REPORT ON
HOUSE CONCURRENT RESOLUTION 113

TASK FORCE ON INFORMATION TECHNOLOGY

OCTOBER 1, 1999

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FOREWORD

House Concurrent Resolution 113 of the 1998 Session established the Task Force on Information Technology to review current and emerging information technologies that impact both the public and private sectors, review associated issues and application of the technologies, keep the General Assembly informed regarding the technologies and their impact, and make recommendations to the 2000 General Assembly. Confronted with an extensive list of issues and insufficient time to address them all, the Task Force focused on three primary issues: the shortage of information technology workers in Kentucky, information technology businesses in Kentucky, and security of electronic commerce transactions. Information on these subjects was gathered primarily from presentations and discussions with Kentuckians having expertise and experience in a particular topic and with national experts and consultants. Additional information was gathered from staff research.

The report was prepared by Joyce N. Crofts. The assistance of Jim Swain, Chief Information Officer in the legislative branch, and his staff, and of Aldona Valicenti, Chief Information Officer in the executive branch, and her staff in supplying information is gratefully acknowledged.

Robert Sherman
Director

The Capitol
Frankfort, Kentucky
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TABLE OF CONTENTS

REPORT ON
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Introduction

1998 House Concurrent Resolution 113 established the Task Force on Information Technology to review current and emerging information technologies that impact both the public and private sectors, review associated issues and application of the technologies, keep the General Assembly informed regarding the technologies and their impact. and make recommendations to the 2000 General Assembly. The resolution included a broad list of duties and the latitude for the Task Force to conduct any other reviews that it considered pertinent or necessary. The membership consisted of nineteen members representing all three branches of government, the constitutional offices, the American Bankers' Association, the Kentucky Hospital Association, the Kentucky Bar Association, the Kentucky Chamber of Commerce, the Executive Branch Chief Information Officer, the Department of Financial Institutions, the Finance and Administration Cabinet, the Health Services Cabinet, the Department of Education, and the Director of the Long-Term Policy Research Center. (Appendix A.)

In its first two meetings, the Task Force heard presentations from the three branches of government and the private sector members regarding information technology (IT) applications currently used by each and discussion of the information technology issues that each proposed for study by the Task Force. A list of suggested issues was compiled and members were asked to rate the issues in importance. The members were confronted with a very comprehensive list of potential issues as well as the realization that the Task Force would have time to address only a small portion of that list. The list included such issues as: IT worker recruitment and retention; timely procurement process for state government; criminal code update; attraction and support of new IT businesses in Kentucky; internal and external distribution of data in state government; the Y2K problem; e-mail and the open records law; security and confidentiality of data; security and confidentiality of communications; IT standards to minimize inefficiencies of incompatible systems; information technology in law enforcement; data retention and archiving; the effect on state revenues of the explosion of electronic commerce; internet service provider distribution in the state; the public's access to computers; and computer literacy. (Appendix B.)

In its tenth meeting, the Task Force heard updates and status reports regarding the use of information in the executive branch and in the Department of Education in particular. Topics covered included various EMPOWER KENTUCKY projects, such as MARS (Management and Administrative Reporting System), Simplified Access to Commonwealth Services, the Kentucky Vehicle Information System; Y2K readiness in state government; Geographic Information Systems, the Model Courthouse Project, Kentucky Electronic Workplace for Employment Services, Kentucky's Unified Criminal Justice Information System, and the Kentucky Information Highway. The Department of Education discussed its Kentucky Education Technology System (KETS)—its goals, activities, results, and vision; the positive effects of the funding support for technology and the leverage provided by the state law mandate for the technology program; PD (professional development) Direct, which brings training to the teachers in the classroom setting; and various concerns.

In the remainder of its meetings, the Task Force focused its study on three main issues: supply of information technology workers in Kentucky, information technology businesses in Kentucky, and security of electronic commerce transactions. Information on these subjects was primarily gathered through presentations of and discussions with invited guests, consultants, and Task Force members. Additional information was gathered from periodicals and other publications, Internet research, and appropriate web sites. This report will primarily address these three issues.

SHORTAGE OF INFORMATION TECHNOLOGY WORKERS IN KENTUCKY

The Problem

During 1997-1998, various industry reports and newspaper and magazine articles indicated that there were severe shortages of skilled information technology workers in the United States.[1] Although many questions were raised about the alleged shortage, nevertheless, businesses and government alike have expressed their frustrations in obtaining the skilled IT workers they need, whatever the reason. Especially hard hit are governments, whose salary schedules and often outdated hardware and software cannot compete with those of the private sector.

Both public and private sector members of the Task Force indicated that their most important concern was their inability to attract and retain IT workers. The Chief Information Officer of the Executive Branch (CIO) referred to the problem as the "3 R's"—how to recruit,

[1]The primary reports were: *Help Wanted: The IT Workforce Gap at the Dawn of a New Century,* Information Technology Association of America, February 1997, and its 1998 update; *America's New Deficit: The Shortage of Information Technology Workers,* U.S. Department of Commerce, Office of Technology Policy, 1998; and *Information Technology: Assessment of the Department of Commerce's Report on Workforce Demand and Supply*, United States General Accounting Office, March 1998.

retain, and reward IT workers. She said that the private sector faces the same problem but has more flexibility and can offer greater incentives than government is able to offer. State government, traditionally, has not been able to recruit new people in the skilled IT positions that command higher salaries. Further, she noted, much of the talent that is produced in Kentucky leaves the state.

She also pointed out that state government salaries are not competitive. Starting salaries are often less than $20,000/year, whereas private sector starting salaries range from $35,000-$45,000. She suggested that the Commonwealth increase its salaries for IT workers, do more recruiting through internship programs, and offer more scholarships—in engineering as well as information technology. She noted that a four-year college degree is not necessary to perform some functions and that certification in network management or Microsoft certification might be sufficient training for many technology positions.

Recruitment and Retention in the Private Sector

Drawing from her own personal experience in the private sector and from information gleaned from recent national meetings, the CIO discussed private sector practices in recruiting and retaining IT workers. Generally, recruitment efforts by private sector companies target specific schools and programs, courses, faculty, and degrees. Frequently, members of their own workforce who are alumni of a specific school personally contact candidates in those schools, or key executives act as a school sponsor. They may visit targeted schools several times a year, preferably in the fall, to foster a relationship with a desired student and perhaps obtain an early commitment. Companies also establish scholarships and internships and hold job fairs. Another recruitment practice is to reward employees with a bonus for recommending or recruiting other good employees. "Signing" bonuses are also commonly used to attract new IT employees, the amount often being negotiable.

New IT employees in the private sector often have 6-12 weeks of orientation classes. Ideally, the orientation process would provide the new employee with an essential understanding of the role of the company's technology in the business goals and direction of the company. In addition, companies are increasingly assigning mentors—or "buddies"—to help new IT employees.

Retention efforts are usually focused on critical staff. They may include such offers as: bonuses to stay for defined periods of time; stock options; flexible working hours or locations (telecommuting); flexible organizational structure (e.g., team structure, competency centers of excellence); flexibility to choose projects; attractive work environment; appealing lifestyle; and other tangible benefits, such as providing leased cars, parking spaces, and special equipment. Companies perform an annual benchmark salary survey, in order to keep their employee compensation competitive, and special projects are often reviewed mid-year, at which time extra retention compensation or a bonus might be offered.

Recruitment and Retention in Kentucky State Government

The Secretary of the Personnel Cabinet discussed the current status of the supply of IT workers in state government and the cabinet's efforts to assist agencies with recruitment and retention of IT workers. She provided a list of all state government job classes in the Information System Group, with pay grade; a list of hard-to-fill classes; a salary schedule for hard-to-fill classes; the number of filled and number of vacant hard-to-fill IT positions; the number of applicants on registers for those positions; and a summary of their survey comparing Kentucky state government IT salaries with those in thirteen southeastern states, plus Indiana, Illinois, and Ohio. (Appendix C.)

As of October 28, 1999, there were 41 IT job classifications in state government. There were more applicants than needed for many of the classes, but 25 of those classes were deemed hard to fill and retain. Of the 594 positions in the hard-to-fill classes, 84 were vacant. The Secretary noted that although the cabinet's information showed 920 applicants on registers for the 25 classes, 569 of the 920 applicants were "internal mobilities," leaving 351 individuals who did not work for state government.

The Secretary pointed out several efforts by the Personnel Cabinet, in cooperation with the Department of Information Systems (DIS) to address the recruitment problem in state government. Acknowledging the difficulty of conceiving a written test that would adequately evaluate an IT applicant's potential, the cabinet substituted certain minimum qualifications for register eligibility. In lieu of a written test, there is a lengthy, comprehensive questionnaire to assess an applicant's suitability for certain positions. However, although the new process has been helpful, there still are not enough qualified applicants for higher level IT positions. In addition, the cabinet has worked with DIS to establish special entrance rate salaries for the 25 hard-to-fill classifications—a move that did not require statutory or administrative regulation changes. The cabinet has also worked on telecommuting as a recruitment tool and has reviewed a proposed scholarship program for IT students in college that is similar to the Transportation Cabinet's engineering scholarship program. The Secretary stated that she believed the ultimate solution will be a separate "market driven" salary schedule for IT positions, but that would require enabling legislation in the next regular session of the General Assembly.

An additional factor is the large number of retirements expected in state government in 1999. Of the 429 employees in DIS, 175 are eligible to purchase enough additional service to retire with full benefits.

Several Task Force members commented on their own experiences, noting: the large number of IT workers leaving state government who were able to double their salaries in the private sector; the inability of the state to pay enough to attract young people with high potential; the importance of having the "latest and greatest" hardware and software for attracting and retaining the best talent; and the need to create an incentive program to recruit and train current state employees who would like to get into the IT field. There was a suggestion that state government imitate private industry in giving monetary incentives for Microsoft, Novell, or NT certifications.

Role of the State's Community and Technical Colleges

Seeking information regarding the role of the state's educational institutions, the Task Force heard from representatives of the community colleges, technical colleges, and universities. The community colleges' program offerings include: (1) an associate degree program in Computer Information Systems (CIS), offered by three of the community colleges; and (2) a program in Management Information Systems (MIS), offered by 11 community colleges as an option in the Business Technology Program. The number of CIS/MIS graduates has declined slightly since 1996-97. The decline was explained as resulting from students' enrolling in a degree program just to take courses to meet immediate needs in specific competencies.

The community colleges reported on their proposed NIST program (Network Information Systems Technology); original curriculum development was funded by the National Science Foundation. Graduates of the NIST program will have the concepts and skills to design, set up, maintain, and expand networked computer systems, and will be eligible to take professional certification exams. Business partners in the program will include Cisco, Oracle/Peoplesoft, and Honeywell; educational partners will include the Kentucky Advanced Technology Institute, at Western Kentucky University, Bowling Green Advanced Technology Institute, at Western Kentucky University, Bowling Green Community College, and Eastern Kentucky University. NIST was also approved to offer three networking courses in the fall of 1999 through the Commonwealth Virtual University as part of a pilot project.

The technical colleges reported eight program areas that fit into the broad definition of information technology: Office, Electronics, Automated Systems, Information, Computer Applications, Software, Visual Communications Art, and Multimedia. These programs offer "42 job title exit points (based on the Dictionary of Occupational Titles), 21 diploma-level exit points, and 21 certificate-level exit points." Most of the diploma programs are two years and require completion of courses in computer fundamentals, workplace readiness, and consumer economics. Students must also pass a written assessment test or, in some instances, be credentialed by a professional association. Diploma graduates are also offered a technical guarantee of free retraining assistance if, within two years of graduation, the employer does not feel the graduate can perform the job. The technical colleges are also beginning to offer an Associate Degree in Applied Technology and to be involved in the associate degree of the NIST (Network Information System Technology) program.

In some technical college programs the enrollment rate is two or three times greater than the graduation rate. The Task Force was told that the reason the number who enroll is significantly higher than the number who graduate is because students are taking courses in order to address the immediate demands of business and industry.

In Task Force discussion, questions were raised concerning the low matriculation rate in IT programs offered by the community and technical colleges; whether programs are being structured appropriately to address the needs of business, industry, and state government; and whether the advisory boards who recommend the programs are providing the kind of information needed.

Role of the State's Colleges and Universities

The President of the Council on Postsecondary Education provided an overview of IT programs in the state's colleges and universities. IT programs are offered at all eight public universities, at about nine community colleges and a similar number of technical colleges, and at 15 proprietary institutions. He reported that of the 21,000 degrees conferred in Kentucky each of the past six or seven years, the average conferred in information technology is about seven doctor's degrees, 50 master's degrees, 300 baccalaureate degrees, and 175 associate degrees. About 400 technical college certificates are also awarded each year. He explained that "information technology" includes disciplines in computer and information science, computing maintenance technology, information science and systems, electrical engineering with an emphasis in computers and computer engineering, mechanical engineering, mechanical and electrical technologies, and management of information systems. Referring to the NIST program, he said that it will be a common curriculum, offered first at Ashland, Jefferson, and Maysville Community Colleges, and at Somerset and Paducah early next year. In addition, Murray State University has developed a program with an emphasis in telecommunications systems management. That program will tie to the network information systems programs, so that students who start in the two-year and technical-level network systems programs can progress into a baccalaureate program in telecommunications systems management and other advanced areas. Next year Northern Kentucky University will propose a master's degree program in computer science, and Eastern Kentucky University will propose one in computer networks.

The President noted the high placement rates for students from the community and technical colleges and affirmed that it is true that IT students at the associate level usually do not complete their general education because they are "snapped up" by employers as soon as they master technology skills. Reportedly, he said, starting salaries range from $40,000-$50,000 for those with a bachelor's degree and as high as $90,000 for someone with a doctor's degree.

Addressing the question of whether the universities were having difficulty hiring IT faculty, he said that all of the schools were having difficulty hiring IT faculty. The high demand for IT workers places tremendous pressure on colleges and universities in managing their salary schedules, since someone hired at the junior level might be paid more than tenured faculty. Murray searched unsuccessfully for two years for a computer science faculty member, and the University of Kentucky reported a three-year search for a particular IT faculty person.

The President noted the value to the working population of the ready availability of distance learning. Many employers are willing to provide facilities for distance learning at the workplace. Of nine pilot programs approved for the Commonwealth Virtual University, two involve information technology. In addition, the Owensboro community and technical colleges together will offer on-line certification in technology-based systems through a combination of video and web-based instruction.

In reference to the number of engineering graduates leaving the state for jobs, the President emphasized that a key element for growth of IT opportunities is the synergy of multiple firms that support, challenge, and complement each other. He said it seemed to him that this

"critical mass" is lacking in Kentucky. The Chief Information Officer in the executive branch mentioned some of the opportunities in information technology available in Kentucky but said there is not the concerted, coordinated effort of government, business, and education that leads to growth of IT-related industries.

INFORMATION TECHNOLOGY BUSINESSES IN KENTUCKY

In order to learn more about the state's economic development activities, programs, and plans to attract IT businesses to Kentucky, the Task Force asked the Economic Development Cabinet to discuss its past and current efforts as well as its future plans for attracting and supporting IT businesses in Kentucky.

The View from the Economic Development Cabinet

The Cabinet discussed a draft copy of their new brochure *"Think Kentucky¾Kentucky Location Advantages for the Information Technology Industry."* The brochure addressed Kentucky's central location, the Kentucky Education Reform Act (KERA), post-secondary education reform, creation of the Commonwealth Virtual University, the various certifications available in dedicated classrooms, expenditure amounts for instructional technology purchases and programs, data relating to value added by manufacture in Kentucky and selected states, the Bluegrass State Skills Corporation, and the Kentucky Jobs Development Act. They noted that the IT industry follows the corridor of educational excellence, and that Kentucky, to be successful in recruiting the IT industry, will have to be able to provide the necessary education and training.

The Cabinet discussed three categories of IT businesses as they perceive them: (1) call centers and centers for telemarketing and data entry, where jobs are entry level ($7.50-$8.00/hr); (2) help desks, or customer service centers; and (3) companies with a wide range of technical services and salaries in the $60,000-$80,000 range. Specific attention was given to the recent recruiting of G. E. Capital Information Technology Solutions (an example of category #3) in Northern Kentucky. A large incentive package was instrumental in attracting G.E., but the deciding factor was the state's ability to create a training center at Northern Kentucky University to meet the company's ongoing training needs.

Other recruiting efforts included a direct mail program to call centers, participating in the trade show for ICCM (International Call Center Management), and support of Bell South's telecommunications center and the Paducah Information Age Park. Cabinet officials noted that the Park, an $18 million investment, has been unsuccessful in the past few years. As for its future efforts, the Cabinet plans to be able to build upon its success in attracting G.E. Responding to a question, the Cabinet stated that Kentucky compares poorly to other states in the recruitment of IT businesses and cited lack of educational excellence in the IT field as the reason.

In the ensuing conversation between Cabinet officials and Task Force members it was noted that the vast majority of growth of IT businesses is that of businesses with a small number of employees—5 to 10. When asked whether the Cabinet had anything to offer these small companies, the officials explained that start-up assistance is available, but, given the high failure rate of entrepreneur development, it is difficult to determine which small businesses should receive assistance and how much public money should be committed. The Cabinet acknowledged that not enough is being done. When a potential startup business is identified, the Cabinet cannot do much more than direct them through the licensing and permitting process, inform them of available financial assistance, and advise them that they must devise a business plan.

Regarding whether a company wishing to relocate in Kentucky would be eligible for financial assistance if the company employed 15 employees at salaries from $40,000-$50,000, Cabinet officials explained that, under statute, assistance through the Kentucky Jobs Development Act program required the creation of 25 new full-time jobs. They said that the Cabinet has a very successful low-interest loan pool that is available to small companies. They do not believe that the 25-new-jobs minimum needs to be lowered, because experience shows that small businesses are more interested in the low-interest loans.

It was pointed out to the Cabinet that other states have been aggressive in supporting and attracting new IT business, in particular programs like Oklahoma's Center for Advancement of Science and Technology (OCAST), Maryland's investment financing program to assist technology business, and a similar program in Kansas. The Cabinet said that it had looked at those programs from a financing standpoint, noting that Kentucky has a lot of money available for financing, though it is not earmarked for IT business. They recognized the need to be more aggressive and the benefit to the state from having a center similar to OCAST.

The View from the Kentucky Science and Technology Corporation

The Kentucky Science and Technology Corporation (KSTC), formed in 1988, is an independent, nonprofit corporation devoted to improving the use of science and technology by business. According to the President, the Corporation focuses on the higher-end, value-added jobs, occupations and companies that the Corporation believes need to be developed in Kentucky if the state is to emerge in the 21st century with a competitive global economy.

Speaking to the Task Force, the Corporation's President discussed four characteristics essential to today's economy:

1. Knowledge is driving economic growth in Kentucky, nationally, and internationally. "Knowledge" companies are creating much of the wealth and growth, and companies that are looking to grow or relocate are looking at "knowledge" at least assets as much as they once looked at physical assets. The Corporation President said the issue Kentucky faces is a systemic challenge. The traditional view that economies are going to be dominated in the future by four or

five large industries is being reversed and is shifting toward knowledge economies dominated by 50, 200, or even 300 companies with 10-50 employees each.

2. Companies need to be entrepreneurial (defined as the unconstrained pursuit of new ideas, resulting in innovative creation).

3. Innovation in companies and organizations must be a way of life.

4. Speed in getting products to market and in improving them has become as important a competitive issue as price.

The Corporation's report, *Kentucky's Entrepreneurial Capacity,* found that the indicators measuring Kentucky's entrepreneurial capacity reflect a state that is largely unprepared to compete in today's economy. The state is not making the progress that is needed, particularly in academic R & D and in new firm growth. Further, some types of venture capital are still very scarce, particularly for startup and growing companies.

The President discussed problem areas that the Council has had to confront in its work with new companies. One problem is the education issue—Kentucky does not have the kind of trained, educated workforce it needs for both technical and higher-end-level jobs. Another problem is the lack of a sufficient "risk capital food chain," partly because there is not enough locally-based capital. He said that most investors of venture capital want direct involvement in the companies in which they invest, and this is difficult for out-of-state capital companies. It would be easier to lure these investors if Kentucky had a locally-based, healthy, dynamic capital market. (He explained that it is not the role of banks to invest in the type of early-stage development necessary to create an entrepreneurial economy.)

A third problem is the state's lack of a "critical mass" of entrepreneurial-type companies. Thus it is difficult to recruit high level personnel and potential entrepreneurs, because they do not perceive the environment as conducive to growth. He said that Kentucky doesn't have nearly enough companies that are based and founded on Kentucky know-how, Kentucky talent, and Kentucky innovation; yet the Council is optimistic about the capability and the capacity to develop and grow some excellent companies in the state. If a way can be found to reshape things and develop incentives to attract people over the short and long term, there is no reason that Kentucky can't have the type of economy and higher-paying jobs needed for a promising future.

Responding to questions, the Council President stated that there were a number of things that other governments, both in this country and internationally, have done—e.g., incubators, and funds to provide added incentive to commercialization of new products coming out of the universities. He referred to the upcoming release of a report that the Governor had asked the Council to develop last year. The report contains specific science and technology strategies for areas of the economy that the state should consider. Acknowledging that it is difficult for governments to get heavily involved in actually "tweaking" individual aspects of the economy, he said that one of government's most important roles is to be a catalyst for change and provide an environment in which changes can happen on their own.

Observations and points made by Task Force members included:

- Our high school graduates entering the workforce are finding that the average business in Kentucky is not willing to look at new ways of doing business. For example, they are not using the Internet, e-mail, word processing, or spreadsheets.

- The mindset in Kentucky is not entrepreneurial; there is still a "big company" mentality.

- There is not yet a real belief that Kentucky is part of a global economy.

The View from Three IT Entrepreneurs in Kentucky

1. Alan Murray, CommerceInc.

A graduate from a Bowling Green high school and an engineering graduate of the University of Kentucky, Mr. Murray, in the mid-1990's, created CommerceInc, with a view toward leveraging what he considered the greatest economic opportunity on the planet—the Internet. He said that the Internet will create more wealth and jobs than any of the major world wars, the transportation or energy economies, or manufacturing technology.

CommerceInc employs about 78 people, 35 of them in Lexington; all have college degrees and are working in professional level jobs. In 18 months, their payroll is projected to increase to 150 professionals. He told of an Internet banking company spawned in Lexington in 1996 that created wealth close to $400 million in less than 120 days, but every bit of that wealth and the jobs are now in Atlanta, Georgia. He said that it is important to create a culture in Lexington that allows such successes. He also spoke of the great minds coming out of Kentucky engineering and business schools to help form new information-based companies.

Mr. Murray explained that information-based companies want more companies like themselves nearby because of the synergy and opportunity that they create. Investment in information technology is not a single-sum investment; it is more of a domino effect. Silicon Valley and Austin, Texas, are good examples. These companies also need a sufficient infrastructure of support services—attorneys, accountants, advertising firms, for example. He reported that his company's headquarters is now evolving in New York City because the necessary infrastructure and resources to help the company grow can't be found in Kentucky.

2. Alan Hawse, Cypress Semiconductor

Mr. Hawse grew up in Lexington and graduated from the University of Kentucky in electrical engineering. He received his master's degree from Georgia Tech, was recruited by Cypress and moved to Silicon Valley for six years. The Valley is an intellectually incredible experience, he explained, but he preferred living in Kentucky. When he wanted to return to

Kentucky, the company formed a satellite office in Lexington. The average salary at his Lexington facility is around $70,000, and the company gives stock options. He said that Kentucky is a beautiful place to live and that the state needs to take advantage of that.

His company did not have a lot of startup problems, since it was a well-established $600-$700 million/year company; but he experienced frustration in the poor infrastructure and with the phone companies who were not responsive to the needs of this type of startup company. He also noted that Kentucky's economic development incentives are not well suited for the 5-10 person startup.

He advised Kentucky not to chase factories, but rather to chase the high-value-added things that drive the factories. The people making the real money are the people who are conceptualizing the ideas. Don't think about bigger sewers or wider roads, he suggested, but rather the other components of infrastructure—the phones, the capital, attorneys, and accountants that it takes to create an effective environment for the new economy. Government can add a new product line to its economic development scenario. Traditionally, agriculture and factories have been motivators of Kentucky's economy; what is needed now is minds. He proposed that there are lots of bright Kentuckians educated here who left the state and who would love to return to Kentucky if they had the chance.

3. Randall Stevens, ArchSoft and ArchVision

Randall Stevens grew up in Pikeville, graduated from Pikeville High School, studied electrical engineering at the University of Kentucky but later switched to architecture. Upon graduation from U.K., he took his knowledge of computers and architecture and created ArchSoft. The company has clients in states from California to New Jersey, and last year entered the commercial software side of business by selling its first tool, written by a U. K. computer science graduate who began working for him during high school. It has sold in 35 states and 34 countries—all credit card transactions through an Internet site. He said he has financed the company himself so far, but that the problem for him now is how to get the venture capital or seed money it takes to "step on the accelerator." He, too, mentioned problems with the lack of infrastructure. For example, when he went to the bank to get set up for Internet credit card transactions, they didn't know how to set up the process.

When he began selling software, he found he could sell it inexpensively through the Internet. He noted that 45% of his software sales are outside the United States and that, of 400 packages sold since June, only one was sold in Kentucky. He pointed out that new money is going to come into Kentucky through sales on the Internet.

Since his company is too small for a human resources department, Mr. Stevens himself does the time-consuming finding and hiring of new employees. When he surfed state government on the Web looking for information on employment opportunities or a jobs talent pool, he found only "billboards" of information and did not have the time to sift through it to find what he needed. He suggested that it would be very helpful to small companies like his if the

state could utilize the technology to expose the information so that it can quickly be found, to allow the customers to identify themselves and the type of information they are seeking, and to permit the technology to push the information back to the customer. He emphasized that state government's resources are important to small startup companies and that there is a great centralized delivery vehicle for it now—information technology.

Responding to a question about Kentucky attorneys' qualifications relating to IT business, Mr. Stevens said that it was difficult to have a discussion with some attorneys because they do not have technology interests or skills, since there hasn't been a demand for them. When he had been debating whether to invest in a software patent, he didn't feel comfortable that the attorneys he talked to had a good understanding of the issues. Mr. Murray added that the experience base for attorneys in Lexington is at "ground zero" for the type of transactions he is involved with on a daily basis. He uses four part-time lawyers out of San Francisco, and for accounting and auditing services he uses PricewaterhouseCoopers out of Atlanta.

The View from a Consultant

Dr. Walt Plosila, Vice-President of Technology Management at Batelle Memorial Institute, the consultant who helped the Kentucky Science and Technology Corporation to establish a state IT strategy, spoke to the Task Force about what other states are doing and what states need to do to establish an environment that will encourage the creation and growth of IT businesses.

Dr. Plosila emphasized the importance of technology to state governments. In this technology-driven economy—an economy driven by brain power rather than brawn—the flexibility and agility of people and companies will be the key. How states harness and utilize technology is critical to growth and development of the economy. Technology offers the ability to improve knowledge and skills, encourages job skills that require brain power, replaces America's high cost of labor with higher value work, contributes to the development of new products and processes, and creates higher-paying jobs.

He said that a large amount of research and development (R&D) funded by the federal government is funnelled through the universities and linked by state government programs to the small companies, entrepreneurs, and innovation. The National Science Foundation has pointed out that most of the innovation in the U.S. is coming from small, young, growing companies that are always in search of capital and collaboration with other people. State programs attempt to link R&D investment to the needs of small companies and entrepreneurs.

States, especially western states, have recognized that their future economy is much more likely to be driven by smaller firms. While there is a need to maintain the larger firms and encourage their maturity and stability, much of the job growth and innovation will come from the small young firms that an entrepreneurial culture encourages.

The question is how to build an entrepreneurial culture. There is no one solution to building an entrepreneurial culture. Entrepreneurs are individualistic and their needs are different. What is done by government and higher education needs to be customized to enable the small entrepreneurial firm to succeed. It requires trying different approaches as the states leverage resources from the private sector and higher education and link efforts and programs.

Dr. Plosila listed the **characteristics of state programs that work with entrepreneurs and technologists:**

1. Willingness to take more risk than in traditional programs -- Whereas a private sector venture capitalist might be happy if 3 out of 10 investments in high-tech firms succeed, failure of 7 out of 10 investments would spark a different reaction in the public sector. It is not easy for the public sector to undertake risks, but some state and local governments have been willing.

2. Inclusion of higher education in contributing to economic development through teaching and R&D -- The universities' resources and intellectual capital can be utilized by both large and small companies.

3. Focus on start-up firms and new enterprises.

4. Metamorphosis in economic development efforts -- The traditional economic development method has been to attract companies by building industrial parks, giving tax abatements, and providing subsidies for "bricks and mortar." Technology firms are more interested in a technology-ready workforce and equity capital to help them develop their product or process.

5. Leveraging of private resources to ensure "market-driven" research and development -- Many state technology programs leverage a lot of private sector money and tend to complement federal programs. States can work with their universities to move the federally funded basic research "downstream" into the marketplace, companies, and growth and development. A clearinghouse of information on the states' economic development programs can be found at the web site of the State Science and Technology Institute, a subsidiary of Batelle Memorial Institute. Their web site, *www.ssti.org,* includes state program profiles and links to relevant web pages for each state.

Dr. Plosila explained that the **keys to building a technology-driven entrepreneurial economy** require:

➔Technology developers (universities, federal laboratories, industry) -- Noting that Kentucky does not rank well on federal labs, therefore it must depend much more on universities and industry. He said that Kentucky ranks 40th in the country in industrial R&D and its universities are 44th in academic R&D.

➔A technology-ready workforce -- Surveys by Batelle Institute indicate that IT firms generally want a "new kind of person"—electrical engineers who also have an MBA degree. It is

harder to find the technical expertise on the business side. Penn State and Indiana University are trying to address the need for this combination of skills.

➔Investment capital -- Usually, if the "pre-seed" (taking the idea and moving it toward a prototype) and "seed" capital is not available locally, it is difficult to move technology companies ahead. "Pre-seed" sources would include the federal STTR program and angel investors. "Seed" capital is generally in amounts of $100,000 to $2 million, and there is a capital gap in most states, including Kentucky, in that range. Venture capitalists usually do not fund deals under $2 million anymore. State governments are funding the $100,000-$2 million gap. He cited the Massachusetts' Technology Development Corporation as an example of the type of intervention that states can undertake. This corporation was funded about 15 years ago with one-time state money and has been operating since then on its reinvestments.

➔Entrepreneurs and seasoned managers.

➔Critical mass (clusters of like companies and business service providers) -- Successful technology centers, such as Boston, Silicon Valley, Research Triangle Park, and Austin, all have a critical mass of like companies and business service providers that understand and work closely with the industry.

➔Risk-receptive environment.

Dr. Plosila said that typically **state programs focus on the following areas:**

1. Equipment and facilities. States often provide small entrepreneurs access to equipment and facilities through their higher education institutions.

2. Government-industry consortia. Increasingly, large firms are creating strategic partnerships and establishing long-term investments with higher education—dubbing them their "preferred universities." The issue is whether small and medium firms can form similar consortia.

3. Incubators and research parks. These can be viewed as the physical manifestation of the technology paradigm. Just as the issue of the industrial revolution became industrial parks, so today the issue is having incubators, research parks, and accelerators. The purpose of the incubators is to help the business survive. After two or three years of growth, the business leaves the incubator and goes into an accelerator—a multi-tenant building. There are approximately 300 research parks nationally, either in place or on the drawing board.

4. Information and data.

5. Regional technology alliances. These are efforts in certain regions to create technology councils and build a technology base network between higher education, government, and industry.

6. Research and technology centers of excellence. Across the country, states are making an effort to fund research and technology centers. In many cases, they are funded by the federal government. The challenge has been to make the centers accessible to small and medium as well as large firms.

7. SBIR (Small Business Innovation Research Act) assistance. This program sets aside 2½ percent of each federal agency's budget for small firms to compete for R&D money. This federal program is the largest formal source of institutional seed venture money in the country. It provides $100,000 in Phase-1 and up to $750,000 in Phase-2.

8. Technical/managerial assistance.

9. Technology extension problem solving. An example of this type of program is the Kentucky Technology Service, a manufacturing extension center.

10. Technology transfer. In the past, technology transfer offices tended to focus more passively on processing invention disclosures by faculty and licensing the technology. Now, technology transfer offices are much more active, even forming companies around technologies that appear to have enough value to warrant creating a company. Last year 333 firms were started out of universities, in contrast to only 258 the previous year.

11. Venture capital. The state's role in venture capital funding includes investing a small amount of state pension money in privately-managed venture capital funds. Investment in venture capital has had the highest and best return of any alternative investment for many years. Most states invest 1%-2% of the pension assets in venture capital; some invest 5%. Even 1% of Kentucky's major pension funds is a significant chunk of money; and any investment should be over a period of years, not all at once. Massachusetts, Pennsylvania, Ohio, and other states have addressed the problem of capital another way—by using a small amount of appropriated dollars to create seed venture funds managed by the private sector.

Dr. Plosila cited as an example of successful state programs Pennsylvania's Ben Franklin Partnership Centers, which have resulted in $340 million of state funds being leveraged over $1.4 billion in industry, federal, and university funds; the creation or retention of 46,000 jobs; 1,180 new products being commercialized or processes implemented; and the establishment of 1,270 firms. Virginia, New York, and Ohio have enjoyed similar successes. He said that these programs have worked partly because they were designed to meet the customer's needs and they recognized that government's role was not to be operator or a "funder of first resort," but rather to be a catalyst or facilitator.

Among states that do not have the critical mass of technology-driven entrepreneurship, there is an increased interest in looking within their regions for clusters, particularly rural, and finding ways to build linkages to the technology base of the state. In Kentucky, for example, the pharmaceutical industry in Louisville buys from suppliers in rural parts of the state, but people do not think of those suppliers as part of the cluster. So rural areas can be rejuvenated by rethinking the approach to economic development and clusters.

In summarizing **the partnering roles of government and industry**, Dr. Plosila said that the federal government supports the science base and has programs such as SBIR (Small Business Innovative Research), STTR (Small Business Technology Transfer Research), ATP (Advanced Technology Program), and MEP (Manufacturing Extension Program in the Department of Commerce, National Institute of Standards & Technology) that are run by state-supported intermediary organizations. State government helps identify technologies and link them to companies, helps assess technology gaps, helps universities develop technology, and helps firms acquire technology and integrate the technology to the business strategy and plan. Industry's role is to take the process of product work and turn it into commercialization, through consortia, alliances, and projects. The state role then becomes helping to get applications downstream into industry, helping to make sense of basic research—reducing it to practice, providing business support for strategic planning, and market assessment, and doing the brokering to bring the various resources of the federal and state governments and the large firms to the entrepreneur's attention.

The **ingredients for success** include long-term regional investment, strong business leadership; public sector investment, whether in technology infrastructure or assistance to business; active leadership from the research universities; networking among firms, academe, and research laboratories; active state government support and promotion, as demonstrated in Austin; and a long-term perspective. Regarding the latter, Dr. Plosila pointed out that it took 16 legislative sessions and the terms of six governors before the Research Triangle Park (N.C.) reached the point where people believed it was going to be successful. Getting federal discretionary and R&D money into states like Kentucky will be crucial.

What are other states' experiences in investing their pension funds to provide seed money? Dr. Plosila replied that North Carolina has had a rate of return on its venture investments that is about equal to its other investments. In Pennsylvania, in 1982, the two state pension funds originally did not want to invest in venture capital, but a rare bipartisan coalition of the legislature passed a law requiring that one percent be invested. After five years of investing in private venture capital, the return was so good that the legislature was asked to increase the mandated investment to two percent. He pointed out that investing pension money in venture capital is only one method of state funding support. Furthermore, he said, since venture capital doesn't invest in the seed stage anymore, it could be argued that the investments aren't that risky, since venture capitalists are very conservative and tend to do later-stage mezzanine financing, buyouts, and acquisitions. Putting one percent of pension money into venture capital is of more importance for what it does in getting venture capitalists to become interested in a state.

With so many factors required to create a technology-driven economy, are there one or two areas where Kentucky could start? Dr. Plosila explained that not everything can be done at once; a starting point has to be determined and priorities set. He advised that people and relationship-building are a good place to start. Relationship-building includes a variety of things; it could be as simple as matching projects between university faculty and entrepreneurs and identifying organizations and vehicles to network with entrepreneurs regionally to build the

entrepreneurs' resource base. Short-term results may be visible, and feedback can reveal whether it is working and whether the right thing is being done. The investment in people—the intellectual foundation—is important but it may take a long time to realize any return. Legislatures should also be concerned about creating a business climate (i.e., regulatory framework, tax laws) to ensure that the technology entrepreneur has a level playing field with traditional manufacturers. Long-term commitment is also required. Creating a technology economy can't be done in six months or a year. States that have been doing it the longest are just beginning to see results. Pennsylvania, for example, has been doing this for 17 years and the success has been slow in coming. Perseverance, building relationships, creating a business climate, addressing people and their skills are the kinds of things that Kentucky needs to pursue. He also said that there are things that can be done to help regions of the state where the technology base is not strong and its emergence is questionable. It is important for business to reach out to those areas and "link them to the agenda."

What can be done regarding the lack of incentive to legal and accounting professionals in Kentucky to focus on the needs of technology-based businesses? Dr. Plosila said that when there are only a few technology companies that need the services, the providers of those services must learn by doing. Accounting and law firms could offer pro bono or reduced-rate help to entrepreneurs. This is normally done in technology growth areas when the providers themselves are still learning the business. Some have even been willing to accept equity in the startup company in lieu of compensation. He suggested that state bar associations, as well as service providers' state associations, can create a technology section to conduct seminars and in-service workshops to build the knowledge base as the industry grows. State government should build regional relationships with technology-related organizations and include the business service providers. He cautioned that service providers have to realize that it is a long-term proposition and that they won't get rich from serving the technology start-up base.

Who generally leads this type of effort in the state? Dr. Plosila said that generally governors of states take the lead in developing technology strategies, but sometimes it is the legislature, as was the case in New York.

How large an investment in venture capital funds would Kentucky need in order to attract national attention? After its initial investing in seed venture funds, Pennsylvania decided it wanted a bigger fund and in 1984 created a $40 million statewide venture fund, but it failed to bring in the venture capitalists. Maryland's approach was better. Maryland invested $3-$4 million each in eight different privately managed venture funds, which diversified the risk and insulated the pensioners somewhat. All eight funds established offices in Maryland and competed with each other, so that spawned more deals and opportunities for entrepreneurs. Dr. Plosila emphasized that he doesn't think the level of funding matters as much as the method. He advised that, based on his experience, it would be wiser for Kentucky to invest in several funds—e.g., four or five funds of $6-$8 million each over a period of three years—overseen by an advisory board, rather than to put a large amount of money into a single venture capital fund.

Should Kentucky give more tax breaks for R&D? Dr. Plosila pointed out that the federal R&D tax credit is a little overblown. Congress never authorizes it for more than one year

at a time, and it is more an accounting arrangement than a strategic investment. Furthermore, although state R&D tax credit is important, it is still marginal compared to the federal credit. He noted that Kentucky offers a qualified investment tax credit of up to $20 million, which is probably a good start in addressing the venture capital problem. What is needed is venture fund money to go with the qualified investment tax credit.

By itself, a state R&D tax credit would have to be carefully crafted, strategic, and permanent in order to complement the investment taxpayer. It would also have to be big enough to make a difference—and that might not be financially affordable. Kentucky clearly needs to encourage its industry and invest more in R&D. R&D is part of investing for the future and having that kind of credit could attract the R&D operations of companies to Kentucky.

ELECTRONIC COMMERCE SECURITY

The Background

The Internet and electronic commerce are changing the way we live our lives—the way we shop, the way we bank, the way we run our businesses, and the way we communicate with and use the services of our governments. As more transactions and communications that require security and authenticity travel on a network that has no inherent security, questions arise concerning the authenticity and integrity of electronic messages and documents. How does the user know the sender is really the person indicated? Has the document or message received been altered in transmission? How can one be sure that the sender will not deny having sent the message? Can it stand up in court? To be able to rely on the electronic messages they receive, governments and businesses alike need the assurance that those messages are reliable, provable, and enforceable.

Today, electronic signatures, digital signatures, and encryption are the technical means to verify the sender and assure that the information has not been altered in transmission. "Electronic signature" is the more general term and is generally defined as any letters, characters, or symbols manifest by electronic or similar means and executed or adopted by a party with an intent to authenticate a writing. Examples of electronic signatures include a name typed at the end of an e-mail message, a digitized image of a handwritten signature that is attached to an electronic document, a PIN number, a biometric signature, and a digital signature. "Digital signature" is one specific type of electronic signature that allows the recipient of a digitally signed communication to determine whether the communication was created by the purported signer, and that, when used with encryption, verifies that the content of the communication has not been damaged or altered in transmission.

Within the last three years, there has been a wave of electronic signature and digital signature legislation across the country, including in Kentucky. In the 1998 Regular Session, Kentucky's General Assembly passed an electronic signatures and electronic records Act.

Codified as KRS Chapter 369, the statutes generally direct that electronic signatures have the same force and effect as manual signatures and that electronic records, with some exceptions, will satisfy any statutory or regulatory requirement that information be in "written" form. KRS Chapter 369 addresses an electronic signature as an identifier with the same effect as a manual signature. It applies to private sector transactions only when both parties agree to the use of an electronic signature or record and to state or local government entities only if the entity agrees to accept an electronic signature or record. It does not require anyone to use or accept an electronic signature or electronic record, nor does it prohibit a recipient from establishing conditions of acceptance, unless the parties have agreed in advance of the transmission. It does not address the trust issues of authenticity, integrity, and nonrepudiation, even though one of the stated purposes of the Act is to "promote public confidence in the integrity and reliability of electronic records."

Against the background of the executive branch's continued work to put Kentucky government on-line, of state government efforts to create a supportive environment for IT entrepreneurs and growing IT businesses in Kentucky, and of increasing on-line transactions by business, state and local governments, and private citizens, it seemed important to look ahead at what legal issues will need to be addressed in legislation addressing the security of electronic transactions. Two national experts, Thomas J. Smedinghoff,[2] an expert on electronic commerce security, especially on electronic and digital signatures, and Amelia H. Boss,[3] a law school professor with expertise in commercial law and national and international efforts on electronic commerce model laws, spoke to the Task Force on electronic commerce security legislation at the state, national, and international levels.

"Electronic Signature Legislation: the Issues and the Responses"

Mr. Smedinghoff said that the goal of electronic commerce is to have the ability to conduct reliable, provable, and enforceable transactions via the Internet with strangers, in real time. Achieving this goal raises three issues that have been the focus of electronic commerce

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[2]Thomas Smedinghoff is a partner with the Chicago law firm of McBride Baker & Coles and Co-Chair of the firm's Information Technology and Electronic Commerce Law Department. His practice focuses on legal issues relating to developing information technology topics, such as electronic commerce, the Internet, digital signatures, encryption, multimedia, software, data security, e-mail, and electronic recordkeeping. Mr. Smedinghoff serves as Chair of the Illinois Commission on Electronic Commerce and Crime, Chair of the American Bar Association's Section of Science and Technology, and as an ABA adviser to the National Conference of Commissioners on Uniform State Laws' drafting committee of its model law, Uniform Electronic Transactions Act. He is a member of the U.S. delegation to the United Nations Commission on International Trade Law (UNCITRAL), where he participates in a working group that is developing international electronic and digital signature legislation.

[3]Amelia H. Boss is Professor of Law at Temple University School of Law, where she teaches in the commercial law, bankruptcy, and electronic commerce areas. She is a member of the Permanent Editorial Board of the Uniform Commercial Code and former chair of the Uniform Commercial Code Committee of the American Bar Association. She was the American Bar Association Advisor to NCCUSL's *Uniform Electronic Transactions Act.* She currently serves as an advisor and as the United States Delegate to the United Nations Commission on International Trade Law (UNCITRAL), working on its model law on electronic commerce and its digital signature law. Professor Boss serves as Chair-Elect of the Business Law Section of the American Bar Association.

legislation: (1) Is the transaction legal, i.e., enforceable? (2) Can the message be trusted? and (3) What are the rules that should govern electronic commerce transactions?

There has been an explosion of related legislative activity both in the United States and in the international community. In the U.S., 49 states have proposed and 44 have enacted some form of electronic signature legislation. The National Conference of Commissioners on Uniform State Laws (NCCUSL) has two drafting committees that are completing projects for approval at this summer's meeting.[4] Several bills have been introduced at the federal level, and more are expected. Internationally, the European Union has just released a directive on electronic signatures, and UNCITRAL (United Nations Commission on International Trade Law) is trying to reconcile e-commerce issues across countries.

He pointed out that there are two major problem areas in state laws—they differ on what qualifies as a legally enforceable electronic signature and the types of transactions for which electronic signatures can be used. Statutes to date have taken three approaches to what qualifies as an electronic signature: (1) Anything qualifies (e.g., any mark made with the intent to sign), (2) Only electronic signatures that possess certain security attributes qualify, and (3) Only digital signatures qualify. Statutes have also taken three approaches as to the type of transaction done electronically: (1) Any transaction, although it may exclude wills, trusts, negotiable instruments, real estate, etc.; (2) Only transactions with government agencies; and (3) Specific types; for example, health care records, bank transactions, tax returns, and election filings.

Mr. Smedinghoff stated that the question of trust, a key issue in electronic commerce, is typically not addressed in most legislation. Key requirements for message trust are authenticity, integrity, and nonrepudiation—Who really sent the message? Has the message been altered? Can it stand up in court? A message sent over a medium that is not "trustworthy" can be protected by using security procedures that allow the receiver to verify the identity of the sender and the integrity of the message (whether it has been altered). He stated that the security procedure of the future is the digital signature.

There are also inconsistencies in state legislative approaches to the "trust" issues and legal presumptions. Most statutes do not address trust issues at all. Some provide that a signature is not valid unless it possesses some attributes of trust. Others consider an electronic signature to be valid but confer a legal benefit on the more trustworthy forms of signature where identity and integrity are legally presumed—e.g., digital signature. Further, most states do not address legal presumptions relating to identity and integrity. Some statutes allow for presumptions where the parties agree between themselves on a certain type of signature; other statutes allow for presumptions when the law specifies that certain procedures are appropriate.

Determining the rules governing the conduct of the parties using electronic signatures is an important issue for legislation. Some of the questions that need to be resolved are: Should electronic transactions be governed by the rules for paper transactions? If different, should they be specified by law or decided by the courts? Who bears the risk of forged messages? What are

[4]On July 29, 1999, NCCUSL approved the model law, *Uniform Electronic Transactions Act.*

the rules for attribution? How do we decide what is trustworthy? Should consumers be treated differently? Additional issues will need to be addressed, depending on the technology used. For example, digital signatures require a third party—a certification authority—to verify the authenticity of a message, and this raises new issues to be resolved.

Mr. Smedinghoff said that legislation must consider the issue of party autonomy—i.e., can the parties agree between themselves on what the rules are going to be? On the whole, most of the existing legislation does not address the question of what the rules are." Some states specify detailed rules and direct that they cannot be varied contractually; others allow the parties to agree between themselves on almost anything but also specify "default" rules if they don't agree.

Responding to a question about the positives and negatives of government versus private regulatory involvement, Mr. Smedinghoff said that the trend, according to the number of statutes that have been enacted that avoid heavy government regulation, seems to be somewhat away from detailed government regulation. However, the questions have to be answered by somebody at some point, and his sense is that having the answer in a statute will make it easier for the parties to adjust their conduct than if the answer has to be determined years later by the courts.

Responding to a question about the federal government's role, he said that, because of the problems being created by the states' inconsistent approaches to the issue, bills have been introduced in Congress that would, in effect, preempt the states and specify that, for contracts, any type of signature across state borders would be accepted. Even though, traditionally, laws controlling contract and signature validity and Uniform Commercial Code statutes have been state-based, Congress is under increasing pressure from industry to preempt the states. He said he did not have a sense whether the bills will pass. He explained that the *Uniform Electronic Transactions Act*, the model law approved by NCCUSL, focuses only on the question of legality, but if it is passed nationally it would create some uniformity across state borders.

When asked for his recommendations for state legislation, Mr. Smedinghoff stated that his first recommendation would be that the law should cover all types of electronic signatures, not just digital signatures, but that it should go another step and address the question of trust. In addition, he believes it should specify minimum default rules on some of the fundamental questions—e.g., who bears the loss in the event of a forged signature. Lastly, to the extent a technology raises a specific set of issues, e.g., digital signatures, he thinks it is appropriate to look at whether those issues should be addressed. In reference to uniform laws, he said he is not sure a good uniform law will be forthcoming in the short term, other than the very basic one coming out this summer from NCCUSL, which he recommended as a good place to start.

The *Uniform Electronic Transactions Act (UETA),* NCCUSL's Model Law

Professor Amelia Boss said that 15 years ago businesses began to be concerned about the validity and enforceability of electronic transactions and how to determine the rules to govern transactions created in cyberspace. Initially, they tried to deal with many of the issues through

"trading partner agreements," but found that was not possible since, in Internet transactions, they frequently do not know the party with whom they are dealing. The type of negotiations common to a paper-based world do not occur. Consequently it is important to have uniform default rules that: (1) validate and support the use of electronic commerce; and (2) provide some rules (certainty) as businesses venture out, so that they can be assured that those rules apply in the event of a dispute.

The NCCUSL effort to draft a model law began around 1990 and over the years of extensive debate, included input from industry, state governments, and local governments. The Drafting Committee established certain principles it believed should guide any legislation in the electronic commerce area—principles that have been articulated at the international level and in various business and industry organizations. These guiding principles are:

1. The law should be supportive and not proscriptive; it should support and facilitate electronic commerce but not try to direct and regulate it.

2. Any law adopted should be amenable to new technologies and new business practices; it needs to be adaptable.

3. The law should contain "party autonomy"—the ability of the parties to set the rules needed for the particular transaction they are conducting. For example, rules for purchasing a book and the rules for a securities transaction may differ.

4. The law should not impose greater restrictions on electronic transactions than are on paper transactions.

5. The law should not address issues that are primarily business or technology issues rather than legal issues.

Regarding principle #5, Professor Boss noted that some people say that a law is needed to legislate which electronic messages can be trusted, but she maintained that trust is not a matter of law; it is a matter of familiarity and building systems so that they can be tested to determine whether a message is actually from the purported sender.

The scope of UETA is very broad, much broader than some state legislation. It applies not only to businesses and state and local governments but also to the consumer, the latter needing protection of the law in the same way businesses and governments do. It exempts wills, codicils, and testamentary trusts. Professor Boss reviewed individual sections of the UETA, including such points as:

- The definition of "electronic signature" ("an electronic sound, symbol, or process attached to or logically associated with a record and executed or adopted by a person with the intent to sign the record") makes no special mention of digital signatures. The key element "intent to sign" allows parties to agree to go further, e.g., using certain identifying codes or methods of communication.

◆ The language in Section 3(d), "A transaction subject to this Act is also subject to other applicable substantive law," makes it clear that the UETA deals only with the procedure of a transaction and limits the encroachment of the Act into other substantive areas.

◆ Section 5(c) provides the right to refuse to accept transactions in electronic form. This, she said, is an important consumer protection; it also builds flexibility into the law. The section also provides that other laws may determine the legal consequences of a particular message. UETA will not override substantive legislation, and the legal effect will be determined by the other substantive law.

◆ UETA says that if a law requires that information be "provided" in writing, then the recipient must "have" it and be able to keep it (Section 8). In other words, a recipient must be able to download it or print it; it is insufficient for the information to merely be on the website.

◆ The model law addresses the issue of how to prove an electronic message came from the sender by saying it may be "shown in any manner" (Section 9). Sometimes, the Professor pointed out, businesses have their own way of verifying, e.g., the pizza shop's method of verifying telephone orders. Often, the size of the transaction will dictate how much security is desired. Digital signature is one way of verifying the sender, but not the only way. Professor Boss said that some people argue that this section does not provide enough certainty, but her personal view is that enforceability will provide certainty and that fears about uncertainty are really just concerns about something that is new to people.

◆ Section 9 contains no presumptions (elements of trust), although the issue was hotly debated on the UETA Drafting Committee.

◆ Kentucky's law (KRS Chapter 369) establishes characteristics of an "electronic signature" (must be unique to the person using it, capable of verification, and under the sole control of the person using it) that have been rejected by UETA and the United Nations model law, because they exceed the requirements that currently exist, are hard to meet, and their interpretation presents a problem.

Professor Boss noted that several bills now pending in Congress have provisions to preempt states' legislation. While this provision is viewed by some as a way of achieving uniformity, it is of great concern to those who believe states should have the ability to set rules that, though they may not be completely uniform, will reflect the peculiarities of individual states. However, many of these pending bills carve out provisions that essentially say that a state's law will be preempted unless it has enacted a law similar to the UETA. She encouraged Kentucky to consider enacting UETA and said that if the model law is not enacted in the next legislative session, Kentucky will likely find itself preempted by the federal government in 2002.

TASK FORCE RECOMMENDATIONS

The Task Force on Information Technology makes the following recommendations:

ELECTRONIC TRANSACTIONS

1. That the 2000 Kentucky General Assembly should enact the Uniform Electronic Transactions Act (UETA), the model law on electronic signatures approved in July 1999 by the National Conference of Commissioners on Uniform State Laws. The UETA would replace KRS 369.010 to 369.030, Kentucky's current law on electronic signatures.

TRANSITION TO A KNOWLEDGE-BASED ECONOMY

2. That the legislative and executive branches of state government take appropriate actions to facilitate the implementation of the recommendations set forth in *"Kentucky's Science and Technology Strategy,"* (June 1999) prepared by the Kentucky Science and Technology Corporation for Governor Patton. The Task Force recognizes that nationally and globally we are moving to a new economy based on knowledge; that the jobs and wealth of the near future will be created in the information technology and Internet environment; and that Kentucky stands at the brink of aggressively moving forward into the new knowledge-driven economy, by creating its own IT companies—or falling further behind in the race to be globally competitive in the new knowledge-driven economy. Consequently, **the Task Force endorses *Kentucky's Science and Technology Strategy*** (Appendix D) **regarding its four strategies and ten recommended strategic actions below.** A more detailed explanation of each item can be found in the report itself on the page referenced.

a. <u>The four strategies:</u>

(1) <u>Enterprise Development:</u> Create and grow innovation-driven Kentucky enterprises through aggressive support for risk capital and commercialization of research.

(2) <u>Manufacturing Modernization:</u> Modernize existing manufacturers in Kentucky.

(3) <u>Technological Infrastructure:</u> Build the technological infrastructure that is essential to ensuring a competitive Kentucky economy.

(4) People: Ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st century knowledge economy.

b. Ten strategic actions:

(1) Authorize a limited portion of state pension funds (up to 2%) for investing in business ventures (p. 25).

(2) Create Research and Development (R&D) Vouchers for small and medium-size firms to undertake R&D work in partnership with a Kentucky higher education institution (p. 27).

(3) Establish the Kentucky Commercialization Fund to provide development (pre-seed) funds for promising technologies coming out of the R&D work undertaken in the state's higher education institutions (p. 29).

(4) Conduct a review of Kentucky policies and regulations to identify barriers or constraints that may impede the commercialization of knowledge or technology and the start up and growth of innovative Kentucky companies (p. 30).

(5) Establish a statewide system of manufacturing modernization in which the various providers of manufacturing modernization assistance to industry will have better focus, can take on mutually supportive roles and responsibilities, have common rules of the road, and, to the businessperson, operate as an integrated assistance delivery system (p. 31).

(6) Establish Regional Technology Service Corporations, intermediary organizations in Kentucky's rural regions that would link educational institutions, service providers, and industry into effective coalitions and partnerships (p.33).

(7) Create the Kentucky Science and Engineering Foundation, building on the success of EPSCoR and partnering with the Council on Postsecondary Education, in order to accelerate the transition of the state's R&D into the mainstream for receiving federal and private sector support (p. 34).

(8) Set up the Strategic Technology Capacity Initiative, to be used to undertake multiple tasks, such as matching funds for forming and locating industry R&D consortia in Kentucky, and funds to help "jump-start" emerging and new industries, including clusters. The primary function of this fund is to focus the state's recruiting on attracting R&D anchors and filling gaps in supplier chains (p. 36).

(9) Increase state investments in dedicated higher education trust funds that advance Kentucky's scientific and technological competitiveness, and distribute them in a way that offers universities sufficient flexibility to respond quickly to unanticipated, cutting-edge opportunities (p. 37).

(10) Pay premium compensation to all P-12 teachers of mathematics and science and related resource teachers who hold, at a minimum, a degree in mathematics or a science discipline. By 2005, all middle and secondary teachers of mathematics and science should hold such degrees, and all primary schools should hire or have direct, local access to resource people with degrees in mathematics or a science discipline. This strategy implies that in-depth teacher qualifications are the precursor for students learning key concepts in depth—in this case, in math and science (p. 39).

3. That there be created within the Economic Development Cabinet a separate organizational unit devoted to assisting small high-tech and information technology related businesses in Kentucky. This unit should include a "business outreach" component that would actively seek out Kentucky's high-tech and information technology related businesses to identify their needs and problems and either provide assistance to promising businesses or direct them to resources where they can receive assistance.

4. That KRS 154.24-010 to 154.24-150, relating to the Kentucky Jobs Development Act, be amended to exempt an information technology business from having to meet the "25 or more" job creation criteria, or to create a separate governmental incentive program for information technology businesses that have fewer than 25 employees.

5. That the Kentucky Long-Term Policy Research Center conduct ongoing research on information technology careers in Kentucky and report in writing to the Council on Postsecondary Education, the Governor, the Chief Information Officer of the executive branch of state government, and the Legislative Research Commission regarding: (a) information concerning IT careers that are available in Kentucky; (b) salary structures in those careers; (c) information to assist secondary and postsecondary schools in providing training and degree programs appropriate to IT industry needs; (d) data on the number of graduates from IT degree programs and where they go after graduating, especially the numbers leaving the state for IT positions in other states; and (e) any other data that would assist state government, education, and business in making decisions that would develop and sustain Kentucky's efforts to move into the new knowledge-driven economy.

6. That a Kentucky Information Technology Roundtable be established in the Office of the Chief Information Officer of the executive branch of state government, consisting of at least 20 members representing leading large and small businesses in the state; high-tech businesses, especially small entrepreneur businesses; and the state's secondary schools, community and vocational colleges, and universities. The Roundtable would serve as a forum for: (a) discussion of IT issues and needs within Kentucky's business community; (b) development of partnerships (e.g., student internships for academic credit) between the business and education communities that would not only provide business with the skilled IT workforce it needs, but would also provide students opportunities for securing high-wage technology jobs and help to keep our "brightest and best" in Kentucky; (c) creation of a statewide network of IT businesses, especially the small entrepreneur businesses, that would provide an opportunity for sharing of information, interacting, partnering, and assisting each other; and (d) the formulation of any recommendations it may have to propose to state government. The Roundtable would

meet only 2-3 times per year on targeted topics of broad interest and would report annually to the Governor and the Legislative Research Commission concerning its activities, findings, and recommendations.

7. That state government promote an advanced communications infrastructure in the state that would provide affordable high-speed Internet access to all regions of the state. High-speed connections are critical to businesses and households if they are to be able to take full advantage of all that the Internet offers. Without the high-speed link, Kentucky businesses are at a competitive disadvantage. In addition, they are restricted from obtaining high-speed access on their own due to the high cost and limited service options. Moreover, private citizens will miss out on developing high-speed home uses, such as telemedicine, distance learning, and telecommuting. Rural and small-town Kentucky are especially vulnerable, since the phone companies and cable companies build high-speed access first where the high volume and the money are—in cities and larger towns. The Kentucky Information Highway has offered government and education high-speed connection to the Internet, but there has been slower progress and limited service options in the private sector. It will be necessary to reform telecommunications regulations, policies, and taxes that have been developed with voice telephone carriers in mind, even though the majority of network traffic is rapidly moving from voice to data.

RECRUITING & RETAINING IT WORKERS IN STATE GOVERNMENT

8. That a separate pay scale be established for IT positions in state government, in order to recruit and retain good IT employees and to be competitive with the private sector.

9. That state government provide IT training for:

a. Current state employees who are not working in IT positions to learn skills that would enable them to move into IT positions; and

b. Current state employees who are already in IT positions to obtain continuing education to enable them to move up to a higher level IT position.

10. That information technology internships in state government be provided for college credit.

ELECTRONIC GOVERNMENT

11. That state agencies, where appropriate, be required (a) to provide Internet-enabled electronic government services as new systems are updated and renovated; and (b) to

provide mandates and incentives that would stimulate the use of electronic transactions between state government and the state's businesses and citizens. State government must provide convenient, easy-to-use electronic access to its services and its vast store of public information. Citizens and businesses who want to transact business with state government electronically should be able to do so. Using the Internet, they should expect to conduct such business with their state government as renewing licenses, filing taxes, researching corporations, submitting plans for review, purchasing and viewing vital records, viewing and downloading vital records, such as mortgages and deeds, and searching a centralized lien database. In order to maximize the benefits of electronic government, the Commonwealth may have to mandate that businesses conduct business transactions or submit payments electronically, and it may need to provide incentives for both businesses and citizens to conduct business electronically with the state.

HELPING KENTUCKIANS ACCESS THE TECHNOLOGY

12. That the state, in order to stimulate citizens' ownership of home computers, grant a one-time individual tax credit for the purchase of a home computer. Lack of access to technology is a significant barrier to Kentuckians' participation in the new knowledge-driven economy. Kentucky has a significant number of households without access to a personal computer or the Internet. According to both national and state surveys, the two factors having the most effect on technology use are education and age, followed by income and location.

13. That state government partner with such local resources as school districts and local governments to promote awareness of how information technology can make their lives easier and to train citizens to use the technology, especially the Internet. Using local, familiar trainers and teachers can make it easier for the uncertain citizen to learn to use the new technology. Government will need to provide both the resources and financial assistance for citizen IT awareness and training activities.

SPAMMING
(unsolicited commercial e-mail)

14. That the General Assembly enact legislation to restrict unsolicited commercial e-mail (junk, or "spam" electronic mail) by use of a market-based solution that would place control and responsibility in the hands of Internet service providers and establish penalties for firms that violate the rules. Unsolicited commercial e-mail means any commercial electronic mail that is: (a) addressed to a recipient with whom the initiator of the mail does not have an existing business or personal relationship, and (b) not sent at the request of, or with the express consent of, the recipient. Examples include chain letters, pyramid and other "get-rich-quick" schemes, ads for pornographic sites, and illegally pirated software. This type of e-mail is

not only a nuisance but is also costly in time and money and squanders such expensive resources as network bandwidth and computer storage.

GENERAL ASSEMBLY

15. That the General Assembly establish within its structure a forum (e.g., a committee, subcommittee) on information technology that, (1) consists of legislators from both chambers, and (2) would be available on a continuing basis to:

Acquire and maintain a continuous knowledge of information technology issues and developments that affect, or have the potential to affect, both public and private sectors in the Commonwealth;

Use this knowledge to assist the General Assembly—its members, committees, subcommittees, and task forces—in understanding information technology issues and developments;

Provide ongoing interaction between the General Assembly and the Chief Information Officer of the executive branch, in order to communicate information and to foster a shared commitment to the future;

Review the use and management of information technology in the executive branch of state government; and

Recommend legislation regarding the use and management of technology.

GENERAL ASSEMBLY
COMMONWEALTH OF KENTUCKY

1998 REGULAR SESSION

HOUSE CONCURRENT RESOLUTION NO. 113

TUESDAY, MARCH 17, 1998

The following concurrent resolution was reported to the Senate from the House and ordered to be printed.

A CONCURRENT RESOLUTION to create a Task Force on Information Technology.

WHEREAS, information technology is permitting governments, business, and commerce to migrate increasingly toward a paperless society in which information is created, stored, and communicated electronically;

WHEREAS, the appropriate use of information technology is essential to the effective and efficient operation of government, providing necessary services to the public and enhancing citizen access to government; and

WHEREAS, vigilance is required to ensure the security, quality, and integrity of governmental information; and

WHEREAS, the privacy of the citizens of the Commonwealth should not be sacrificed by the use of information technology; and

WHEREAS, it is imperative that the General Assembly keep abreast of the development of information technologies and their impact on both citizen and private enterprise constituents; and

WHEREAS, the General Assembly must not only keep abreast of development of information technologies, it must also assume a leadership role in enacting legislation which will ensure that information technologies are utilized in ways that promote and protect the public interest;

NOW, THEREFORE,

Be it resolved by the House of Representatives of the General Assembly of the Commonwealth of Kentucky, the Senate concurring therein:

Section 1. There is hereby established a Task Force on Information Technology as a subcommittee of the Legislative Research Commission to review current and emerging information technologies that impact both the public and private sectors, review associated issues and application of the technologies, keep the General Assembly informed regarding the technologies and their impact, and make recommendations to the General Assembly

for needed legislation.

Section 2. The membership shall consist of the following:

(1) One (1) member of the House of Representatives appointed by the Speaker of the House;

(2) One (1) member of the Senate appointed by the President of the Senate;

(3) The Chief Information Officer of the Commonwealth;

(4) One (1) representative of the judicial branch appointed by the Chief Justice;

(5) One (1) representative of the Department of Financial Institutions appointed by the Commissioner of the Department of Financial Institutions;

(6) One (1) representative of the Finance and Administration Cabinet appointed by the Secretary of Finance and Administration;

(7) One (1) representative of the Health Services Cabinet appointed by the Secretary of Health Services;

(8) One (1) representative of the Department of Education appointed by the Commissioner of Education;

(9) The Lieutenant Governor or his designee;

(10) The Secretary of State or his designee;

(11) The Attorney General or his designee;

(12) The Treasurer or his designee;

(13) The Commissioner of Agriculture or his designee;

(14) The Auditor of Public Accounts or his designee;

(15) The Director of the Long-Term Policy Research Center or his designee;

(16) One (1) representative of the American Bankers' Association appointed by the Legislative Research Commission;

(17) One (1) representative of the Kentucky Hospital Association appointed by the Legislative Research Commission;

(18) One (1) representative of the Kentucky Bar Association appointed by the

Legislative Research Commission;

(19) One (1) representative of the Kentucky Chamber of Commerce appointed by the Legislative Research Commission.

Section 3. The member of the Senate and the member of the House of Representatives shall serve as co-chairs. Members of the Task Force who are not otherwise public officials shall receive reimbursement for their actual and necessary expenses.

Section 4. The duties and responsibilities of the Task Force shall include but not be limited to:

(1) Examining current and emerging information technology, including electronic data and information processing, telecommunications, software and hardware technology, and the application of those technologies;

(2) Researching the potential impact of information technology on public policy and commerce and determining areas that may need legislative attention;

(3) Serving as a forum for private sector entities to present their concerns, perspectives, and suggestions for possible legislation to address their needs;

(4) Reviewing legal aspects and issues relating to information technologies and their application;

(5) Studying information security issues and requirements as they relate to electronic commerce and on-line state and local government;

(6) Assisting the General Assembly in determining whether it is in the public interest to regulate specific areas of information technology;

(7) Studying means to minimize the incidence of computer-related crimes;

(8) Evaluating current and emerging technologies to ensure the privacy of the citizens of the Commonwealth; and

(9) Conducting any other studies or evaluations the task force considers pertinent or necessary to effectuate its purpose.

Section 5. No later than August 1, 1999, the Task Force on Information Technology shall report its findings and recommendations, including proposals for legislation, to the Legislative Research Commission for review by the Interim Joint Committee on State Government.

Section 6. Staff services shall be provided by the staff of the Legislative Research Commission and are estimated to cost $30,000. These staff services shall be provided from the regular Commission budget and are subject to the limitations and other research responsibilities of the Commission.

Potential Issues for Consideration by the Task Force on Information Technology

Note: Questions listed under each sub-heading are meant to serve as examples; they are not meant to constrain the issue.

Issues Specific to the Operation of State Government

Personnel

____(1) IT worker recruitment—Is the state able to recruit and retain IT workers in order to meet current and future needs for specific skills?

____(2) Telecommuting—Is telecommuting becoming a viable option for some Kentucky State Government jobs? What are the benefits and costs of this particular work arrangement?

Data and information

____(3) Internal distribution of data—What options are available to minimize internal barriers to the exchange of data across departments in order to facilitate efficient and effective policy formulation? These barriers may be a combination of technological and administrative.

____(4) External distribution—In what ways should the Internet be used in order to more effectively serve and inform the public. Is the use of a centralized web administrator more efficient than having numerous websites distributed across departments?

____(5) Security and confidentiality of data—Does the state maintain sensitive data in a manner that ensures confidentiality? What are the criteria for assessing the sensitivity of data?

____(6) E-mail under open records law—Should e-mail be treated as a public document or a private phone conversation?

____(7) Data retention and archiving—As communication increasingly moves from hardcopy to digital form, are appropriate measures being taken to preserve, for the public record, items that may be of historical significance in the future?

____(8) Expert systems—In what ways can the state benefit from expert systems technology? The field of expert systems is formulated on the belief that human expertise on a given subject can be broken into numerous discrete decision steps that can be written into programs. Examples range from disease diagnosis to business location recommendations.

Procurement of technology

____(9) IT standards—Are existing IT standards sufficient to minimize inefficiencies of incompatible systems? These inefficiencies include added costs of transferring data across systems, costs of training staff across multiple systems, and costs of purchasing dead-end technologies.

____(10) Timely procurement—Can the procurement process be expedited in order to improve the ability to quickly take advantage of emerging technologies?

____(11) Vendor selection—Does the procurement process give the appropriate level of opportunity to in-state vendors?

Other

____(12) Millenium bug (Y2K)—Where does the state stand in addressing the Y2K problem? What potential litigation may result from disruption of services?

____(13) Revenue—Does the state face a potential loss of future revenue as a greater share of commerce is conducted over the Internet? What options are available to counteract any loss?

APPENDIX B

Potential Issues for Consideration by the Task Force on Information Technology
(cont.)

Other Issues Not Specific to State Government Operations

Public protection

____(14) Criminal Code—Is criminal code up-to-date in addressing the public's exposure to misuse of new technologies? (e.g. hacking/vandalizing webpages, destruction of data by employees or outsiders, theft of personal data). How does one place a value on the destruction of mission critical information?

____(15) Law Enforcement—Are law enforcement hardware and personnel keeping up with technological advances? Can the state be more effective in deterring illegal on-line activity?

____(16) Security and confidentiality of communications—Is there a role for the state in nurturing the development of standards that enhance secure and confidential communications on the Internet? It is said that Internet commerce will not thrive until these standards become ubiquitous.

Economic development

____(17) Local information infrastructure—What alternatives are available for state government to assist communities in the development of local area information infrastructure?

____(18) Assisting existing businesses—Is there a role for the state in assisting existing businesses in their transition to Internet commerce?

____(19) Attracting new industry—In what ways might new businesses formed around Internet commerce be attracted to Kentucky? Might our central location to national markets and our local access to an international shipment hub make a good match for Internet startups seeking access to global markets?

Social equity

____(20) Internet service provider mix/distribution—Will the Internet service provider market develop in a manner that serves all of Kentucky? Will the phone, cable, and electric companies participate to a degree that provides sufficient competition? Does the state have a role in shaping the development of these markets?

____(21) Public computer access—As access to a computer becomes more necessity rather than luxury, what can the state do to provide computer access for those without the personal resources to own a computer?

____(22) Computer literacy—What options exist to improve the computer literacy of those not yet exposed to computers? The elderly and poor are particularly vulnerable.

PRESENTATION FOR
TASK FORCE ON INFORMATION TECHNOLOGY

BY

CAROL M. PALMORE, SECRETARY
PERSONNEL CABINET

OCTOBER 28, 1998

APPENDIX C

Information Systems Group (7300)

Title Code	Class Title	SER	Pay Grade
7301	Production Technician I		6
7302	Production Technician II		8
7303	Production Specialist		9
7304	Production Specialist Senior		10
7305	Production Specialist Principal		11
7306	Production Specialist Chief		12
7307	Production Coordinator		13
7310	Systems Support Technician		9
7311	Systems Support Technician Senior		10
7312	Systems Support Technician Principal		11
7313	Systems Support Technician Chief		12
7314	Systems Support Coordinator		13
7320	Resource Management Analyst		11
7321	Resource Management Analyst Senior		12
7322	Resource Management Analyst Chief		13
7330	Data Base Analyst		15
7331	Data Base Analyst Senior		16
7332	Systems Programmer		15
7333	Systems Programmer Senior		16
7334	Systems Consultant		15
7335	Systems Consultant Senior		16
7336	Systems Engineer		15
7337	Systems Engineer Senior		16
7340	Information Systems Supervisor		15
7341	Information Systems Manager		16
7360	Programmer/Analyst		10
7361	Programmer/Analyst Senior		12
7363	Programmer/Analyst Chief		13
7364	Systems Analyst		10
7365	Systems Analyst Senior		12
7367	Systems Analyst Chief		13
7380	Network Technician		8
7381	Network Technician Senior		10
7382	Network Technician Principal		11
7384	Network Technician Chief		12
7385	Network Analyst		10
7386	Network Analyst Senior		12
7387	Network Analyst Principal		13

Information System Group (Code7300)

Title Code	Class Title	SER	Pay Grade
7388	Network Analyst Chief		14
7389	Network Engineer		15
7390	Network Engineer Senior		16

HARD TO FILL INFORMATION TECHNOLOGY CLASSES

Data Base Analyst
Data Base Analyst Senior
Systems Programmer
Systems Programmer Senior
Systems Consultant
Systems Consultant Senior
Systems Engineer
Systems Engineer Senior
Information Systems Manager
Program/Analyst
Programmer/Analyst Senior
Programmer/Analyst Chief
System Analyst
System Analyst Senior
System Analyst Chief
Network Technician
Network Technician Senior
Network Technician Principal
Network Technician Chief
Network Analyst
Network Analyst Senior
Network Analyst Principal
Network Analyst Chief
Network Engineer
Network Engineer Senior

IT Salary Survey of 25 hard to fill classes

Class Title	Grade	Minimum	Midpoint	Maximum
Data Base Analyst	15	$ 29,280	$ 42,792	$ 56,304
Data Base Analyst Senior	16	$ 32,280	$ 47,184	$ 62,088
Systems Programmer	15	$ 29,280	$ 42,792	$ 56,304
Systems Programmer Senior	16	$ 32,280	$ 47,184	$ 62,088
Systems Consultant	15	$ 29,280	$ 42,792	$ 56,304
Systems Consultant Senior	16	$ 32,280	$ 47,184	$ 62,088
Systems Engineer	15	$ 29,280	$ 42,792	$ 56,304
Systems Engineer Senior	16	$ 32,280	$ 47,184	$ 62,088
Information Systems Supervisor	15	$ 29,280	$ 42,792	$ 56,304
Information Systems Manager	16	$ 32,280	$ 47,184	$ 62,088
Programmer Analyst	10	$ 17,964	$ 26,256	$ 34,548
Programmer Analyst Senior	12	$ 21,840	$ 31,920	$ 42,000
Programmer Analyst Chief	13	$ 24,084	$ 35,196	$ 46,308
Systems Analyst	10	$ 17,964	$ 26,256	$ 34,548
Systems Analyst Senior	12	$ 21,840	$ 31,920	$ 42,000
Systems Analyst Chief	13	$ 24,084	$ 35,196	$ 46,308
Network Technician Senior	10	$ 17,964	$ 26,256	$ 34,548
Network Technician Principal	11	$ 19,812	$ 28,956	$ 38,100
Network Technician Chief	12	$ 21,840	$ 31,920	$ 42,000
Network Analyst Senior	12	$ 21,840	$ 31,920	$ 42,000
Network Analyst Principal	13	$ 24,084	$ 35,196	$ 46,308
Network Analyst Chief	14	$ 26,544	$ 38,796	$ 51,048
Network Engineer	15	$ 29,280	$ 42,792	$ 56,304
Network Engineer Senior	16	$ 32,280	$ 47,184	$ 62,088

POSITION		FILLED	VACANCIES	APPLICANTS
8203	Data Base Analyst	6	1	32
8204	Data Base Analyst Senior	13	2	35
6182	Systems Programmer	5	0	19
6183	Systems Programmer Senior	14	1	15
6184	Systems Consultant	44	6	72
6354	Systems Consultant Senior	52	9	59
6185	Systems Engineer	34	6	37
6355	Systems Engineer Senior	71	3	31
6187	Information Systems Manager	30	4	85
8259	Program/Analyst	13	5	68
8260	Programmer/Analyst Senior	27	4	30
8262	Programmer/Analyst Chief	18	8	13
8263	System Analyst	4	0	55
8264	System Analyst Senior	13	3	42
8266	System Analyst Chief	23	2	41
8267	Network Technician	4	0	29
8268	Network Technician Senior	10	5	30
8269	Network Technician Principal	14	2	22
8270	Network Technician Chief	4	0	6
8271	Network Analyst	3	0	20
8272	Network Analyst Senior	19	6	56
8273	Network Analyst Principal	32	3	41
8274	Network Analyst Chief	40	13	63
8275	Network Engineer	9	0	10
8276	Network Engineer Senior	8	1	9
TOTALS		**510**	**84**	**920**

INFORMATION TECHNOLOGY SURVEY SUMMARY

Class Title	Pay Grade	Kentucky Minimum	Survey Minimum	Kentucky Midpoint	Survey Midpoint	Kentucky Maximum	Survey Maximum	Kentucky Average	Survey Average
Data Base Analyst (7330)	15	$29,280	$31,832	$42,792	$41,215	$56,304	$50,790	$45,242	$40,053
Data Base Analyst Senior (7331)	16	$32,280	$35,779	$47,184	$45,634	$62,088	$56,745	$50,489	$47,048
Systems Programmer (7332)	15	$29,280	$30,145	$42,792	$38,994	$56,304	$47,814	$46,254	$37,233
Systems Programmer Senior (7333)	16	$32,280	$34,297	$47,184	$44,433	$62,088	$54,524	$59,311	$45,070
Systems Consultant (7334)	15	$29,280	$33,538	$42,792	$43,442	$56,304	$54,222	$44,464	$42,957
Systems Consultant Senior (7335)	16	$32,280	$37,183	$47,184	$49,132	$62,088	$60,848	$53,013	$49,897
Systems Engineer (7336)	15	$29,280	$35,020	$42,792	$44,464	$56,304	$56,242	$45,330	$41,757
Systems Engineer Senior (7337)	16	$32,280	$41,139	$47,184	$52,775	$62,088	$65,604	$50,493	$58,204
Information Systems Supervisor (7340)	15	$29,280	$38,659	$42,792	$50,714	$56,304	$61,821	$47,022	$52,116
Information Systems Manager (7341)	16	$32,280	$41,865	$47,184	$54,914	$62,088	$68,043	$54,723	$58,849
Programmer Analyst (7360)	10	$17,964	$23,720	$26,256	$30,471	$34,588	$37,103	$21,415	$26,910
Programmer Analyst Senior (7361)	12	$21,840	$27,910	$31,920	$36,403	$42,000	$44,756	$29,121	$34,078
Programmer Analyst Chief (7363)	13	$24,084	$33,181	$35,196	$43,074	$46,308	$52,767	$38,526	$43,746
Systems Analyst (7364)	10	$17,964	$27,883	$26,256	$35,888	$34,588	$43,963	$30,748	$34,094
Systems Analyst Senior (7365)	12	$21,840	$31,038	$31,920	$40,388	$42,000	$49,267	$32,651	$40,039
Systems Analyst Chief (7367)	13	$24,084	$35,882	$35,196	$46,899	$46,308	$56,825	$39,084	$48,417
Network Technician Senior (7381)	10	$17,964	$22,499	$26,256	$28,926	$34,588	$35,519	$23,919	$26,261
Network Technician Principal (7382)	11	$19,812	$25,859	$28,956	$33,179	$38,100	$40,704	$27,912	$31,783
Network Technician Chief (7384)	12	$21,840	$28,525	$31,920	$36,403	$42,000	$47,637	$41,997	$36,933
Network Analyst Senior (7385)	12	$21,840	$27,858	$31,920	$36,210	$42,000	$44,507	$31,337	$34,304
Network Analyst Principal (7387)	13	$24,084	$31,766	$35,196	$41,935	$46,308	$51,086	$35,295	$40,790
Network Analyst Chief (7388)	14	$26,544	$36,563	$38,796	$46,293	$51,048	$57,264	$39,349	$40,373
Network Engineer (7389)	15	$29,280	$36,964	$42,792	$48,395	$56,304	$60,165	$47,793	$48,672
Network Engineer Senior (7390)	16	$32,280	$43,573	$47,184	$55,587	$62,088	$68,301	$56,355	$60,431
This survey involved the thirteen southeastern states plus Indiana, Illinois, and Ohio.									

KENTUCKY'S SCIENCE AND TECHNOLOGY

STRATEGY

Strategies and Actions

Kentucky Science and
Technology Corporation

1999

For more information contact:

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PO Box 1049
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Phone: 606.233.3502 ext 221
Fax: 606.259.0986
Email: kstc@kstc.org

Look for on-line discussions and updates on *Kentucky's Science and Technology Strategy* at www.kstc.org.

COMMONWEALTH OF KENTUCKY
OFFICE OF THE GOVERNOR

PAUL E. PATTON
GOVERNOR

700 CAPITOL AVENUE
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FAX (502) 564-2517

June 17, 1999

Dear Reader:

Nearly a year ago in response to changing global economic conditions I called for the creation of a statewide blueprint to aggressively advance Kentucky's science, technology and engineering capacity. The recently completed *Kentucky Science and Technology Strategy* is the result of extensive research, analysis and discussions among a broad spectrum of leaders, from both the public and private sectors.

The *Strategy* offers a well thought-out series of bold actions that invigorate the innovation and entrepreneurial process in Kentucky. It supports the creation of new knowledge, technologies and companies through research and places Kentucky in a more competitive position for winning federal and private R&D funding. It will catalyze the transfer of that new knowledge through public-private partnerships between universities and industry. It will aggressively support the start-up and expansion of new value-added companies in growth sectors important to Kentucky's future competitiveness. The *Strategy* further develops the infrastructure required for a knowledge-based workforce necessary for Kentucky to compete nationally and globally in the next century.

I am calling for broad dissemination and discussion of this *Strategy*, especially as universities, state agencies and other organizations begin their planning for the 2000-2002 biennium and beyond.

Let me thank Kentucky Science and Technology Corporation in cooperation with the Kentucky EPSCoR Committee for their willingness to lead this effort and also the many key stakeholders who were instrumental in creating Kentucky's first-ever *Science and Technology Strategy*.

I am offering my strong support of *Kentucky's Science and Technology Strategy* as a key element in preparing the Commonwealth for the new millennium and urge other partners to help lead the way to make this plan a reality.

Sincerely,

Paul E. Patton

EDUCATION PAYS

AN EQUAL OPPORTUNITY EMPLOYER M/F/D

Table of Contents

Key Partner Acronyms

CPE: Kentucky Council on Postsecondary Education
KDE: Kentucky Department of Education
KEDC: Kentucky Economic Development Cabinet
KY EPSCoR: Kentucky Experimental Program to Stimulate Competitive Research
KRS: Kentucky Retirement Systems
KSTC: Kentucky Science and Technology Corporation
KTRS: Kentucky Teachers' Retirement System
KTS: Kentucky Technology Service, Inc.

Preface

Governor Paul Patton, at the urging of University of Kentucky President Charles Wethington and University of Louisville President John Shumaker, asked the Kentucky Science and Technology Corporation (KSTC) to develop this science and technology strategy — a blueprint for future decisions and strategic investments by the Commonwealth. KSTC carried out this directive in collaboration with, and with funding from, the Governor, the Kentucky Chamber of Commerce, the Council on Postsecondary Education, Kentucky EPSCoR (Experimental Program to Stimulate Competitive Research), the National Science Foundation, LG&E Energy Corporation, the Tennessee Valley Authority and the U.S. National Institute of Standards and Technology.

Part of the impetus for developing this strategy was the preferred position such a statewide vision would promote for securing future research and development investments from many sources. The strategy's success will be measured, in part, by its ability to help guide education, business and government in coordinated efforts to achieve a stronger, entrepreneurial economy and quality of community life. This strategy builds on preliminary work by various groups including Kentucky's universities, the Kentucky Cabinet for Economic Development, Kentucky EPSCoR and KSTC. The involvement of Kentucky businesses also was critical in its development. Nearly 100 people from across all sectors participated on a steering committee that met three times in the development of this strategy.

Through a nationwide request for proposals, KSTC selected an outstanding team to assist in producing a far-reaching vision for Kentucky science and technology. This team gave KSTC access to some of the best thinking and practical experience in technology-based economic development policies, programs and practices in the U.S. and internationally. The consulting team was led by Battelle Memorial Institute of Columbus, Ohio, one of the world's largest nonprofit research and development organizations. In addition, the team included Regional Technology Strategies, Inc., a Chapel Hill, North Carolina-based nonprofit organization that has worked internationally and in rural communities and states on issues of workforce and technology. The third partner in this effort was the Southern Technology Council, an affiliate of the Southern Growth Policies Board, which has undertaken major benchmarking studies of innovative technology programs and policies across the South and nation.

Key aspects of the study included holding focus group meetings with businesses to obtain their input and views on developing and using technology to make their firms and industries more competitive. Focus group meetings also were held with publicly supported groups and organizations including higher education institutions to obtain their views on needs, priorities and resources. Input from 85 people was obtained through this qualitative research.

Other tasks undertaken by the consulting team included: (1) conducting an industry analysis of Kentucky's economy, future directions and key technologies; (2) a public technology assets analysis to assess what is already being done and what more needs to be done to ensure an industry-driven, priority-setting process for public investments in technology; and (3) a strategic assessment of the state's strengths, weaknesses, threats and opportunities in pursuing a knowledge-driven economy in the future.

The process resulted in the ten recommendations contained in this report in four strategic areas: enterprise development, manufacturing modernization, technological infrastructure and people.

Executive Summary

The New Forces (page 10)

Change...knowledge...innovation...and speed. These are the primary forces that drive and shape today's world. Consequently any science and technology strategy, if it is to be successful, must not only respond to these forces but embrace and actually promote them.

The Entrepreneurial Economy (page 13)

The interplay of these new forces coupled with other economic changes (e.g., globalization) are leading to the emergence of the entrepreneurial age where entrepreneurship, defined as *the unconstrained pursuit of new ideas resulting in an innovative creation,* is the key integrating element for economic growth and development. Kentucky needs more firms — innovative, growth-oriented enterprises founded on the ideas, creativity and know-how of Kentuckians, companies with real roots in the Commonwealth and the communities in which they reside.

This *Strategy* involves a broad range of factors central to building such an economy, including:

- Schools that infuse innovation throughout the learning enterprise, stress science and mathematics, help create an environment that views entrepreneurship as a viable employment option and an alternative to simply "getting a job";
- Universities that promote the development of new knowledge, ideas, products and firms;
- A range of capital resources required to support new ideas and start up and growing enterprises;
- Public policies that encourage rather than discourage entrepreneurship, innovation, risk-taking and business expansion;
- The scientific and technological capacity to support the start up and growth of innovative companies;
- Communities with dynamic local and regional support systems; and
- A culture that supports and rewards high-speed innovation and entrepreneurship.

Kentucky's Current Situation (page 16)

Research on Kentucky has shown a state struggling under the demands of the global technological economy. It demonstrates a region, despite real progress in recent years, burdened by relatively low-wage industries and jobs and lacking dynamic growth sectors, a state that has yet to create sufficient knowledge, technological and capital assets required for real and sustained economic development in the knowledge economy.

Kentucky has several underlying weaknesses that, if not addressed quickly, will create significant problems for the state's economy over the long term. These include:

- An inadequately prepared knowledge workforce;
- An insufficiently developed entrepreneurial culture and capital base;
- A failure to maximize its intellectual capital resources in concert with industry; and
- A manufacturing base not taking full advantage of technology for competitiveness.

Independent analyses undertaken in the development of this *Strategy* concluded that:

- There needs to be closer ties and relationships between emerging industries in the state and research and development emphases being considered by the state's public universities;
- To build a stronger entrepreneurial environment, Kentucky will require increased partnerships, more innovation at all levels, a greater focus on growth from "within" and appropriate state-supported organizations and efforts;
- The state's system for delivering assistance to small and medium-size manufacturing firms suffers from a multiplicity of service groups and organizations;
- Manufacturing modernization assistance can help build a critical mass of new industries for the state if this assistance is broadened to product development as well as process improvement;
- Technology incubators and related programs in Kentucky are in short supply; and
- There exists no clear strategic focus on science and technology within state government.

In short, the Commonwealth's current situation suggests that a science and technology strategy for Kentucky must focus on these key elements: enterprise development, manufacturing modernization, technological infrastructure and people.

Kentucky's Future Potential (page 19)

Based on a preliminary analysis and broad-based discussions, Kentucky appears to have the potential to build world class knowledge and companies in several areas including (in alphabetical order):

- Electronic Commerce (including printers, printing, logistics and software);
- Energy and Materials Science;
- Life Sciences (including medical sciences, pharmaceuticals, agricultural biotechnology);
- Logistics and Distribution (including software and engineering services);
- Nutrition and Food Technologies; and
- Vehicle Parts and Components (including plastics, metals, parts, components, materials and devices).

Goal (page 21)

Kentucky's Science and Technology Strategy is driven by a single goal:

To create an innovation-driven entrepreneurial economy that makes Kentucky a leader in the development of knowledge and its applications to people, firms and products.

Conditions for Success (page 22)

- A critical mass of knowledge and technology firms;
- Increased federal and industry R&D funds;
- An indigenous risk capital industry in Kentucky;
- Expanded university support and leadership role; and
- Joint ventures.

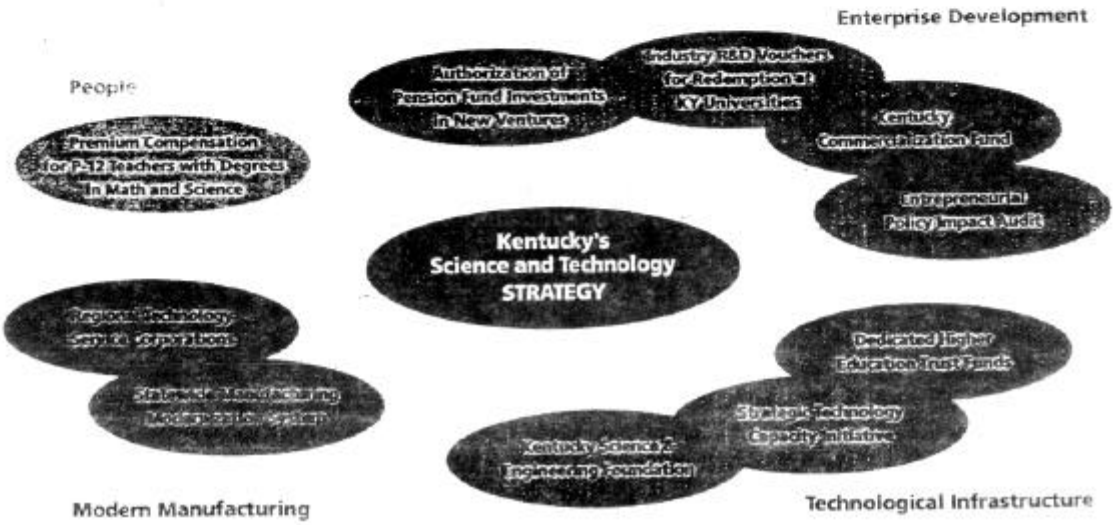
Strategies (page 23)

Four key strategies drive *Kentucky's Science and Technology Strategy* toward achieving its goal.

1. **Enterprise Development:** Create and grow innovation-driven Kentucky enterprises through aggressive support for risk capital and commercialization of research.
2. **Manufacturing Modernization:** Modernize existing manufacturers in Kentucky.
3. **Technological Infrastructure:** Build the technological infrastructure (i.e., Kentucky know-how) that is essential to ensuring a competitive Kentucky economy.
4. **People:** Ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy.

Ten Strategic Actions (page 24)

Ten actions are recommended in four areas of enterprise development, manufacturing modernization, technological infrastructure and people.



■ 1

Strategy	Recommendation
Enterprise Development	Pension Fund Investments (page 25)

Strategic Action

Authorize a limited portion of state pension funds for investing in business ventures.

Lead Partners

Kentucky Retirement Systems (KRS) and Kentucky Teachers' Retirement System (KTRS)

Investment

Authorization of up to 2% of Pension Boards' assets (i.e., up to $432 million for investments).

Timeframe

Propose to 2000 Regular Session of General Assembly.

■ 2

Strategy	Recommendation
Enterprise Development	R&D Vouchers (page 27)

Strategic Action

Create Research and Development (R&D) Vouchers for small and medium-size firms.

Lead Partner

Kentucky Science and Technology Corporation (KSTC)

Investment

$1 million annually, increasing with experience/demand.

Timeframe

Propose to 2000 Regular Session of General Assembly.

■ 3

Strategy	Recommendation
Enterprise Development	Commercialization Fund (page 29)

Strategic Action

Establish the Kentucky Commercialization Fund.

Lead Partners

Council on Postsecondary Education (CPE)/KSTC

Investment

$750,000 (first year)

Timeframe

Propose to 2000 Regular Session of General Assembly.

■ 4

Strategy	Recommendation
Enterprise Development	Entrepreneurial Policy Audit (page 30)

Strategic Action

Conduct a review of Kentucky policies and regulations to identify barriers, constraints, etc. that may impede the commercialization of knowledge or technology and the start up and growth of innovative Kentucky companies.

Lead Partner

Kentucky Science and Technology Corporation (KSTC)

Investment

$250,000 (nonrecurring)

Timeframe

Immediate

■ 5

Strategy	Recommendation
Manufacturing Modernization	Statewide Manufacturing Modernization System (page 31)

Strategic Action

Establish a statewide manufacturing modernization "system".

Lead Partners

Kentucky Technology Service, Inc. (KTS) and Kentucky Economic Development Cabinet (KEDC)

Investment

$1 million annually

Timeframe

Propose to 2000 Regular Session of General Assembly.

■ 6

Strategy	Recommendation
Manufacturing Modernization	Regional Technology Service Corporations (page 33)

Strategic Action

Establish Regional Technology Service Corporations.

Lead Partner

Council on Postsecondary Education (CPE)

Investment

$500,000 per year, increasing to $1-2,000,000 annually depending on industry demand.

Timeframe

Establish within the next 2-4 years. Propose to 2000 Regular Session of General Assembly.

■ 7

Strategy	Recommendation
Technological Infrastructure	Kentucky Science & Engineering Foundation (page 34)

Strategic Action

Create the Kentucky Science and Engineering Foundation.

Lead Partner

Kentucky EPSCoR

Investment

$5 million annually, rising to $10 million per year by 2006.

Timeframe

Propose to 2000 Regular Session of General Assembly.

■ 8

Strategy	Recommendation
Technological Infrastructure	Strategic Technology Capacity Initiative (page 36)

Strategic Action

Set up the Strategic Technology Capacity Initiative.

Lead Partner

Kentucky Economic Development Cabinet (KEDC)

Investment

$2 million annually, increasing with experience/demand.

Timeframe

Establish within the next 2-4 years. Propose to 2000 Regular Session of General Assembly.

■ 9

Strategy	Recommendation
Technological Infrastructure	Dedicated Trust Funds (page 37)

Strategic Action

Increase state investments in targeted higher education trust funds that advance Kentucky's scientific and technological competitiveness.

Lead Partner

Council on Postsecondary Education (CPE)

Investment

Approximately $3 million (Each biennium add no less than 10 percent new Research trust funds, with an additional 3 percent held in reserve to respond quickly to unanticipated, cutting-edge research opportunities).

Timeframe

Propose to 2000 Regular Session of General Assembly and each subsequent biennial session.

■ 10

Strategy	Recommendation
People	Premium Compensation for Math and Science Teachers (page 39)

Strategic Action

Pay premium compensation to all P-12 teachers of mathematics and science and related resource teachers who hold, at a minimum, a degree in math or a science discipline.

Lead Partner

Kentucky Department of Education (KDE)

Investment

$35 million (estimate)

Timeframe

a. By 2005, all middle and high school teachers of mathematics and science will hold a degree in their respective field.
b. By 2002, all elementary schools will have school-based access to qualified resource people who hold degrees in mathematics and/or science disciplines.
c. By 2002, premium compensation packages will be in place for qualified teachers listed in a. and b. above.

Implementation (page 41)

Bottom Line Annual Investments and Lead Partners

Recommended Action	Lead Partners	Current Funds	New Investments
Pension Fund Investment Authorization	KRS/KTRS	*	*
R&D Vouchers	KSTC		$ 1,000,000
Commercialization Fund	CPE/KSTC		$ 750,000
Entrepreneurial Policy Audit	KSTC	$ 125,000**	$ 125,000**
Manufacturing Modernization System	KTS/KEDC	$ 350,000	$ 650,000
Technology Service Corporations	CPE		$ 500,000
KY Science & Engineering Foundation	KY EPSCoR	$2,500,000	$ 2,500,000
Strategic Technology Capacity Initiative	KEDC		$ 2,000,000
Dedicated Trust Funds	CPE		$ 3,000,000
TOTALS		**$ 2,975,000**	**$ 10,525,000**
Premium Compensation for M/S Teachers	KDE		$ 35,000,000 (estimate)
Supplemental Actions/Cluster Analysis	KSTC		$ 150,000**

* Current Kentucky pension funds total $21.6 billion so authorization of up to 2 percent could make available $432 million for investments in new, value-added business ventures.
** Nonrecurring

Strategic Execution: The implementation of *Kentucky's Science and Technology Strategy* is too vital and complex an undertaking to be the responsibility of a single entity. The introduction of a lattice or web-type approach builds a mechanism to support the multiple systems that must take on implementation in order to achieve overall success. Rather than create a new "command and control" structure to oversee *Kentucky's Science and Technology Strategy*, the ten actions are presented as interdependent functions of existing systems to ensure a systemic approach and maximum innovation.

Ultimate Accountability: To integrate these Actions, it is suggested that the Governor appoint the Secretary of the Cabinet with the ultimate accountability to catalyze and champion the implementation of this *Strategy*.

Overall Monitoring: Monitoring will be supported by a website to share and link to vital information among participating systems and other interested parties. The site will become an ongoing site for conversations about new ideas emanating from *Kentucky's Science and Technology Strategy* Actions and the evolution of new actions, accompanied by periodic reporting to the Governor's Office.

Supplemental Analyses (page 44)

Further in-depth analyses are recommended including a comprehensive cluster analysis and a study of supplier chains to these clusters and to each other so that the state's recruitment efforts can help support filling gaps in supplier chains. A further review and detailed survey of the financial needs of technology-driven Kentucky firms is needed to determine what changes, if any, are needed in state business finance vehicles especially for emerging industries and clusters.

Prediction is very hard, especially when it is about the future.

Yogi Berra

Introduction

Investing in Kentucky Technology and Know-How

Change...knowledge...innovation...speed. These are the primary forces that drive and shape today's world. Consequently any science and technology strategy, if it is to be successful, must not only respond to these forces but embrace and promote them.

First, note that this is a *strategy* not a plan — an important difference. A strategy is organic, fluid and continually changing...it provides a *road map* for future actions and investments. Yet it is a map of a place that routinely changes...constantly opening new paths while rerouting or closing others. This strategic "map" will require regular updating to be most effective and likely will need to be redrawn in three years to take advantage of unforeseeable opportunities.

The science and technology strategies and actions contained in this report build upon what Kentucky has accomplished in the past but also breaks new ground with innovative approaches, concepts and ideas. This is a strategy not just for state government, but for the private sector as well. Both sectors must invest in this strategy if it is to be successfully executed.

Kentucky's strategy must also be responsive in order to drive change and help people and places manage change rather than be managed or controlled by it. The new economy gives individuals greater responsibility and opportunities to chart their future and their destiny, but creates little support if these choices are not responsive to markets. And this is where the strategies laid out in this report can be of assistance — helping people acquire and maintain skills; helping firms compete in global markets; helping the state and its citizens take advantage of the intellectual capital of our education institutions in support of state and regional economies.

The strategy confronts and seizes upon the opportunities presented by change. A world characterized by instability and chaos, while presenting incredible challenges, also provides a basis for dynamic progress. As the pace of change accelerates, it unleashes in its path forces that can lead to innovation and uncover new opportunities that can be exploited for progress.

The force of this process can lead to rapid advances perhaps unimaginable in more stable, slow-moving times. For example, one recent report noted that the software industry for personal computers grew from virtual nonexistence in 1980 to over 7,800 companies in 1997, with nearly $30 billion in revenues.

For regions like Kentucky with unrealized potential, this situation, if properly managed, offers exciting possibilities. But these opportunities can be realized only if Kentucky moves quickly and boldly to develop an innovation-driven economy capable of creating the ideas, products, high-paying jobs and enterprises necessary for success in the new millennium. In a world increasingly running on *Internet-time*, timid and piecemeal actions will not work.

The New Forces

Change

Change

Change is constant and unrelenting. It also has become the predominant force influencing every aspect of our lives. David Birch, noted economist, argues that 50 percent of firms in business today will be gone and the other 50 percent will be much different in what they do five years from now. Experts argue that today's high school graduate will likely go through 11 career changes before he or she retires, compared to the one or two career changes of the past. Only about 16 of the 100 largest companies around in 1900 are still in business at the close of the century. The life-span of products is becoming shorter and shorter, as demonstrated by the evolution of the personal computer in just the past decade. Many jobs on which Kentuckians now depend will be dramatically altered or gone completely in the years ahead. In short, jobs will change, careers will change, firms will change. Consequently, Kentucky must embrace a culture of change. It must become innovative and entrepreneurial if it is to be a catalyst and facilitator that enables people, firms and communities to adjust to and manage such relentless change.

Knowledge

Innovation

The effects of change are felt not only in the speed and breadth at which things happen but also in our understanding of how they happen and how to best respond.

Speed

In the not so distant past, we believed in a fairly structured world — a place where change was more predictable, i.e., a linear world of cause and effect. Quantum and chaos theories have dispelled this notion with a profound effect on how we view the world and solve problems. This new worldview blurred the concept of an orderly, predictable, mechanistic world. The quantum revolution has provided the basis for important scientific and technological advancements.

It is also changing the way we view economic change, business and development. George Gilder, writing in *Microcosm*, explains that quantum theory often is difficult to grasp because "...the prevailing common sense is wrong. Common sense serves the materialistic superstition: the belief that we live in a world of solid phenomena mechanically interconnected in chains of cause and effect." Stan Davis and Christopher Meyer, writing in their book, *Blur: The Speed of Change in the Connected Economy*, note that, "Since the economy and your business are part of the universe, time, space and mass are the fundamental dimensions of them as well."

Understanding the impact of these nonlinear, unpredictable processes is prerequisite to crafting and executing an effective science and technology strategy.

Knowledge

In the future there will be two kinds of economies: smart and dead. Today ideas and knowledge are the primary tools of production. The real assets of most successful organizations are its knowledge resources and its people, rather than equipment, buildings or other physical things. John Kao, author and former Harvard Business School professor, concludes that, "In today's new economy... the minds of gifted people are what truly distinguishes one organization from another..." Knowledge is creating the dynamic companies and jobs that Kentucky must grow if it is going to develop a competitive economy.

To fully grasp the importance of knowledge to the *bottom line*, one only need observe the market capitalization value of many Internet companies and other innovative firms. These companies are being valued not on physical things but on ideas and people. Kao explains that the company Dreamworks was originally valued at about $2.7 billion. "Not bad for a start up with rented offices, leases on the copying machines, and little if anything in the way of traditional tangible assets," he states.

It was reported that, in a study by BankBoston of the economic (knowledge) impact of the Massachusetts Institute of Technology (MIT), as of 1994 MIT graduates had founded about 4,000 companies employing over 1.1 million people and generating $232 billion in world sales!

Consequently, the creation and management of knowledge is of paramount importance in developing a successful company, university or economy. This is no small task for it involves not only education and training but also the quality of and the speed at which knowledge is created and transferred. It has been noted that human knowledge is now doubling every ten years. *Kentucky's Science and Technology Strategy* begins and ends with promoting an investment in people and knowledge.

CHANGE

KNOWLEDGE

INNOVATION

SPEED

Innovation

If it's not broke...fix it anyway has become the mantra of business. In today's economy, a company's only real competitive advantage is to innovate relentlessly and continually. Michio Kaku, noted physicist writing in the book *Visions*, states that, "In the past decade, more scientific knowledge has been created than in all human history." This knowledge is driving high-speed progress and innovation in virtually every area of human endeavor.

One reason why small companies have been so successful, with many big companies trying to emulate them, is that they can innovate cheaper and faster. And when we speak of innovation, we are not talking of the occasional product or process improvement or having an office of innovation. We are talking about innovation that is infused through every aspect of the organization — where innovation is a way of life.

When dealing with innovation one can't escape the critical role technology plays in this process. Today scientific and technological innovations are creating new products, processes and entire new industries. To effectively compete in this increasingly technological world, firms must have ready access to: workers who are highly skilled, scientifically and mathematically literate; cutting-edge R&D; capital; and an entrepreneurial economic environment.

No state, including the Commonwealth of Kentucky, can afford to ignore technology — except at its own peril. Technological innovation drives traditional industries — from automobiles to metalworking — in how they make and what they make — from materials to robots, sensors, computers, etc. Technological innovation drives new product development from medical devices and instruments to computer hardware and software and the means by which goods and services are distributed. In short, technology is pervasive. Even more so than a decade ago, the Commonwealth must embrace, adopt, encourage and facilitate technological innovation in the classroom, in government and in industry.

The management and promotion of innovation have significant implications for Kentucky. Carl Sagan and Anne Druyan, writing on the biology of evolution and change, explain that in rapidly changing times such as ours, advantageous transformations happen relatively rarely so that accelerating the pace of change (innovation) in very active times may be useful. Conclusion: Kentucky needs to devise dynamic strategies that catalyze and promote innovation.

Speed

Speed has become as important as price in defining competitive advantage. According to James Champy in the book *Reengineering Management*, Sony Corporation produces four new products every day. The life of an American industrial product, once measured in decades and then in years, is now often measured in months. This is the competitive environment in which companies, organizations and Kentucky find themselves. Speed is essential.

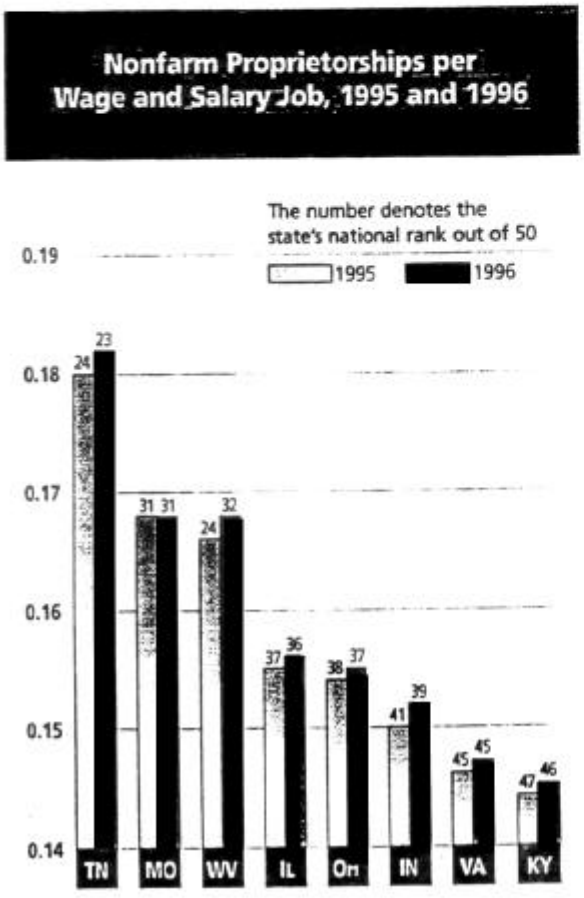
The speed at which technology is changing is fueling this race to introduce new products into the marketplace. Michio Kaku notes that, "Computer power is doubling every eighteen months...The Internet is doubling every year...In fact if we go back eighty years, computer power has increased by a factor of one trillion."

In this high-speed world, any successful science and technology strategy must build a sense of urgency into every process and action. Being first "to market" is often the difference between success and failure. To delay or be hesitant in today's high-speed world is to invite failure.

The Entrepreneurial Economy

The interplay of these new forces coupled with other economic changes (e.g., globalization) are leading to the emergence of the entrepreneurial age where entrepreneurship, defined by KSTC as *the unconstrained pursuit of new ideas resulting in an innovative creation*, is the key integrating element for economic growth and development.

Figure 1. Nonfarm Proprietorships



Source: U.S. Department of Commerce

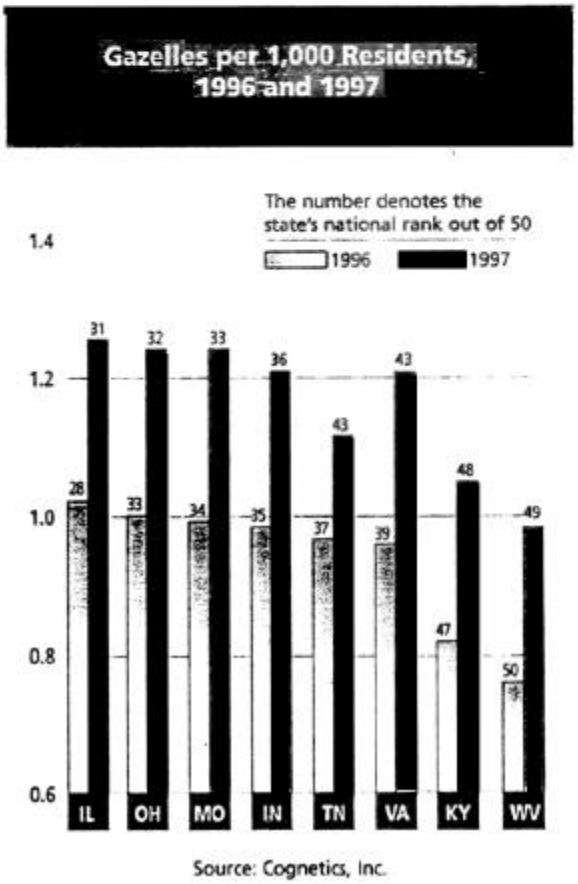
Kentucky needs more firms — innovative, growth-oriented enterprises founded on the ideas, creativity and know-how of Kentuckians — companies with real roots in the Commonwealth and the communities in which they reside. Figure 1 shows U.S. Department of Commerce data on how Kentucky compares to selected peer states in willingness of residents to be self-employed, one measure of entrepreneurship.

We need homegrown firms that can generate the opportunities, wealth and good jobs that the state must have if it is to successfully build a modern competitive economy. In today's highly competitive marketplace, the birth of new firms and the development of an entrepreneurial economy are essential elements in creating and sustaining economic growth.

Creating an entrepreneurial economy is critical for Kentucky for multiple reasons. First, in today's economy, long-term development is a process and occurs primarily from "within." Second, small entrepreneurial firms are a critical source of growth and good paying jobs. Recent data indicate that between the mid-1980s and mid-1990s, the U.S. economy created about 20 million new jobs — almost all of them from small to medium-size companies.

Small enterprises are often laboratories for innovation and new thinking — important factors in building a strong economy. In addition, small innovative firms are incubators for new entrepreneurs and frequently attract other similar enterprises, leading to the formation of economic "growth clusters." States and regions want to encourage a "churning" process of new births, some of which become the giants of tomorrow, referred to as gazelles. Data from Cognetics, Inc. in Figure 2 show Kentucky's gazelle ranking compared to peer states.

Figure 2. Gazelles per 1,000 Residents



Source: Cognetics, Inc.

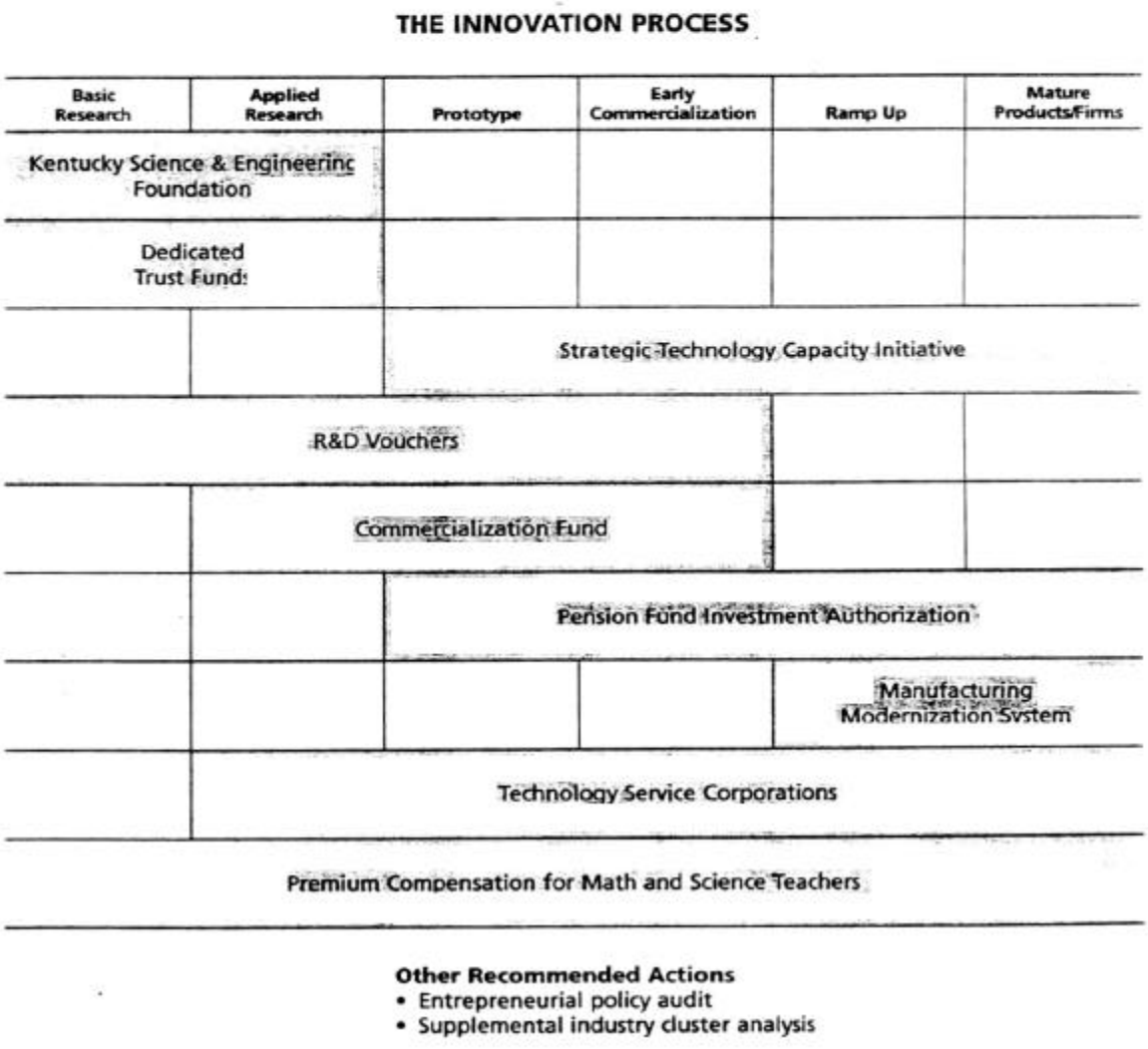
Building an entrepreneurial economy in Kentucky rests not on one or two factors, but with a constellation of interrelated factors central to building such an economy, including:

- Schools that infuse innovation throughout the learning enterprise, stress science and mathematics, help create an environment that views entrepreneurship as a viable employment option and an alternative to simply "getting a job";
- Universities that promote the development of new knowledge, ideas, products and firms;
- A range of capital resources required to support new ideas and start up and growing enterprises;
- Public policies that encourage rather than discourage entrepreneurship, innovation and business expansion;
- The scientific and technological capacity to support the start up and growth of innovative companies;
- Communities with dynamic local and regional support systems; and
- A culture that supports and rewards high-speed innovation and entrepreneurship.

The innovation process helps set the context for the actions recommended in this *Strategy*. Below is a diagram of the innovation process and recommended actions related to each step of the process.

The recommendations contained in this report are designed to fill gaps in the marketplace, enabling Kentucky technology and know-how to be commercialized and the state to build a stronger entrepreneurial culture.

Diagram 1. Recommended actions to fill gaps in Kentucky's innovation process.



Kentucky's Current Situation

Research completed in the development of this *Strategy* has shown Kentucky as a state struggling under the demands of the global technological economy. It demonstrates a region, despite real progress in recent years, burdened by relatively low-wage industries and jobs and lacking dynamic growth sectors, a state that has yet to create sufficient knowledge, technological and capital assets required for real and sustained economic development.

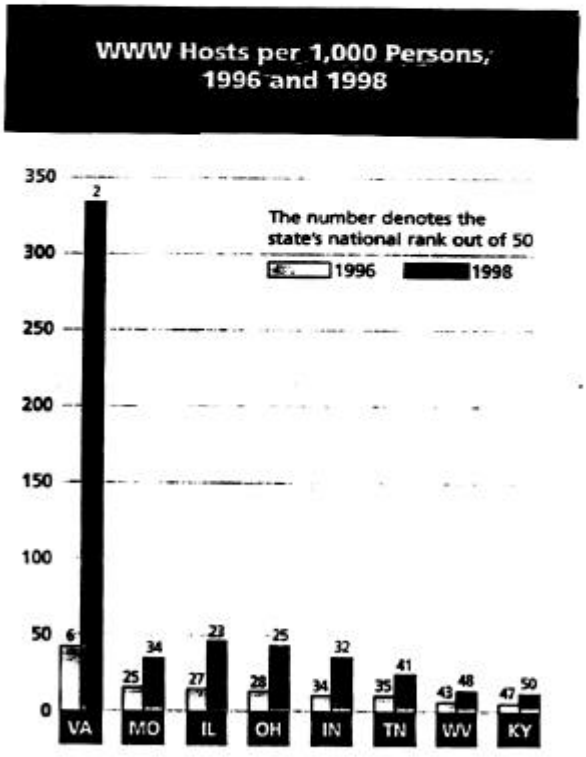
Kentucky's economy is in transition from an economy based on tobacco, mining and traditional manufacturing to one driven by technological innovation and knowledge. Assembly-line manufacturing using the latest production technologies has done well in Kentucky, as recognized in its world-renown quality products from vehicles to printers to refrigerators. In the past 30 years, Kentucky has built a solid manufacturing base with a growing proportion of this base working in higher wage positions, generally in metropolitan areas. But in nonmetropolitan areas there still exists a disproportionate number of lower paying, manufacturing jobs.

Not enough of the product development, design (i.e., knowledge work) and distribution aspects of these anchor-manufacturing operations are done in Kentucky. A good example of this is the continued out-migration of engineers from the state's engineering schools to other states because of insufficient opportunities in the Commonwealth. R&D investments by Kentucky industries lag behind industries in other states. In fact, Kentucky investments are only 19 percent of what industries invest in R&D nationwide. Kentucky's industries employ high tech workers at just over 49 percent of the U.S. rate. In short, Kentucky's manufacturing base remains in the lower tier at the lower end of the high technology sector.

One way to benchmark Kentucky's industry and workforce is to see to what extent they are using the Internet. Figure 3 shows comparative data from Matrix Information and Directory Services on worldwide web hosts per 1,000 persons.

There are some positive signs, however. In 1995-96, Kentucky ranked 8th in growth in export sales; 22nd in change in average hourly wages; 16th in long-term employment growth; 12th in short-term employment growth; 12th in average annual pay growth; and 12th in sector diversity. So in the most recent time period, in a time of flush national economy, the Commonwealth has exhibited some strong short-term results. The influx of manufacturing in recent years has diversified Kentucky's economy, reduced dependency on such industries as tobacco, distilled spirits and mining.

Figure 3. WWW Hosts Per 1,000 Persons

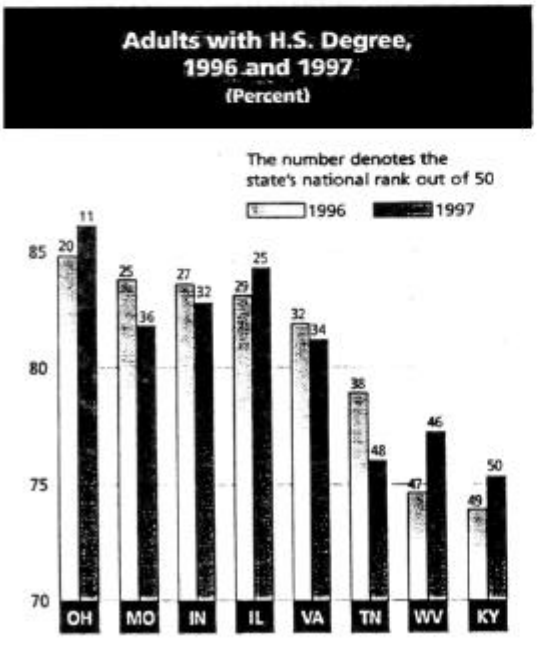


Source: Matrix Information and Directory Services

Yet compared to other states and regions, Kentucky has several underlying weaknesses that, if not addressed quickly, will likely lead to real problems for the well-being of the state's economy over the long term. These include:

An inadequately prepared knowledge workforce. Kentucky has not taken full advantage of the intellectual capital of its universities and industry. Its workforce skills lag the nation. Most telling, it is still in the bottom ten states in personal income per capita (42nd); percent of adults with less than a high school education (50th) (Figure 4) and percent of adults with four years of college (46th); and industry R&D (40th). A particularly significant problem facing Kentucky is that its year 2008 workforce is mostly in place and a large percentage of it is unskilled. Half of Kentucky's population lacks knowledge and skills to participate in the knowledge economy. This will make it difficult for Kentucky to grow and compete for new generation businesses that rely on ideas and technologies.

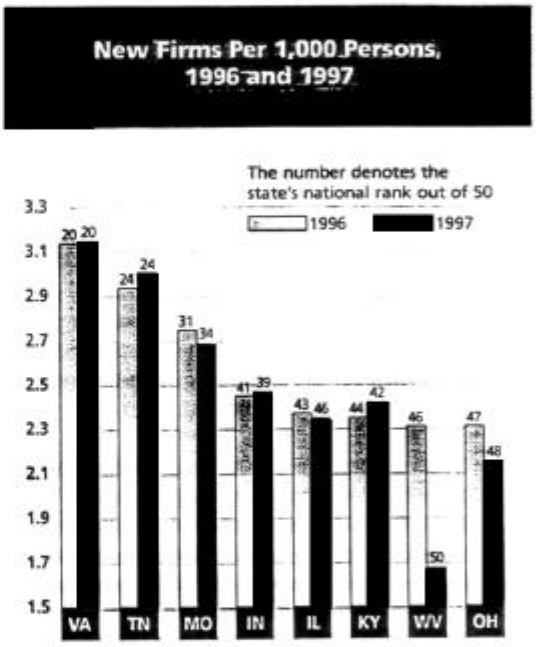
Figure 4. Adults with H.S. Degree



Source: U.S. Department of Commerce

An insufficiently developed entrepreneurial culture and capital base. Kentucky has a relatively weak entrepreneurial culture and ranks within the bottom tier of states in equity capital available (40th); ranks 42nd in new firm creation (Figure 5); and 43rd in incubators per million population.

Figure 5. New Firms Per 1,000 Persons



Source: Small Business Administration

A failure to maximize its intellectual capital resources in concert with industry. Kentucky is not maximizing its brainpower in ways that translate into regional and state economic development. It ranks 49th in patents per million; 50th in web hosts per 1,000; 50th in federal R&D funds per capita (Figure 6); 44th in science and engineering graduate students; 48th in academic; 40th in industry R&D; and 47th in percent of Ph.D. scientists and engineers in the workforce.

A manufacturing base not taking full advantage of technology for competitiveness. Industry R&D significantly lags the nation; engineers are less likely to be employed in the manufacturing base of many small and medium enterprises in Kentucky than in many competitor states.

Independent analyses on Kentucky's current situation, including private and public sector focus groups, undertaken in the development of this *Strategy* concluded that:

- There needs to be closer ties and relationships between emerging industries in the state and research and development emphases being considered by the state's public universities. Recent legislation and additional state funding support make it even more critical that the state's limited resources support and, in turn, be supported by emerging strengths and developments in the state's economic base.
- To build a stronger entrepreneurial environment in Kentucky, will require increased partnerships between communities, regions, schools and higher education institutions serving them, more innovation at all levels, a greater focus on growth from "within" and appropriate state-supported organizations and efforts.
- The state's system of delivering modernization services to small and medium-size manufacturing firms suffers from a multiplicity of groups and organizations, each designed to individually assist manufacturers but without benefit of any real interaction, specialization or linked services.
- Manufacturing modernization assistance can help build a critical mass of new industries for the state, if this assistance is broadened to product development as well as process improvement.
- Technology incubators and related programs in Kentucky are in short supply. Alternatives need to be developed to capture more of the universities' graduates wishing to start innovation-driven firms as well as others wishing to become entrepreneurs.
- There exists no clear organizational focus within state government on science and technology understanding or appreciation for the role science and technology could play as part of the state's overall development efforts.

In short, an analysis of Kentucky's current situation suggests that a science and technology strategy for Kentucky must focus on these four key elements: enterprise development, manufacturing modernization, technological infrastructure and people.

Kentucky's Future Potential

Historically, Kentucky, like most states, has responded to opportunities presented to it by the private sector to locate, expand, etc. The resulting economic base of the state, driven by these private sector decisions, has shown major improvement. In fact, it is largely through recent efforts of the Kentucky Cabinet for Economic Development that Kentucky has been among the most successful states in industrial recruitment. At the same time, the state remains farther back on the value-chain of good jobs and high performance firms.

Part of the problem lies in the fact that too many of our communities' vision of the future may be colored more by the 1960s than that of the new century. This has to change. It is time to telescope into the future rather than looking into a rearview mirror. One way to look forward is to look at Kentucky's comparative advantages — determining what Kentucky is, or could be, good at and, in concert with market forces, build a forward-looking economic base driven by knowledge, innovation and technology. As part of this effort, preliminary research was undertaken to identify growth-oriented industries, technologies, etc. that Kentucky has currently or in which it has the potential to achieve a competitive advantage. These areas (listed below) are all innovation-driven industries that currently exhibit growth potential. Please note that in each of these areas, the focus is on the high-end, value-added part of the industry. Remember though that rapid changes and developments could alter the economic landscape thereby requiring a quick rethinking of any given strategy.

Based on a preliminary analysis, Kentucky appears to have the potential to build world-class enterprises and to grow in several areas including (in alphabetical order):

- Electronic Commerce (including printers, printing, logistics and software);
- Energy and Materials Science;
- Life Sciences (including medical sciences, pharmaceuticals, agricultural biotechnology);
- Logistics and Distribution (including software and engineering services);
- Nutrition and Food Technologies; and
- Vehicle Parts and Components (including plastics, metals, parts, components, materials and devices).

Emerging Technologies

Also of central importance to this list is emerging technologies. As evidenced by the earlier comments on the explosive growth of the software industry, new opportunities can emerge at any point in time. Consequently, building mechanisms that anticipate and exploit emerging technologies and opportunities are a key factor in the ultimate success of this *Strategy*. Tracking such changes should be a priority for the state's colleges and universities. Execution tactics for the strategies in this plan will include investment provisions that allow for taking advantage of new opportunities. With new knowledge and technology creating so much fast-paced change, this *Strategy*, at its core, must be highly flexible. This argues for a decentralized and market-driven implementation process.

Effective science and technology-based economic development strategies are based on an incisive understanding of the state's economy and are grounded in private sector sensibilities. Good jobs, higher incomes and wealth in communities are ultimately a result of private sector competitiveness. Consistent competitiveness and long-run profitability implies knowledge, skill, determination, savvy, aggressiveness, resiliency and luck. For this reason, a fundamental tenet of this *Strategy* is that, first and foremost, it must make sense within Kentucky's private sector.

Methodology

The objective of looking at Kentucky's growth potential is to offer a view of the state's economy that, when analyzed in concert with public technology assets, serves as a basis for strategic assessment of Kentucky's competitive position in the science, technology and innovation-based economic development marketplace. This independent analysis was conducted in three parts.

The first step used data and findings from existing published analyses to construct an overview of the state's economic base and then to scan the economy for above average industrial concentrations that indicate potential for regional competitive advantage — especially higher value-added competitive advantage. After specifying the relationship between higher incomes and good jobs and higher value-added commerce, this step focused on gauging Kentucky's current capacity to create and use technology throughout its economy to generate better jobs and higher incomes for its citizens and more wealth for its communities.

The second step of this analysis presented perspectives and findings from seven focus groups of private sector firms and public agencies and institutions conducted in three different parts of the state. Each of these groups explored current and future competitiveness needs and opportunities for the participating firms, the role of government and higher education in servicing these needs and technology-based development issues and opportunities within the group's regional economy.

The final step built on the industry analysis and the focus group findings to offer general observations on technology-based development needs and opportunities as well as options within the state's private sector. This list was then offered for review to key players during executive briefings and was refined only slightly based on these discussions.

Goal and Objectives

Kentucky's Science and Technology Strategy is driven by a single goal:

To create an innovation-driven entrepreneurial economy that makes Kentucky an international leader in the development of knowledge and its applications to people, firms and products.

Achieving this goal ensures that Kentucky can produce:

- Highly knowledgeable and skilled employees;
- Globally-competitive firms and industries;
- Technologically-sophisticated processes and products used in and developed by its industries;
- Competitive production systems; and
- A dynamic and diverse mix of entrepreneurial firms.

Rather than making goods at the low end of the value chain — which is where many of Kentucky's basic industries fall — it will consciously move its economy toward key clusters and industries of the future, those on the cutting-edge of global markets and competition. This transition will not be easy nor will it occur overnight. It will take perseverance and a willingness to stick to core values over an extended timeframe. But make no mistake — Kentucky is a developed state in the most highly developed country in the world. Our advantage will be gained by competing at the high end of the value chain.

Kentucky's Science and Technology Strategy has dual objectives: to maintain and improve the competitive position of basic industries and to give nourishment and support for new, emerging companies and industries to develop and grow.

Conditions for Success

Conditions for Success

- A critical mass of technology firms
- Increased federal and industry R&D funds
- An indigenous risk capital industry in Kentucky
- Expanded university support and leadership role
- Joint ventures

Like other states and regions of the U.S. and elsewhere, there are five key conditions that must be emphasized for successful implementation of this strategy.

Technology Firms

Kentucky is not there yet, but focusing on emerging clusters, supplier chains and enterprise development provides a basis for creating these strengths over the long term. Recruitment efforts should complement this by attracting firms that help fill gaps in supplier chains, attract R&D anchors to the state and, where possible, add to the value-added nature of the economy.

Federal and Industry R&D Funds

Kentucky needs to obtain a greater share of federal R&D funds and secure R&D anchors in the state. Discretionary federal dollars will help build strength and capacity in the state.

Indigenous Risk Capital

Kentucky needs to establish a stronger "local" risk capital industry addressing capital gaps from pre-seed to seed to later stages of funding.

University Support and Leadership Role

Successful states and regions harness their higher education institutions as partners in the commercialization of R&D and in support of technology deployment.

Joint Ventures

Collaboration among firms and with academe and government needs to be increased and encouraged with various incentive mechanisms such as R&D vouchers and university-business matching investments.

Strategies

Based on an analysis of the strengths and weaknesses of Kentucky's economy and the opportunities and threats a global economy driven by knowledge and technology represents for Kentucky, four key strategies drive *Kentucky's Science and Technology Strategy*. These include:

1 Enterprise Development:
Create and grow innovation-driven Kentucky enterprises through aggressive support for risk capital and commercialization of research.

2 Manufacturing Modernization:
Modernize existing manufacturers in Kentucky.

3 Technological Infrastructure:
Build the technological infrastructure (i.e., Kentucky know-how) that is essential to ensuring a competitive Kentucky economy.

4 People:
Ensure that Kentucky education systems prepare highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy.

These four strategies — enterprise development, manufacturing modernization, technological infrastructure and people — represent the key goals of *Kentucky's Science and Technology Strategy*. These, for the most part, are man-made, that is, what Kentuckians make of themselves not what natural resources they can extract from the earth. Each requires state government, education and business investments and collaboration, yet decentralized commitment to act for the benefit of all Kentucky. Many of the actions to implement these strategies require increased, or refocused, activities by the state's higher education institutions.

Actions to implement these strategies were designed and should be implemented in accordance with the following principles:

- Actions should be part of a broader, accepted strategy;
- Each action must be designed realistically for implementation;
- Each action should be guided by a private-public partnership;
- Industry must play a role and private resources should be linked and leveraged;
- Existing resources should be redeployed before seeking new resources;
- Actions should be considered components of an investment portfolio with expected return on investment (ROI);
- There must be bipartisan ownership and involvement; and
- Decentralized groups close to the source of responsibility should be used for strategic execution of actions.

Strategic Actions

Upon beginning the design of this *Strategy*, it was decided that a long list of recommendations covering every conceivable problem would not be particularly useful. Instead, the goal was to develop a concise package of achievable actions that, taken together, could result in the first steps toward real transformational change in Kentucky. In other words, where would Kentucky "get the most bang for the buck"? This approach was taken out of a realization that time is running out and, absent dramatic changes, Kentucky will find itself falling farther, and perhaps permanently, behind in the race to be globally competitive in the knowledge economy.

STRATEGY: ENTERPRISE DEVELOPMENT

Proposed Strategy:

Create and grow innovation-driven enterprises through aggressive support for risk capital and commercialization of research.

Kentucky's long-term economic future in large part depends on growing its own young, knowledge and technology firms. Its university graduates and research centers provide a base from which such entrepreneurs can emerge; as do new industry clusters where success breeds further success in creating a potential for several generations of entrepreneurs. Building an entrepreneurial economy takes time and, while it is more than money, it does require risk capital available locally and strong networks of service providers (private and public) working with entrepreneurs. Community-based business development resources are critical. In short, Kentucky needs more innovative, growth-oriented enterprises founded on the ideas and creativity of Kentuckians.

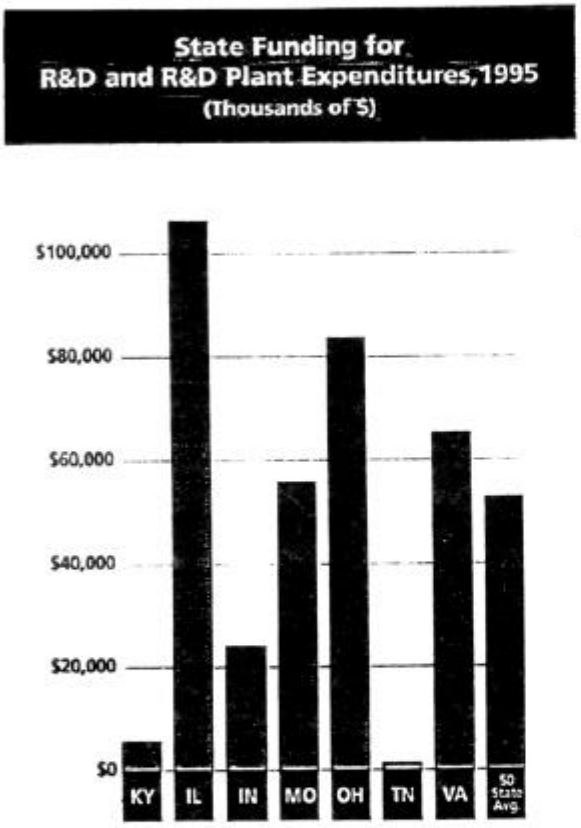
Kentucky's higher education institutions, like their counterparts around the U.S., have given increased attention in recent years to commercialization of their R&D. Kentucky's universities have increased resources for technology transfer, undertaken more creative approaches such as taking equity in firms, helped develop research parks/technology incubators and supported various intermediary organizations to provide business-planning assistance. Collaboration among industry, higher education and government, particularly at the state level, is likely to continue to increase. Yet, as shown in Figure 6 (page 25), Kentucky fares poorly among the 50 states in its financial support for business-university partnerships. States such as Virginia, Ohio, North Carolina and Georgia invest substantially more state dollars in programs to build relationships between industry and higher education.

In addition to providing risk capital, other actions focus on public-private partnerships, state investments for R&D projects between firms and faculty, increased funding and resources for the university technology transfer function and taking a reality check on the impact of existing laws and policies on Kentucky's entrepreneurial culture.

Enterprise Development Recommended Strategic Actions

- Pension Fund Investment Authorization
- R&D Vouchers
- Commercialization Fund
- Entrepreneurial Policy Audit

Figure 6. State Funding for R&D and R&D Plant Expenditures



Source: "Survey of State Research and Development Expenditures: FY 1995" SSTI, September 1998

Pension Fund Investments

Recommended Strategic Action

Authorize a limited portion of state pension funds for investments in business ventures.

Rationale: To build a stronger enterprise development system, Kentucky must find ways to interest the private sector in addressing gaps in equity capital markets — along all parts of the risk capital food chain. A majority of the 50 states now invest some portion of their assets in venture capital. Such investments have played a critically important role in expanding capital markets and fueling entrepreneurial growth while helping to adequately diversify pension fund investment portfolios.

States have had considerable success with their pension fund investments. In 1997, the North Carolina Retirement Systems reported an over 20 percent annualized rate of return for venture investments and a 5.88 percent return since inception. Ohio's Police and Fireman's Disability and Pension Fund reported a 1997 annualized rate of return for venture investments of over 30 percent in 1997 and 31.34 percent in the past five years. The Pennsylvania Public School Employees Retirement System reported an annualized rate of return for venture investments in FY 98 of 26.2 percent and a five-year annualized rate of return of 14.2 percent. In Pennsylvania's case, initially the two state pension funds did not want to invest any dollars in venture capital in the 1980s and were mandated to invest at least 1 percent of their assets by the Pennsylvania General Assembly. After several years of successful returns, the pension funds requested the Pennsylvania Legislature to increase this amount to 2 percent.

State pension funds usually do not invest large amounts of their assets in venture capital, only a few percentage points. To protect their retirees, most funds are required to meet a fiduciary standard of highest and best return. Many pension funds could have legitimately been charged by their beneficiaries for failing to invest funds in venture capital given its rates of return. Because state pension funds generally invest only small percentages of their total assets in venture investments, should venture investments do well, it will marginally improve a pension fund's overall performance; similarly, should it not do well, it will only marginally adversely affect overall return. But failure to invest at all should be of concern to beneficiaries.

Pension Investments

Lead Partners:
Kentucky Retirement Systems (KRS) and Kentucky Teachers' Retirement System (KTRS)

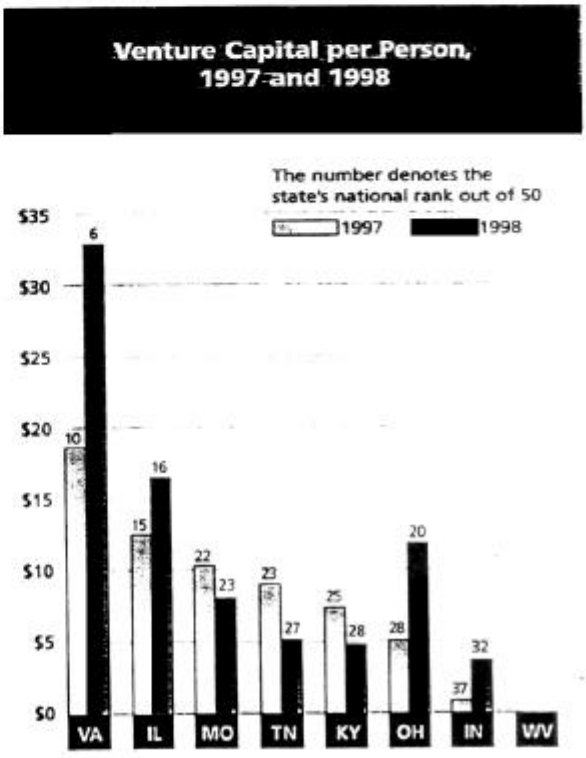
Investment:
Authorization of up to 2% of Pension Boards' assets (i.e., up to $432 million).

Timeframe:
Propose to 2000 Regular Session of the General Assembly.

There are several ground rules, based on history and experience, to avoid the few situations where state pension investments in venture capital have not done as well as the marketplace overall. First, these venture pension fund investments should be managed by third party professional venture capitalists, not state employees. Second, because the failures in venture investments occur earlier in a ten-year period and successes occur toward the end of this time period, investors should not panic when early results are not always positive. A few good deals will override the average and bad deals.

Third, it is important to recognize the additional benefits to a state's economy of using state pension funds for venture capital without in any way suggesting that pension funds themselves should undertake social engineering. Venture funds in which investments are made would be encouraged to open an office in Kentucky, with each private venture manager setting as a goal, not a requirement, that it attempt to invest in Kentucky firms. At those stages, where there are capital gaps, everything else being equal, venture investments can have positive returns for the beneficiaries of these funds while building a stronger entrepreneurial economy in the state. Figure 7 displays comparative data from PriceWaterhouse-Coopers on Kentucky's lagging position in financing for new ventures that could be addressed by adoption of this strategy.

Figure 7. Venture Capital per Person



Source: PriceWaterhouse-Coopers

Operations: States such as Pennsylvania are investing up to 2 percent of their pension fund assets in several privately managed venture funds. Current combined Kentucky pension funds from Kentucky Retirement Systems (KRS) and The Kentucky Teachers' Retirement System (KTRS) total approximately $21.6 billion. Without jeopardizing the integrity of these pension funds, authorization of up to 2 percent, or $432 million, could be made for investments in this particular asset class. The Kentucky Teachers' Retirement System currently has, with restrictions, the authority to invest in this particular asset class.

Like successful funds in other states, these funds should be managed by a private sector manager with no direct involvement by the state. In each case, the state should insist that a goal of each investment (not a requirement) is to take advantage of good deals in Kentucky and each fund in which the pension boards invest should be encouraged to locate an office in the Commonwealth.

The primary goal of the investments is for the retirement systems to earn appropriate rates of return in this particular asset class. And over time for the Boards and staff to become knowledgeable and comfortable with this asset class. The Boards and staff should look for good funds that have a clear strategy to take advantage of investment opportunities in Kentucky.

R&D Vouchers

Recommended Strategic Action

Create Research and Development (R&D) Vouchers for small and medium-size firms.

Rationale: R&D vouchers would be provided to Kentucky-based firms to undertake research and development work in partnership with a Kentucky higher education institution. This "market" approach to R&D is designed to build partnerships between industry and the state's universities and gives the authority to private sector firms to initiate such partnerships, rather than be driven by public sector organizations.

Kentucky's small and medium firms, where much innovation occurs, do not take full advantage of the resources found in the universities and research institutes in Kentucky. As both a demonstration and experiment to let the marketplace decide, Kentucky should undertake a three-year demonstration effort to provide *vouchers* for qualified small and medium-size firms to undertake R&D work in partnership with higher education institutions in the state. Each firm can *shop* its voucher among faculty and institutes at any college or university in the state. The maximum amount of a voucher would be capped (e.g., at $75,000 a year) and the total state investment would not exceed $1,000,000 in the first year. After three years, this demonstration would be evaluated to determine if it resulted in both increased linkages with higher education institutions and commercialization from the R&D.

Operations: A third party (e.g., a quasi-public organization or nonprofit group) would be designated to operate this program. A firm wishing to avail itself of a voucher would make application for certification of a maximum voucher amount to this designated third party. This application would not be made until such time as a partnership between a firm and a Kentucky higher education institution had reached an agreement on the scope of an R&D project. The certification process would require authorizing signatures of both the firm and the higher education institution.

In addition, the operating organization would, much like a private investment firm, undertake an analysis of the proposed investment to determine its merits and potential return on investment. This information would serve as a basis for the final investment decision.

A three-year demonstration project would be established. A direct appropriation of state funds would set a cap on total funding each year. The demonstration project should establish a maximum amount of state funds available for a project. It should be recognized that a minimum R&D project size now is probably $500-750,000 over three years. If a firm could receive a three-year term of voucher support of $75,000 per year, or $225,000, and be required to match this with three times that amount in private funds, then projects would likely be in this range, provided multi-year vouchers were permitted. An alternative is a maximum of a one-year voucher permitting more firms to participate and making it easier for smaller firms to qualify. If match is defined to include in-kind as well as cash, the larger amounts should not necessarily be a barrier to small-firm participation. The process might fund one year at a time up to three years based on progress made. All state funds would have to be used within the Kentucky higher education institution. Matching funds could be used by the firm on its premises.

R&D Vouchers

Lead Partner:
Kentucky Science and Technology Corporation (KSTC)

Investment:
$1M first year, rising to $2M by year 3

Timeframe:
Propose to 2000 Regular Session of the General Assembly.

The administering authority would certify vouchers up to the maximum funds available on a first come, first served basis. If eligibility requirements are met and a partnership has been established with a Kentucky higher education institution, the administering organization is duty bound to support a market place decision thereby enabling a firm to shop around for a partner that can best work with it to meet certain firm objectives.

The program would be open to any firm interested in partnering with a university to undertake any type of R&D from basic through application and prototype. Projects exclusively focused on marketing, market positioning, sales and/or bricks and mortar would be excluded. Manufacturing and technology firms would be eligible and value-added service firms, such as communications services serving export markets outside of Kentucky, also could be considered. A firm would have to have facilities within Kentucky and show evidence that the project would directly affect activities and operations within Kentucky.

Firms participating in this program must agree to report up to five years after completion of the voucher-supported R&D effort the results and impacts on commercialization within the firm, using measures established by the administering party. Two key objectives to be measured are commercialization and building of ongoing relationships and partners between firms and Kentucky's higher education institutions.

Commercialization Fund

Recommended Strategic Action

Establish the Kentucky Commercialization Fund.

Rationale: The Kentucky Commercialization Fund (KCF) would provide development funds for promising technologies coming out of the R&D work undertaken in the state's higher education institutions. This Fund would provide important *pre-seed* funding for promising technologies. This investment initiative is a key part of Kentucky's effort to focus on emerging technologies and opportunities that may not have an industry sponsor.

KCF would invest at the point where the private marketplace is unlikely to participate, thus filling a critical gap in the *risk-capital food chain*. The Fund ends its mission where private investors and lenders begin theirs.

Operations: Funds would be provided to enable each research university in the state to, on a case-by-case basis, financially support promising technologies coming out of university research that shows commercial potential but is not far enough along to determine its commercial value and use. This Fund would invest from a few thousand dollars to several hundred thousand dollars in technology platforms identified by each university's technology transfer office that do not yet have industry sponsorship. A review committee would be used by the respective university composed of respected technology transfer officers, venture capitalists and others who would review proposals for development funds to further *reduce to practice* the research.

KCF would make available matching funds earmarked for patent protection (e.g., comprehensive patent searches and, if appropriate, legal fees for the initial U.S. filing of a patent). An important step in qualifying for KCF support for patent protection should be peer review of disclosures and search results. Such a review process would be the basis for recommending whether patent protection would be appropriate. While patents guarantee exclusive rights to a given invention/idea, university policies should be supportive of technology transfer to the private sector for commercialization.

Commercialization Fund

Lead Partners:
Council on Postsecondary Education (CPE) and Kentucky Science and Technology Corporation (KSTC)

Investment:
$750,000 (first year)

Timeframe:
Propose to 2000 Regular Session of the General Assembly.

Funds would be used primarily within the university to continue applied research, undertake market assessment and commercialization potential and help move the research towards prototype. Outside consultants and advisors could be supported should the necessary expertise not be available within the university. Projects would vary in time from a few months to, probably at most, 24 months.

In addition, some portion of these funds would be used to increase university outreach to industry in Kentucky to make them aware of promising developments and the results of this *reduction to practice* effort to encourage more licensing to Kentucky firms. In some instances, a new Kentucky firm might be started around these technologies, and this funding also could be used to support the formation of such firms and get them organized.

Entrepreneurial Policy Audit

Recommended Strategic Action

Conduct a review of Kentucky policies and regulations to identify barriers, constraints, etc. that may impede the commercialization of knowledge or technology and the start up and growth of innovative Kentucky companies.

Rationale: The success of *Kentucky's Science and Technology Strategy* rests with a myriad of people and organizations dedicated to growing an entrepreneurial culture and the capacity of Kentucky's people. With such a diverse mix of players responsible for different aspects of this strategy, isolated policies and regulations will play key roles, positively or negatively, in the state's quest to develop knowledge, grow companies and create an entrepreneurial economy.

Public policies and practices must coalesce around this common goal, even though independent government organizations, institutions, boards and commissions may set the policies. In fact, government laws already abound that may have an impact on Kentucky's capacity for becoming a leader in the knowledge economy.

Entrepreneurial Policy Audit

Lead Partner:
Kentucky Science and Technology Corporation (KSTC)

Investment:
$250,000

Timeframe:
Immediate

Operations: A comprehensive review of state policies and regulations must be undertaken to quickly ascertain which ones directly support this goal and which ones inadvertently limit Kentucky's ability to grow aggressive, knowledge-based companies founded on Kentucky know-how. For example, this review should explore a range of practices that involve commercialization, incentives, etc. to determine where they might be improved in order to aid organizations, companies and the state to enhance their competitiveness.

Other considerations for entrepreneurial enterprise development will be included in the review. The review design will be developed in close coordination with a representative group. An experienced external party will be selected through a national request-for-proposals to help design and complete the review.

STRATEGY: MANUFACTURING MODERNIZATION

Proposed Strategy:

Modernize existing manufacturers in Kentucky.

Kentucky has a strong manufacturing base but not enough of it is concentrated in the high tech manufacturing end of the continuum. To move existing manufacturers up the value chain through introduction of new products and new manufacturing methods, the state must expand assistance from what is primarily process improvement work to product development work.

This manufacturing modernization service support also is critical to helping build supplier chains and linkages among second and third tier suppliers in emerging clusters such as vehicle parts, electronic commerce and logistics and distribution.

Specific actions proposed under this strategy relate to improving the service delivery system for manufacturers, expanding assistance to include product development, establishing regional Technology Service Corporations, increasing the state's recruitment focus on filling gaps in supplier chains and assisting small and medium-size manufacturers to form associations and other collaborative mechanisms, particularly within emerging growth areas. (See earlier section on Kentucky's Future Potential.)

Recommended Strategic Actions

- Statewide Manufacturing Modernization System
- Regional Technology Service Corporations

Statewide Manufacturing Modernization System

Recommended Strategic Action

Establish a statewide system of manufacturing modernization.

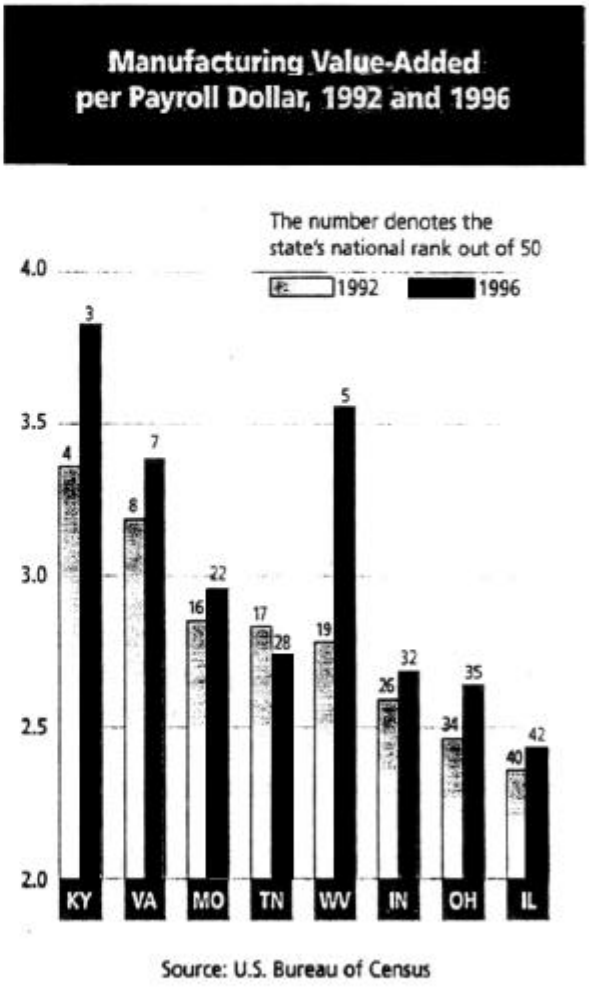
Rationale: Kentucky currently has various organizations providing manufacturing modernization assistance to industry. These organizations rarely communicate with each other, have separate approaches and priorities, have no coordinated outreach effort and may or may not focus on value-added products and market segments. Studies of industry needs in Kentucky have confirmed the disjointed nature of the current modernization process and the need for market-driven assistance.

Operations: Kentucky needs to form a common strategic umbrella under which the various providers will have better focus and can take on mutually supportive roles and responsibilities; have common rules of the road; and, to the businessperson, operate as an integrated assistance delivery system. As part of this restructuring, more attention can be given to serving emerging industry clusters and increasing the focus on product development assistance, whereas now each of these organizations primarily focuses on process improvement assistance. A consolidated operating strategy would be prepared that delineates the various roles and performance measures in the system. Outreach support to this system would be provided through Regional Technology Service Corporations in rural areas of Kentucky (see next section). This system also would develop a strategy to support supplier chain linkages and cluster development through a set of services that help firms move towards higher value-added products and markets.

The state's workforce is attractive to investors. In recent years, Kentucky has continued its upward climb, now standing 3rd in the nation in value added per dollar of payroll (Figure 8). Kentucky's manufacturing base must incorporate, apply and use technology to continue to maintain this comparative advantage.

While this proposed system is not meant to function in a *command and control* nature, one organization needs to have the responsibility to organize, lead and coordinate the effort. This should be the Kentucky Technology Service, Inc. (KTS). Originally established in 1994 by the state and federal government to serve as the manufacturing extension program for Kentucky, this independent nonprofit organization is in the best position to effectively lead this system. But KTS should be restructured in order to fulfill this mission effectively. It must also receive, contingent upon measurable outcomes, adequate funding to carry out this important function.

Figure 8. Manufacturing Value-Added per Payroll Dollar



Source: U.S. Bureau of Census

Manufacturing Modernization System

Lead Partners:
Kentucky Technology Service, Inc. (KTS) and Kentucky Economic Development Cabinet (KEDC)

Investment:
$1 million annually

Timeframe:
Propose to 2000 Regular Session of the General Assembly.

Regional Technology Service Corporations

Recommended Strategic Action

Establish Regional Technology Service Corporations.

Rationale: Kentucky's rural regions, unlike its metropolitan areas, suffer from not having sufficient intermediary organizations driven by the knowledge economy that more readily link educational institutions, service providers and industry into effective coalitions and partnerships. In each of the state's metropolitan areas, entrepreneurial organizations, technology councils and others have undertaken such roles. Until this function is consolidated in each rural region of the state, these areas will continue to lag economically and fail to take advantage of often unanticipated opportunities that might arise. Therefore, it is proposed that a Technology Service Corporation (on campuses of community or technical colleges, Kentucky universities, etc.) be established in each of the rural regions across the state.

Regional Technology Service Corporations

Lead Partner:
Council on Postsecondary Education (CPE)

Investment:
$500,000 per year increasing to $1-2,000,000 annually depending on industry demand.

Timeframe:
Establish within next two to four years. Propose to 2000 Regular Session of the General Assembly.

Operations: These Service Corporations would undertake the following specific functions:

- Identify key areas or clusters in which the region has comparative advantages and the key supplier chains involving that region, (documentation and inventory analysis).
- Using the above information, undertake a matchmaking function, working with the key suppliers and industry anchors in the region to identify ways to link to other industries in the state.
- Working with economic development recruitment organizations, assist in identifying and helping recruit firms to the state that help fill gaps in supplier chains or serve as anchors for cluster development.
- Organize, form and support networks of manufacturers, suppliers and others to learn about trends and developments, to access technology, capital and other resources and to link other public programs to these industries. The Corporations can become and serve as regional one-stop clearinghouses for servicing the region's industries.
- Identify and help implement actions to ensure that curricula, short course and certificate programs as well as degree and non-degree programs, are in place to serve emerging industries and clusters of a region. Service Corporations would serve as workforce advocates.
- Help existing industry associations and form new associations in emerging industries and clusters in a region.
- Develop regional strategies and serve as advocates to secure public and private resources to implement such strategies.

While the exact configuration of services would vary from region to region, over time these Service Corporations might also become operators of various innovation-based programs as well as be the location for the field personnel of various statewide organizations such as Kentucky Technology Service, Inc. This would further create a single point of access for assistance and support in the rural regions of the state.

STRATEGY: TECHNOLOGICAL INFRASTRUCTURE

Proposed Strategy:

Build the technological infrastructure (i.e., Kentucky know-how) that is essential to ensuring a competitive Kentucky economy.

Much as Kentucky governments invested in roads, bridges and other transportation improvements during the past 100 years, they now need to make investments in information highways, technology incubators, science parks and related technological infrastructure to grow technology and knowledge-driven firms in the state and attract others. The Kentucky know-how — to use these new highways and to fill the incubators and science parks — is the raw material essential to grow these firms.

Key immediate actions to implement this strategy include:

- Establishment of the Kentucky Science and Engineering Foundation,
- Creation of the Strategic Technology Capacity Initiative and
- Increased, targeted state investments in the R&D base of higher education institutions.

Recommended Strategic Actions

- Kentucky Science and Engineering Foundation
- Strategic Technology Capacity Initiative
- Dedicated Trust Funds

Kentucky Science and Engineering Foundation

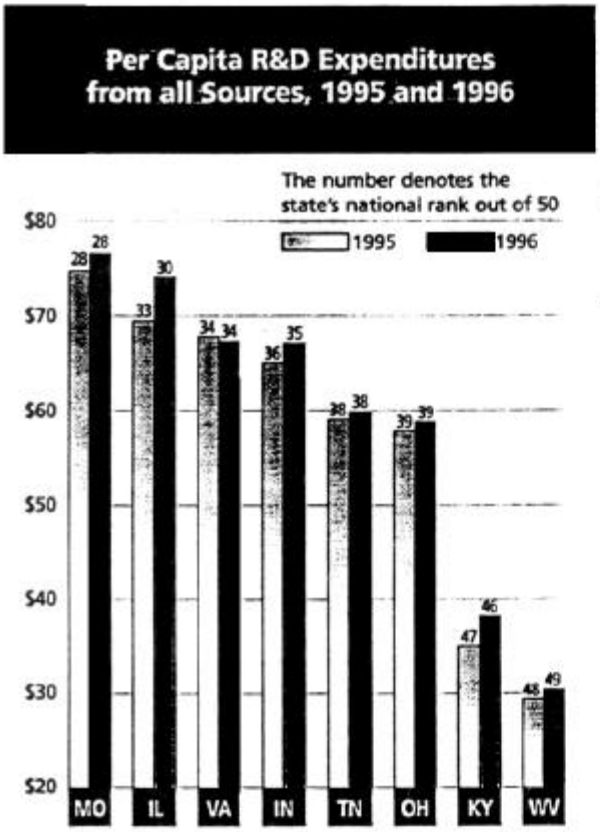
Recommended Strategic Action

Create the Kentucky Science and Engineering Foundation.

Rationale: To build a 21st Century Kentucky economy will require significant investments in the state's underlying science and technology infrastructure. *The Kentucky Science and Technology Strategy* emanates in part from the Kentucky Experimental Program to Stimulate Competitive Research (EPSCoR), the highly collaborative and successful R&D program with matching state funds responsible for bringing to Kentucky over $36 million in federal research dollars since 1985. The return on the state's investment in this program equals $2.50 of federal funding for every dollar of state funds invested in EPSCoR.

To a large extent, this *Strategy's* ultimate success will be measured by the state's willingness to expand these funds and make its own investments in peer-reviewed science and engineering research. While Kentucky EPSCoR is considered a national model for enhancing research, Kentucky's capacity to become a leader state in competitive research hinges on its ability to dedicate and attract even more research funding from all sources. In building on EPSCoR, and modeled in part after the National Science Foundation, the formal presence of the Kentucky Science and Engineering Foundation (KSEF) would accelerate the transition of the state's R&D into the mainstream for receiving federal and private sector support. See Figure 9 on Kentucky's comparatively limited share of federal R&D funding from all sources.

Figure 9. Per Capita R&D Expenditures from all Sources



Source: National Science Foundation

Creating a counterpart of the National Science Foundation for Kentucky would further demonstrate the importance Kentucky places on science and engineering. KSEF would provide a mechanism to further promote science and engineering progress in research and education for the benefit of the Commonwealth. The core operation for the Foundation would build on the recognized success of Kentucky EPSCoR to leverage more extensive federal funding opportunities for research that is deemed important to the state.

Operations: KSEF would take over functions now provided by the Statewide EPSCoR Program in partnership with the Kentucky Council on Postsecondary Education. The Statewide EPSCoR Committee is comprised of research leaders from across the state who would be asked to continue serving in a leadership capacity. KSEF functions would include the acquisition and distribution of state matching funds for nationally and internationally peer-reviewed research projects and the stimulation of collaborative research among academic institutions. EPSCoR's highly successful visiting faculty program for less experienced researchers establishes the basis for KSEF's role in identifying and supporting human resource programs that impact R&D enhancement.

State funds currently appropriated to EPSCoR would be rededicated to the Kentucky Science and Engineering Foundation, with expansion over the next three biennia. Since the Kentucky EPSCoR Program is a function of the Kentucky Science and Technology Corporation, KSEF likewise would be under the umbrella of this independent, nonprofit Kentucky enterprise dedicated to the advancement of science and technology.

Kentucky Science and Engineering Foundation

Lead Partner:
Kentucky Experimental Program to Stimulate Competitive Research (EPSCoR)

Investment:
$5M annually, rising to $10M per year by 2006

Timeframe:
Propose to 2000 Regular Session of the General Assembly.

Strategic Technology Capacity Initiative

Recommended Strategic Action

Set up the Strategic Technology Capacity Initiative.

Rationale: Kentucky needs a flexible source of funds to be used for several purposes, consistent with this *Strategy*, to enable Kentucky to be a recognized world-class leader in several fields. These funds would encourage industry consortia to locate their new activities in the state and provide *seed* funds for building a critical mass within the emerging industry clusters of Kentucky.

Operations: These funds would be used to undertake multiple tasks such as matching funds for forming and locating industry R&D consortia in Kentucky and funds to help *jump-start* emerging and new industries including clusters.

Strategic Technology Capacity Initiative

Lead Partner:
Kentucky Economic Development Cabinet (KEDC)

Investment:
$2 million annually, increasing as experience and demand warrant.

Timeframe:
Establish within next two to four years. Propose to 2000 Regular Session of the General Assembly.

Focusing the state's recruiting on attracting R&D anchors and filling gaps in supplier chains is a primary function of this fund. The state's economic development recruiting could further help support efforts to built strong world-class industry clusters in Kentucky. Once further studies of gaps in supplier chains and the full dimensions of a cluster have been identified (see later section on Supplemental Analyses), state and local recruiters can focus on filling gaps that will make the supplier chain stronger in Kentucky and, at the same time, build critical mass around a cluster of innovation-driven related industries. State recruiters can focus on attracting R&D anchors that help build clusters and form the basis for additional supplier chains. Part of this recruiting will include focusing on small and medium manufacturing that, if recruited to Kentucky, will add value to and help build a stronger industrial base in the state.

Funds from this effort could be used by the Kentucky Economic Development Cabinet to obtain any assistance/expertise needed to better address the unique recruiting issues surrounding technology companies. In addition, this program could help jump-start some targeted incentive efforts.

Dedicated Trust Funds

Recommended Strategic Action

Increase state investments in dedicated higher education trust funds that advance Kentucky's scientific and technological competitiveness and distribute them in a way that offers universities sufficient flexibility to respond quickly to unanticipated, cutting-edge opportunities.

Rationale: Education reforms at the postsecondary levels, perhaps the most far-reaching since the passage of the Kentucky Education Reform Act, have laid an important piece of the foundation for achieving the central goal of the *Kentucky's Science and Technology Strategy*. The Council on Postsecondary Education's translation of these reforms into an action agenda rightfully addresses, among other issues, the need for advanced research that "will create new knowledge and technologies that can be transferred to businesses and labor groups," with investments in faculty dedicated to "creating new ideas and technologies." These aims are lofty but already have been backed by significant financial investments by the state in the form of dedicated postsecondary education trust funds. This represents a major shift in how higher education dollars are appropriated, which traditionally was largely based on enrollment levels.

The state must maintain its fortitude to make targeted investments in research, technology and, perhaps most importantly, in its higher education faculty who create the new knowledge and technologies. Other *Strategy* recommendations complement such investments with incentives for collaborative research with business and industry and for commercialization of new technologies. Yet the state's direct allocations to research, technology and research equipment/facilities are vital signs of Kentucky's commitment to *be among the leader states in the development of knowledge*, the central goal of *Kentucky's Science and Technology Strategy*.

Dedicated Trust Funds

Lead Partner:
Council on Postsecondary Education (CPE)

Investment:
Approximately $3 million annually (Each biennium add no less than 10 percent new research trust funds, with an additional 3 percent held in reserve to respond quickly to unanticipated, cutting-edge research opportunities).

Timeframe:
Propose to 2000 Regular Session of the General Assembly and each subsequent biennial Session.

In a study of innovative European universities, ongoing frustration in higher education "is rooted in a simple fact: demands on universities outrun their capacity to respond." At the more local level, "thoughtful administrators and faculty saw that their institution could not become all that it could be if it remained in its 1970s form; a revised posture less hobbled by imbedded constraints was required." The need for flexibility to respond to changing demands is not confined to Kentucky, or even this country. *Kentucky's Science and Technology Strategy* recognizes the global extent of the challenges for higher education to achieve more with less.

While this action focuses on better securing the state's R&D infrastructure, the broader message to higher education is no less relevant here: take entrepreneurial approaches to meeting new demands that embrace a *will to change* or "ignore the need to undergo significant transformation at considerable peril."

This recommendation also is relevant to the state's and the universities' capacity to respond to new, unanticipated opportunities to develop emerging technologies. The ability to compete at the often lightning-fast speed with which new technologies emerge requires deliberate action. To reach its full potential, Kentucky must create a rapid-response mechanism — including access to additional Trust Funds held in reserve — for universities to take advantage of new research capabilities, discoveries and opportunities beyond the original priorities set for the Trust Fund allocations.

Operations: The operation of these reserve Trust Funds will need to be set up in a way that rewards flexibility to recognize new opportunities that enhance the state's technological competitiveness. So a few other considerations are in order. Interdisciplinary efforts must be nurtured since new ideas often arise out of a willingness to learn through open debate and dialog that challenge the boundaries of current knowledge. At the same time, faculty must have the means not only to stay current in their field but especially to maintain a competitive, cutting-edge capacity to create new knowledge.

The current higher education Trust Funds by their very existence demonstrate a will to change. This Action applauds this investment and calls for expanded funding and flexibility to advance Kentucky universities' scientific and technological competitiveness.

STRATEGY: PEOPLE

Proposed Strategy

Ensure that the education system prepares highly skilled, knowledgeable graduates (including teachers) with the necessary mathematics and science capabilities for successfully maneuvering in the 21st Century knowledge economy.

Workforce skills, aptitudes and capabilities are becoming the single most important factor to business competitiveness. It is not likely to change in coming years as the technology quotient required for every job continues to increase. Kentucky's education reform efforts address a number of areas employers find critical to improving the academic capabilities of high school and college graduates. (For example, in the 1990s Kentucky successfully competed for National Science Foundation funding to support the Partnership for Reform Initiatives in Science and Mathematics (PRISM) and the Appalachian Rural Systemic Initiative (ARSI) — both of which support student academic achievement in math and science.)

This strategy is focused on the knowledge and technology aspects of the workforce, hoping to ensure that Kentuckians have the capacity to grow and the necessary skills to compete in tomorrow's economy. This strategy requires action to improve the scientific and technological capabilities of the future workforce.

Recommended Strategic Action

Premium Compensation for Math and Science Teachers with Degrees in Mathematics or Science Disciplines.

While recommending specific action concerning qualifications of mathematics and science teachers, this strategy has implications for all teachers being highly qualified in whatever field they teach. Likewise, this strategy further implies that in-depth teacher qualifications are the precursor for students learning key concepts in depth, in this case in math and science. Internationally competitive student achievement is the ultimate desired result of this action on valuing math and science teachers.

Premium Math/Science Teacher Compensation

Recommended Strategic Action

Pay premium compensation to all P-12 teachers of mathematics and science and related resource teachers who hold, at a minimum, a degree in math or a science discipline. By 2005, all middle and secondary teachers of mathematics and science should hold such degrees and all primary schools should hire or have direct, local access to resource people with degrees in mathematics or science disciplines.

RATIONALE: As noted in *Preparing Students for the 21st Century*, "Most would agree that leadership in science is directly connected to our nation's capacity to maintain a sound economy..." In addition, math "must be viewed as a language and as a way of communicating or making sense of the world...Math is one way to generate thinking and reasoning skills among students." An increasingly complex world requires knowledge of mathematics and science to be a truly literate person capable of creating new technological innovations for practical and commercial applications.

Mathematics and science teachers set the bar for learning in these subjects. If teachers are underprepared, for whatever reason, so too will their students likely be ill-equipped to reach their potential. Yet Kentucky cannot afford to lose the potential of a single student, let alone whole classes, if this *Kentucky's Science and Technology Strategy* is to be successful. This recommendation is based on the straightforward premise that all students can best learn mathematics and science if their teachers are themselves lifelong learners in the subjects — and that schools are able to compete with the private sector in order to attract qualified people to teach these subjects. Raising expectations requires bold actions, which understandably will not be easy or happen overnight.

Premium Math/Science Teacher Compensation

Lead Partner:
Kentucky Department of Education (KDE)

Investment:
$35 million (estimate)

Timeframe:

a. By 2005, all middle and high school teachers of mathematics and science will hold a degree in their respective field.

b. By 2002, all elementary schools will have school-based access to qualified resource people who hold degrees in mathematics and/or science.

c. By 2002, premium compensation packages will be in place for qualified teachers listed in a. and b. above.

There are lessons to be learned from related efforts right here in Kentucky where teachers have sought to advance their knowledge of mathematics and science. They have gained confidence to challenge their students to reach their full capacity. This happens best when the resources for teachers to learn are school-based and always available, not in some far off central office accessible only once or twice a year due to funding or geographic limitations.

Yet any less dramatic steps will have far less impact on the systemic nature of persistent problems Kentucky and other states face in student achievement in these important subjects.

For example, economist Lester Thurow has noted the vital importance of education in achieving any competitive advantage in the knowledge economy. He has made the point that small incremental steps in education reform will never allow for catching up, let alone getting ahead.

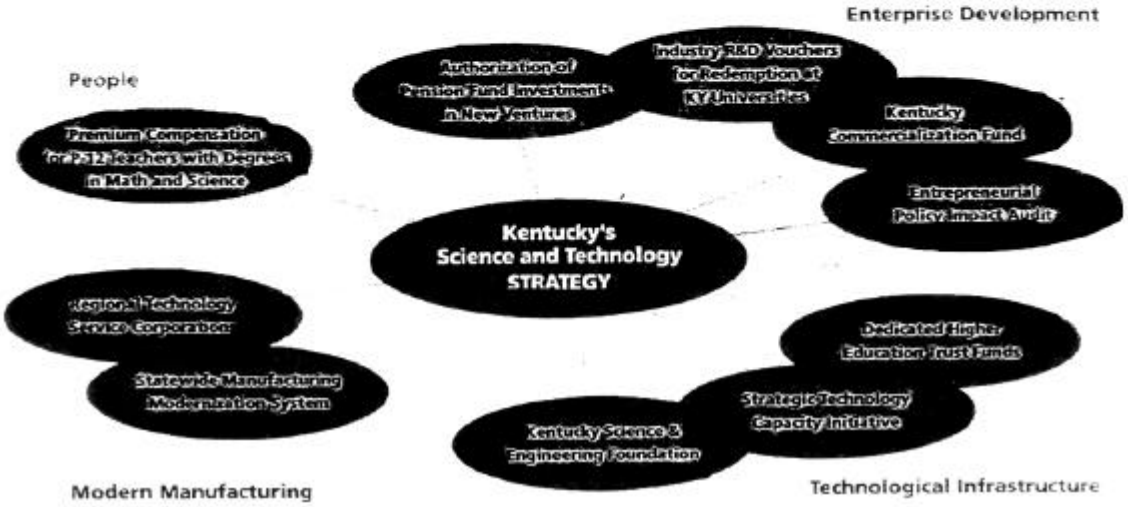
Operations: Realistically, this recommendation will be most effective following two related paths, one for middle and secondary teachers and the other for primary teachers. Premium compensation is proposed for any teachers of mathematics and science who hold a degree in the respective field, presumably middle and high school teachers. While all primary teachers are not expected to have the same level of expertise, these teachers must have highly accessible school-based, or at least district-based, resource people who hold majors in mathematics and science disciplines. Such hiring parameters have significant funding implications for local school personnel decisions and are reflected in the estimated funding proposal to carry out this action.

There likely are a number of ways to operationalize these hiring practices that are most appropriately addressed at state and local levels. So this recommendation is proposed to demonstrate the scope of actions necessary to solve the problem of math/science underachievement. Let's be clear about this: incremental solutions will not result in graduates who are qualified to compete in the knowledge economy. Anything less will undermine Kentucky's capacity to *be among the leader states in the development of knowledge and its application to firms, skills and products,* the central goal of *Kentucky's Science and Technology Strategy.*

Implementation

Ten Strategic Actions

The ten recommended actions are summarized below.



Bottom Line Investments and Lead Partners

The lead partners and new or redirected annual investments needed to initiate each action are listed below.

Recommended Action	Lead Partners	Current Funds	New Investments
Pension Fund Investment Authorization	KRS/KTRS	*	*
R&D Vouchers	KSTC		$ 1,000,000
Commercialization Fund	CPE/KSTC		$ 750,000
Entrepreneurial Policy Audit	KSTC	$ 125,000 **	$ 125,000 **
Manufacturing Modernization System	KTS/KEDC	$ 350,000	$ 650,000
Technology Service Corporations	CPE		$ 500,000
KY Science & Engineering Foundation	KY EPSCoR	$2,500,000	$ 2,500,000
Strategic Technology Capacity Initiative	KEDC		$ 2,000,000
Dedicated Trust Funds	CPE		$ 3,000,000
TOTALS		**$ 2,975,000**	**$ 10,525,000**
Premium Compensation for M/S Teachers	KDE		$ 35,000,000 (estimate)
Supplemental Actions/Cluster Analysis	KSTC		$ 150,000 **

* Current Kentucky pension funds total $21.6 billion so authorization of up to 2 percent could make available $432 million for investments in new, value-added business ventures.

** Nonrecurring

Strategic Execution

The implementation of *Kentucky's Science and Technology Strategy* is too vital and complex an undertaking to be the responsibility of a single entity. The introduction of a lattice approach offers a mechanism to support the multiple systems that must take this on.

"...The predominant organization of the information age" is the knowledge team, according to *The Distributed Mind*. "The most important asset of the organization has shifted as well.... Although the earlier assets have remained important as these ages have evolved, the key asset in the information age — the competitive advantage — is the knowledge. Consequently, the primary challenge is no longer basic tooling or automation but effective information transfer." From this, one begins to understand that no longer is there a single, predominant organizational structure — a command and control function — that, no matter how well intentioned, can lead without limiting innovation and the necessary flow of information in the creation of knowledge. The latticework concept recognizes this new dimension and is offered as a model for the successful, yet distributed, mode of implementation and oversight of *Kentucky's Science and Technology Strategy*.

This implementation approach takes its design from the biological systems that run on DNA. "Although each cell is specialized..., it contains information about every other cell, organ and system within its DNA strands so that it can function harmoniously within a larger system while accomplishing its own tasks efficiently." Similarly, the lattice approach is designed to promote core characteristics necessary for overall success of the *Strategy*, while each system in the lattice structure performs its own function.

One other design feature is worth discussion. The adaptability of any structure is critical in a world that changes so rapidly. How do we achieve success amidst all this change without endless drifting? In *Blur: The Speed of Change in the Connected Economy*, the authors note that, "Adaptive systems exist in a state known as 'the edge of chaos,' where they are stable enough to persist, yet flexible enough to quickly discover new solutions when a new problem arises." This same adaptability is necessary to take advantage of, or even simply recognize, new opportunities for advancing science and technology in Kentucky.

Implementation

- ✓ Ten Actions
- ✓ Bottom Line Investments and Lead Partners
- ✓ Strategic Execution with Lead Partners
- ✓ Ultimate Accountability in Governor's Office
- ✓ Overall Web-Based Monitoring

The ten actions of *Kentucky's Science and Technology Strategy* are interdependent functions of existing systems that never before have had the opportunity to cohere around the statewide goal of advancing science and technology.

Thus, the defining implementation characteristics are:

- Accessibility to a variety of information in the pursuit of new ideas;
- Adaptability to solve problems and recognize new opportunities;
- Distribution of functions across systems to maximize innovation; and
- Permeable boundaries within organizations and among sectors.

Ultimate Accountability

To make sense of these efforts and activities, ultimate accountability lies with the Governor to serve as catalyst and champion within Kentucky state government to ensure that this strategy is implemented. Ideally this accountability function will be at the highest level of authority in the Governor's Office, i.e., the Secretary of the Cabinet. This office also has oversight responsibility over executive functions within the state. In so doing, the full force of the Governor's Office would support implementation, collaboration and monitoring the *Strategy* without creating any new state office.

Core measures of success are proposed to assess the implementation of this *Strategy* in the years ahead. Measures that can be used to monitor and assess progress include, but are not limited to:

- Recognized research stature of Kentucky universities in several fields;
- Status of Actions: completed, partially implemented, initiated, no action;
- Federal and industry funds leveraged to each action;
- Size of emerging clusters (compared to baseline in terms of jobs, sales, etc.);
- Kentucky firm start up and growth rate;
- Disclosures, patents, licenses and sales from university intellectual property;
- Venture capital attracted/invested/leveraged in Kentucky (over baseline);
- Industry R&D investments in Kentucky (over baseline); and
- Technology firms recruited/attracted.

Moreover, a point system should be developed whereby value-added jobs are measured by their economic impact. This level of accountability would lend focus to *Kentucky's Science and Technology Strategy's* emphasis on creating not just jobs, but value-added, wealth-creating jobs and the culture to sustain these knowledge-driven areas of strength in Kentucky. One accountability scenario to recognize this feature is offered here by way of example to differentiate measuring value-added jobs from traditional employment figures.

Possible Scenario for Measuring Value-Added Jobs

Points	Criteria
5	Four-Year College Degree Required
3	Special Skills/Training Required
1	Annual Salary: up to $15,000
1	Each Additional $10,000 of Salary

Therefore, a manufacturing job that requires a high school diploma, no special training and pays $7 per hour would generate only one point. A high-tech job that requires a degree, special training and pays $75,000 per year would generate 15 points (i.e., 5+3+7).

Overall Monitoring

Monitoring will be supported by a website to share and link to vital information from all participating systems. Moreover, the site will become a home for conversations about ideas emanating from *Kentucky's Science and Technology Strategy* Actions and the evolution of new ones, with periodic reporting to the Governor's Office. Kentucky Science and Technology Corporation will maintain the site. These participating systems include, but are not limited to:

- Primary and Secondary Education,
- Postsecondary Education (public & private universities, colleges & technical schools),
- Workforce Development Agencies and Organizations,
- Research and Development (public & private entities),
- Economic Development Agencies and Organizations,
- Private Sector Enterprises and
- Governments (local, state, federal).

Supplemental Analyses

In addition to the strategic actions presented here, further, in-depth analyses in key areas must be given immediate attention. These include:

- Completion of a comprehensive cluster analysis of the state to determine if the emerging clusters identified in the preparation of this Strategy are at a point in their evolution for state focus and support.
- Completion of a study of supplier chains to these clusters and to each other so that the state's recruitment efforts can help support filling gaps in supplier chains.
- A further review and detailed survey of the financial needs of technology-driven Kentucky firms to determine what changes, if any, are needed in the state's finance vehicles for business to ensure they are assisting technology firms and firms in emerging clusters.

Using clusters as one means to help build economic capacity in Kentucky does not imply a traditional means of assessing strength. Analyzing the strength or potential of a cluster means evaluating its real assets...not necessarily its current or historical products... but its knowledge base or technology both of which could lead to multiple future economic scenarios.

While clusters of related industries in Kentucky tend to be concentrated in urban or metropolitan settings, in each emerging cluster there also are rural firms. In fact, clusters represent one way to link urban and rural firms, suppliers, expertise and knowledge together.

Clusters can help state government, higher education institutions and service providers assess how each firm they work with fits into a larger value chain. By recognizing and working in this larger value chain, each organization can collectively have a greater impact on the state's economy, helping build value to individual efforts.

The Kentucky Economic Development Cabinet, along with other organizations in the state, has helped encourage and extend the capacity of clusters through *networking* programs. In these efforts, companies are encouraged to form *networks* to help address common problems or opportunities.

The second key economic development tool we need to consider is that of supplier chains. In each of these emerging clusters, we see examples of first, second and third tier suppliers serving anchor or core manufacturers. These supplier chains are not always fully developed in Kentucky and there are likely gaps in coverage. By undertaking more detailed analysis of supplier chains, gaps can be identified both statewide and regionally. Once these gaps are identified, particularly those associated with emerging industry clusters, the state and local economic development recruiting can be more complementary by focusing on attracting anchor lead firms and suppliers around emerging clusters.

Conclusion

Look for on-line discussions and updates on *Kentucky's Science and Technology Strategy* at www.kstc.org

Kentucky is at a crossroads. It can continue to build its economy primarily on assembly-line manufacturing and old-line industries; or it can recognize its many assets and aggressively move forward to take advantage of them and create its own knowledge and companies. It can better position itself for the knowledge-driven economy.

Kentucky's Science and Technology Strategy was designed for widespread ownership. It requires collaboration to be successfully implemented. It focuses on innovation, entrepreneurship, knowledge and R&D to move Kentucky toward higher-value products and processes. A technology management portfolio approach has been proposed whereby the state's funding commitments are seen as investments, not grants. Recognition has been given to differences and similarities in rural and urban Kentucky.

Finally, the *Strategy* proposes a reasoned set of Actions but cautions that it will take long-term commitment and results will be seen best over many years. This is a private and public strategy and requires both types of investments for its successful implementation.

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