S.A.
10. Lyon D. (1988) The information society: Issues and illusions. Polity Press, Cambridge, UK.
11. Marburger, John. Information and communication technology is a key to the future prosperity of all nations. 2003. U.S.A., The World Summit on the Information Society.
12. Nerat, T. (2003) One Gigabit or Bust. CENIC.
13. Norris P. (2001) Digital divide. Civic engagement, information poverty, and the Internet worldwide. Cambridge University Press, U.S.A.
14. Prosperity, the north coast's strategy Vol III. 2003. The County of Humboldt Office of Economic Development and Comprehensive Economic Development Strategy Committee.
15. Schement, J. and Tate M.A. (2003) Rural America in the digital Age: A preliminary assessment of the state of the information/telecommunications infrastructure in ten counties of North Dakota and Pennsylvania. Accessed from <http://www.rupri.org/telecomm/publications/default.asp?flashVersion=&SubSection=Publications&Panel=3> on Nov 10, 2003
16. Taylor R.S. (1996) The value-added model. The value-added processes in information systems. Ablex Publishing Corporation, NJ.
17. Trauth, E. (1999) Leapfrogging an IT labor force: Multinational and indigenous perspectives. *Journal of Global Information Management* 7, 22-32.
18. Trauth E. (1993) Educating information technology professionals for work in Ireland: An emerging post-industrial country. In: *Global information technology Education: Issues and Trends*, pp. 205-233. Idea Group Publishing, Harrisburg, PA.
19. Trauth E. (1996) Impact of an imported IT sector: Lessons from Ireland. In: *Technology development and policy: Theoretical perspectives and practical challenges*, pp. 245-261. Avebury Publishing Ltd, Aldershot, UK.
20. Trauth, E. (2001) Mapping information-sector work to the workforce: The lessons from Ireland. *Communications of the ACM, Special Issue on The Global IT Workforce*, 44, 74-75.
21. Trauth E. (2000) The culture of an information economy. Influences and impact in the Republic of Ireland. Kluwer Academic Publishers, Netherlands.
22. Vojtek, R.O. and Vojtek.R. (1997) Connecting the human infrastructure. *Journal of Staff Development* Vol. 18 .