Information Technology

Career Cluster Resources
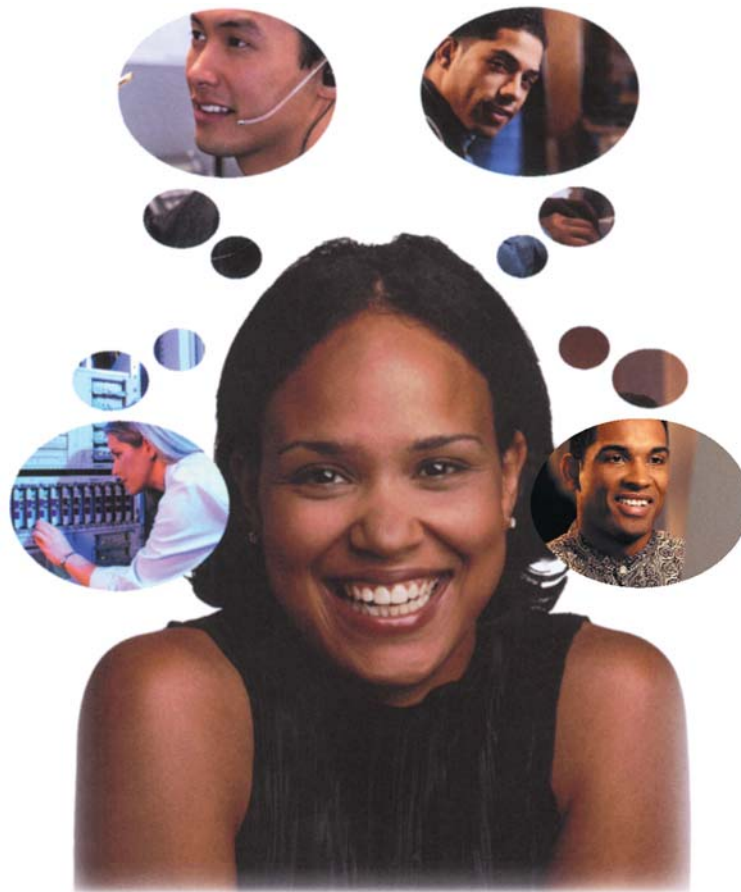# for Information Technology

www.careerclusters.org

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Introduction

The States' Career Cluster Initiative
9/01/02

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The U.S. Department of Education Office of Vocational and Adult Education (OVAE) has identified 16 career clusters representing career opportunities for the 21st century economy. These clusters will frame student opportunities as they pursue postsecondary education and a wide range of career opportunities from front-line to professional and managerial careers.

Helping students make their dreams become a reality was the driving force behind the nation's Career Clusters initiative launched June 1, 2001. Twelve lead states and the District of Columbia were partners in the development of the tools supporting eleven career clusters which, when combined with the five clusters that have already been developed, will represent all career possibilities.

The National Association of State Directors for Career and Technical Education Consortium (NASDCTEc) and their Board of Directors assumed leadership for coordinating the project. This in itself was unique for a project of this scope. The Board and the State Directors organization believed that this initiative was of such potential impact on the Career Technical delivery system in the country that they needed to play this leadership role in the project, assuring that the materials had utility in their states once completed. Therefore, the NASDCTEc in conjunction with the State of Oklahoma (the project fiscal agent) prepared and submitted a proposal to OVAE in January of 2001. This proposal was funded at a $2.2 million dollar level, with expectations of a second year of funding of $2.5 million. The plan to develop eleven curriculum frameworks was very aggressive, given that each of the prior projects, designed to develop and pilot test materials for a single cluster, had received in excess of $1 million dollars for their multiyear development work.

The project was designed to establish curriculum frameworks and supportive materials for each cluster, with a broad-based advisory committee for each cluster, led by a state. There was also a National Advisory Committee consisting of members from each of the cluster committees, along with other stakeholders. The National and State Cluster advisory committees were responsible for identifying the frameworks, pathway and foundation knowledge and skills, and other supportive

materials. The committees included representatives from states, schools, education and training, business and industry, associations, and others directly impacted by the materials.

The development of materials for each of the eleven clusters was led by a different state, with business and industry at the helm. The lead states included: Idaho and Iowa (jointly leading the Agriculture, Food and Natural Resources cluster), Pennsylvania (Architecture and Construction), Ohio (Marketing, Sales and Service), North Dakota (Finance), West Virginia (Hospitality and Tourism), South Carolina (Business, Management and Administration), Kentucky (Human Services), Arkansas (Law, Public Safety and Security), North Carolina (Science, Technology, Engineering and Mathematics), Michigan (Education and Training), and Oklahoma and the District of Columbia/Washington D.C. (jointly leading the Government and Public Administration cluster).

The five additional career clusters included Health Science led by the State of Utah, Manufacturing led by the State of Indiana, Arts, Audio Video Technology and Communications led by the V-TECS Consortium, Information Technology led by the Educational Development Center, Inc., and Transportation, Distribution and Logistics Cluster led by the State of Illinois. These clusters plan to complete their work by June 30 of 2003.

To facilitate and coordinate the developmental work of the Cluster Initiative, staff was identified and housed at the Oklahoma Department of Career and Technical Education. The staff consisted of four Cluster Coordinators: Marsha Daves, Greg Dewald, Curtis Shumaker, and Pam Stacey. Additionally, Denise Christy provided research and web development support, Lisa Batchelder provided financial support, and Karan Smith provided administrative support.

Development work for the States' Career Clusters Initiative began June 1, 2001, and the first meeting of lead states, OVAE staff, and cluster staff was held in Oklahoma City in mid-June. At this meeting, project objectives, general direction, timelines, and the initial research goals were identified. This work continued through the fall and winter of 2001 and included the identification of cluster advisory committee members, the development of cluster frameworks based on the prototype cluster models provided by V-TECS, and the identification of occupations and draft pathways along with degrees and certificates associated with the career specialties/occupations in each of the clusters.

In January of 2002, the lead state teams were brought together in Phoenix to begin the process of developing knowledge and skill statements for each of the cluster pathways and foundations. Contracted writers and lead state cluster advisory committee members, depending upon

the decisions of cluster leadership, carried out this work. A part-time editor in Oklahoma provided consistency across the cluster knowledge and skill statements. One concern that was addressed early in the process was the need for a "common look and feel" across the clusters. Ultimately, this was accomplished not only for the eleven clusters in the States' Career Clusters Initiative, but also through close cooperative relationships between the projects, all the cluster knowledge and skill statements were developed (or retro-fitted) using the same format. This format includes a knowledge/skill statement with associated performance elements and measurement criteria. This format provides the tools needed for curriculum and assessment developers as they take the materials to the classroom.

The National Advisory Committee met in March of 2002, and reviewed the curriculum frameworks, credentials list, and lead state advisory committee memberships and structures, and forwarded those materials to the Executive Committee for the Project. The Executive Committee, made up of the Board of the NASDCTEc, also met in March, approved the materials and discussed the future actions needed to assure implementation of the cluster materials.

Originally, the project was designed for a minimum of two years and was to include the identification of 110 pilot test sites across the country, along with the development of assessments and certifications for the clusters. The Office of Vocational and Adult Education, however, determined in November of 2001 that the goals of the project were "too broad", and terminated the project as of September 30, 2002.

Development of the products needed for curriculum and assessment was fast-tracked, with the knowledge and skill statements, performance elements and measurement criteria ready for validation by July 15, 2002. This was the result of a major effort of lead state advisory committees and staff responding to the shortened timeline and the need for quality product.

Given the efforts of the developmental teams, cluster advisory committee members were able to review and validate the knowledge and skills and supporting elements. Additionally, a national web-based validation was conducted from July 15 to August 15, 2002. All 50 states were invited to a dissemination meeting held in Charleston, South Carolina Sept 13, 2002, where the materials were distributed to participants for their use in updating their curriculum.

For further information on the status of the materials, go to the web-site, http://www.careerclusters.org/.

Section I – Pathway Model

Sample of Career Specialties / Occupations			
Network Design and Administration: ❑ Communications Analyst * Data Communications Analyst * Information Systems Administrator * Information Systems Operator * Information Technology Engineer ❑ **Network:** Administrator * Analyst * Architect * Engineer * Manager * Operations Analyst * Security Analyst * Specialist * Technician * Transport Administrator ❑ PC Support Specialist * Systems Support Lead * Network Engineer ❑ **Systems:** Administrator * Engineer * Support Lead ❑ Technical Support Specialist * User Support Specialist ❑ Telecommunications Network Technician	**Database Development and Administration:** ❑ **Data:** Administrator * Analyst * Architect * Management Associate * Modeler * Modeling Specialist ❑ **Database:** Administration Associate * Administrator * Analyst * Developer * Manager * Modeler * Security Expert * DSS (Decision Support Services) * Knowledge Architect ❑ **Senior:** Database Administrator * Systems Analyst ❑ **Systems:** Administrator * Analyst ❑ Tester **Technical Writer:** ❑ Desktop Publisher * Document Specialist * Documentation Specialist * Editor ❑ **Electronic** Publications Specialist * Publisher ❑ Instructional Designer, Online Publisher ❑ **Technical** Communicator * Editor * Publications Manager * Writer **Technical Support:** ❑ Analyst * Call Center Support Representative * Content Manager ❑ **Customer:** Liaison * Service Representative * Service Professional ❑ **Help Desk:** Specialist * Technician ❑ Maintenance Technician * PC Support Specialist * PC Systems Coordinator * Product Support Engineer * Sales Support Technician * Systems Analyst ❑ **Technical:** Account Manager * Support Engineer * Support Representative ❑ Testing Engineer **Enterprise Systems Analysis and Integration:** ❑ Application Integrator * Business Continuity Analyst * Cross-Enterprise Integrator ❑ **Data:** Systems Designer * Systems Manager * Warehouse Designer ❑ E-Business Specialist * Electronic Transactions Implementer ❑ **Information Systems:** Architect * Planner ❑ **Systems:** Analyst * Architect * Integrator	**Digital Media:** ❑ 2D/3D Artist * Animator * Audio/Video Engineer * Designer * Media Specialist * Media/Instructional Designer ❑ **Multimedia:** Author * Authoring Specialist * Developer * Specialist ❑ Producer * Production Assistant * Programmer * Streaming Media Specialist * Virtual Reality Specialist ❑ **Web:** Designer * Producer * Specialist **Web Development and Administration:** ❑ **Web:** Administrator * Architect * Designer * Page Developer * Producer * Site Developer * Specialist * Webmaster – Level 1 & 2 (c) ❑ **Webmaster**	**Programming / Software Engineering:** ❑ **Applications:** Analyst * Engineer ❑ Business Analyst * Computer Engineer * Data Modeler ❑ **Operating System:** Designer/Engineer * Programmer Analyst ❑ Program Manager * Programmer * Programmer/Analyst * Project Lead ❑ **Software Applications:** Specialist * Architect * Design Engineer * Development Engineer * Engineer * QA Specialist * Tester ❑ **Systems:** Analyst * Administrator ❑ Test Engineer * Tester

Pathways			
Network Systems	**Information Support and Services**	**Interactive Media**	**Programming and Software Development**

Cluster K&S
Cluster knowledge and skills   ♦Academic Foundations ♦Communications ♦Problem Solving and Critical Thinking ♦Information Technology Applications ♦ Systems ♦ Safety, Health and Environmental ♦Leadership and Teamwork ♦Ethics and Legal Responsibilities ♦Employability and Career Development ♦Technical Skills

Section II – Cluster Knowledge and Skills

Information Technology

Academic Foundations

Statement: Demonstrate Language Arts knowledge and skills required to pursue the full-range of career and post-secondary education opportunities within the IT career cluster.

Performance Element: Listen actively.

Performance Element: Adapt language (diction/structure, style) for audience, purpose, situation.

Performance Element: Collect/Organize oral and written information.

Performance Element: Compose/edit (agenda, audio-visuals, bibliographies, drafts, forms/documents, notes, oral presentations, reports, technical terminology).

Performance Element: Comprehend oral and written information (cause/effect, comparisons/contrasts, conclusions, context, purpose, charts/tables/graphs, evaluation/critiques, mood, persuasive text, sequence, summaries, technical matter).

Performance Element: Evaluate oral and written information (accuracy, adequacy/sufficiency, appropriateness, clarity, conclusions/solutions, fact/opinion, propaganda, relevancy, validity, relationship of ideas).

Performance Element: Identify (oral and written) assumptions, purpose, outcomes/solutions, and propaganda techniques.

Performance Element: Predict from oral and written information trends, outcomes/solutions.

Performance Element: Present formal and informal speech, discussion, information requests/supplying, interpretation, persuasive.

Performance Element: Use library, text and Internet resources.

Statement: Demonstrate Mathematics knowledge and skills required to pursue the full-range of career and post-secondary education opportunities within the IT career cluster.

Performance Element: Identify whole numbers, decimals, fractions, complex numbers, polynomials, geometrical figures.

Performance Element: Apply basic arithmetic add, subtract, multiply, and divide operations.

Performance Element: Applied relational (equal, not equal, greater than, less then, etc.) and logical operators in a logical expression.

Performance Element: Understand the relationship of data and measurements to the problem.

Performance Element: Produce mathematical formulae, expressions, and/or sequence of solution steps from problem statements.

Performance Element: Analyze problem statements for missing/irrelevant data, estimate/exact values, inconsistent parameters.

Performance Element: Construct charts/tables/graphs from functions and data.

Cluster Knowledge and Skill Statement

Performance Element: Describe problem solving techniques (for example: successive approximation, trial and error).

Statement: Demonstrate Science knowledge and skills required to pursue the full-range of career and post-secondary education opportunities within the IT career cluster.

Performance Element: Analyze/evaluate conclusions, conflicting data, controls, data, inferences, limitations, questions, sources of errors, variables.

Performance Element: Use computers for information processing, mathematical applications and problem solving.

Performance Element: Apply/use scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, problem identification.

Cluster Knowledge and Skill Statement

Communications

Statement: Comprehend and use reading strategies to learn meaning, technical concepts, vocabulary, and follow instructions.

Performance Element: Determine and use reading strategy (skimming, reading for detail, reading for meaning and critical analysis) to determine purpose of text.

> ***Measurement Criteria:*** *Use reading strategy to achieve intended purpose.*
> ***Measurement Criteria:*** *Identify purpose of text.*
> ***Measurement Criteria:*** *Identify complexity of text.*
> ***Measurement Criteria:*** *Explain purpose of text.*

Performance Element: Analyze information, read to learn meaning, technical concepts, vocabulary, and follow directions.

> ***Measurement Criteria:*** *Determine relevance, accuracy and appropriateness to purpose.*
> ***Measurement Criteria:*** *Identify complexities and discrepancies in information.*
> ***Measurement Criteria:*** *Analyze information presented in a variety of formats, such as tables, lists, figures.*
> ***Measurement Criteria:*** *Identify key technical concepts and vocabulary.*
> ***Measurement Criteria:*** *Follow all instructions as specifically given.*

Performance Element: Interpret, transcribe and communicate information, data, and observations to apply information learned from reading to actual practice.

> ***Measurement Criteria:*** *Explain meaning of new terms, vocabulary and concepts.*
> ***Measurement Criteria:*** *Interpret technical materials used.*
> ***Measurement Criteria:*** *Summarize overall meaning of text.*
> ***Measurement Criteria:*** *Write specific steps for applying information learned to task or new situation.*
> ***Measurement Criteria:*** *Write set of directions for others sharing information learned and applying that to task or new situation.*

Statement: Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.

Performance Element: Locate written information to communicate with co-workers and clients/participants.

> ***Measurement Criteria:*** *Identify topic.*
> ***Measurement Criteria:*** *Conduct search of information using card catalog, keywords, and/or search engines.*
> ***Measurement Criteria:*** *Locate variety of resources such as books, journals, and magazines.*
> ***Measurement Criteria:*** *Locate information from electronic forms including the Internet.*
> ***Measurement Criteria:*** *Organize resources to use key information.*

Performance Element: Organize information to use in written and oral communications.

> ***Measurement Criteria:*** *Read and take notes from selected resources.*
> ***Measurement Criteria:*** *Prepare outline that emphasizes major points with supporting data.*
> ***Measurement Criteria:*** *Present information in organized, easy-to-follow manner.*
> ***Measurement Criteria:*** *Prepare working bibliography according to MLA, APA, CBE, Chicago, depending on the warranted language style.*

Cluster Knowledge and Skill Statement

Performance Element: Document the source and proper reference for written information.

Measurement Criteria: *Prepare a bibliography according to MLA, APA, CBE, Chicago, depending on the warranted language style.*

Measurement Criteria: *Use parenthetical, footnotes and endnotes text citations accurately.*

Measurement Criteria: *Follow plagiarism and copyright rules and regulations.*

Statement: Use correct grammar, punctuation and terminology to write and edit documents.

Performance Element: Compose multi-paragraph writing clearly, succinctly, and accurately to write documents.

Measurement Criteria: *Organize and arrange information for effective coherence.*

Measurement Criteria: *Report relevant information in order of occurrence.*

Measurement Criteria: *Interpret information, data, and observations correctly.*

Measurement Criteria: *Present main ideas and supporting facts.*

Performance Element: Use description of audience and purpose to prepare written documents.

Measurement Criteria: *Use technical terms and concepts.*

Measurement Criteria: *Incorporate and use references effectively and accurately.*

Measurement Criteria: *Report objective and/or subjective information.*

Performance Element: Use correct grammar, spelling, punctuation and capitalization to prepare written documents.

Measurement Criteria: *Use correct grammar and sentence structure.*

Measurement Criteria: *Use correct spelling.*

Measurement Criteria: *Use correct punctuation and capitalization.*

Performance Element: Use computer skills to design and develop written and supporting material.

Measurement Criteria: *Use word processing software to develop text, charts, graphs or figures correctly.*

Measurement Criteria: *Use presentation software to prepare visual support materials.*

Measurement Criteria: *Format written documents with correct font and layout for easy reading.*

Statement: Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.

Performance Element: Prepare oral presentation to provide information for intended purpose and audience.

Measurement Criteria: *Know subject matter well enough to be independent of written aids.*

Measurement Criteria: *Identify characteristics of the audience and adjust to their ability to understand.*

Measurement Criteria: *Use technical terms and concepts correctly.*

Measurement Criteria: *Use proper organization and structure to achieve coherence of major points.*

Cluster Knowledge and Skill Statement

    Performance Element: Identify and prepare support materials to accompany oral presentation.

        Measurement Criteria: *Identify media and visual aids appropriate to understanding of topic.*

        Measurement Criteria: *Prepare visual aids and support materials for easy viewing and without error.*

        Measurement Criteria: *Operate any equipment used with support materials smoothly and efficiently.*

    Performance Element: Deliver presentation to sustain listener's attention and interest.

        Measurement Criteria: *Deliver presentation without grammatical error.*

        Measurement Criteria: *Speak clearly with appropriate volume, rate and gestures while making and maintaining appropriate eye contact.*

        Measurement Criteria: *Use support materials in the presentation that enhance the understanding of the topic and the interest level of the audience.*

        Measurement Criteria: *Stay within presentation time parameters.*

        Measurement Criteria: *Evaluate listeners' interest and receptiveness.*

        Measurement Criteria: *Use verbal and nonverbal feedback strategies to engage discussion and adjust message and delivery.*

        Measurement Criteria: *Respond to questions and comments on presentation.*

Statement: Interpret verbal and nonverbal behaviors to enhance communication with co-workers and clients/participants.

    Performance Element: Interpret verbal behaviors to enhance communication.

        Measurement Criteria: *Identify verbal cues.*

        Measurement Criteria: *Observe voice speed, voice quality and tone.*

        Measurement Criteria: *Explain message conveyed by verbal behaviors.*

    Performance Element: Interpret nonverbal behaviors to enhance communication.

        Measurement Criteria: *Identify nonverbal cues.*

        Measurement Criteria: *Observe eye contact, facial expressions, posture, gestures and other body language.*

        Measurement Criteria: *Explain message conveyed by nonverbal behaviors.*

Statement: Apply active listening skills to obtain and clarify information.

    Performance Element: Interpret message/information given to clarify information.

        Measurement Criteria: *Determine familiarity of discussion.*

        Measurement Criteria: *Respond accordingly using appropriate verbal and non verbal language.*

        Measurement Criteria: *Explain the message given in your own words.*

    Performance Element: Respond with restatement and clarification techniques to clarify information.

        Measurement Criteria: *Ask questions to seek or confirm understanding.*

        Measurement Criteria: *Paraphrase and/or repeat information.*

        Measurement Criteria: *Record and summarize information in written notes.*

        Measurement Criteria: *Follow directions and/or respond in a positive way with clear, concise comments.*

Statement: Interpret and use tables, charts, and figures to support written and oral communications.

Cluster Knowledge and Skill Statement

Performance Element: Develop tables, charts and figures to support written and oral communication.

Measurement Criteria: Compile facts and arrange in an organized manner for a table, chart or figure.

Measurement Criteria: Document sources of data.

Measurement Criteria: Determine most appropriate way to display data for effective coherence.

Measurement Criteria: Prepare table, chart, graph or figure for inclusion in publication or presentation.

Performance Element: Interpret tables, charts and figures used to support written and oral communication.

Measurement Criteria: Evaluate reference or source of data for authenticity and reliability.

Measurement Criteria: Explain information presented in tables, charts and figures.

Measurement Criteria: Prepare written summary of findings expressed in tables, charts and figures.

Statement: Demonstrate sensitivity in communicating with a diverse workforce.

Performance Element: Understand factors and strategies for communicating with a diverse workforce.

Measurement Criteria: Identify factors (e.g., culture, ethnicity, equity, special/exceptional needs) that impact communication.

Measurement Criteria: Identify strategies for successful communication with a diverse workforce

Performance Element: Demonstrate ability to communicate and resolve conflicts with a diverse workforce

Measurement Criteria: Determine communication style appropriate for listener(s).

Measurement Criteria: Bridge communication styles.

Measurement Criteria: Establish guidelines for dealing with conflict.

Statement: Conduct meetings.

Performance Element: Plan and schedule meetings.

Measurement Criteria: Plan meeting.

Measurement Criteria: Set agenda.

Measurement Criteria: Schedule meeting.

Measurement Criteria: Reserve meeting room.

Measurement Criteria: Invite appropriate personnel.

Measurement Criteria: Identify need for outside speakers.

Measurement Criteria: Assign someone to take minutes.

Performance Element: Run meetings.

Measurement Criteria: Make introductions.

Measurement Criteria: Invite questions, comments, and group participation.

Measurement Criteria: Determine appropriate action, time frame, and person accountable for identified tasks.

Measurement Criteria: Monitor time.

Measurement Criteria: Publish minutes in timely manner.

Statement: Build customer relations.

Performance Element: Demonstrate knowledge of organization's offerings and of customers' importance to the organization.

>   ***Measurement Criteria:*** *Identify organizations' products and services (including own strengths as a sales agent).*

>   ***Measurement Criteria:*** *Recognize the importance of all customers to the business.*

Performance Element: Demonstrate ability to assist customers in a professional manner.

>   ***Measurement Criteria:*** *Determine customers' individual needs.*

>   ***Measurement Criteria:*** *Project a professional business image (e.g., appearance, voice, grammar, word usage, enunciation, nonverbal communication).*

>   ***Measurement Criteria:*** *Interact with customers and colleagues in a professional manner (e.g., prompt, friendly, courteous, respectful, helpful, knowledgeable, understandable).*

Performance Element: Effectively use organizational protocols and systems to fulfill customer service requirements.

>   ***Measurement Criteria:*** *Comply with established business protocols and company policies.*

>   ***Measurement Criteria:*** *Communicate company policies to customers.*

>   ***Measurement Criteria:*** *Handle merchandise returns in accordance with customer service policy.*

>   ***Measurement Criteria:*** *Handle customer complaints in accordance with customer service policy.*

>   ***Measurement Criteria:*** *Facilitate customer service through the maintenance of key information systems.*

Performance Element: Ensure that customers' needs are met and that customer base is maintained.

>   ***Measurement Criteria:*** *Follow through on commitments made to customers (e.g., special orders, delivery specifications, new items).*

>   ***Measurement Criteria:*** *Maintain customer base.*

Statement: Perform scheduling functions to meet customers needs.

Performance Element: Schedule customer appointments.

>   ***Measurement Criteria:*** *Create calendars/schedules.*

>   ***Measurement Criteria:*** *Maintain appointment calendars.*

>   ***Measurement Criteria:*** *Process requests for appointments.*

>   ***Measurement Criteria:*** *Verify appointments.*

>   ***Measurement Criteria:*** *Notify customers of changes in schedule.*

>   ***Measurement Criteria:*** *Manage scheduling conflicts.*

Performance Element: Document results of customer appointments.

>   ***Measurement Criteria:*** *Document results.*

Cluster Knowledge and Skill Statement

Problem Solving and Critical Thinking

Statement: Guide progress in assigned areas of responsibility/accountability.

Performance Element: Set goals.
Measurement Criteria: Set short- and long-term goals for assigned areas of responsibility/accountability.
Measurement Criteria: Demonstrate commitment to established goals and vision.

Performance Element: Monitor and adjust goals.
Measurement Criteria: Obtain support for goals.
Measurement Criteria: Provide support for goals.
Measurement Criteria: Monitor goal achievement.
Measurement Criteria: Adjust goals.

Performance Element: Communicate and recognize goal achievement.
Measurement Criteria: Communicate goal achievement.
Measurement Criteria: Provide recognition for goal achievement.

Statement: Conduct technical research.

Performance Element: Determine audience and information needs.
Measurement Criteria: Identify target audience.
Measurement Criteria: Define research questions.

Performance Element: Gather information.
Measurement Criteria: Determine priorities for the information that should be gathered.
Measurement Criteria: Identify potential sources of information.
Measurement Criteria: Target audience/user group as a key information source.
Measurement Criteria: Identify subject-matter experts.
Measurement Criteria: Evaluate potential sources of information based on established criteria (e.g., affordability, relevance).
Measurement Criteria: Conduct interviews with selected human information sources.
Measurement Criteria: Gather information from selected print and electronic sources.

Performance Element: Evaluate information.
Measurement Criteria: Determine the accuracy and completeness of the information gathered.

Statement: Produce a quality product/service.

Performance Element: Understand product/service design.
Measurement Criteria: Design product (e.g., using brainstorming, thumbnail sketches, rendering).
Measurement Criteria: Consider customer satisfaction in determining product characteristics (e.g., usefulness, price, operation, life, reliability, safety, cost of operation).

Cluster Knowledge and Skill Statement

Performance Element: Use reliability factors effectively to plan for and create products/services.

> ***Measurement Criteria:*** *Consider reliability factors (e.g., cost, human, producibility).*
> ***Measurement Criteria:*** *Achieve reliability through maintainability, good design, design simplification, and design redundancy.*
> ***Measurement Criteria:*** *Recognize the relationship of maintainability and reliability.*
> ***Measurement Criteria:*** *Align cost components with quality objectives.*
> ***Measurement Criteria:*** *Classify quality costs (e.g., preventive, evaluation, pre-delivery failures, post-delivery failures).*

Performance Element: Test and maintain products/services.

> ***Measurement Criteria:*** *Test products for reliability.*
> ***Measurement Criteria:*** *Initiate predictive maintenance procedures.*

Statement: Demonstrate knowledge of the process required to evaluate and verify the nature of a problem.

Performance Element: Understand information systems theory and practice.

> ***Measurement Criteria:*** *Demonstrate knowledge of the underlying concepts of the information systems discipline.*
> ***Measurement Criteria:*** *Demonstrate knowledge of methods for achieving productivity in knowledge work.*
> ***Measurement Criteria:*** *Apply general systems theory to the analysis and development of an information system.*
> ***Measurement Criteria:*** *Identify procedures for formal problem solving.*
> ***Measurement Criteria:*** *Demonstrate knowledge of the fundamental concept of information theory and organizational system processes.*
> ***Measurement Criteria:*** *Identify the essential properties of information systems.*

Statement: Demonstrate knowledge of the process required to solve a problem.

Performance Element: Understand information systems problem solving techniques and approaches.

> ***Measurement Criteria:*** *Demonstrate knowledge of problem-solving steps and techniques.*
> ***Measurement Criteria:*** *Summarize application planning, development, and risk management for information system.*
> ***Measurement Criteria:*** *Identify potential problems in system implementation.*
> ***Measurement Criteria:*** *Demonstrate knowledge of the information analysis process.*
> ***Measurement Criteria:*** *Demonstrate knowledge of information technology solutions.*

Statement: Demonstrate an ability to evaluate and verify the appropriateness of a solution to a problem.

Performance Element: Evaluate information systems problem solving techniques and approaches.

> ***Measurement Criteria:*** *Demonstrate knowledge of decision-making skills and techniques.*
> ***Measurement Criteria:*** *Demonstrate knowledge of critical thinking skills and techniques.*
> ***Measurement Criteria:*** *Summarize application planning, development, and risk management for information system.*
> ***Measurement Criteria:*** *Identify potential problems in system implementation.*
> ***Measurement Criteria:*** *Determine whether prototyping system is feasible.*

Cluster Knowledge and Skill Statement

Measurement Criteria: *Develop a plan using data-oriented techniques.*

Measurement Criteria: *Evaluate systems engineering considerations.*

Measurement Criteria: *Determine software design process, from specification to implementation.*

Measurement Criteria: *Appraise software process and product life-cycle models.*

Measurement Criteria: *Assess software design methods and tools.*

Statement: Demonstrate knowledge of information organization principles.

Performance Element: Understand information organization principles.

Measurement Criteria: *Demonstrate knowledge of group support technology for common knowledge requirements.*

Measurement Criteria: *Demonstrate knowledge of the information analysis process.*

Measurement Criteria: *Demonstrate knowledge of information technology solutions.*

Measurement Criteria: *Demonstrate knowledge of methods for achieving productivity in knowledge work.*

Statement: Demonstrate knowledge of design principles.

Performance Element: Understand and employ design and color principles.

Measurement Criteria: *Demonstrate knowledge of the two-dimensional picture plan.*

Measurement Criteria: *Demonstrate knowledge of the principles and elements of design and their relationship to each other.*

Measurement Criteria: *Demonstrate knowledge of the nature of color and color harmonies.*

Measurement Criteria: *Assess the impact of various color harmonies on a two-dimensional picture plan.*

Measurement Criteria: *Assess how color affects the principles of line, value, shape and form.*

Cluster Knowledge and Skill Statement

Information Technology Applications

Statement: Use Personal information Management (PIM)/ Productivity applications.

    Performance Element: Manage personal schedule and contact information.

        Measurement Criteria: *Identify PIM applications such as MS Outlook, Lotus Notes, and others.*

        Measurement Criteria: *Create tasks (to-do) list.*

        Measurement Criteria: *Manage daily/weekly/monthly schedule using applications such as Notes, MS Outlook, etc.*

    Performance Element: Create memos and notes.

        Measurement Criteria: *Create reminder for oneself.*

        Measurement Criteria: *Create and send notes, informal memos, reminder using PIM applications such as Lotus Notes, MS Outlook, and others.*

Statement: Use Electronic Mail applications.

    Performance Element: Use email to communicate within and across organizations.

        Measurement Criteria: *Access email system using login and password functions.*

        Measurement Criteria: *Access email messages received.*

        Measurement Criteria: *Create e-mail messages in accordance with established business standards (e.g., grammar, word usage, spelling, sentence structure, clarity, e-mail etiquette).*

        Measurement Criteria: *Demonstrate knowledge of e-mail etiquette.*

        Measurement Criteria: *Send e-mail messages.*

    Performance Element: Use email to share files and documents.

        Measurement Criteria: *Access email attachments.*

        Measurement Criteria: *Attach documents to messages.*

        Measurement Criteria: *Save e-mail messages/attachments.*

        Measurement Criteria: *Demonstrate knowledge of contamination protection strategies for email.*

Statement: Use Internet Applications.

    Performance Element: Search for information and resources.

        Measurement Criteria: *Select search engine(s) to use.*

        Measurement Criteria: *Select appropriate search procedures and approaches.*

        Measurement Criteria: *Locate information using search engine(s) and Boolean logic.*

        Measurement Criteria: *Navigate web sites using software functions.*

    Performance Element: Access and evaluate Internet resources.

        Measurement Criteria: *Access business and technical information using the Internet.*

        Measurement Criteria: *Access commercial, government, and education resources.*

        Measurement Criteria: *Evaluate Internet resources (e.g., accuracy of information).*

Statement: Use Writing/Publishing applications.

    Performance Element: Prepare simple documents and other business communications.

        Measurement Criteria: *Retrieve existing documents.*

        Measurement Criteria: *Create documents (e.g., letters, memos, reports) using existing forms and templates.*

        Measurement Criteria: *Safeguard documents using name and save functions.*

Cluster Knowledge and Skill Statement

        Measurement Criteria: *Format text using basic formatting functions.*

        Measurement Criteria: *Employ word processing utility tools (e.g., spell checker, grammar checker, thesaurus).*

    Performance Element: Prepare reports and other business communications, integrating graphics and other non-text elements.

        Measurement Criteria: *Use advanced formatting features (e.g., headers/footers/dropped caps, indexing).*

        Measurement Criteria: *Place graphics in document.*

        Measurement Criteria: *Enhance publications using different fonts, styles, attributes, justification, etc.*

        Measurement Criteria: *Enhance publications using paint/draw functions.*

    Performance Element: Prepare complex publications.

        Measurement Criteria: *Create new word processing forms, style sheets, and templates.*

        Measurement Criteria: *Prepare publications using desktop publishing software.*

        Measurement Criteria: *Format new desktop publishing files.*

        Measurement Criteria: *Output desktop publishing files.*

Statement: Use Presentation applications.

    Performance Element: Prepare presentations for training, sales and information sharing.

        Measurement Criteria: *Create computer presentation and handouts in accordance with basic principles of graphics design and visual communication.*

        Measurement Criteria: *Insert graphic elements (e.g., graph, clip art, table) in a slide.*

        Measurement Criteria: *Edit presentations.*

    Performance Element: Deliver presentations, with supporting materials.

        Measurement Criteria: *Identify hardware items that support presentation software (e.g., scanners, digital cameras, printers, and projection systems).*

        Measurement Criteria: *Print a single slide, an entire presentation, an outline, and notes.*

        Measurement Criteria: *Run slide shows manually and automatically.*

Statement: Use Spreadsheet applications.

    Performance Element: Create a spreadsheet.

        Measurement Criteria: *Create spreadsheets.*

        Measurement Criteria: *Retrieve existing spreadsheets.*

        Measurement Criteria: *Edit spreadsheets.*

        Measurement Criteria: *Save spreadsheets.*

        Measurement Criteria: *Print spreadsheets*

    Performance Element: Perform calculations and analysis on data.

        Measurement Criteria: *Group worksheets.*

        Measurement Criteria: *Create charts and graphs from spreadsheets.*

        Measurement Criteria: *Perform calculations using simple formulas.*

        Measurement Criteria: *Input/process data using spreadsheet functions.*

Statement: Use Database applications

    Performance Element: Manipulate data elements.

        Measurement Criteria: *Enter data using a form.*

        Measurement Criteria: *Locate/replace data using search and replace functions.*

Cluster Knowledge and Skill Statement

    Measurement Criteria: *Process data using database functions (e.g., structure, format, attributes, relationships, keys)*

Performance Element: Manage, analyze and report on interrelated data elements.

    Measurement Criteria: *Search a database table to locate records.*

    Measurement Criteria: *Sort data using single- and multiple-field sorts.*

    Measurement Criteria: *Perform single- and multiple-table queries (e.g., create, run, save).*

    Measurement Criteria: *Print forms, reports, and results of queries.*

    Measurement Criteria: *Verify accuracy of output.*

Statement: Use Collaborative/Groupware applications.

Performance Element: Facilitate group work through management of shared schedule and contact information.

    Measurement Criteria: *Manage daily/weekly/monthly schedule using applications.*

    Measurement Criteria: *Maintain shared database of contact information.*

Performance Element: Facilitate group work through management of shared files and online information.

    Measurement Criteria: *Organize, store, and share files in network directories.*

    Measurement Criteria: *Organize, store, and share files using web sites.*

    Measurement Criteria: *Organize, store, and share files using document libraries or databases.*

Performance Element: Facilitate group work through instant messaging or virtual meetings.

    Measurement Criteria: *Participate in virtual group discussions and meetings.*

Statement: Use Computer Operations applications.

Performance Element: Manage computer operations.

    Measurement Criteria: *Apply basic commands of operating system software.*

    Measurement Criteria: *Employ desktop operating skills.*

Performance Element: Manage file storage.

    Measurement Criteria: *Apply appropriate file and disk management techniques.*

    Measurement Criteria: *Differentiate between files and directories.*

    Measurement Criteria: *Determine file organization.*

    Measurement Criteria: *Demonstrate knowledge of the system utilities used for file management.*

Performance Element: Compress or alter files.

    Measurement Criteria: *Convert file formats.*

    Measurement Criteria: *Unpack files using compression software.*

    Measurement Criteria: *Convert existing files.*

Statement: Use Computer-based Equipment (containing embedded computers (or processors) used to control electromechanical devices).

Performance Element: Operate computer driven equipment and machines.

    Measurement Criteria: *Secure needed supplies and resources.*

    Measurement Criteria: *Follow power-up and log-on procedures.*

    Measurement Criteria: *Interact with/respond to system messages using console device.*

    Measurement Criteria: *Run applications/jobs in accordance with processing procedures.*

Cluster Knowledge and Skill Statement

  Measurement Criteria: *Follow log-off and power-down procedure(s).*

Performance Element: Use installation and operation manuals.

  Measurement Criteria: *Access needed information using appropriate reference materials.*

Performance Element: Troubleshoot computer driven equipment and machines and access support as needed.

  Measurement Criteria: *Test system using diagnostic tools/software.*

  Measurement Criteria: *Repair/replace malfunctioning hardware.*

  Measurement Criteria: *Reinstall software as needed.*

  Measurement Criteria: *Recover data and/or files.*

  Measurement Criteria: *Restore system to normal operating standards.*

Cluster Knowledge and Skill Statement

Systems

Statement: Characterize the nature of business.

  Performance Element: Understand types and functions of businesses.
    Measurement Criteria: *Identify types of business organizations and functions.*
    Measurement Criteria: *Identify business reporting and information flow.*
    Measurement Criteria: *Define stakeholder relationships (e.g., customers, employees, shareholders, and suppliers).*

  Performance Element: Understand functions and interactions of departments within a business.
    Measurement Criteria: *Demonstrate knowledge of the components of a business plan.*
    Measurement Criteria: *Identify the ways in which organizational functions are interdependent.*
    Measurement Criteria: *Identify types of communication channels (e.g., formal, informal).*
    Measurement Criteria: *Define the role of strategic planning in business.*

Statement: Demonstrate knowledge of the nature of IT in business.

  Performance Element: Understand the functions of information systems in business.
    Measurement Criteria: *Determine how business activities interface with data processing functions.*
    Measurement Criteria: *Differentiate between the role of information systems within a company and their role in a global environment.*
    Measurement Criteria: *Measure increases in productivity realized by the implementation of information systems.*

Statement: Demonstrate knowledge of the operation of cross-functional teams in achieving project goals.

  Performance Element: Understand the importance of cross-functional teams in achieving IT project goals.
    Measurement Criteria: *Consider the benefits of using a cross-functional team in policy and procedure development.*
    Measurement Criteria: *Identify desired group and team behavior in an IS context.*

Statement: Explain/discuss general strategies for maximizing organizational learning and productivity in a high tech environment.

  Performance Element: Understand strategies for maximizing productivity in a high tech environment.
    Measurement Criteria: *Assess the importance of new technologies to future developments and to the future knowledge worker productivity.*
    Measurement Criteria: *Demonstrate knowledge of methods for achieving productivity in knowledge work.*
    Measurement Criteria: *Create/maintain an environment supportive of productivity.*

Cluster Knowledge and Skill Statement

Safety, Health, and Environmental

Statement: Maintain a safe working environment.

Performance Element: Understand health and safety standards and concepts in the workplace.

Measurement Criteria: *Demonstrate knowledge of the relationship between health, safety, and productivity.*

Measurement Criteria: *Identify health and safety standards established by government agencies.*

Measurement Criteria: *Access needed safety information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, and flowcharts).*

Measurement Criteria: *Ensure maintenance of a clean work area.*

Measurement Criteria: *Solve safety problems using problem solving, decision-making, and critical thinking strategies.*

Measurement Criteria: *Demonstrate knowledge of ergonomics and repetitive strain injury.*

Cluster Knowledge and Skill Statement

Leadership and Teamwork

Statement: Demonstrate knowledge of the skills needed for leadership in the IT environment.

Performance Element: Understand key approaches to successful leadership in the IT environment.

Measurement Criteria: *Demonstrate knowledge of how to apply team methods to empower coworkers.*

Measurement Criteria: *Establish goals and objectives for IS.*

Measurement Criteria: *Define mission and critical success factors.*

Measurement Criteria: *Identify desired group and team behavior in an IS context.*

Statement: Build interpersonal skills with individuals and other team members.

Performance Element: Understand best practices for successful team functioning.

Measurement Criteria: *Analyze the interdependence of empathetic listening, synergy, and consensus building.*

Measurement Criteria: *Define roles within the group decision-making process.*

Measurement Criteria: *Demonstrate knowledge of how to apply team methods to empower coworkers*

Performance Element: Apply best practices for successful team functioning.

Measurement Criteria: *Apply knowledge of group dynamics.*

Measurement Criteria: *Promote teamwork, leadership, and empowerment.*

Measurement Criteria: *Identify strategies for fostering creativity.*

Cluster Knowledge and Skill Statement

Ethics and Legal Responsibilities

Statement: Demonstrate appropriate knowledge and behaviors of legal responsibilities and of positive cyber-citizenry.

Performance Element: Understand legal issues faced by IT professionals.

Measurement Criteria: *Demonstrate knowledge of the legal issues that face information technology professionals.*

Measurement Criteria: *Identify issues and trends affecting computers and information privacy*

Statement: Demonstrate knowledge of the rights and responsibilities of IT workers.

Performance Element: Understand the rights and responsibilities of IT workers.

Measurement Criteria: *Identify generally accepted business ethics.*

Measurement Criteria: *Demonstrate knowledge of federal laws governing discrimination and harassment.*

Measurement Criteria: *Demonstrate knowledge of key concepts related to employment discrimination.*

Measurement Criteria: *Demonstrate sensitivity to diversity, including differences in gender, culture, race, language, physical and mental challenges, and family structures.*

Measurement Criteria: *Establish procedures for maintaining the confidentiality of client information.*

Statement: Demonstrate knowledge of social, ethical, and legal issues in the information technology field.

Performance Element: Understand ethical issues in the IT field.

Measurement Criteria: *Analyze the social implications of decisions made and actions taken as an information technology professional.*

Measurement Criteria: *Demonstrate knowledge of the ethical issues that face information technology professionals.*

Performance Element: Understand legal issues in the IT field.

Measurement Criteria: *Determine the practical implications of lawsuits in terms of good will, client relations, the bottom line, diversion of company resources, cash flow and accounts receivable.*

Measurement Criteria: *Demonstrate knowledge of basic business law concepts.*

Cluster Knowledge and Skill Statement

Employability and Career Development

Statement: Explain written organizational policies, rules and procedures to help employees perform their jobs.

   Performance Element: Locate appropriate information on organizational policies in handbooks and manuals.
   Measurement Criteria: Identify the contents of various organizational publications.
   Measurement Criteria: Determine the appropriate document (s) for specific job responsibilities and work assignments.

   Performance Element: Discuss how specific organizational policies and rules influence a specific work situation.
   Measurement Criteria: Locate and identify specific organizational policy, rule or procedure to assist with a given situation.
   Measurement Criteria: Articulate how a specific organizational policy, rule or procedure will improve a given situation.

Statement: Identify and demonstrate positive work behaviors and personal qualities.

   Performance Element: Demonstrate self-discipline, self-worth, positive attitude, and integrity in a work situation.
   Measurement Criteria: Demonstrate regular attendance.
   Measurement Criteria: Follow company dress and appearance standards.
   Measurement Criteria: Exhibit pride in work.
   Measurement Criteria: Demonstrate leadership and teamwork.

   Performance Element: Demonstrate flexibility and willingness to learn new knowledge and skills.
   Measurement Criteria: Exhibit ability to handle stress.
   Measurement Criteria: Display initiative and open-mindedness.
   Measurement Criteria: Participate in company orientation and training programs with enthusiasm.
   Measurement Criteria: Identify progressive strategies that will impact efficiency of job.

   Performance Element: Exhibit commitment to the organization.
   Measurement Criteria: Follow established rules, regulations and policies.
   Measurement Criteria: Explain employer/management responsibilities.
   Measurement Criteria: Demonstrate cost effectiveness.
   Measurement Criteria: Demonstrate time management.
   Measurement Criteria: Complete all tasks thoroughly.

Statement: Identify and explore career opportunities in one or more career pathways.

   Performance Element: Locate and identify career opportunities that appeal to personal career goals.
   Measurement Criteria: Locate and interpret career information for at least one career cluster.
   Measurement Criteria: Identify job requirements for three career pathways.
   Measurement Criteria: Identify educational and credentialing requirements for three careers.

Cluster Knowledge and Skill Statement

Performance Element: Match personal interests and aptitudes to selected careers.

Measurement Criteria: *Identify personal interests and aptitudes.*

Measurement Criteria: *Identify job requirements and characteristics of selected careers.*

Measurement Criteria: *Compare personal interests and aptitudes with job requirements and characteristics.*

Measurement Criteria: *Modify career goals based on results of personal interests and aptitudes with career requirements and characteristics.*

Statement: Develop a personal career plan to meet career goals and objectives.

Performance Element: Develop career goal and objectives to plan future career direction.

Measurement Criteria: *Identify career that matches individual interests and   aptitudes.*

Measurement Criteria: *Develop career goal with time frame.*

Measurement Criteria: *Identify goals and objectives for reaching and advancing in career.*

Performance Element: Develop strategies to reach career objectives.

Measurement Criteria: *Write a list of strategies for achieving educational requirements.*

Measurement Criteria: *Identify strategies for obtaining employment experiences.*

Measurement Criteria: *Write a time line for achieving career goals and objectives.*

Measurement Criteria: *List alternatives and potential changes.*

Statement: Demonstrate ability to seek and apply for employment.

Performance Element: Use multiple resources to locate job opportunities.

Measurement Criteria: *Identify resources for finding employment.*

Measurement Criteria: *Analyze resources to determine those that are most appropriate for desired career.*

Measurement Criteria: *Compare job requirements with personal qualifications, interests, and aptitudes.*

Measurement Criteria: *Select job that matches personal qualifications, interests, and aptitudes.*

Performance Element: Prepare a resume and letter of application to apply.

Measurement Criteria: *Identify respective employer's submission requirements.*

Measurement Criteria: *Gather information and prepare rough draft of resume.*

Measurement Criteria: *Put resume in proper format.*

Measurement Criteria: *Write letter of application for specific job opening in correct format without error.*

Performance Element: Complete an employment application to obtain employment.

Measurement Criteria: *Gather information for application.*

Measurement Criteria: *Complete all questions on application with appropriate and honest answers.*

Measurement Criteria: *Sign and date application.*

Measurement Criteria: *Attach any supporting material required or requested.*

Measurement Criteria: *Submit full application package to employers.*

Cluster Knowledge and Skill Statement

Performance Element: Interview to obtain employment.
Measurement Criteria: *Dress appropriately for interview.*
Measurement Criteria: *Exhibit professional conduct before, during and after interview.*
Measurement Criteria: *Explain your qualifications and interests clearly and concisely.*
Measurement Criteria: *Answer all questions honestly and concisely.*
Measurement Criteria: *Write follow-up letter after the interview.*

Statement: Demonstrate ability to evaluate and compare employment opportunities and accept employment.

Performance Element: Evaluate and compare employment opportunity to individual needs and career plan.
Measurement Criteria: *Identify job advantages and disadvantages.*
Measurement Criteria: *Compare job benefits to individual needs.*
Measurement Criteria: *Compare job opportunities and responsibilities to career plan.*

Performance Element: Accept or reject employment.
Measurement Criteria: *Make decision to accept or reject employment.*
Measurement Criteria: *Write acceptance or rejection letter without error.*
Measurement Criteria: *Complete employment forms upon acceptance.*

Statement: Provide examples of how IT is transforming business in various industries.

Performance Element: Understand the impact of IT on business.
Measurement Criteria: *Demonstrate knowledge of how both PCs and larger computer systems impact people and are used in business/industry/government and other institutions.*
Measurement Criteria: *Demonstrate knowledge of the impact of computers on career pathways in business/industry (e.g., how computers have eliminated and created jobs).*
Measurement Criteria: *Demonstrate knowledge of the impact of computers on access to information and information exchange worldwide.*
Measurement Criteria: *Demonstrate knowledge of ethical issues that have surfaced in the information age.*

Statement: Demonstrate knowledge of the relationship between lifelong learning and IT career development.

Performance Element: Demonstrate knowledge of IT as a constantly changing and fast growing field.
Measurement Criteria: *Identify present and future IT employment opportunities.*
Measurement Criteria: *Demonstrate knowledge of the potential impact of IT on future society.*
Measurement Criteria: *Identify the importance of lifelong learning in the IT field.*

Performance Element: Identify education and training requirements for selected career pathway.
Measurement Criteria: *Identify certification and/or degree requirements.*
Measurement Criteria: *Identify required knowledge and skills for career ladder.*

Cluster Knowledge and Skill Statement

Performance Element: Identify education and training opportunities available for selected career pathway.

Measurement Criteria: *Research educational and training opportunities.*

Measurement Criteria: *Identify present and future IT education and training opportunities.*

Measurement Criteria: *Design a lifelong learning plan that ties in with career advancement plan.*

Statement: Demonstrate knowledge of career development/progression patterns in the IT industry.

Performance Element: Identify career development patterns in the IT industry.

Measurement Criteria: *Identify education and training requirements for IT career pathways.*

Performance Element: Identify and understand the benefits of membership in professional IT organizations.

Measurement Criteria: *Identify professional organizations in the area of information technology.*

Measurement Criteria: *Identify benefits derived from membership in specific professional organizations.*

Cluster Knowledge and Skill Statement

Technical Skills

*Statement: **Demonstrate knowledge of the hardware components associated with information systems.***

   Performance Element: Understand the fundamentals of operating systems.
   Measurement Criteria: *Identify major operating system fundamentals and components.*

   Performance Element: Explain the role of number systems in information systems.
   Measurement Criteria: *Identify the role the binary system in information systems.*
   Measurement Criteria: *Demonstrate knowledge of number systems and internal data representation*

   Performance Element: Identify computer classifications and hardware.
   Measurement Criteria: *Identify the three main classifications of computers (i.e., micro-, mid-range, and mainframes).*
   Measurement Criteria: *Identify major hardware components and their functions.*
   Measurement Criteria: *Identify the hardware associated with telecommunications functions.*
   Measurement Criteria: *Identify types of computer storage devices.*

   Performance Element: Understand elements and types of information processing.
   Measurement Criteria: *Identify the elements of the information processing cycle (i.e., input, process, output, and storage).*
   Measurement Criteria: *Identify types of processing (e.g., batch, interactive, event-driven, object-oriented).*

   Performance Element: Use available reference tools as appropriate.
   Measurement Criteria: *Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts).*

*Statement: **Demonstrate knowledge of the classes of software associated with information systems.***

   Performance Element: Explain the key functions and applications of software.
   Measurement Criteria: *Demonstrate knowledge of the key functions of systems software.*
   Measurement Criteria: *Demonstrate knowledge of widely used software applications (e.g., word processing, database management, spreadsheet development).*
   Measurement Criteria: *Demonstrate knowledge of the function and operation of compilers and interpreters.*

   Performance Element: Understand the range of languages used in software development.
   Measurement Criteria: *Demonstrate knowledge of the range of languages used in software development.*

   Performance Element: Understand how data is organized in software development.
   Measurement Criteria: *Demonstrate knowledge of how data is organized in software development.*

   Performance Element: Explain new and emerging classes of software.
   Measurement Criteria: *Identify new and emerging classes of software.*

*Statement: **Explore the future of information technologies.***

   Performance Element: Explain measurement techniques for increased productivity

due to information systems implementation.

Measurement Criteria: *Measure increases in productivity realized by the implementation of information systems.*

Performance Element: Identify new IT technologies and assess their potential importance and impact in the future.

Measurement Criteria: *Identify new technologies relevant to information technology.*

Measurement Criteria: *Assess the importance of new technologies to future developments and to future knowledge worker productivity.*

Measurement Criteria: *Identify new and emerging drivers and inhibitors of information technology change.*

Statement: Demonstrate knowledge of basic data communications components and trends.

Performance Element: Explain data communications procedures, equipment and media.

Measurement Criteria: *Demonstrate knowledge of key communications procedures.*

Measurement Criteria: *Demonstrate knowledge of the uses of data communication equipment.*

Measurement Criteria: *Demonstrate knowledge of types of communications media.*

Performance Element: Understand data transmission codes and protocols.

Measurement Criteria: *Demonstrate knowledge of data transmission codes and protocols.*

Performance Element: Explain the differences between local and wide area networks.

Measurement Criteria: *Distinguish between local area networks and wide-area networks.*

Performance Element: Understand data communications trends and issues.

Measurement Criteria: *Identify data communication trends.*

Measurement Criteria: *Identify major current issues in data communications.*

Statement: Demonstrate technical knowledge of the Internet.

Performance Element: Understand Internet protocols.

Measurement Criteria: *Demonstrate knowledge of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite.*

Measurement Criteria: *Demonstrate knowledge of Simple Network Management Protocol (SNMP).*

Measurement Criteria: *Demonstrate knowledge of IP forwarding, encapsulation, and fragmentation.*

Performance Element: Explain Domain Name Server (DNS).

Measurement Criteria: *Demonstrate knowledge of the Domain Name Server (DNS).*

Performance Element: Understand Internet security issues and systems available for addressing them.

Measurement Criteria: *Demonstrate knowledge of Internet security issues.*

Measurement Criteria: *Identify available Internet security systems.*

Statement: Access the Internet.

Performance Element: Use and troubleshoot Internet connection.

Measurement Criteria: *Connect to the Internet.*

Measurement Criteria: *Test Internet connection.*

Cluster Knowledge and Skill Statement

Performance Element: Explain the components of Internet software.
> *Measurement Criteria:* *Demonstrate knowledge of the components of Internet software.*

Performance Element: Install and use Internet software.
> *Measurement Criteria:* *Explore browser features.*
> *Measurement Criteria:* *Install Internet software.*
> *Measurement Criteria:* *Download free software upgrades and shareware from the Internet.*
> *Measurement Criteria:* *Unpack files using compression software.*

Performance Element: Understand virus protection procedures.
> *Measurement Criteria:* *Demonstrate acute awareness of virus protection techniques.*

Statement: Utilize Internet services.

Performance Element: Use web browser software.
> *Measurement Criteria:* *Navigate web sites using software functions (e.g., Forward, Back, Go To, Bookmarks).*
> *Measurement Criteria:* *Bookmark web addresses (URLs).*

Performance Element: Apply search procedures to locate information on the Internet.
> *Measurement Criteria:* *Select search engine(s) to use.*
> *Measurement Criteria:* *Select appropriate search procedures and approaches.*
> *Measurement Criteria:* *Locate information using search engine(s) and Boolean logic.*

Performance Element: Obtain, compile and evaluate information from the Internet.
> *Measurement Criteria:* *Access business and technical information using the Internet.*
> *Measurement Criteria:* *Access library catalogs on the Internet.*
> *Measurement Criteria:* *Access commercial, government, and education resources.*
> *Measurement Criteria:* *Compile a collection of business sites (e.g., finance and investment).*
> *Measurement Criteria:* *Evaluate Internet resources (e.g., accuracy of information).*

Performance Element: Install and download software from the Internet.
> *Measurement Criteria:* *Download files from FTP archives.*
> *Measurement Criteria:* *Retrieve online tools.*
> *Measurement Criteria:* *Download/convert Internet programming files.*
> *Measurement Criteria:* *Install/configure web browser.*
> *Measurement Criteria:* *Explore the multimedia capabilities of the World Wide Web.*
> *Measurement Criteria:* *Add plug-ins and helpers to the web browser.*
> *Measurement Criteria:* *Archive files.*

Performance Element: Use the Internet to communicate and collaborate.
> *Measurement Criteria:* *Communicate via e-mail using the Internet.*
> *Measurement Criteria:* *Subscribe to mailing lists.*
> *Measurement Criteria:* *Participate in newsgroups.*
> *Measurement Criteria:* *Explore collaboration tools.*
> *Measurement Criteria:* *Participate in online audio and video conferencing.*
> *Measurement Criteria:* *Explore electronic commerce.*

Statement: Install and configure software programs.

Performance Element: Ensure that hardware and software system components are

compatible prior to performing installation.

> ***Measurement Criteria:*** *Identify hardware requirements (e.g., processor, memory, disk space, communications, printers, monitors).*
>
> ***Measurement Criteria:*** *Determine compatibility of hardware and software.*

Performance Element: Ensure that software to be installed is licensed prior to performing installation.

> ***Measurement Criteria:*** *Verify conformance to licensing agreement.*

Performance Element: Perform installation accurately and completely, using available resources as needed.

> ***Measurement Criteria:*** *Install given application/system software on various platforms in accordance with manufacturer's procedures.*
>
> ***Measurement Criteria:*** *Disable/uninstall software that may interfere with installation of new software.*
>
> ***Measurement Criteria:*** *Differentiate between procedures for an upgrade and for a new installation.*
>
> ***Measurement Criteria:*** *Differentiate between stand-alone and network installation procedures.*
>
> ***Measurement Criteria:*** *Select appropriate installation options (e.g., default, customized).*
>
> ***Measurement Criteria:*** *Configure software to appropriate operating system settings.*
>
> ***Measurement Criteria:*** *Configure macros, tools, and packages to accomplish simple organizational and personal tasks.*
>
> ***Measurement Criteria:*** *Convert data files if required.*
>
> ***Measurement Criteria:*** *Verify software installation and operation*

Performance Element: Resolve problems with installation if they occur.

> ***Measurement Criteria:*** *Troubleshoot unexpected results.*
>
> ***Measurement Criteria:*** *Access needed help using manufacturers' technical help lines or Internet sites.*
>
> ***Measurement Criteria:*** *Formulate new installation procedure if needed.*

Performance Element: Perform customization as requested.

> ***Measurement Criteria:*** *Customize software to meet user preferences.*

Performance Element: Clearly document procedures for future use.

> ***Measurement Criteria:*** *Document step-by-step installation and configuration procedures.*

Statement: Demonstrate knowledge of web page basics.

Performance Element: Explain the features and functions of web browsing software.

> ***Measurement Criteria:*** *Demonstrate knowledge of the role of browsers in reading files on the World Wide Web (text-only, hypertext).*
>
> ***Measurement Criteria:*** *Identify how different browsers affect the look of a web page.*
>
> ***Measurement Criteria:*** *Demonstrate knowledge of the characteristics and uses of plug-ins.*

Performance Element: Explain the features and functions of web page design software.

> ***Measurement Criteria:*** *Compare/contrast the features and functions of software editors available for designing web pages.*

Cluster Knowledge and Skill Statement

Performance Element: Understand the differences between a client and a server.
    Measurement Criteria: *Differentiate between a client and a server.*

Performance Element: Understand how bandwidth affects data transmission and on-screen image.
    Measurement Criteria: *Demonstrate knowledge of how bandwidths affect data transmission and on-screen image.*

Performance Element: Explain the benefits of hosting a web site on a local server vs. at an ISP (Internet Service Provider).
    Measurement Criteria: *Compare the advantages and disadvantages of running your own server vs. using a server provider.*

Statement: Operate system.

Performance Element: Configure/modify system as needed.
    Measurement Criteria: *Secure needed supplies and resources.*
    Measurement Criteria: *Review automated scheduling software.*
    Measurement Criteria: *Identify data requirements.*
    Measurement Criteria: *Identify scheduling priority in programming.*
    Measurement Criteria: *Build system software command structures using operating system macro facilities for computer systems.*

Performance Element: Apply knowledge of operating systems principles to ensure optimal functioning of system.
    Measurement Criteria: *Apply basic commands of operating system software.*
    Measurement Criteria: *Apply appropriate file and disk management techniques.*
    Measurement Criteria: *Employ desktop operating skills.*
    Measurement Criteria: *Handle materials and equipment in a responsible manner.*
    Measurement Criteria: *Follow power-up and log-on procedures.*
    Measurement Criteria: *Interact with/respond to system messages using console device.*
    Measurement Criteria: *Run applications/jobs in accordance with processing procedures.*
    Measurement Criteria: *Follow log-off and power-down procedure(s).*

Performance Element: Use available reference tools as appropriate.
    Measurement Criteria: *Access needed information using appropriate reference materials.*

Performance Element: Document procedures and actions.
    Measurement Criteria: *Develop audit trails.*

Statement: Perform standard computer backup procedures.

Performance Element: Explain the need for regular backup procedures.
    Measurement Criteria: *Recognize the need for regular backup procedures.*

Performance Element: Configure & maintain backup system.
    Measurement Criteria: *Load backup software.*
    Measurement Criteria: *Load compression drive backup software.*
    Measurement Criteria: *Install surge suppression protection.*
    Measurement Criteria: *Identify battery backup equipment.*
    Measurement Criteria: *Maintain battery backup system*

Cluster Knowledge and Skill Statement

Performance Element: Perform backup procedures.

Measurement Criteria: *Perform restore operation using backup software.*

Measurement Criteria: *Perform restore operation using compression drive backup software.*

Statement: Describe system components.

Performance Element: Understand CPUs.

Measurement Criteria: *Demonstrate knowledge of central processing unit (CPU) control and architecture.*

Measurement Criteria: *Identify CPU modes of operations.*

Performance Element: Understand operating systems.

Measurement Criteria: *Demonstrate knowledge of operating system architecture types.*

Measurement Criteria: *Identify operating system goals.*

Measurement Criteria: *Demonstrate knowledge of operating system structuring methods, layered models, and the object-server model.*

Measurement Criteria: *Differentiate between microcomputer, minicomputer, and mainframe operating systems.*

Measurement Criteria: *Demonstrate knowledge of network operating systems.*

Measurement Criteria: *Define the role of memory management in an operating system.*

Measurement Criteria: *Demonstrate knowledge of the commands used to handle tasks in operating systems.*

Measurement Criteria: *Demonstrate knowledge of interface theory in an operating system.*

Performance Element: Understand the fundamentals of operating systems.

Measurement Criteria: *Demonstrate knowledge of the basics of process management.*

Measurement Criteria: *Demonstrate knowledge of the system utilities used for file management.*

Statement: Maintain security requirements.

Performance Element: Understand potential security threats to information systems.

Measurement Criteria: *Demonstrate knowledge of potential internal and external threats to security.*

Performance Element: Assess security threats and develop plan to address.

Measurement Criteria: *Maximize threat reduction.*

Measurement Criteria: *Assess exposure to security issues.*

Measurement Criteria: *Implement countermeasures.*

Measurement Criteria: *Ensure compliance with security rules, regulations, and codes.*

Measurement Criteria: *Demonstrate knowledge of virus protection strategy.*

Measurement Criteria: *Implement security procedures in accordance with business ethics.*

Cluster Knowledge and Skill Statement

Performance Element: Implement and document security procedures.

Measurement Criteria: *Maintain confidentiality.*

Measurement Criteria: *Load virus detection and protection software.*

Measurement Criteria: *Identify sources of virus infections.*

Measurement Criteria: *Remove viruses.*

Measurement Criteria: *Report viruses in compliance with company standards.*

Measurement Criteria: *Implement backup and recovery procedures.*

Measurement Criteria: *Follow disaster plan.*

Measurement Criteria: *Provide for user authentication (e.g., assign passwords, access level).*

Measurement Criteria: *Document security procedures.*

Statement: Employ computer system interfaces.

Performance Element: Configure systems to provide optimal system interfaces.

Measurement Criteria: *Define hardware-software interface issues for a computer system.*

Measurement Criteria: *Identify standards and issues related to I/O programming and design of I/O interfaces.*

Measurement Criteria: *Interface peripheral devices/controllers in the computer system (e.g., software and hardware interrupts, exceptions, Direct Memory Addressing [DMA], bus structures).*

Measurement Criteria: *Apply concepts of privileged instructions and protected mode programming.*

Measurement Criteria: *Configure peripheral device drivers (e.g., disk, display, printer, modem, keyboard, mouse, network).*

Measurement Criteria: *Apply advanced I/O concepts (e.g., disk caching, data compression, extended memory, magnetic disk/CD-ROM storage and formats).*

Measurement Criteria: *Allocate disk space, non-sharable resources, and I/O devices.*

Statement: Maintain system

Performance Element: Implement queries and reports to provide access to critical system information.

Measurement Criteria: *Create a query to extract information from a file.*

Measurement Criteria: *Create a query to extract information from multiple files.*

Measurement Criteria: *Create reports from queries.*

Measurement Criteria: *Create and use logical files.*

Measurement Criteria: *Develop a display screen for use with high-level language program.*

Measurement Criteria: *Access needed information using appropriate reference materials*

Cluster Knowledge and Skill Statement

Performance Element: Ensure that system is functioning optimally.

   Measurement Criteria: *Monitor system status and performance.*

   Measurement Criteria: *Run diagnostics.*

   Measurement Criteria: *Respond to system messages.*

   Measurement Criteria: *Perform preventive maintenance procedures on computer and peripheral devices.*

   Measurement Criteria: *Handle materials and equipment in a responsible manner.*

   Measurement Criteria: *Optimize windows environment to maximize performance of desktop resources.*

   Measurement Criteria: *Review automated scheduling software.*

Performance Element: Fix and document system problems.

   Measurement Criteria: *Fix recoverable problems.*

   Measurement Criteria: *Restore system.*

   Measurement Criteria: *Document computer system malfunction(s).*

   Measurement Criteria: *Document software malfunction(s).*

Statement: Provide support and training.

Performance Element: Provide Help Desk service to computer users within the organization.

   Measurement Criteria: *Operate help desk.*

   Measurement Criteria: *Employ desktop productivity tools.*

   Measurement Criteria: *Support computer users.*

Performance Element: Provide training .

   Measurement Criteria: *Train computer users.*

Performance Element: Ensure that network is functioning within specification.

   Measurement Criteria: *Support Network Operating Center (NOC).*

   Measurement Criteria: *Demonstrate knowledge of the operations of Network Operating Center (NOC).*

Statement: Demonstrate a basic knowledge of quality assurance concepts.

Performance Element: Explain the history and standards of key quality management initiatives.

   Measurement Criteria: *Demonstrate knowledge of the historical evolution of quality assurance/total quality management (e.g., Deming, ISO 9000).*

   Measurement Criteria: *Demonstrate knowledge of changes brought about by quality leaders in the world.*

   Measurement Criteria: *Demonstrate knowledge of the ISO 9000 process.*

   Measurement Criteria: *Demonstrate knowledge of the standards/requirements for the Baldridge award.*

   Measurement Criteria: *Demonstrate knowledge of successful efforts by industry to improve quality and/or reduce costs.*

Performance Element: Explain the terminology, role and benefits of quality within an organization.

   Measurement Criteria: *Demonstrate knowledge of quality management terminology.*

   Measurement Criteria: *Identify the role of quality within the organization.*

   Measurement Criteria: *Identify the features and benefits of quality planning.*

Cluster Knowledge and Skill Statement

Performance Element: Explain the elements of a quality management system.

Measurement Criteria: *Demonstrate knowledge of the control devices used in functional areas (e.g., SPC, equipment).*

Measurement Criteria: *Demonstrate knowledge of the relationship among organizational structures, policies, procedures, and quality assurance.*

Measurement Criteria: *Identify internal and external customers.*

Measurement Criteria: *Differentiate between prevention and detection.*

Measurement Criteria: *Differentiate between variable and attribute data.*

Measurement Criteria: *Identify types of control charts.*

Measurement Criteria: *Demonstrate knowledge of how statistical techniques are used to control quality (e.g., SPC, DOE, CR).*

Section III – Pathway Knowledge and Skills

PATHWAY: Network Systems

Pathway Topic: Network Systems Pathway

Pathway KS Statement: Identify and analyze customer/organizational network system needs and requirements.

Performance Element: **Gather data to identify customer/organizational requirements.**

Measurement Criteria: *Gather data to identify customer requirement.*

Measurement Criteria: *Identify system and network requirements.*

Measurement Criteria: *Develop functional requirements/specifications for high-level systems.*

Measurement Criteria: *Identify security requirements.*

Measurement Criteria: *Identify time, technology, and resource constraints.*

Measurement Criteria: *Identify physical requirements for system implementation.*

Measurement Criteria: *Identify system requirements for various types of installations.*

Measurement Criteria: *Identify new application requirements within the system.*

Measurement Criteria: *Identify environment requirements, conditions and limitations.*

Measurement Criteria: *Determine required service level.*

Measurement Criteria: *Gather information using interviewing strategies.*

Measurement Criteria: *Identify input and output requirements.*

Measurement Criteria: *Identify system processing requirements.*

Measurement Criteria: *Clarify specifications using questioning techniques.*

Measurement Criteria: *Identify hardware, networking, and software system functional requirements.*

Measurement Criteria: *Demonstrate knowledge of nonfunctional requirements (e.g., security, integrity response time, reliability, support, and documentation).*

Performance Element: **Conduct needs analysis.**

Measurement Criteria: *Gather information on problems from users.*

Measurement Criteria: *Perform workflow analysis to determine user needs.*

Measurement Criteria: *Analyze existing procedures.*

Measurement Criteria: *Define business problem to be solved by the application.*

Measurement Criteria: *Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts).*

Performance Element: **Develop networking requirements specification.**

Measurement Criteria: *Demonstrate knowledge of the use, structure, and contents of a requirements specification document.*

Measurement Criteria: *Define system and software requirements.*

Measurement Criteria: *Develop informal specifications.*

Measurement Criteria: *Develop formal specification.*

Measurement Criteria: *Evaluate installation requirements.*

Measurement Criteria: *Resolve conflicting requirements.*

Measurement Criteria: *Review and verify specification with customer.*

Performance Element: **Analyze requirements/specifications using current approaches.**

Measurement Criteria: *Analyze facilities' bandwidth requirements.*

Pathway Topic: Network Systems Pathway

Measurement Criteria: *Demonstrate knowledge of how to use software methodologies to analyze a real-world problem.*

Measurement Criteria: *Identify constraints.*

Pathway KS Statement: Perform project management.

Performance Element: Produce strategies and plan to solve the specific network problem.

Measurement Criteria: *Evaluate project requirements.*

Measurement Criteria: *Define scope of work to meet customer/organizational requirements.*

Measurement Criteria: *Conduct organizational planning for information system.*

Measurement Criteria: *Demonstrate knowledge of the key functions and subsystems of the network system.*

Measurement Criteria: *Demonstrate knowledge of the system life-cycle approach.*

Performance Element: Create project plan.

Measurement Criteria: *Demonstrate knowledge of project budgeting, scheduling, and control issues related to development and support of a network system.*

Measurement Criteria: *Prepare overall plan for integrating new processes, protocols, and equipment.*

Measurement Criteria: *Develop implementation plan.*

Measurement Criteria: *Identify tools and resources for the job.*

Measurement Criteria: *Identify and evaluate risks.*

Measurement Criteria: *Identify critical milestones.*

Measurement Criteria: *Identify interdependencies.*

Measurement Criteria: *Estimate time requirements.*

Performance Element: Manage information system project methodologies.

Measurement Criteria: *Define the project's contribution to business needs.*

Measurement Criteria: *Define the scope of the project.*

Measurement Criteria: *Identify stakeholders and decision makers.*

Measurement Criteria: *Identify escalation procedures.*

Measurement Criteria: *Develop task list (work breakdown structures).*

Measurement Criteria: *Evaluate project requirements and risks.*

Measurement Criteria: *Identify required resources and budget.*

Measurement Criteria: *Develop initial project management flowchart.*

Measurement Criteria: *Identify interdependencies.*

Measurement Criteria: *Identify and track critical milestones.*

Measurement Criteria: *Prepare contingency plan.*

Measurement Criteria: *Manage the change control process.*

Measurement Criteria: *Participate in project phase review.*

Measurement Criteria: *Report project status.*

Measurement Criteria: *Utilize project management software.*

Measurement Criteria: *Develop a method of evaluation.*

Pathway KS Statement: Analyze network system interdependencies and

Pathway Topic: Network Systems Pathway

constraints.

    Performance Element: Analyze the computer site environment.

        Measurement Criteria: *Identify power and power supplies.*

        Measurement Criteria: *Define power conversion.*

        Measurement Criteria: *Identify ergonomic issues.*

        Measurement Criteria: *Identify Structural capacities and Electrical wiring codes.*

        Measurement Criteria: *Analyze facilities' capacity planning (power cable/wire conduit).*

        Measurement Criteria: *Evaluate emerging technologies as either potential effect on information system software/hardware.*

    Performance Element: Analyze network security systems.

        Measurement Criteria: *Identify security requirements and the need for data protection.*

        Measurement Criteria: *Identify specific access levels that need to be accommodated.*

        Measurement Criteria: *Match security system design to identified security requirements.*

        Measurement Criteria: *Develop security plan.*

    Performance Element: Evaluate the correctness and effectiveness of implementing the network system.

        Measurement Criteria: *Evaluate user support outcomes to determine whether the problem was solved as intended.*

        Measurement Criteria: *Evaluate whether the process was applied in an efficient and responsible manner.*

        Measurement Criteria: *Assess the validity and usefulness of the outcomes.*

        Measurement Criteria: *Determine needed follow-up actions.*

Pathway KS Statement: Demonstrate knowledge of designing a network system.

    Performance Element: Demonstrate knowledge of the basics of network architecture.

        Measurement Criteria: *Demonstrate knowledge of the characteristics and uses of network components (e.g., hub, switches, routers, firewall).*

        Measurement Criteria: *Differentiate between a physical and logical topology.*

        Measurement Criteria: *Demonstrate a basic knowledge of OSI modeling.*

        Measurement Criteria: *Demonstrate knowledge of LAN transmission methods and standards.*

        Measurement Criteria: *Demonstrate knowledge of LAN transmission protocols.*

        Measurement Criteria: *Demonstrate knowledge of various frame types and formats.*

        Measurement Criteria: *Differentiate processes, services, and protocols.*

    Performance Element: Demonstrate knowledge of basic network classifications and topologies.

        Measurement Criteria: *Differentiate between LANs, MANs, and WANs.*

        Measurement Criteria: *Demonstrate knowledge of how to turn LANs into MANs and WANs.*

        Measurement Criteria: *Identify the basic point-to-point network topologies (e.g., star, ring, tree, network, irregular).*

Pathway Topic: Network Systems Pathway

Measurement Criteria: *Demonstrate knowledge of packet-switching techniques.*

Measurement Criteria: *Identify basic broadcast topologies (e.g., star, ring, bus).*

Measurement Criteria: *Demonstrate knowledge of characteristics of connection-oriented and connectionless networks.*

Measurement Criteria: *Identify stand high-speed network (e.g., broadband, ISDN, SMDS, ATMN, FDDI).*

Measurement Criteria: *Identify emerging networks (e.g., ATM, ISDN, satellite nets, optic nets, integrated voice, data, and video).*

Measurement Criteria: *Investigate emerging technologies.*

Measurement Criteria: *Demonstrate knowledge of electronic communications (e.g., LAN, Internet, remote database access, EDI).*

Measurement Criteria: *Demonstrate knowledge of basic telephony (analog vs. digital signals).*

Performance Element: Demonstrate knowledge of common network computing platforms.

Measurement Criteria: *Identify how the four components of a network operating system (i.e., server platform, network services software, network redirection software, communications software) support network operations.*

Measurement Criteria: *Select a LAN/WAN technology that meets defined set of requirements.*

Performance Element: Demonstrate knowledge of LAN physical media.

Measurement Criteria: *Demonstrate knowledge of the reasons for installing a network.*

Measurement Criteria: *Demonstrate knowledge of local-area network (LAN) trends and issues.*

Measurement Criteria: *Trace the evolution of networks.*

Measurement Criteria: *Analyze current trends and development in LANs.*

Performance Element: Demonstrate knowledge of network connectivity basis and transmission line applications.

Measurement Criteria: *Demonstrate knowledge of the principles and operation of wire (coaxial, fiber optics, etc.) and wireless systems.*

Measurement Criteria: *Demonstrate knowledge of the principles and operation of fiber optics, analog and digital circuits.*

Performance Element: Demonstrate knowledge of communication standards for networks.

Measurement Criteria: *Demonstrate knowledge of the open system interconnection (OSI) standard (ISO Standard 7498).*

Measurement Criteria: *Identify standard high-speed networks (e.g., broadband, ISDN, SMDS, ATM, FDDI).*

Measurement Criteria: *Demonstrate knowledge of the TCP/IP protocol.*

Performance Element: Demonstrate knowledge of WAN systems.

Measurement Criteria: *Demonstrate knowledge of the conversion of analog speech to digital.*

Measurement Criteria: *Relate voice, data concepts, and video to video area networks.*

Pathway Topic: Network Systems Pathway

> **Measurement Criteria:** *Select primary and backup data circuits.*
>
> **Measurement Criteria:** *Evaluate analog and digital transmission for cost performance, and reliability.*
>
> **Measurement Criteria:** *Demonstrate knowledge of firewall between trusted network and WAN.*
>
> **Measurement Criteria:** *Establish a Virtual Private Network (VPN) to form the infrastructure of the WAN.*
>
> **Measurement Criteria:** *Determine routers needed to connect with LAN.*
>
> **Measurement Criteria:** *Demonstrate knowledge of interconnecting LANs using WAN services.*
>
> **Measurement Criteria:** *Incorporate cost-saving approaches, including frame-relay ATM and voice/video/data compression.*

Performance Element: Demonstrate knowledge of network security systems.

> **Measurement Criteria:** *Demonstrate knowledge security requirements and the need for data protection.*
>
> **Measurement Criteria:** *Demonstrate the knowledge of access levels that need to be accommodated.*
>
> **Measurement Criteria:** *Develop security plan.*

Performance Element: Demonstrate knowledge of Network Operating Systems.

> **Measurement Criteria:** *Demonstrate knowledge of the general characteristics of network operating systems.*
>
> **Measurement Criteria:** *Demonstrate knowledge of network operating systems (i.e., window NT, LINUX, UNIX, etc.).*

Pathway KS Statement: Perform network system installation and configuration.

Performance Element: Install system.

> **Measurement Criteria:** *Evaluate installation requirements.*
>
> **Measurement Criteria:** *Install information system application programs in accordance with requirements.*
>
> **Measurement Criteria:** *Install appropriate operating system and telecommunications hardware and software.*
>
> **Measurement Criteria:** *Access needed technical information using software help facilities.*
>
> **Measurement Criteria:** *Operate server applications.*
>
> **Measurement Criteria:** *Ensure that all multi-user aspects of the application function are operational.*
>
> **Measurement Criteria:** *Operate coupled application systems.*

Performance Element: Perform software loading and configuration.

> **Measurement Criteria:** *Load software with minimum disruption of process flow.*
>
> **Measurement Criteria:** *Resolve compatibility issues.*
>
> **Measurement Criteria:** *Convert data.*
>
> **Measurement Criteria:** *Configure software appropriately for system and user application.*
>
> **Measurement Criteria:** *Add capability to a software system by recording macros and*

Pathway Topic: Network Systems Pathway

storing them in the system's library.

Measurement Criteria: *Customize a general-purpose software package (e.g., DBMS) to provide specific functionality beyond the default setting.*

Measurement Criteria: *Assemble necessary components to complement information system design.*

Measurement Criteria: *Install LAN Management software.*

Pathway KS Statement: Perform network administration and monitoring.

Performance Element: Monitor the information/network system.

Measurement Criteria: *Support network operating center (NOC).*

Measurement Criteria: *Monitor system status and performance.*

Measurement Criteria: *Conduct post-implementation evaluation.*

Measurement Criteria: *Identify abnormal system performance.*

Measurement Criteria: *Identify required service level.*

Measurement Criteria: *Recognize system alerts.*

Measurement Criteria: *Recognize security problems.*

Measurement Criteria: *Recognize environmental problems.*

Measurement Criteria: *Perform remote monitoring.*

Performance Element: Demonstrate knowledge of disaster recovery and business continuance.

Measurement Criteria: *Differentiate between disaster recovery and business resumption.*

Measurement Criteria: *Identify the steps in a disaster recovery plan and a business resumption plan.*

Measurement Criteria: *Identify methods for avoiding common computer system disasters.*

Measurement Criteria: *Identify common backup devices.*

Measurement Criteria: *Identify the criteria for selecting a backup systems.*

Measurement Criteria: *Compare/contract streaming an file-by-file backup systems.*

Measurement Criteria: *Establish process for archiving files.*

Measurement Criteria: *Develop a disaster recovery plan.*

Measurement Criteria: *Develop a business resumption plan.*

Measurement Criteria: *Backup system.*

Measurement Criteria: *Restore system.*

Performance Element: Perform network system administration tasks.

Measurement Criteria: *Identify principles governing software acquisition and upgrades.*

Measurement Criteria: *Manage inventory and assets.*

Measurement Criteria: *Retrieve/analyze historical data for trends analysis.*

Measurement Criteria: *Perform administration functions using LAN manager software.*

Measurement Criteria: *Response to system messages.*

Pathway KS Statement: Perform network maintenance and user support services.

Performance Element: Identify technical support needed.

Pathway Topic: Network Systems Pathway

Measurement Criteria: *Identify support requirements.*

Measurement Criteria: *Apply information and data analysis techniques.*

Measurement Criteria: *Identify skill level needs.*

Measurement Criteria: *Define scope of work to meet customer needs.*

Measurement Criteria: *Identify resources and risks.*

Measurement Criteria: *Evaluate present data and system configuration.*

Measurement Criteria: *Formulate a support plan.*

Performance Element: Perform technical support needed.

Measurement Criteria: *Respond to user questions.*

Measurement Criteria: *Communicate and document technical support provided.*

Measurement Criteria: *Perform technical functions required by customer/user.*

Measurement Criteria: *Employ technical and computer tools to perform task in the most cost-effective manner.*

Measurement Criteria: *Manage working relationships with customer within support boundaries.*

Measurement Criteria: *Balance resource against customer/user needs.*

Measurement Criteria: *Manage multiple customer requirements.*

Measurement Criteria: *Participate in application and system development reviews.*

Performance Element: Perform software upgrades and fixes.

Measurement Criteria: *Analyze operational problems.*

Measurement Criteria: *Install and configure Internet software packages.*

Measurement Criteria: *Upgrade network system software.*

Performance Element: Perform standard computer backup procedures.

Measurement Criteria: *Recognize the need for regular backup procedures.*

Measurement Criteria: *Develop backup process.*

Measurement Criteria: *Load backup software.*

Measurement Criteria: *Perform restore operation using backup software*

Measurement Criteria: *Identify battery backup equipment.*

Measurement Criteria: *Maintain battery backup system.*

Measurement Criteria: *Install surge suppression protection.*

Performance Element: Perform network system maintenance.

Measurement Criteria: *Demonstrate knowledge of the basic elements of network maintenance.*

Measurement Criteria: *Identify available diagnostic tools used for system maintenance.*

Measurement Criteria: *Identify maintenance procedures and processes.*

Measurement Criteria: *Identify problems using diagnostic tools.*

Measurement Criteria: *Run diagnostics.*

Measurement Criteria: *Respond to system messages.*

Measurement Criteria: *Document network system malfunction(s).*

Measurement Criteria: *Fix recoverable problems.*

Measurement Criteria: *Perform preventive maintenance procedures on computer and peripheral devices.*

Pathway Topic: Network Systems Pathway

Measurement Criteria: *Restore system.*

Measurement Criteria: *Identify new or replacement networking components needed.*

Measurement Criteria: *Establish a preventive maintenance plan.*

Measurement Criteria: *Create maintenance plan for regular integrity checks.*

Measurement Criteria: *Identify maintenance procedures and processes.*

Measurement Criteria: *Evaluate maintenance processes and outcomes.*

Measurement Criteria: *Select most appropriate solution.*

Measurement Criteria: *Implement selected solution.*

Measurement Criteria: *Minimize impact of problems on productivity (e.g., minimize downtime).*

Performance Element: Troubleshoot problems.

Measurement Criteria: *Demonstrate knowledge of basic troubleshooting steps.*

Measurement Criteria: *Identify available diagnostic tools used for system maintenance.*

Measurement Criteria: *Perform appropriate analysis to identify problem cause.*

Measurement Criteria: *Develop resolution plan.*

Measurement Criteria: *Identify possible solutions.*

Measurement Criteria: *Test identified solutions.*

Measurement Criteria: *Detect problems.*

Measurement Criteria: *Identify criticality of problem.*

Measurement Criteria: *Identify problems using diagnostic tools.*

Measurement Criteria: *Document results & solution.*

Performance Element: Troubleshoot data communications.

Measurement Criteria: *Isolate system faults in various types of networks, cables, data modems, and carrier systems.*

Measurement Criteria: *Determine hardware communication faults utilizing diagnostic tools.*

Measurement Criteria: *Identify network problems utilizing network management tools (e.g., hardware, software carriers).*

PATHWAY: Information Support and Services

Pathway Topic: Information Support & Services Pathway

Pathway KS Statement: *Perform computer user support.*

Performance Element: Analyze technical support needed.

Measurement Criteria: *Identify support requirements.*

Measurement Criteria: *Apply information and data analysis techniques.*

Measurement Criteria: *Identify skill level needs.*

Measurement Criteria: *Define scope of work to meet customer needs.*

Measurement Criteria: *Identify resources and risks.*

Measurement Criteria: *Evaluate present data and system configuration.*

Measurement Criteria: *Formulate a support plan.*

Measurement Criteria: *Communicate and document technical support provided.*

Performance Element: Perform customer service.

Measurement Criteria: *Provide high-level technical support.*

Measurement Criteria: *Respond to user questions*

Measurement Criteria: *Provide troubleshooting for hardware/software.*

Measurement Criteria: *Diagnose problems within system.*

Measurement Criteria: *Perform technical functions required by customer/user.*

Measurement Criteria: *Employ technical and computer tools to perform task in the most cost-effective manner.*

Measurement Criteria: *Manage working relationships with customer within support boundaries.*

Measurement Criteria: *Balance resources against customer needs.*

Measurement Criteria: *Manage multiple customer requirements.*

Pathway KS Statement: *Manage software systems.*

Performance Element: Perform configuration management activities.

Measurement Criteria: *Demonstrate knowledge of identification and control functions.*

Measurement Criteria: *Demonstrate knowledge of version management and interface control.*

Measurement Criteria: *Select appropriate tools for configuration management.*

Measurement Criteria: *Determine standards to be applied (e.g., international, industry, military).*

Measurement Criteria: *Specify baseline and software life-cycle phases.*

Measurement Criteria: *Assess the impact of changes that affect interfaces.*

Performance Element: Evaluate application software packages.

Measurement Criteria: *Perform work flow analysis to determine user needs.*

Measurement Criteria: *Evaluate appropriateness of software for specific projects.*

Measurement Criteria: *Prepare a cost-benefit analysis for a software package.*

Measurement Criteria: *Document results of the software evaluation.*

Measurement Criteria: *Perform a software configuration audit.*

Measurement Criteria: *Perform a physical configuration audit.*

Measurement Criteria: *Develop a method for evaluation.*

Measurement Criteria: *Test the functionality of proposed software configuration.*

Pathway Topic: Information Support & Services Pathway
Pathway KS Statement: Demonstrate and apply knowledge of web programming and hosting.

Performance Element: **Demonstrate knowledge of Internet programming basics.**

Measurement Criteria: *Recognize the importance of Internet programming standards.*

Measurement Criteria: *Demonstrate knowledge of standard Internet programming coding.*

Measurement Criteria: *Demonstrate knowledge of special Internet programming feature codes.*

Measurement Criteria: *Differentiate between various versions of Internet programming.*

Measurement Criteria: *Demonstrate knowledge of how to use standard programs to produce an Internet application.*

Measurement Criteria: *Identify authoring programs specifically designed for Internet programming production.*

Measurement Criteria: *Compare/contrast features, strengths, and weaknesses of different authoring programs.*

Measurement Criteria: *Identify cross-platform issues.*

Measurement Criteria: *Keep up-to-date with new and emerging trends related to Internet programming.*

Performance Element: **Apply knowledge of basic web programming.**

Measurement Criteria: *Demonstrate knowledge of the purpose of web content delivery enablers (e.g., CGI, API, SSI).*

Measurement Criteria: *Demonstrate knowledge of how to interface client/server.*

Measurement Criteria: *Demonstrate knowledge of client-side processing and its advantages/disadvantages.*

Measurement Criteria: *Identify security issues related to client-side processing.*

Measurement Criteria: *Identify standard scripting languages (e.g., JavaScript, Visual Basic Script, ActiveX).*

Measurement Criteria: *Demonstrate knowledge of the uses and advantages/disadvantages of various scripting languages.*

Measurement Criteria: *Demonstrate knowledge of how to use a scripting language to program a site.*

Measurement Criteria: *Demonstrate knowledge of how to use advanced communication protocols.*

Performance Element: **Apply knowledge of web hosting.**

Measurement Criteria: *Compare the advantages and disadvantages of running your own server vs. using a server provider.*

Measurement Criteria: *Identify hardware requirements for a server.*

Measurement Criteria: *Identify server software options.*

Measurement Criteria: *Evaluate server providers.*

Measurement Criteria: *Establish a domain name.*

Measurement Criteria: *Comply with TCP/IP (Transfer Control Protocol/Internet Protocol).*

Measurement Criteria: *Upload files to the server.*

Pathway Topic: Information Support & Services Pathway

Measurement Criteria: *Publicize the site (e.g., submit announcements to major search engines).*

Measurement Criteria: *Collect/analyze usage statistics.*

Pathway KS Statement: Demonstrate and apply knowledge of hardware design, operation and maintenance.

Performance Element: Demonstrate knowledge of CPU components.

Measurement Criteria: *Demonstrate knowledge of chip configuration and structure.*

Measurement Criteria: *Demonstrate knowledge of the functions of internal components (e.g., motherboards, co-processor boards, memory devices).*

Measurement Criteria: *Demonstrate knowledge of the characteristics and operation of controller and network interface cards.*

Measurement Criteria: *Demonstrate knowledge of circuits, logic elements and switching theory, including minimization concepts and implementation of functions.*

Performance Element: Install computer system (e.g., monitor, keyboard, disk drive, and printer).

Measurement Criteria: *Identify primary PC components and the functions of each.*

Measurement Criteria: *Demonstrate knowledge of how hardware components interact and how conflicts arise.*

Measurement Criteria: *Access needed information using manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts).*

Measurement Criteria: *Secure supplies and resources.*

Measurement Criteria: *Respond to error messages and symptoms of hardware failures.*

Measurement Criteria: *Install boards to support peripherals.*

Measurement Criteria: *Connect peripherals to CPU.*

Measurement Criteria: *Employ appropriate safety precautions when working with PCs.*

Measurement Criteria: *Configure system.*

Measurement Criteria: *Verify system operation.*

Measurement Criteria: *Document system installation activities.*

Measurement Criteria: *Backup system configuration.*

Measurement Criteria: *Test all applications.*

Performance Element: Troubleshoot computer systems.

Measurement Criteria: *Identify priorities and interrupts at system level.*

Measurement Criteria: *Demonstrate the use of volatile and nonvolatile memory.*

Measurement Criteria: *Repair/replace volatile and nonvolatile memory.*

Measurement Criteria: *Test system using diagnostic tools/software.*

Measurement Criteria: *Identify problems in the operating system and related hardware.*

Measurement Criteria: *Differentiate between hardware and software failure.*

Measurement Criteria: *Update flash memory (BIOS).*

Measurement Criteria: *Optimize hard drive.*

Pathway Topic: Information Support & Services Pathway

    Measurement Criteria: Gather information on problem from user.

    Measurement Criteria: Conduct appropriate diagnostic tests.

    Measurement Criteria: Repair/replace malfunctioning hardware.

    Measurement Criteria: Reinstall software as needed.

    Measurement Criteria: Recover data and/or files.

    Measurement Criteria: Restore system to normal operating standards.

Pathway KS Statement: Demonstrate knowledge of programming theory.

Performance Element: Demonstrate knowledge of programming language concepts.

    Measurement Criteria:

    Measurement Criteria: Demonstrate knowledge of the concept of physical representation of digitized information (e.g., data, text, image, voice).

    Measurement Criteria: Demonstrate knowledge of the hardware-software connection.

    Measurement Criteria: Demonstrate knowledge of the concepts of data and procedural representation.

    Measurement Criteria: Demonstrate knowledge of the function and operation of compilers and interpreters.

    Measurement Criteria: Demonstrate knowledge of the basic principles for analyzing a programming language.

    Measurement Criteria: Demonstrate knowledge of the basics of structured, object-oriented, and event-driven programming.

    Measurement Criteria: Demonstrate knowledge of how a programming language can support multitasking and exception-handling.

    Measurement Criteria: Demonstrate knowledge of current key programming languages and the environment they are used in (e.g., C, C++, Visual Basic, Java, RPG, COBOL, Assembler).

Performance Element: Demonstrate knowledge of the stages of program development.

    Measurement Criteria: Identify the use of program design tools.

    Measurement Criteria: Demonstrate knowledge of structured/modular programming.

    Measurement Criteria: Demonstrate knowledge of the information system (IS) life cycle.

Performance Element: Demonstrate knowledge of technical documentation associated with software development.

    Measurement Criteria: Secure needed information using appropriate reference materials.

    Measurement Criteria: Analyze specifications.

    Measurement Criteria: Identify constraints.

    Measurement Criteria: Identify input and output (I/O) requirements.

    Measurement Criteria: Prepare logic using a program flowchart.

Pathway KS Statement: Demonstrate knowledge of networking concepts.

Performance Element: Demonstrate knowledge of basic network classifications and topologies.

    Measurement Criteria: Interpret basic networking terminology.

Pathway Topic: Information Support & Services Pathway

> *Measurement Criteria:* *Differentiate between LANs, MANs and WANs.*
>
> *Measurement Criteria:* *Demonstrate knowledge of how to turn LANs into MANs and WANs.*
>
> *Measurement Criteria:* *Identify the basic point-to-point network topologies (e.g., star, ring, tree, network, irregular).*
>
> *Measurement Criteria:* *Demonstrate knowledge of packet-switching techniques.*
>
> *Measurement Criteria:* *Identify the basic broadcast topologies (e.g., star ring, bus).*

Performance Element: Demonstrate knowledge of the basics of network architecture.

> *Measurement Criteria:* *Demonstrate knowledge of the characteristics and uses of network components (e.g., hub, switches, routers, firewall).*
>
> *Measurement Criteria:* *Differentiate between a physical and logical topology.*
>
> *Measurement Criteria:* *Demonstrate a basic knowledge of OSI modeling.*
>
> *Measurement Criteria:* *Demonstrate knowledge of LAN transmission methods, standards and protocols.*
>
> *Measurement Criteria:* *Demonstrate knowledge of various frame types and formats.*

Performance Element: Demonstrate knowledge of the general characteristics of network operating systems.

> *Measurement Criteria:* *Identify the purposes of a network operating system (NOS).*
>
> *Measurement Criteria:* *Differentiate between network operating systems and data distribution systems.*
>
> *Measurement Criteria:* *Identify how the four components of a network operating system (i.e., server platform, network services software, network redirection software, communications software) support network operations.*
>
> *Measurement Criteria:* *Define the criteria used to evaluate network operating systems.*
>
> *Measurement Criteria:* *Identify how protocols are supported.*
>
> *Measurement Criteria:* *Identify licensing requirements.*
>
> *Measurement Criteria:* *Demonstrate knowledge of the characteristics of the client/server models.*
>
> *Measurement Criteria:* *Analyze the advantages and disadvantages of the client/server model.*
>
> *Measurement Criteria:* *Demonstrate knowledge of a typical program function call.*
>
> *Measurement Criteria:* *Identify the properties of open systems.*
>
> *Measurement Criteria:* *Demonstrate knowledge of LAN connectivity issues.*

Performance Element: Demonstrate knowledge of network applications.

> *Measurement Criteria:* *Demonstrate knowledge of how disk storage is shared across a network.*
>
> *Measurement Criteria:* *Demonstrate knowledge of how processing power is shared across a network.*
>
> *Measurement Criteria:* *Demonstrate knowledge of application-specific servers (e.g., database, print, communications, terminal, fax, security).*
>
> *Measurement Criteria:* *Identify the advantages of sharing backup and management of PCs across a network.*
>
> *Measurement Criteria:* *Identify software licensing requirements and categories.*

Pathway Topic: Information Support & Services Pathway

Pathway KS Statement: *Demonstrate knowledge of application development lifecycle.*

    Performance Element: **Conduct needs analysis.**

        Measurement Criteria: *Define business problem to be solved by the application (e.g., through interview process).*

        Measurement Criteria: *Identify scope of project.*

        Measurement Criteria: *Access needed information using company procedural manuals, references, documentation, and standards.*

        Measurement Criteria: *Define business information requirements.*

        Measurement Criteria: *Align information system (IS) design with the business process.*

        Measurement Criteria: *Determine hardware and software needs.*

        Measurement Criteria: *Interpret source data, charts, and graphs.*

        Measurement Criteria: *Review organizational structure.*

        Measurement Criteria: *Interpret existing operating documents and procedures for the system.*

        Measurement Criteria: *Observe existing procedures.*

        Measurement Criteria: *Document existing procedures.*

        Measurement Criteria: *Document possible alternative solutions.*

        Measurement Criteria: *Identify processing requirements.*

        Measurement Criteria: *Define variables.*

        Measurement Criteria: *Analyze specifications.*

        Measurement Criteria: *Present findings and recommendations to users and management (e.g., work plan, project estimate).*

Pathway KS Statement: *Demonstrate and apply knowledge of Information System Analysis and Design*

    Performance Element: **Initiate a system project.**

        Measurement Criteria: *Identify the phases in a system project.*

        Measurement Criteria: *Select basic fact-gathering techniques to be used.*

        Measurement Criteria: *Define the scope of the systems project.*

        Measurement Criteria: *Conduct a preliminary investigation.*

    Performance Element: **Evaluate applications within the information system.**

        Measurement Criteria: *Design a framework for evaluating information system functions.*

        Measurement Criteria: *Design a framework for evaluating individual applications.*

        Measurement Criteria: *Recommend new features or enhancements to existing tools.*

Pathway KS Statement: *Demonstrate and apply knowledge of System Installation and Maintenance.*

    Performance Element: **Apply knowledge of the life cycle of an information system.**

        Measurement Criteria: *Research the concept of information system life cycles.*

        Measurement Criteria:

    Performance Element: **Manage backup and recovery, both on- and off-site.**

        Measurement Criteria: *Implement backup procedures in accordance with a regular schedule.*

Pathway Topic: Information Support & Services Pathway

Measurement Criteria: *Implement recovery procedures as needed.*

Performance Element: Troubleshoot problems.

Measurement Criteria: *Demonstrate knowledge of basic troubleshooting steps.*

Measurement Criteria: *Minimize impact of problems on productivity (e.g., minimize downtime).*

Performance Element: Evaluate problem-solving processes and outcomes.

Measurement Criteria: *Evaluate problem-solving outcomes to determine whether the problem was solved as intended.*

Measurement Criteria: *Evaluate whether the process was applied in an efficient and responsible manner.*

Measurement Criteria: *Assess the validity and usefulness of the outcomes.*

Measurement Criteria: *Determine needed follow-up actions.*

Pathway KS Statement: Demonstrate knowledge of System Administration and Control.

Performance Element: Perform general system administration tasks.

Measurement Criteria: *Facilitate the delivery of technical services.*

Measurement Criteria: *Set up/maintain user accounts on multiple systems.*

Measurement Criteria: *Participate in the evaluation, analysis, and   recommendation of technical computing products.*

Measurement Criteria: *Document performance problems.*

Measurement Criteria: *Prepare required reports.*

Measurement Criteria: *Maintain technical industry knowledge.*

Pathway KS Statement: Demonstrate and apply knowledge of Project Management.

Performance Element: Define scope of work to achieve individual and group goals.

Measurement Criteria: *Assess the task's contribution to overall business needs.*

Measurement Criteria: *Identify size and specifics of the task.*

Measurement Criteria: *Formulate task sequence.*

Measurement Criteria: *Plan multiple tasks simultaneously.*

Measurement Criteria: *Identify potential problems.*

Measurement Criteria: *Develop contingency plans.*

Performance Element: Manage information system project methodologies.

Measurement Criteria: *Define the project's contribution to business needs.*

Measurement Criteria: *Define the scope of the project.*

Measurement Criteria: *Identify stakeholders and decision makers.*

Measurement Criteria: *Identify escalation procedures.*

Measurement Criteria: *Develop task list (work breakdown structures).*

Measurement Criteria: *Evaluate project requirements.*

Measurement Criteria: *Identify required resources and budget.*

Measurement Criteria: *Estimate time requirements.*

Measurement Criteria: *Develop initial project management flowchart.*

Measurement Criteria: *Identify interdependencies.*

Pathway Topic: Information Support & Services Pathway

>>> ***Measurement Criteria:*** *Identify critical milestones.*

>>> ***Measurement Criteria:*** *Evaluate risks.*

>>> ***Measurement Criteria:*** *Prepare contingency plan.*

>>> ***Measurement Criteria:*** *Manage the change control process.*

>>> ***Measurement Criteria:*** *Track critical milestones.*

>>> ***Measurement Criteria:*** *Participate in project phase review.*

>>> ***Measurement Criteria:*** *Report project status.*

>>> ***Measurement Criteria:*** *Utilize project management software.*

>>> ***Measurement Criteria:*** *Develop a method of evaluation.*

>> **Performance Element: Develop time and activity plan to achieve objective.**

>>> ***Measurement Criteria:*** *Coordinate plan with team, cross-functional groups, or individuals.*

>>> ***Measurement Criteria:*** *Formulate a task strategy.*

>>> ***Measurement Criteria:*** *Prioritize tasks according to business needs.*

>>> ***Measurement Criteria:*** *Manage multiple tasks simultaneously.*

>>> ***Measurement Criteria:*** *Devise plan of action.*

> ***Pathway KS Statement: Demonstrate and apply knowledge of Technical Writing and Documentation.***

>> **Performance Element: Evaluate technical writing requirements.**

>>> ***Measurement Criteria:*** *Define/prioritize communication needs.*

>>> ***Measurement Criteria:*** *Specify project objectives.*

>>> ***Measurement Criteria:*** *Determine the size and specifics of the work to be completed.*

>>> ***Measurement Criteria:*** *Estimate time, materials, and capabilities needed to complete assignment.*

>>> ***Measurement Criteria:*** *Evaluate strengths and weaknesses of completed project.*

>> **Performance Element: Conduct technical research.**

>>> ***Measurement Criteria:*** *Identify target audience.*

>>> ***Measurement Criteria:*** *Define research questions.*

>>> ***Measurement Criteria:*** *Determine priorities for the information that should be gathered.*

>>> ***Measurement Criteria:*** *Identify potential sources of information.*

>>> ***Measurement Criteria:*** *Target audience/user group as a key information source.*

>>> ***Measurement Criteria:*** *Identify subject-matter experts.*

>>> ***Measurement Criteria:*** *Evaluate potential sources of information based on established criteria (e.g., affordability, relevance).*

>>> ***Measurement Criteria:*** *Conduct interviews with selected human information sources.*

>>> ***Measurement Criteria:*** *Gather information from selected print and electronic sources.*

>>> ***Measurement Criteria:*** *Determine the accuracy and completeness of the information gathered.*

>> **Performance Element: Design technical documentation.**

>>> ***Measurement Criteria:*** *Define purpose of documentation.*

>>> ***Measurement Criteria:*** *Specify standards for documentation, including critical success criteria.*

Pathway Topic: Information Support & Services Pathway

Measurement Criteria: *Identify delivery options.*

Measurement Criteria: *Evaluate cost-effectiveness of each delivery option.*

Measurement Criteria: *Select tools appropriate for task purpose.*

Measurement Criteria: *Plan information flow.*

Measurement Criteria: *Select writing style and tone appropriate for given documentation.*

Measurement Criteria: *Determine level of detail needed.*

Measurement Criteria: *Identify visuals appropriate for given documentation.*

Measurement Criteria: *Provide feedback on design to development team/individual.*

Performance Element: Write technical reports.

Measurement Criteria: *Determine audience.*

Measurement Criteria: *Access needed information using standard references and sources.*

Measurement Criteria: *Identify type of report needed.*

Measurement Criteria: *Compile relevant data.*

Measurement Criteria: *Organize data into charts and graphs.*

Measurement Criteria: *Analyze data.*

Measurement Criteria: *Draw conclusions from data analysis.*

Measurement Criteria: *Outline report.*

Measurement Criteria: *Draft report.*

Measurement Criteria: *Edit report (e.g., check spelling, grammar, punctuation, sentence structure, accuracy of content).*

Measurement Criteria: *Review report with peers.*

Measurement Criteria: *Revise report as needed based on peer feedback.*

Measurement Criteria: *Proofread revised report.*

Measurement Criteria: *Present reports.*

Pathway KS Statement: Understand and implement Quality Assurance processes.

Performance Element: Employ quality tools.

Measurement Criteria: *Demonstrate knowledge of the characteristics and functions of available quality tools.*

Measurement Criteria: *Select quality tool(s) appropriate to situation.*

Performance Element: Apply knowledge of quality cost implications.

Measurement Criteria: *Establish cost/quality objectives.*

Measurement Criteria: *Classify costs (e.g., direct and indirect, fixed and variable, methods and standards).*

Measurement Criteria: *Classify quality costs (e.g., prevention, evaluation, pre-delivery failure, post-delivery failure).*

Measurement Criteria: *Interpret quality cost reports.*

Measurement Criteria: *Establish guidelines for liability prevention.*

Measurement Criteria: *Identify safety terms of product.*

Measurement Criteria: *Identify safety responsibility within organization.*

PATHWAY: Interactive Media

Pathway Topic: Interactive Media Pathway

Pathway KS Statement: Gather and analyze interactive media customer requirements.

Performance Element: Gather data to identify customer requirements.

Measurement Criteria: Gather information using interviewing strategies.

Measurement Criteria: Determine client's needs and expected outcomes.

Performance Element: Interpret and evaluate requirements.

Measurement Criteria: Determine purpose of the interactive media project.

Measurement Criteria: Determine the target audience.

Measurement Criteria: Determine the interactive media elements to be used.

Pathway KS Statement: Define scope of interactive media work in written form.

Performance Element: Define scope of work to meet customer requirements.

Measurement Criteria: Develop a design brief.

Measurement Criteria: Identify available media and content sources.

Measurement Criteria: Develop time line for completion.

Measurement Criteria: Determine staffing resources – internal and external - required to complete project.

Measurement Criteria: Develop preliminary project budget.

Measurement Criteria: Write document.

Measurement Criteria: Obtain client approval on scope of work.

Pathway KS Statement: Create interactive media product specifications.

Performance Element: Prepare functional specifications.

Measurement Criteria: Develop flowchart/navigational blueprints.

Measurement Criteria: Determine delivery platform(s).

Measurement Criteria: Design system architecture.

Measurement Criteria: Design user interface.

Measurement Criteria: Design navigational schema.

Performance Element: Prepare visual design specifications.

Measurement Criteria: Apply principles of design.

Measurement Criteria: Identify technical constraints.

Measurement Criteria: Create sample design showing placement of buttons/navigational graphics and suggested color scheme.

Performance Element: Create final project plan.

Measurement Criteria: Identify and obtain tools and resources to do the job.

Measurement Criteria: Identify and evaluate risks.

Measurement Criteria: Develop detailed task list.

Measurement Criteria: Identify critical milestones.

Measurement Criteria: Identify interdependencies.

Pathway KS Statement: Demonstrate and apply knowledge of Project Management.

Performance Element: Manage information system project methodologies.

Pathway Topic: Interactive Media Pathway

> ***Measurement Criteria:*** *Define the project's contribution to business needs.*
>
> ***Measurement Criteria:*** *Define the scope of the project.*
>
> ***Measurement Criteria:*** *Identify stakeholders and decision makers.*
>
> ***Measurement Criteria:*** *Identify escalation procedures.*
>
> ***Measurement Criteria:*** *Develop task list (work breakdown structures).*
>
> ***Measurement Criteria:*** *Evaluate project requirements.*
>
> ***Measurement Criteria:*** *Identify required resources and budget.*
>
> ***Measurement Criteria:*** *Estimate time requirements.*
>
> ***Measurement Criteria:*** *Develop initial project management flowchart.*
>
> ***Measurement Criteria:*** *Identify interdependencies.*
>
> ***Measurement Criteria:*** *Identify critical milestones.*
>
> ***Measurement Criteria:*** *Evaluate risks.*
>
> ***Measurement Criteria:*** *Prepare contingency plan.*
>
> ***Measurement Criteria:*** *Manage the change control process.*
>
> ***Measurement Criteria:*** *Track critical milestones.*
>
> ***Measurement Criteria:*** *Participate in project phase review.*
>
> ***Measurement Criteria:*** *Report project status.*
>
> ***Measurement Criteria:*** *Utilize project management software.*
>
> ***Measurement Criteria:*** *Develop a method of evaluation.*

Performance Element: Define scope of work to achieve individual and group goals.

> ***Measurement Criteria:*** *Assess the task's contribution to overall business needs.*
>
> ***Measurement Criteria:*** *Identify size and specifics of the task.*
>
> ***Measurement Criteria:*** *Formulate task sequence.*
>
> ***Measurement Criteria:*** *Plan multiple tasks simultaneously.*
>
> ***Measurement Criteria:*** *Identify potential problems.*
>
> ***Measurement Criteria:*** *Develop contingency plans.*

Performance Element: Develop time and activity plan to achieve objectives.

> ***Measurement Criteria:*** *Coordinate plan with team, cross-functional groups, or individuals.*
>
> ***Measurement Criteria:*** *Formulate a task strategy.*
>
> ***Measurement Criteria:*** *Prioritize tasks according to business needs.*
>
> ***Measurement Criteria:*** *Manage multiple tasks simultaneously.*
>
> ***Measurement Criteria:*** *Devise plan of action.*

Pathway KS Statement: Demonstrate the effective use of tools for interactive media production, development and project management.

Performance Element: Select and utilize appropriate software tools.

> ***Measurement Criteria:*** *Demonstrate proficiency in the use of digital imaging techniques and equipment.*
>
> ***Measurement Criteria:*** *Synthesize available interactive media technologies into a unified presentation using appropriate authoring software.*
>
> ***Measurement Criteria:*** *Demonstrate knowledge of available graphics software programs.*
>
> ***Measurement Criteria:*** *Manipulate images.*

Pathway Topic: Interactive Media Pathway

Measurement Criteria: *Demonstrate knowledge of the basic principles of animation.*

Measurement Criteria: *Identify how different browsers affect the look of a web page.*

Pathway KS Statement: Demonstrate and apply knowledge of web programming and hosting.

Performance Element: **Demonstrate knowledge of Internet programming basics.**

Measurement Criteria: *Recognize the importance of Internet programming standards.*

Measurement Criteria: *Demonstrate knowledge of standard Internet programming coding.*

Measurement Criteria: *Demonstrate knowledge of special Internet programming feature codes.*

Measurement Criteria: *Differentiate between various versions of Internet programming.*

Measurement Criteria: *Demonstrate knowledge of how to use standard programs to produce an Internet application.*

Measurement Criteria: *Identify authoring programs specifically designed for Internet programming production.*

Measurement Criteria: *Compare/contrast features, strengths, and weaknesses of different authoring programs.*

Measurement Criteria: *Identify cross-platform issues.*

Measurement Criteria: *Keep up-to-date with new and emerging trends related to Internet programming.*

Performance Element: **Apply knowledge of basic web programming.**

Measurement Criteria: *Demonstrate knowledge of the purpose of web content delivery enablers (e.g., CGI, API, SSI).*

Measurement Criteria: *Demonstrate knowledge of how to interface client/server.*

Measurement Criteria: *Demonstrate knowledge of client-side processing and its advantages/disadvantages.*

Measurement Criteria: *Identify security issues related to client-side processing.*

Measurement Criteria: *Identify standard scripting languages (e.g., JavaScript, Visual Basic Script, ActiveX).*

Measurement Criteria: *Demonstrate knowledge of the uses and advantages/disadvantages of various scripting languages.*

Measurement Criteria: *Demonstrate knowledge of how to use a scripting language to program a site.*

Measurement Criteria: *Demonstrate knowledge of how to use advanced communication protocols.*

Performance Element: **Apply knowledge of web hosting.**

Measurement Criteria: *Compare the advantages and disadvantages of running your own server vs. using a server provider.*

Measurement Criteria: *Identify hardware requirements for a server.*

Measurement Criteria: *Identify server software options.*

Measurement Criteria: *Evaluate server providers.*

Measurement Criteria: *Establish a domain name.*

Measurement Criteria: *Comply with TCP/IP (Transfer Control Protocol/Internet*

Pathway Topic: Interactive Media Pathway

       Protocol).

  Measurement Criteria: *Upload files to the server.*

  Measurement Criteria: *Publicize the site (e.g., submit announcements to major search engines).*

  Measurement Criteria: *Collect/analyze usage statistics.*

 Pathway KS Statement: Create/implement interactive media product.

  Performance Element: Produce interactive media as member of a development team.

  Measurement Criteria: *Define the role of individual team members.*

  Measurement Criteria: *Develop a conceptual model for the interactive media project.*

  Measurement Criteria: *Select the media elements (e.g., sound, video, graphics, text, animation) to be used.*

  Measurement Criteria: *Integrate media elements.*

  Measurement Criteria: *Select the publication process to be used.*

  Measurement Criteria: *Select the distribution method to be used.*

  Performance Element: Implement functional design criteria.

  Measurement Criteria: *Identify, utilize and create reusable components.*

  Measurement Criteria: *Create and produce content.*

  Measurement Criteria: *Create and refine design concepts.*

  Performance Element: Create product visual design.

  Measurement Criteria: *Apply principles and elements of design.*

  Measurement Criteria: *Apply color theory to select appropriate colors.*

  Measurement Criteria: *Create and/or implement the look and feel of the product.*

  Measurement Criteria: *Create graphical images.*

  Measurement Criteria: *Apply knowledge of typography.*

  Measurement Criteria: *Enhance interactive media presentation using a photographic process.*

  Measurement Criteria: *Alter digitized images using an image manipulation program.*

  Measurement Criteria: *Evaluate visual appeal.*

  Performance Element: Produce or acquire content.

  Measurement Criteria: *Produce or acquire graphics content.*

  Measurement Criteria: *Produce or acquire animation content.*

  Measurement Criteria: *Produce or acquire audio content.*

  Measurement Criteria: *Produce or acquire video content.*

  Performance Element: Apply knowledge of web programming.

  Measurement Criteria: *Demonstrate knowledge of Internet programming codes for formatting page layout.*

  Measurement Criteria: *Demonstrate knowledge of the purpose of web content delivery enablers (e.g., CGI, API, SSI).*

  Measurement Criteria: *Demonstrate knowledge of how to interface client/server.*

  Measurement Criteria: *Demonstrate knowledge of client-side processing and its advantages/disadvantages.*

  Measurement Criteria: *Identify security issues related to client-side processing.*

  Measurement Criteria: *Identify standard scripting languages (e.g., JavaScript, Visual*

Pathway Topic: Interactive Media Pathway

Basic Script, ActiveX).

Measurement Criteria: *Demonstrate knowledge of the uses and advantages/disadvantages of various scripting languages.*

Measurement Criteria: *Demonstrate knowledge of how to use a scripting language to program a site.*

Measurement Criteria: *Demonstrate knowledge of how to use advanced communication protocols.*

Measurement Criteria: *Demonstrate knowledge of how bandwidths affect data transmission and on-screen image.*

Measurement Criteria: *Keep up-to-date with new and emerging trends related to Internet programming.*

Performance Element: Integrate media elements.

Measurement Criteria: *Integrate the use of photographic special effects into interactive media presentations.*

Measurement Criteria: *Integrate photographically derived images with hand-drawn graphic images.*

Performance Element: Participate in iterative development with clients and team members.

Measurement Criteria: *Manage the change control process.*

Measurement Criteria: *Identify and track critical milestones.*

Measurement Criteria: *Report project status.*

Pathway KS Statement: Test interactive media product.

Performance Element: Develop and implement a test plan.

Measurement Criteria: *Perform usability tests.*

Measurement Criteria: *Assess product effectiveness.*

Measurement Criteria: *Test product for reliability.*

Measurement Criteria: *Plan and coordinate customer acceptance testing.*

Performance Element: Resolve product problems.

Measurement Criteria: *Define the problem.*

Measurement Criteria: *Identify/test possible solutions.*

Measurement Criteria: *Develop resolution plan.*

Measurement Criteria: *Implement solution.*

Measurement Criteria: *Evaluate problem solving processes and outcomes.*

Pathway KS Statement: Deliver a quality interactive media product.

Performance Element: Demonstrate knowledge of interactive media quality assurance.

Measurement Criteria: *Demonstrate knowledge of the QA process.*

Measurement Criteria: *Demonstrate knowledge of the standards/requirements for QA.*

Measurement Criteria: *Develop team relationships to support quality assurance tasks.*

Performance Element: Perform quality assurance tasks to produce a quality product.

Measurement Criteria: *Use customer satisfaction in determining product characteristics (e.g., cost, user-friendliness).*

Measurement Criteria: *Recognize the relationship between dependability,*

Pathway Topic: Interactive Media Pathway

functionality, ease of use, etc.

Measurement Criteria: *Follow established procedures for testing, identifying problems, and tracking resolutions.*

Pathway KS Statement: Perform maintenance and customer support functions for interactive media products.

Performance Element: Analyze software technical support needs.

Measurement Criteria: *Identify maintenance and support requirements.*

Measurement Criteria: *Apply information and data analysis techniques.*

Measurement Criteria: *Define scope of work to meet customer support needs.*

Performance Element: Perform customer service.

Measurement Criteria: *Access needed information using appropriate reference materials.*

Measurement Criteria: *Provide help to first line user-support personnel to answer user questions.*

Measurement Criteria: *Provide troubleshooting for interactive media products.*

Measurement Criteria: *Perform system-tuning function.*

Measurement Criteria: *Diagnose problems within system.*

Measurement Criteria: *Perform technical functions required by customer/user.*

Measurement Criteria: *Communicate and document technical support provided.*

Performance Element: Perform product maintenance activities.

Measurement Criteria: *Following organizational procedural in communicate and document maintenance tasks.*

Measurement Criteria: *Identify and analyze problem.*

Measurement Criteria: *Analyze and propose solutions.*

Measurement Criteria: *Implement solutions in code and documentation.*

Measurement Criteria: *Release software and documentation updates according to procedures.*

PATHWAY: Programming and Software Development

Pathway Topic: Programming and Software Engineering Pathway

Pathway KS Statement: Identify and analyze customer software needs and requirements.

Performance Element: Gather data to identify customer requirements.

Measurement Criteria: *Gather information using interviewing strategies.*

Measurement Criteria: *Identify input and output requirements.*

Measurement Criteria: *Identify system processing requirements.*

Measurement Criteria: *Clarify specifications using questioning techniques.*

Measurement Criteria: *Identify hardware, networking, and software system functional requirements.*

Measurement Criteria: *Demonstrate knowledge of nonfunctional requirements (e.g., security, integrity response time, reliability, support, and documentation).*

Performance Element: Conduct needs analysis.

Measurement Criteria: *Gather information on problems from users.*

Measurement Criteria: *Perform workflow analysis to determine user needs.*

Measurement Criteria: *Analyze existing procedures.*

Measurement Criteria: *Define business problem to be solved by the application*

Performance Element: Development software requirements   specification.

Measurement Criteria: *Demonstrate knowledge of the use, structure, and contents of a requirements specification document.*

Measurement Criteria: *Define system and software requirements.*

Measurement Criteria: *Develop informal specifications.*

Measurement Criteria: *Develop formal specification.*

Measurement Criteria: *Resolve conflicting Requirements.*

Measurement Criteria: *Review and verify specification with customer.*

Performance Element: Analyze requirements/specifications using current approaches.

Measurement Criteria: *Demonstrate knowledge of how to use software methodologies to analyze a real-world problem.*

Measurement Criteria: *Identify constraints.*

Measurement Criteria: *Demonstrate knowledge of modeling and analyzing functional requirements (e.g., dataflow diagrams, process specifications, and a data dictionary).*

Measurement Criteria: *Demonstrate knowledge of modeling and analyzing data requirements (e.g., Jackson diagrams, entity relationship diagrams, and relations).*

Performance Element: Use available reference tools as appropriate.

Measurement Criteria: *Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts).*

Pathway KS Statement: Produce IT-based strategies and project plan to solve the specific problem.

Performance Element: Define scope of work for the programming project.

Pathway Topic: Programming and Software Engineering Pathway

Measurement Criteria: *Define scope of work to meet customer needs.*

Measurement Criteria: *Demonstrate knowledge of the key functions and subsystems of the software product.*

Measurement Criteria: *Demonstrate knowledge of software development process and issues.*

Measurement Criteria: *Demonstrate knowledge of the system life-cycle approach.*

Performance Element: Demonstrate knowledge and skills of working in a software development team.

Measurement Criteria: *Identify resources and risks.*

Measurement Criteria: *Demonstrate knowledge of cross-functional team structures and team members' roles.*

Performance Element: Design project plan.

Measurement Criteria: *Demonstrate knowledge of project budgeting, scheduling, and control issues related to software development.*

Measurement Criteria: *Demonstrate knowledge of software development methodology.*

Measurement Criteria: *Develop implementation plan.*

Pathway KS Statement: Define and analyze system and software requirements.

Performance Element: Identify new IT technologies and assess their potential importance and impact in the future.

Measurement Criteria: *Identify new technologies relevant to information technology.*

Measurement Criteria: *Assess the importance of new technologies to future developments.*

Measurement Criteria: *Identify system processing requirements.*

Measurement Criteria: *Identify data communication trends and major current issues.*

Performance Element: Explain new and emerging classes of software.

Measurement Criteria: *Identify new and emerging classes of software.*

Measurement Criteria: *Determine compatibility of hardware and software.*

Performance Element: Understand elements and types of information processing.

Measurement Criteria: *Identify the elements of the information processing cycle (i.e., input, process, output, and storage).*

Performance Element: Explain measurement techniques for increased productivity due to information systems implementation.

Measurement Criteria: *Identify metrics for measurements.*

Measurement Criteria: *Measure increases in productivity realized by the implementation of information systems.*

Measurement Criteria: *Identify new and emerging drivers and inhibitors of information technology change.*

Pathway KS Statement: Demonstrate the effective use of tools for software development.

Performance Element: Apply tools for developing software applications.

Measurement Criteria: *Demonstrate knowledge of software development environment.*

Measurement Criteria: *Use prototyping techniques.*

Pathway Topic: Programming and Software Engineering Pathway

> ***Measurement Criteria:*** *Use appropriate Configuration Management tools.*
>
> ***Measurement Criteria:*** *Use appropriate issues tracking tools.*
>
> ***Measurement Criteria:*** *Demonstrate knowledge of reuse and components.*

Performance Element: Apply language specific programming tools/techniques.

> ***Measurement Criteria:*** *Develop programs using appropriate language.*
>
> ***Measurement Criteria:*** *Use appropriate development environment for the selected language (e.g., compilers, debuggers, test generation, static analyzer, etc.).*
>
> ***Measurement Criteria:*** *Use user interface development tools.*

Performance Element: Demonstrate knowledge of how to use computer-aided software engineering (CASE) tools.

> ***Measurement Criteria:*** *Use appropriate requirement analysis tools.*
>
> ***Measurement Criteria:*** *Use appropriate modeling and analysis tools.*
>
> ***Measurement Criteria:*** *Use requirement tracking tools.*
>
> ***Measurement Criteria:*** *Demonstrate knowledge of software reuse, design pattern, and components.*

Pathway KS Statement: Demonstrate knowledge of the software development process.

Performance Element: Demonstrate knowledge of software development methodology.

> ***Measurement Criteria:*** *Demonstrate knowledge of the information system life cycle.*
>
> ***Measurement Criteria:*** *Demonstrate knowledge of system analysis issues related to design, testing, implementation, and maintenance.*
>
> ***Measurement Criteria:*** *Record and analyze process.*
>
> ***Measurement Criteria:*** *Identify the use of program design tools in a software development process.*
>
> ***Measurement Criteria:*** *Identify roles on team members/customers in the software development process.*
>
> ***Measurement Criteria:*** *Identify current information life cycle models.*

Pathway KS Statement: Design a software application.

Performance Element: Create design specification for a computer application.

> ***Measurement Criteria:*** *Demonstrate knowledge of the principles of program design (e.g., structured, object oriented, event-driven) to analyze real-world problems.*
>
> ***Measurement Criteria:*** *Perform a logical design.*
>
> ***Measurement Criteria:*** *Document design specification according to defined procedures.*
>
> ***Measurement Criteria:*** *Design system input, output, processing, and interfaces.*
>
> ***Measurement Criteria:*** *Review system design with management and users.*
>
> ***Measurement Criteria:*** *Use current computer-aided software engineering (CASE) tools.*

Performance Element: Demonstrate comprehension of the trade-off involved in design choices.

> ***Measurement Criteria:***

Pathway Topic: Programming and Software Engineering Pathway

Demonstrate knowledge of the characteristics and the uses of processing (e.g., batch, interactive, event-driven, object-oriented).

Measurement Criteria: *Identify basic concepts of algorithm and data structure development.*

Measurement Criteria: *Demonstrate knowledge of different data types (e.g., numeric, alphanumeric, tables, etc.).*

Measurement Criteria: *Identify constraints.*

Measurement Criteria: *5 Demonstrate knowledge of nonfunctional requirements (e.g., security, integrity, response time, cost, dependability, migration, etc.).*

Measurement Criteria: *Demonstrate knowledge of modular design concepts.*

Measurement Criteria: *Demonstrate knowledge of the features, functions, and architectures of client/server computing.*

Performance Element: Apply the principles of effective information management, information organization, and information-retrieval skills.

Measurement Criteria: *Demonstrate knowledge of database management concepts.*

Measurement Criteria: *Define the objectives of a client/server application.*

Measurement Criteria: *Implement online transition processing.*

Measurement Criteria: *Design static and dynamic online processing systems.*

Measurement Criteria: *Employ interface techniques.*

Performance Element: Demonstrate knowledge of computing/networking hardware and software architecture.

Measurement Criteria: *Demonstrate knowledge of how data is stored, organized, managed and retrieve in various computer and network architecture.*

Measurement Criteria: *Demonstrate knowledge of software architectures for different classes of applications.*

Pathway KS Statement: *Produce (code) a computer application.*

Performance Element: Demonstrate knowledge of programming language concepts.

Measurement Criteria: *Demonstrate knowledge of he hardware-software connection.*

Measurement Criteria: *Demonstrate knowledge of the concepts of data and procedural representation.*

Measurement Criteria: *Demonstrate knowledge of the basic principles for analyzing a programming languages.*

Measurement Criteria: *Demonstrate knowledge of the basics of structured, object-oriented, and event-driven programming.*

Measurement Criteria: *Demonstrate knowledge of how a programming language can support multitasking and exception-handling.*

Performance Element: Demonstrate proficiency in developing an application using an appropriate programming language.

Measurement Criteria: *Demonstrate knowledge of current key programming languages and the environment they are used in (e.g., C, C++, Visual Basic, Java, RPG, COBOL, Assembler).*

Pathway Topic: Programming and Software Engineering Pathway

Measurement Criteria: *Translate data structure and program design into code in an appropriate language.*

Measurement Criteria: *Demonstrate knowledge of key constructs and commands specific to a language.*

Performance Element: Understand the range of languages used in software development.

Measurement Criteria: *Demonstrate knowledge of the range of languages used in software development.*

Performance Element: Demonstrate knowledge of program development methodology.

Measurement Criteria: *Demonstrate knowledge of how to resolve program implementation issues (e.g., debugging, documentation, auditing).*

Measurement Criteria: *Demonstrate knowledge of software development issues (e.g., correctness, reliability, and productivity).*

Measurement Criteria: *Demonstrate knowledge of code analysis issues related to design , testing, implementation, and maintenance.*

Measurement Criteria: *Demonstrate knowledge of how to design and implement programs in a top-down manner.*

Measurement Criteria: *Demonstrate knowledge of how to translate algorithmic and modular design to develop a program.*

Measurement Criteria: *Demonstrate knowledge of structured/modular programming.*

Measurement Criteria: *Demonstrate knowledge of how programming control structures are used to verify correctness.*

Measurement Criteria: *Use code development tools (debugger, integrated development environments).*

Performance Element: Demonstrate knowledge of basic software systems implementation.

Measurement Criteria: *Use appropriate programming language.*

Measurement Criteria: *Analyze and prepare logic using program flowchart.*

Measurement Criteria: *Review design (e.g., peer and/or user walkthought).*

Measurement Criteria: *Compile and debug code.*

Measurement Criteria: *Prepare code documentation.*

Measurement Criteria: *Prepare unit testing plan.*

Measurement Criteria: *Conduct unit testing and bug fixes.*

Performance Element: Develop software requirements/specifications.

Measurement Criteria: *Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, word flowcharts).*

Measurement Criteria: *Divide design specifications into logical process blocks.*

Measurement Criteria: *Identify parameters.*

Measurement Criteria: *Follow specifications or drawings.*

Measurement Criteria: *Record process (e.g., using flowchart, step-by-step narrative).*

Measurement Criteria: *Record data.*

Pathway Topic: Programming and Software Engineering Pathway

> **Performance Element: Resolve problems with integration if they occur.**
>> *Measurement Criteria:* *Troubleshoot unexpected results.*
>> *Measurement Criteria:* *Fix code.*

Pathway KS Statement: Demonstrate knowledge of software testing.

> **Performance Element: Develop test plan.**
>> *Measurement Criteria:* *Access needed information using appropriate reference materials.*
>> *Measurement Criteria:* *Define test procedures.*
>> *Measurement Criteria:* *Analyze requirement and design specifications.*
>> *Measurement Criteria:* *Development test cases using requirements and design specification.*

> **Performance Element: Perform testing & validation.**
>> *Measurement Criteria:* *Perform integration testing.*
>> *Measurement Criteria:* *Perform regression testing.*
>> *Measurement Criteria:* *Help with user-acceptance test.*
>> *Measurement Criteria:* *Validate user documentation.*
>> *Measurement Criteria:* *Document discovered errors.*

> **Performance Element: Document test results.**
>> *Measurement Criteria:* *Document errors discovered.*
>> *Measurement Criteria:* *Perform defect tracking.*

> **Performance Element: Develop software testing audit trails.**
>> *Measurement Criteria:* *Record error correction procedures and actions.*

Pathway KS Statement: Perform quality assurance tasks to produce quality products.

> **Performance Element: Demonstrate knowledge of software quality assurance.**
>> *Measurement Criteria:* *Demonstrate knowledge of Software QA process.*
>> *Measurement Criteria:* *Demonstrate knowledge of the standards/requirements for Software QA.*
>> *Measurement Criteria:* *Develop team relationships to support software quality assurance tasks.*

> **Performance Element: Perform software quality assurance tasks to produce a quality software product.**
>> *Measurement Criteria:* *Identify standards and issues related to I/O programming and design of I/O interfaces.*
>> *Measurement Criteria:* *Use customer satisfaction in determining product characteristics (e.g., cost, user-friendliness).*
>> *Measurement Criteria:* *Recognize the relationship between dependability, functionality, ease of use, etc.*
>> *Measurement Criteria:* *Conduct code walkthrough and/or inspection.*
>> *Measurement Criteria:* *Follow established procedures for testing, identifying problems, and tracking resolutions.*

Pathway KS Statement: Perform maintenance and customer support functions.

Pathway Topic: Programming and Software Engineering Pathway

    Performance Element: Analyze software technical support needs.

        Measurement Criteria: *Identify maintenance and support requirements.*

        Measurement Criteria: *Apply information and data analysis techniques.*

        Measurement Criteria: *Define scope of work to meet customer support needs.*

    Performance Element: Perform customer service.

        Measurement Criteria: *Access needed information using appropriate reference materials.*

        Measurement Criteria: *Provide help to first line user-support personnel to answer user questions.*

        Measurement Criteria: *Provide troubleshooting for software.*

        Measurement Criteria: *Perform system-tuning function.*

        Measurement Criteria: *Diagnose problems within system.*

        Measurement Criteria: *Perform technical functions required by customer/user.*

        Measurement Criteria: *Communicate and document technical support provided.*

    Performance Element: Perform software maintenance activities.

        Measurement Criteria: *Following organizational procedural in communicate and document maintenance tasks.*

        Measurement Criteria: *Identify and analyze problem.*

        Measurement Criteria: *Analyze and propose solutions.*

        Measurement Criteria: *Implement solutions in code and documentation.*

        Measurement Criteria: *Release software and documentation updates according to procedures.*

Section IV – O*NET Crosswalk Report

Career Specialty/ Occupational Coding and Crosswalk

Summary

The objective of the <u>Career Specialty/ Occupational Coding and Crosswalk</u> project is to accomplish two basic tasks. The first is to design and establish a classification and coding structure for the States' Career Clusters Initiative. When completed, the classification and coding structure will be compatible with existing occupational classification systems and designed in a manner that allows for easy updating and the flexibility to add additional career pathways and occupational specialties.

Once the first step is completed for each cluster, the second step is to build a linkage system or crosswalk between the new career cluster classification system and the O*NET occupational classification system developed and operated by the U S Department of Labor. O*NET is a nationally recognized taxonomy with detailed descriptions and a rich database of information for each occupation.

Explanation of Crosswalk Table

The attached table lists each occupational specialty and its related O*NET occupation. It is sequenced by career pathway and occupational specialty code. It should be noted that the relationship between an occupational specialty and its related O*NET occupation is often not one-to-one. The O*NET occupation is often much broader covering two or more occupational specialties. In fact, even when multiple occupational specialties are assigned, they may only represent a part of a broader O*NET occupation.

Column 1: Lists occupational specialties that were identified by the Career Clusters Initiative. The occupational specialties are organized by cluster pathways and represent occupational titles with no definitions. They are intended to be a sample of occupations that help define the cluster and pathway.

Column 2: Represents related occupations from the O*NET occupational coding system.

Note: A crosswalk from the occupational specialties to the Classification of Instructional Programs (CIP) codes is forthcoming. The National Crosswalk Service Center is currently developing the CIP to O*NET crosswalk which will be the bridge to the career cluster occupational specialties. You may access this crosswalk in the near future at: http://www.xwalkcenter.org/

Information Technology Career Cluster: Occupational Specialties and Related O*NET Occupations,
Sequenced by Career Pathway and Occupational Specialty Code

Occupational Specialty		Related SOC/O*NET Occupation	
	Title	**Code**	**Title**
11.10000	**Network Systems Pathway**		
11.10010	Network Systems Communications Analyst	15-1081.00	Network Systems and Data Communications Analysts
11.10020	Network Systems Data Communications Analyst	15-1081.00	Network Systems and Data Communications Analysts
11.10030	Network Information Systems Administrator	15-1071.00	Network and Computer Systems Administrators
11.10040	Network Information Systems Operator	15-1071.00	Network and Computer Systems Administrators
11.10050	Network Information Systems Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.10060	Network Administrator	15-1071.00	Network and Computer Systems Administrators
11.10070	Network Analyst	15-1051.00	Computer Systems Analysts
11.10080	Network Architect	15-1032.00	Computer Software Engineers, Systems Software
11.10090	Network Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.10100	Network Manager	15-1071.00	Network and Computer Systems Administrators
11.10110	Network Operations Analyst	15-1081.00	Network Systems and Data Communications Analysts
11.10120	Network Security Analyst	15-1071.01	Computer Security Specialists
11.10130	Network Specialist	15-1081.00	Network Systems and Data Communications Analysts
11.10140	Network Technician	15-1041.00	Computer Support Specialists
11.10150	Network Transport Administrator	15-1071.00	Network and Computer Systems Administrators
11.10160	Network PC Support Specialist	15-1041.00	Computer Support Specialists
11.10170	Network Systems Support Lead	15-1051.00	Computer Systems Analysts
11.10180	Systems Administrator	15-1071.00	Network and Computer Systems Administrators
11.10190	Systems Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.10200	Systems Technical Support Specialist	15-1041.00	Computer Support Specialists
11.10210	Systems User Support Specialist	15-1041.00	Computer Support Specialists
11.10220	Telecommunications Network Technician	15-1041.00	Computer Support Specialists
11.20000	**Information Support Services**		
11.20010	Data Administrator	15-1061.00	Database Administrators
11.20020	Data Analyst	15-1051.00	Computer Systems Analysts
11.20030	Data Architect	15-1051.00	Computer Systems Analysts
11.20040	Data Management Associate	15-1061.00	Database Administrators
11.20050	Data Modeler	15-2031.00	Operations Research Analysts
11.20060	Data Modeling Specialist	15-2031.00	Operations Research Analysts
11.20070	Database Administration Associate	15-1061.00	Database Administrators

**Information Technology Career Cluster: Occupational Specialties and Related O*NET Occupations,
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialty		Related SOC/O*NET Occupation	
	Title	**Code**	**Title**
11.20080	Database Administrator	15-1061.00	Database Administrators
11.20090	Database Analyst	15-1051.00	Computer Systems Analysts
11.20100	Database Developer	15-1051.00	Computer Systems Analysts
11.20110	Database Manager	15-1061.00	Database Administrators
11.20120	Database Security Expert	15-1071.01	Computer Security Specialists
11.20130	Database DSS (Decision Support Services)	15-1051.00	Computer Systems Analysts
11.20140	Database Knowledge Architect	15-1051.00	Computer Systems Analysts
11.20150	Senior Database Administrator	15-1061.00	Database Administrators
11.20160	Database Systems Analyst	15-1051.00	Computer Systems Analysts
11.20170	Database Systems Administrator	15-1061.00	Database Administrators
11.20180	Database Analyst	15-1051.00	Computer Systems Analysts
11.20190	Database Tester	15-1051.00	Computer Systems Analysts
11.20200	Desktop Publisher	43-9031.00	Desktop Publishers
11.20210	Documentation Specialist	27-3042.00	Technical Writers
11.20220	Electronic Publications Specialist	43-9031.00	Desktop Publishers
11.20230	Electronic Publisher	43-9031.00	Desktop Publishers
11.20240	Instructional Designer	27-3042.00	Technical Writers
11.20250	Online Publisher	43-9031.00	Desktop Publishers
11.20260	Technical Editor	27-3042.00	Technical Writers
11.20270	Publications Manager	27-3041.00	Editors
11.20280	Technical Writer	27-3042.00	Technical Writers
11.20290	Technical Support Analyst	15-1041.00	Computer Support Specialists
11.20300	Call Center Support Representative	15-1041.00	Computer Support Specialists
11.20310	Technical Support Content Manager	11-3021.00	Computer and Information Systems Managers
11.20320	Customer Liaison	15-1041.00	Computer Support Specialists
11.20330	Customer Service Representative	15-1041.00	Computer Support Specialists
11.20340	Customer Service Professional	15-1041.00	Computer Support Specialists
11.20350	Help Desk Specialist	15-1041.00	Computer Support Specialists
11.20360	Help Desk Technician	15-1041.00	Computer Support Specialists
11.20370	Help Desk Maintenance Technician	15-1041.00	Computer Support Specialists
11.20380	Help Desk PC Support Specialist	15-1041.00	Computer Support Specialists
11.20390	Help Desk PC Systems Coordinator	15-1041.00	Computer Support Specialists
11.20400	Help Desk Product Support Engineer	15-1041.00	Computer Support Specialists

Information Technology Career Cluster: Occupational Specialties and Related O*NET Occupations,
Sequenced by Career Pathway and Occupational Specialty Code

Occupational Specialty		Related SOC/O*NET Occupation	
	Title	Code	Title
11.20410	Help Desk Sales Support Technician	15-1041.00	Computer Support Specialists
11.20420	Help Desk Systems Analyst	15-1041.00	Computer Support Specialists
11.20430	Technical Account Manager	15-1041.00	Computer Support Specialists
11.20440	Technical Support Engineer	15-1031.00	Computer Software Engineers, Applications
11.20450	Technical Support Representative	15-1041.00	Computer Support Specialists
11.20460	Technical Testing Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.20470	Application Integrator	15-1081.00	Network Systems and Data Communications Analysts
11.20480	Business Continuity Analyst	15-2031.00	Operations Research Analysts
11.20490	Cross-Enterprise Integrator	15-1081.00	Network Systems and Data Communications Analysts
11.20500	Data Systems Designer	15-1081.00	Network Systems and Data Communications Analysts
11.20510	Data Systems Manager	11-3021.00	Computer and Information Systems Managers
11.20520	Data Warehouse Designer	15-1081.00	Network Systems and Data Communications Analysts
11.20530	E-Business Specialist	11-2021.00	Marketing Managers
11.20540	Electronic Transactions Implementers	15-1099.00	Computer Specialist, All Other
11.20550	Information Systems Architect, Planner	15-1032.00	Computer Software Engineers, Systems Software
11.20560	Systems Analyst	15-1051.00	Computer Systems Analysts
11.20570	Systems Architect	15-1032.00	Computer Software Engineers, Systems Software
11.20580	Systems Integrator	15-1081.00	Network Systems and Data Communications Analysts
11.30000	**Interactive Media Pathway**		
11.30010	Artist, 2D/3D	27-1014.00	Multi-Media Artists and Animators
11.30020	Animator	27-1014.00	Multi-Media Artists and Animators
11.30030	Audio/Video Engineer	27-4011.00	Audio and Video Equipment Technicians
11.30040	Digital Media Designer	27-1024.00	Graphic Designers
11.30050	Digital Media Specialist	27-1014.00	Multi-Media Artists and Animators
11.30060	Media/Instructional Designer	27-1014.00	Multi-Media Artists and Animators
11.30070	Multimedia Author	27-3042.00	Technical Writers
11.30080	Multimedia Authoring Specialist	27-3042.00	Technical Writers
11.30090	Multimedia Developer	27-1014.00	Multi-Media Artists and Animators
11.30100	Multimedia Specialist	27-1014.00	Multi-Media Artists and Animators
11.30110	Multimedia Producer	27-2012.01	Producers
11.30120	Multimedia Production Assistant	27-2012.01	Producers
11.30130	Streaming Media Specialist	27-1024.00	Graphic Designers

Information Technology Career Cluster: Occupational Specialties and Related O*NET Occupations, Sequenced by Career Pathway and Occupational Specialty Code

Occupational Specialty		Related SOC/O*NET Occupation	
	Title	Code	Title
11.30140	Virtual Reality Specialist	27-1024.00	Graphic Designers
11.30150	Web Designer	27-1014.00	Multi-Media Artists and Animators
11.30160	Web Producer	27-2012.01	Producers
11.30170	Web Administrator	15-1071.00	Network and Computer Systems Administrators
11.30180	Web Architect	15-1031.00	Computer Software Engineers, Applications
11.30190	Web Designer	15-1031.00	Computer Software Engineers, Applications
11.30200	Web Page Developer	15-1031.00	Computer Software Engineers, Applications
11.30210	Web Producer	15-1031.00	Computer Software Engineers, Applications
11.30220	Web Site Developer	15-1031.00	Computer Software Engineers, Applications
11.30230	Web Specialist	15-1031.00	Computer Software Engineers, Applications
11.30240	Webmaster	15-1071.00	Network and Computer Systems Administrators
11.40000	**Programming and Software Development Pathway**		
11.40010	Applications Analyst	15-1031.00	Computer Software Engineers, Applications
11.40020	Applications Engineer	15-1031.00	Computer Software Engineers, Applications
11.40030	Applications Business Analyst	15-1031.00	Computer Software Engineers, Applications
11.40040	Applications Computer Engineer	15-1031.00	Computer Software Engineers, Applications
11.40050	Applications Data Modeler	15-2031.00	Operations Research Analysts
11.40060	Operating Systems Designer/Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.40070	Operating Systems Programmer/Analyst	15-1081.00	Network Systems and Data Communications Analysts
11.40080	Operating Systems Program Manager	11-3021.00	Computer and Information Systems Managers
11.40090	Operating Systems Programmer	15-1021.00	Computer Programmers
11.40100	Operating Systems Programmer/Analyst	15-1021.00	Computer Programmers
11.40110	Operating Systems Project Lead	15-1071.00	Network and Computer Systems Administrators
11.40120	Software Applications Specialist	15-1031.00	Computer Software Engineers, Applications
11.40130	Software Applications Architect	15-1031.00	Computer Software Engineers, Applications
11.40140	Software Applications Design Engineer	15-1031.00	Computer Software Engineers, Applications
11.40150	Software Applications Development Engineer	15-1031.00	Computer Software Engineers, Applications
11.40160	Software Applications Engineer	15-1031.00	Computer Software Engineers, Applications
11.40170	Software Applications QA Specialist	15-1041.00	Computer Support Specialists
11.40180	Software Applications Tester	15-1041.00	Computer Support Specialists
11.40190	Systems Analyst	15-1051.00	Computer Systems Analysts
11.40200	Systems Administrator	15-1071.00	Network and Computer Systems Administrators

Information Technology Career Cluster: Occupational Specialties and Related O*NET Occupations,
Sequenced by Career Pathway and Occupational Specialty Code

Occupational Specialty		Related SOC/O*NET Occupation	
	Title	**Code**	**Title**
11.40210	Systems Test Engineer	15-1032.00	Computer Software Engineers, Systems Software
11.40220	Systems Tester	15-1032.00	Computer Software Engineers, Systems Software

Section V – Cluster Profile
Advisory Committee List

IT CAREER CLUSTER INITIATIVE… AT A GLANCE

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§ INITIATIVE OBJECTIVE §

DEVELOP AND PILOT TEST AN IT WORKFORCE DEVELOPMENT MODEL – FOR CAREERS INVOLVING THE DESIGN, DEVELOPMENT, MANAGEMENT AND SUPPORT OF HARDWARE, SOFTWARE, MULTIMEDIA AND SYSTEMS INTEGRATION SERVICES - TO BE USED IN SECONDARY AND POST-SECONDARY SCHOOLS ACROSS THE COUNTRY.

KEY FACTS

- ITCCI is one of 16 Career Cluster Initiatives funded by the U.S. Department of Education which is reforming career and technical education across the country.
- Initiative is a partnership of Education Development Center (**EDC**), National Alliance of Business (**NAB**), and Information Technology Association of America (**ITAA**).
- Twelve state education departments - Arkansas, Illinois, Maryland, Michigan, Minnesota, Nebraska, New York, North Carolina, Ohio, Oklahoma, Utah, and Washington - have designated secondary and post-secondary schools in their states to participate in the initiative.

KEY DELIVERABLES

Model Development & Testing
- Organize IT occupations into pathways based on commonalties.
- Identify industry-recognized knowledge and skills for IT Foundation and Pathway levels.

Curriculum & Assessment
- Connect existing and/or develop IT assessment instruments that measure student achievement according to the knowledge and skills in the model.
- Establish a portable IT skill certification program that documents student achievement of the knowledge and skills in the model.

Professional Development
- Develop a strategy for professional development and teacher preparation related to the model.

Dissemination
- Develop rollout strategies for implementing the ITCC model nationwide.

ACHIEVEMENTS TO DATE

Model Development & Testing
- Formed an Advisory Consortium of industry and education experts and receive ongoing feedback on key issues and outputs.
- Developed IT Career Cluster Framework indicating Foundation and Pathways with associated knowledge and skills. Framework is being implemented and tested at pilot site schools

Curriculum & Assessment
- Worked with pilot sites to conceptualize and develop scenario-based assessments that measure student performance in authentic, real-life work situations and include problem solving.
- Worked with selected members of the Advisory Consortium and state representatives to develop consensus around skills certification issues.

Professional Development
- Offered online and in-person institutes for pilot site teachers on topics including: Integrating IT Across the Curriculum and Scenario Based Assessments for IT knowledge and skills.

Business Engagement and Internships
- ITAA and NAB assisted pilot sites in developing and expanding business engagement and internships opportunities for students and teachers.

CONTACT INFORMATION

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Career Cluster Profile

Cluster Name: Information Technology

Project Lead:
Education Development Center, Inc. (EDC) with Information Technology Association of America (ITAA) and National Alliance of Business (NAB)

Project Lead Contact Information: Joyce Malyn-Smith, Ed.D.

Cluster Coordinators: Linda Scott lscott@edc.org 617-618-2170

Participating States:
Arkansas, Illinois, Maryland, Michigan, Minnesota, Nebraska, North Carolina, New York, Ohio, Oklahoma, Utah, Washington

Cluster Definition:

IT careers involve the design, development, support, and management of hardware, software, multimedia, and systems integration services. In addition to career opportunities in the IT industry, IT careers are available in every sector of the economy, from Financial Services to Manufacturing; Transportation, to Education.

Cluster Pathways:
- Network Systems (Network Design & Administration)
- Information Support & Services (Database Development & Administration & Enterprise Systems Analysis & Integration (Technical Support & Technical Writer))
- Programming & Software Development (Programming/Software Engineering)
- Interactive Media (Digital Media and Web Development & Administration)

3/11/03

Cluster Partners: List attached.

Number of cluster partners in each of the following categories:
    Postsecondary Education: **15**
    Secondary Education: **5**
    Business & Industry: **50**
    Labor: **0**
    Associations: **8**
    Government Agencies   **3**

Pilot Sites (with contact information):

State	Site	Contact	Phone
Arkansas:	Bryant High School	Contact: Sandra Porter	501-847-5611
Illinois:	Heartland Community College	Contact: Bob Shaw	309-827-0500 x322
	Bloomington Area Vocation Center	Contact: Steve Poznic	309-829-8671
Maryland:	Western School of Technology	Contact: Lisa Gleason	410-887-0947
Michigan:	Traverse Bay School District	Contact: Mike Hill	231-922-6280
	Oakland School District	Contact: Sue Maxam	248-209-2534
Minnesota:	Northwest Technical College	Contact: Teri Bradel	218-755-4264
Nebraska:	Omaha South High School	Contact: Pat Weddle	402-557-2615
North Carolina:	Guilford County Schools	Contact: Robert White	336-370-8393
New York:	George Westinghouse High School	Contact: Jean-Claude Brizard	718-858-8334
	New York City College of Technology	Contact: Anne Gawkins	718-260-5207
Ohio:	Auburn Career Center	Contact: Tom Schultz	800-544-9750 x211
Oklahoma:	Muskogee District	Contact: Sue Godwin	918-687-6383
	Ponca City District	Contact: Judy Sindelar	580-762-8336
Utah:	Davis Applied Technology College	Contact: Joe Osborne	801-593-2500
Washington:	Pasco High School	Contact: Chris Martinson	509-543-6770 x2164
	South Kitsap High School	Contact: Dale Green	360-876-5989

EDC

IT CAREER CLUSTER INITIATIVE

PILOT SITES

ARKANSAS	Bryant High School
ILLINOIS	Bloomington Area Vocational Center Heartland Community College
MARYLAND	Western School of Technology
MICHIGAN	Traverse Bay School District Oakland School District
MINNESOTA	Northwest Technical College
NEBRASKA	Omaha South High School
NEW YORK	George Westinghouse High School New York City College of Technology
NORTH CAROLINA	Guilford County Schools
OHIO	Auburn Career Center
OKLAHOMA	Indian Capital Technology Center Pioneer Technology Center
UTAH	Davis Applied Technology College
WASHINGTON	Pasco High School South Kitsap High School

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Section VI – Credentials

INFORMATION TECHNOLOGY CAREER CLUSTER SAMPLE LIST OF CREDENTIALS
(Includes licenses, education and industry certificates, as well as postsecondary degree options)
FINAL - July, 2002

Education and Industry *Licenses*		
Title/Type/Descriptor of Licensing Program	**Licensing Organization**	**Source for Contact Information**
Computer Hardware Engineers	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Computer Science Teachers, Postsecondary	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Computer Specialists (all others)	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Electrical Engineers	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Electricians	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Electronics Engineering Technicians	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Engineering Managers	States, Commonwealths, and Territories, Government Agencies	www.alx.org Search under career tools
Software Engineer	Texas Board of Professional Engineers	http://www.tbpe.state.tx.us/

Education and Industry *Certificates*		
Title/Type/Descriptor of Certification Program	**Issuing Organization**	**Source for Contact Information**
Certified Computing Professional (CCP)	ICCP (Institute for the Certification of Computing Professionals) 2350 East Devon Avenue, Suite 115 Des Plaines, IL 60018-4610	http://www.iccp.org/

Title/Type/Descriptor of Certification Program	Issuing Organization	Source for Contact Information
Associate Computing Professional (ACP)	ICCP (Institute for the Certification of Computing Professionals) 2350 East Devon Avenue, Suite 115 Des Plaines, IL 60018-4610	http://www.iccp.org/
Certified Systems Professional (CSP)	ICCP (Institute for the Certification of Computing Professionals) 2350 East Devon Avenue, Suite 115 Des Plaines, IL 60018-4610	http://www.iccp.org/
Certified Data Processor (CDP)	ICCP (Institute for the Certification of Computing Professionals) 2350 East Devon Avenue, Suite 115 Des Plaines, IL 60018-4610	http://www.iccp.org/
Certified Computer Programmer (CCP)	ICCP (Institute for the Certification of Computing Professionals) 2350 East Devon Avenue, Suite 115 Des Plaines, IL 60018-4610	http://www.iccp.org/
Certified Software Development Professional	IEEE (Institute of Electrical and Electronics Engineers) Computer Society	http://www.computer.org/certification/
Entry- level computer service technician (A+® certification)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Mastery-level document imaging technology Certification (Certified Document Imaging Architech™ (CDIA+))	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Entry-Level Internet Certification (i-Net+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
networking technologies certification (Network+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Standard Server Architecture Technologies certification (Server+ ™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/

Title/Type/Descriptor of Certification Program	Issuing Organization	Source for Contact Information
vendor-neutral Linux operating system certification (Linux+ ™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
IT Project Management Certification (IT Project+ ™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
e-Business certification (e-Biz+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Title/Type/Descriptor of Certification Program	**Issuing Organization**	**Source for Contact Information**
Technical Instructor Certification (CTT+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Security Certification (Security+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Home Technology Integrator Certification (HTI+™)	Computing Technology Industry Association (CompTIA) 1815 S. Meyers Road Ste. 300 Oakbrook Terrace, IL 60181	http://www.comptia.org/
Network Consultant/Engineer	Natl. Assoc. of Communication Systems Engineers (NACSE) 6595 South Dayton, Suite 3100 Greenwood Village, CO 80111	http://www.nacse.com/
Senior Network Designer/Engineer	Natl. Assoc. of Communication Systems Engineers (NACSE) 6595 South Dayton, Suite 3100 Greenwood Village, CO 80111	http://www.nacse.com/
Telecom Network Technician	Natl. Assoc. of Communication Systems Engineers (NACSE) 6595 South Dayton, Suite 3100 Greenwood Village, CO 80111	http://www.nacse.com/
Certified Info Systems Security Professional (CISSP)	International Information Systems Security Certification Consortium, (ISC)2 860 Worcester Road, Suite 101 Framingham, MA 01702	http://www.isc2.org/
System Security Certified Practioner (SSCP)	International Information Systems Security Certification Consortium, (ISC)2 860 Worcester Road, Suite 101 Framingham, MA 01702	http://www.isc2.org/

Certified Web Professional Associate	International Webmasters Association 119 E. Union Street. Suite #F Pasadena, California 91103	http://iwanet.org/profdevel/
Certified Web Professional Specialist	International Webmasters Association 119 E. Union Street. Suite #F Pasadena, California 91103	http://iwanet.org/profdevel/
Master Certified Web Professional Certifications.	International Webmasters Association 119 E. Union Street. Suite #F Pasadena, California 91103	http://iwanet.org/profdevel/
System Administrators SAGE Certification	USENIX is the Advanced Computing Systems Association 2560 Ninth Street, Suite 215 Berkeley, CA, 94710	http://www.usenix.org/sage/
Title/Type/Descriptor of Certification Program	**Issuing Organization**	**Source for Contact Information**
Certified Knowledge and Innovation Manager - Government (CKIM-G)	Knowledge Management Consortium International (KMCI) P.O. Box 191, Hartland Four Corners, VT 05049	http://www.kmci.org/
Certified Knowledge and Innovation Manager- Commercial (CKIM-C)	Knowledge Management Consortium International (KMCI) P.O. Box 191, Hartland Four Corners, VT 05049	http://www.kmci.org/
Professional Technical Trainer	ITrain International Association of Information Technology Trainers PMB 451 6030-M Marshalee Dr Elkridge, MD 21075-5935	http://itrain.org/certification/
Certified Insurance Data Manager (CIDM)	Insurance Data Management Association (IDMA) 545 Washington Boulevard, 22-16 Jersey City, NJ 07310-1686	http://www.idma.org/
Associate Insurance Data Manager (AIDM)	Insurance Data Management Association (IDMA) 545 Washington Boulevard, 22-16 Jersey City, NJ 07310-1686	http://www.idma.org/

Apprentice Certifications: Certified Apprentice Webmaster (CAW), Certified Web Designer Apprentice (CWDSA), Certified Web Developer Apprentice (CWDVA), Certified Web Administrator Apprentice (CWAA)	The World Organization of Webmasters 9580 Oak Avenue Parkway, Suite 7-177 Folsom, CA 95630	http://www.joinwow.org/
Certified Professional Webmaster (CPW):	The World Organization of Webmasters 9580 Oak Avenue Parkway, Suite 7-177 Folsom, CA 95630	http://www.joinwow.org/
Certified Web Consultant (CWSB)- Small Business	The World Organization of Webmasters 9580 Oak Avenue Parkway, Suite 7-177 Folsom, CA 95630	http://www.joinwow.org/

Postsecondary *Degree Options*		
Title/Type/Descriptor of Degree Program	**Degree Conferring Organization**	**Source for Contact Information**
Applied Computer Science, Computer Science Sequence (BS)	Colleges and Universities	Computer Science Accreditation Commission
Communications Technologies and Support Services	Public & Private Technical Schools	Classification of Instructional Programs Manual 10.01
Computer Aided Drafting and Design (AS)	Public & Private Technical Schools	Accreditation Board for Engineering an Technology, Inc.
Computer Aided Drafting and Design Technology (AS)	Public & Private Technical Schools	Accreditation Board for Engineering an Technology, Inc.
Computer and Information Science and Support Services	Public & Private Technical Schools	Classification of Instructional Programs Manual 11.99
Computer and Information Sciences	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc. Classification of Instructional Programs Manual 11.00

Title/Type/Descriptor of Certification Program	Issuing Organization	Source for Contact Information
Computer and Information Sciences, Computer Science Specialization (BS)	Colleges and Universities	Computer Science Accreditation Commission
Computer and Telecommunications Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Computer Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Computer Engineering Technologies/Technicians	Public & Private Technical Schools	Classification of Instructional Programs Manual 15.12
Computer Engineering Technology	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Computer Hardware Engineering	Colleges and Universities	Classification of Instructional Programs Manual 14.0902
Computer Integrated Manufacturing Technology (AS)	Public & Private Technical Schools	Accreditation Board for Engineering an Technology, Inc.
Computer Programming	Public & Private Technical Schools	Classification of Instructional Programs Manual 11.02
Computer Science	Colleges and Universities	Classification of Instructional Programs Manual 11.01
Computer Science - Scientific Option	Colleges and Universities	Computer Science Accreditation Commission
Computer Science and Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Computer Science and Engineering Technology (BS)	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Title/Type/Descriptor of Certification Program	**Issuing Organization**	**Source for Contact Information**
Computer Software and Media Applications	Colleges and Universities	Classification of Instructional Programs Manual 11.08
Computer Software Engineering	Colleges and Universities	Classification of Instructional Programs Manual 14.0903
Computer System Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Computer Systems Analysis	Colleges and Universities	Classification of Instructional Programs Manual 11.05
Computer Systems Engineering Technology (AS)	Public & Private Technical Schools	Accreditation Board for Engineering an Technology, Inc.
Computer Systems Networking and Telecommunications	Colleges and Universities	Classification of Instructional Programs Manual 11.09
Computer Teacher	College and Universities	Classification of Instructional Programs Manual 13.13
Computer Technology	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.

Computer/Information Technology Administration and Management	Public & Private Technical Schools	Classification of Instructional Programs Manual 11.10
Data Entry/Microcomputer Applications	Public & Private Technical Schools	Classification of Instructional Programs Manual 11.06
Data Processing	Public & Private Technical Schools	Classification of Instructional Programs Manual 11.03
E-Commerce/Business/managerial operations	Colleges and Universities	Classification of Instructional Programs Manual 52.0208
Electrical and Computer Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Electrical and Electronic Engineering Technologies/ Technician	Public & Private Technical Schools	Classification of Instructional Programs Manual 15.0303
Electrical, electronics and communication engineering	Colleges and Universities	Classification of Instructional Programs Manual 14.1001
Electronics and Computer Engineering Technology	Public & Private Technical Schools	Accreditation Board for Engineering an Technology, Inc.
Engineering Mathematics and Computer Science (BS)	Colleges and Universities	Computer Science Accreditation Commission
Information Science	Colleges and Universities	Classification of Instructional Programs Manual 11.04
Management Information Systems and Services	Colleges and Universities	Classification of Instructional Programs Manual 52.12
Systems and Computer Science (BS)	Colleges and Universities	Computer Science Accreditation Commission
Title/Type/Descriptor of Certification Program	**Issuing Organization**	**Source for Contact Information**
Telecommunications Engineering	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Telecommunications Engineering Technology (BS)	Colleges and Universities	Accreditation Board for Engineering an Technology, Inc.
Telecommunications Technology/Technician	Public & Private Technical Schools	Classification of Instructional Programs Manual 01.0401

Section VII – Validation Overview/ Results

EDC

INFORMATION TECHNOLOGY CAREER CLUSTER INITIATIVE

Academic Foundations and Pathway Standards

Validation Studies

REPORT SUMMARY

August 2002

Acknowledgements

EXECUTIVE SUMMARY OF FINDINGS

Introduction

This report represents the findings from 56 companies that participated in the validation of the standards (skills/knowledge and performance elements) required for inclusion in education programs leading to careers in Information Technology (IT). Two sets of standards were validated in this study:

1. Academic Foundation Standards (Language Arts, Mathematics, Science)
2. Pathway Standards (from the ITCC model[1]: Network Systems, Information Support and Services, Programming and Software Development, and Interactive Media)

Background

Sponsored by the United States Department of Education (DOE) and the National School to Work Office, IT Career Cluster Initiative (ITCCI) is a partnership of Education Development Center, Inc. (EDC), the Information Technology Association of America (ITAA), and the National Alliance of Business (NAB). The goal of the initiative is to develop and pilot a national model and curricular framework for education programs leading to IT careers that involve the design, development, support and management of hardware, software, multimedia and systems integration services. This framework includes standards, curriculum, and assessments for three levels: Core Skills, Pathway Skills, and Specialization Skills. This model builds upon computer user skills previously developed by learners in academic, technical or community based education programs. It offers an inclusive framework inviting existing programs and initiatives to recognize each other as partners in a large scale, broad-based national IT workforce development movement.

One element of this initiative's work is to identify and align industry-validated skill standards to this national model. These skill standards are important tools to develop curriculum and assessments that will prepare students for employment and/or further education in the field of Information Technology.

Existing Materials

Our materials review surfaced existing industry validated IT skill standards that made significant contributions to the field. These included the standards of 8 specializations developed by the National Workforce Center for Emerging Technologies (NWCET) [formerly Northwest Center for Emerging Technologies] and the skills and knowledge sets identified in the ITWorks.OHIO project.

Project staff matched existing skill standards with the model and drafted additional skill and knowledge statements to "fill in the gaps." As much as possible, the language of existing skill standards was retained and referenced.

The first part of the validation study (Summer 2000) confirmed the importance and utility of the skills and knowledge statements for 8 of the 10 core IT cluster areas. This study focuses on the

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[1] IT Career Cluster Model: www.edc.org/EWIT/bltext.htm

skills and knowledge statements for the Academic Foundations and Pathways.[2] (For purposes of this study, Academic Foundations are those skill and knowledge sets that may not be covered in a general academic curriculum, but are essential to the success of future IT workers.)

How can the results of this study be used?

- Program expansion: Determine what new courses and IT program areas might be added to existing school offerings.
- Accountability/evaluation: Examine existing programs to ensure that the skills/knowledge identified by the technology industry are included, and that faculty are addressing them.
- Evaluation of vendor specific programs: Assess the value of vendor specific training programs for schools' IT program offerings.
- Curriculum development: Develop a balanced curriculum that reflects rigorous academic and industry validated skills and knowledge needed by prospective technology workers.
- Strengthen academic program offerings: Add academic skills/knowledge sets to augment gen-ed (general education) curriculum.

Study Methodology

ITAA and EDC worked together to develop the study with input from the project's Standards Working Group (composed of representatives from IT and IT-reliant industries, education, and IT certification organizations who are also members of the project's Advisory Consortium). The IT Pathway standards used in this study are based on the itWorks.OHIO IT Competencies and on the NWCET skill standards for IT careers, supplemented by original work from EDC.

The Academic Foundation standards are based on Snyder's Taxonomy[3] and have been summarized and modified by EDC.

The Knowledge and Skills Validation Study was presented in an online format on a special website designed and created for the survey. The survey was available for a six week period during which respondents logged in at their convenience to complete the study. The beginning of the study asked each respondent to provide some demographic information about their organization's classification and size, their role in the organization, and their experience in the IT industry. They were then asked to rank each item according to the following five-point scale:
- critical
- necessary and important
- useful/helpful
- an asset but not necessary
- not applicable.

Data Analysis Methodology

This brief summary outlines the methods and procedures used to assess the respondent data of the Validation Survey.

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[2] The remaining topic (IT Applications) is being validated in a separate NSF initiative: IT Applications Across Career Clusters. Results will be available in October, 2002.
[3] Lester M. Snyder, Jr., Taxonomy of Academic Performance Indicators, V-Tecs, 2000.

All 96 participants responded to the Academic Foundations portion of the study. Of the 96 participants, the following responded to the Pathways section of the study:

19 responded to Information Support and Services (ISSP)
32 responded to Network Systems (NSP)
39 responded to Programming and Software Development (PSDP)
14 responded to Interactive Media (IMP)

All proportions for item level statistics were calculated from the total number of responses for each item in question. After all proportions were calculated, responses of critical and necessary/important were combined for each item. Taking into account the sample size, a combined percentage score of 60% was selected as a threshold for inclusion of skill items in the Academic Foundations, Network Systems Pathway, and Programming and Software Development Pathway. In these groups, items with a combined percentage score or 60% of higher were included in the skill sets. Items with a combined percentage score below 60% would be considered optional.

For the Information Support and Services and the Interactive Media Pathways, the items that received a combined percentage score of 50% or higher were identified for inclusion in the skill sets. Those with a combined percentage score below 50% would be considered optional.

Demographic Profile of Respondents

About one-third (36%) of the respondents come from computer-related industries and VAR/VAD/Systems or Network Integrator firms. A smaller proportion (28%) of the respondents come from education and training services industries. 44% of the participants come from firms with more than a thousand employees. The participants are divided almost equally between management and staff positions: (49%) in management and (51%) in staff positions. Almost one-third (32%) consider their primary job function to be Executive IS (CIO, CTO, VP/IS, DIR, IS Mgr). More than half of the participants (60%) have in excess of 10 years experience in the IT industry.

Summary of Results

Participants rated 21 out of 25 Academic Foundation Standards to be critical or necessary. The following two performance elements received critical or necessary ratings from 90% or more of the participants:

Language Arts
F01.1.5 Comprehend oral and written information (cause/effect, comparisons/contrasts, conclusions, context, purpose, charts/tables/graphs, evaluation/critiques, mood, persuasive text, sequence, summaries, technical matter)
F01.1.1 Listen actively

Participants rated 114 out of 138 Pathway performance elements to be critical or necessary. Furthermore, participants rated all of the performance elements grouped under the skill or knowledge statements below to be critical and necessary.

The following performance elements received critical or necessary ratings from 90% or more of the participants:

Information Support and Services Pathway
ISSP2.2: Evaluate application software packages

Programming and Software Development Pathway
PSDP7.2: Demonstrate proficiency in developing an application using an appropriate programming language
PSDP7.1: Demonstrate knowledge of programming language concepts
PSDP8.2: Perform testing and validation
PSDP1.1: Gather data to identify customer requirements
PSDP2.1: Define scope of work for the programming project
PSDP6.1: Create design specification for a computer application
PSDP1.4: Analyze requirements/specifications using current approaches
PSDP1.3: Develop software requirements specification
PSDP4.1: Apply tools for developing software applications
PSDP1.5: Use available reference tools as appropriate

Interactive Media Pathway
IMP5.1: Select and utilize appropriate software tools
IMP2.1: Define scope of work to meet customer requirements
IMP1.2: Interpret and evaluate requirements
IMP8.2: Resolve product problems
IMP1.1: Gather data to identify customer requirements
IMP6.2: Apply knowledge of basic web programming
IMP4.3: Develop time and activity plan to achieve objectives

Section VIII – Assessment Protocol
Certification Protocol

Deliverable #7
Title: Protocol for Career Clusters Assessment
8/5/2002 4:00 PM

Definition of Career Clusters Assessment

Assessment, within the context of the Career Clusters Initiative, is defined as *a **measurement** of what a learner should know and be able to do*. The academic and technical knowledge and skills common to all occupations and pathways within a single cluster are initially addressed in the Career Clusters Initiative. Each cluster measures or assesses a learner's knowledge and skills related to the cluster.

Purpose of the Protocol for Career Clusters Assessments

The purpose of this document is to provide:
- Minimum criteria for selecting existing assessment instruments that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for developing new assessment instruments that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for validating and determining reliability of assessment instruments.

Functions of Career Clusters Assessment

 Career Cluster Assessment serves to
- *measure* (assess) *student achievement*, both cognitive and performance, in areas of academic and technical knowledge and skills for each cluster
- *provide the basis* for a transportable, industry-endorsed certification.

Operational Guidelines for Career Clusters Assessment

This protocol includes minimum criteria/expectations career cluster designers need to apply in the selection/development of assessment modalities. Career clusters assessment:

CONTENT
- measures all 10 Foundation knowledge and skills.
- customizes context of questions and applications to individual clusters.
- reflects a high degree of specificity of measurable knowledge and skills.
- aligns to academic standards.
- connects to post high school standards and competencies.
- is consistent with Perkins data-quality criteria.

FORM
- combines a minimum of two modalities: cognitive and performance.
- includes an item bank that can accommodate multiple applications.
- reflects quality design and clear formats.

APPLICATIONS AND USES
- offers diagnostic feedback to the learner.
- provides added value to the user (employer, post high school); not required for employment.
- affords portability of results.
- provides cues for instruction.

ADMINISTRATION

- validates identity of test takers through a secure system.
- affords flexible administration, e.g. single assessment per foundation cluster topic or combination of topics.
- provides flexible timing for administration.
- affords no cost or low cost to students.
- includes an affordable, user-friendly process to cover administrative costs.
- reflects an administration process that is as consistent as possible with other career cluster assessments.
- includes an affordable, user-friendly maintenance process.

VALIDITY AND RELIABILITY

- uses consistent, reliable, and technically strong elements.
- is recognized by business and industry.
- is recognized by post high school education and training.

Deliverable #8
Title: Protocol for Career Clusters Certification
8/23/2002 2:28 PM

Definition of Career Clusters Certification

Certification, within the context of the States' Career Clusters Initiative, *documents* learner achievement of the academic and technical knowledge and skills common to all pathways and occupations within a cluster. It is based on valid and reliable assessments. A certificate is recognized by employers, secondary education, and post high school education as "value added to the admissions process to further education, immediate employment process, and/or to employment advancement".

Purposes of the Protocol for Careers Cluster Certification

The purposes of this document are to provide:
- Minimum criteria for selecting existing certification programs that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for developing new certification programs that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for determining the value of a certification program.

Functions of Career Clusters Certification

Career Cluster Certification serves to provide a consistent, transportable method of documenting learner achievement of a Career Cluster's validated academic and technical knowledge and skills. The system is based on valid and reliable assessments.

Operational Guidelines for Career Clusters Certification

This protocol includes minimum criteria/expectations career cluster designers need to apply in the selection/development of certification processes. Career clusters certification:

- Defines the purpose and scope of the certificate.
- Bases issue of the certificate on assessed learner proficiencies and competencies related to a Career Cluster's validated academic and technical knowledge and skills.
- Requires learner to meet the assessment benchmark identified.
- Informs the public concerning the knowledge and skills of the certificate holder.
- Indicates date of issue on the certificate.
- Issues certificate from the State (State Director of Career-Technical Education or appropriate designee) if the issuing organization is a secondary or post secondary education institution.
- Issues certificate from the CEO (or an appropriate designee) of an issuing professional organization/agency/institution/company.
- Requires issuing organization to maintain a database (state and/or national) of certificate holders based on the respective term of renewal.