# Building a Foundation *for* Tomorrow

*Sponsored in part by the National Science Foundation*

NWCET
National Workforce Center *for* Emerging Technologies

## *Skill Standards for* INFORMATION TECHNOLOGY

2003 EDITION

# Acknowledgments

The 2003 Edition of *Building a Foundation for Tomorrow: Skill Standards for Information Technology* reflects the value of skill standards to education, government and business. Building on the outstanding success of the Millennium Edition, this third edition embodies NWCET's ongoing commitment to the community of skill standards users.

As in the previous editions, CEOs, CIOs, technology managers, human resource personnel and other Information Technology (IT) professionals from many companies across the nation and internationally participated in generating and reviewing the data that comprise the skill standards. Thought leaders, representing the breadth and scope of the information technology workforce both in IT companies and in firms that use and depend on IT, provided the direction that guided our research and development of this document.

The National Workforce Center for Emerging Technologies especially acknowledges the major funding provided by the National Science Foundation (NSF), and the encouragement and vision of Dr. Gerhard Salinger, Dr. Corby Hovis and Dr. Elizabeth Teles, NSF Advanced Technology Education program directors. We are also indebted to our National Advisory Board for their perspective, feedback and continued support of our work.

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As in the Millennium Edition, Terryll Bailey, of The Allison Group, developed the research design and data gathering process for the 2003 Edition. Ms. Bailey also facilitated the various data gathering meetings and interviews, and refined and helped analyze the raw data. Her devotion to the project and her dedication to the accurate development, categorizing and presentation of the tremendous amount of new data represented in this work deserve the highest praise.

We acknowledge the valuable contributions and support of many state community college boards; professional associations; federal, state and local government agencies; and faculty experts from across the country that collaborated on this project. Special thanks go to Jean Floten, President of Bellevue Community College, and Neil Evans, NWCET Executive Director, without whose vision the NWCET would not exist.

Special recognition goes to the dedicated individuals within NWCET whose devotion to this project made it a reality. Dr. Sandra Mikolaski managed the overall project from research through final production. Dr. Laurie Stephan provided a crucial educational and workforce perspective. Dr. Manjari Wijenaike facilitated communication with NSF throughout the project. Heather Sipple helped coordinate the project and kept track of the countless details. Jackie Thoms graciously supported the contractual and financial aspects of the project. Thanks also to Carey Osborne, Manuel Garibay and Robyn Sandbo for their assistance with various project tasks.

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The Millennium Edition of *Building a Foundation for Tomorrow: Skill Standards for Information Technology* was in no small part responsible for the center's name change from the "NorthWest" to the "National Workforce" Center for Emerging Technologies. Therefore, honor is most assuredly due to the many thousands of users of the Millennium Edition from education, government, business, professional associations, certifying bodies and standards organizations that derived value and benefit from this work, and encouraged and inspired us to the 2003 Edition. Thank you.

**Peter Saflund**
Associate Director, NWCET

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# Introduction



Skill standards have proven to be efficient foundation tools for developing curriculum profiling jobs, recruiting technical staff, evaluating employees, designing professional development programs and designing academic and professional certification. Standards provide a common-language framework for educators, business and other stakeholders to develop the educational and training tools necessary to prepare students and incumbent workers for today's workplace challenges as well as those that lie ahead.

In 1996, the National Workforce Center for Emerging Technologies (NWCET) and the Regional Advanced Technology Education Consortium (RATEC) identified skill standards for the original eight Information Technology (IT) career clusters in the first edition of Building a Foundation for Tomorrow: Skill Standards for Information Technology. Furthering this work, in the summer of 1998, the NWCET and the American Electronics Association (AEA) jointly undertook a nationwide project to validate the IT skill standards and to seek input from expert panels around the country for new and changing skills, work functions, technical knowledge and related foundation skills to include in the Millennium Edition. Additional expert panel sessions were conducted regionally to augment and validate data on emerging career clusters. The Millennium Edition, published in 1999, contained the results of those efforts. In 2001 and 2002 NWCET began integrating new data from numerous sources. We noted the increased emphasis on security and data assurance (a trend which started well before 9/11) and also noted the increased integration of IT solutions in non-IT firms. While preserving our own unique mission and place, we shared our research freely with the National Skill Standards Board (NSSB) and with IT manufacturers developing platform-specific certifications and with vendor-neutral certifying organizations.

In 2002, under a supplemental grant from the National Science Foundation, NWCET researched and developed skill standards for cybersecurity. They are included as an appendix to this work.

Major new research for the 2003 Edition began with the formation of thought leader panels, which provided the high level direction and especially the changes in emphasis pertaining to critical work functions and technical knowledge elements within clusters. Practitioners and supervisors were then surveyed using several methodologies including large and small groups, telephone interviews and in-person interviews. Where feasible, input was also gathered from professional and trade organizations.

Major funding for this project was provided by the National Science Foundation. Additional funding was provided by NWCET sponsors and members. This publication is available electronically by subscription or as a bound printed publication from the NWCET website at *www.nwcet.org*.

# National Context

To remain competitive, the U.S. must close the qualification gap between the knowledge and skills needed in the information- and technology-based workplace, and the current level of preparation of the workforce. The globalization of markets and industries together with the rapid development of technology has created a workplace where, increasingly, knowledge and technology are the key ingredients that must be combined to ensure the successful development and marketing of products and services.

Today even the most basic manufacturing operations are often performed in a technological context. Once the primary concern of software companies and computer manufacturers, the IT skill shortage now affects virtually every manufacturing and service industry, as these segments of the economy increasingly employ technology in their operations. Large multinational corporations report that their economic survival is keyed to the sharpness of their "technological edge" and this, in turn, places similar demands on the myriad of large and small local and regional suppliers, vendors and organizations providing services to these corporations.

E-business and e-commerce will generate additional need for skilled information technology workers and for increased technological literacy among all workers.

The move toward globalization of business and the need for increased organizational efficiency have driven organizations to be less hierarchical and more information- and knowledge-based. Old narrow divisions of labor have, in many cases, given way to more flexible, needs-based descriptions of work, resulting in increasing emphasis on teamwork, fluid transitions from leadership on one project to "followership" on the next and a work environment where contextual application of knowledge and skills is the key ingredient for success. Today, people in virtually every occupation are increasingly required to think critically, solve problems creatively and efficiently, be flexible in the face of changing project demands and demonstrate a commitment to continuous learning.

The shift to an economy and a workplace based more on information and knowledge implies a higher level of technical and foundation skills in the workforce. Education must restructure itself to help prepare this new workforce.

## Why Skill Standards?

Successful industrialized nations that have maintained their competitiveness are characterized by a well-established skill standards system. The U.S. will be competitive only to the extent it is willing to reevaluate existing approaches to workforce development and adopt efficient strategies to ensure an adequate supply of workers with necessary skills. Since the inception of the School-to-Work Opportunities Act (1994), many states have embarked on programs to develop skill standards. The application of skill standards to the development of curriculum results in courses and programs whose outcomes can be assessed across a broad range of contextual technical and foundation performance criteria. This results in learners who are prepared to function effectively in the technology- and information-based workplace.

## What Are Skill Standards?

Voluntary skill standards establish the agreed-upon, industry-identified knowledge, skills and abilities required to succeed in the workplace. They form a solid foundation for the development of outcomes-based instruction and assessment.

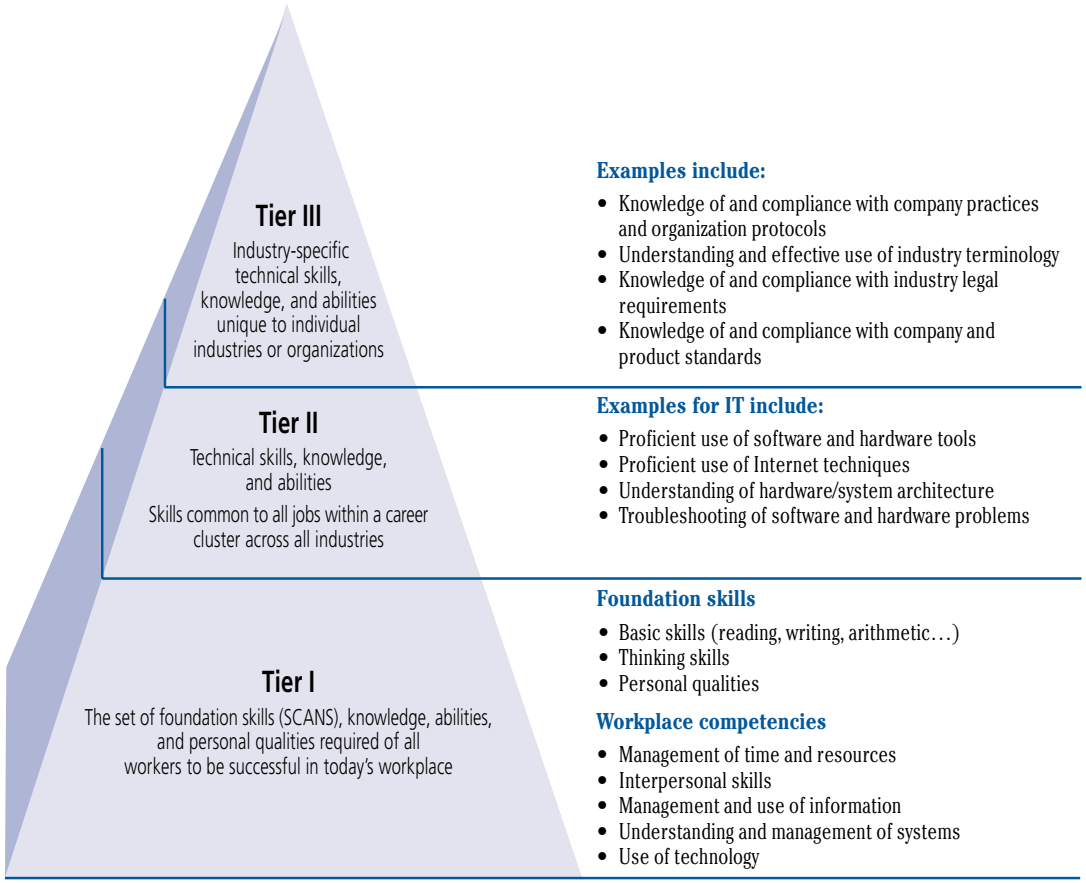
Skill standards differ from competencies in that they define high-level knowledge, skills, abilities and performance criteria.

The pyramid of competencies is a depiction of skill standards in three broad skill categories.

At the broadest level, Tier I, is the set of foundation skills, knowledge, abilities and personal qualities required of all employees to be successful in today's workplace. These are the universal skills-problem solving, team skills and flexibility-that are needed to apply technical knowledge and tools effectively.

Tier II-technical skills, knowledge and abilities-are the skills common to all jobs within a cluster across all industries. For a programmer, for example, knowledge of the principles of programming applies across all industries.

Tier III-industry-specific technical skills, knowledge and abilities-are unique to individual jobs or clusters and are the most prone to rapid change. For example, a programmer's required knowledge of data communications and network protocols may differ across companies and industries.



While traditional competencies may be developed from skill standards, the broad viewpoint taken by skill standards often provides clearer pathways for the development of more flexible and comprehensive curriculum. The practical value of this approach is to enable the development of more varied activities and assessments, provide for easier assessment of prior learning and illuminate opportunities to use instructional resources such as internships or industry-expert guest teachers.

For skill standards to be effective, they must reflect the consensus of the industry professionals in that career field. The development of skill standards involves conducting extensive industry research, often using expert panels in intensive, tightly-focused work sessions aimed at extracting key job functions and tasks, identifying technical knowledge elements, determining performance criteria (how one knows when the task is performed well) and associating related knowledge, skills and abilities (including SCANS skills) to those functions and tasks.

The skill standards contained in this document have been developed utilizing this process with industry expert panels in different parts of the country. While the overall regional variation of industry-supplied data was very slight, our national data panels and world-class research methodology have produced a document of extraordinary reliability and utility.

To ensure the integrity, quality and continuity of the skill standards, several principles have guided their development:

- Experienced workers are the experts in their career field and are best able to identify the work performed and the skills, knowledge and abilities required to be successful.
- Business and education must work as partners to ensure the link between the work expectations and the curriculum.
- Skill standards should represent broad career clusters rather than narrowly defined jobs.
- Standards must be flexible and portable, and should be updated continuously.
- Skill standards must be voluntary and adaptable to regional and local needs.
- Skill standards describe the major functions and tasks, as well as the performance criteria, technical knowledge, tools and employability skills/attributes needed to perform those functions and tasks well.
- Integrated skill standards define work duties and the skills required to perform them in the context of work settings.

## What Are the Benefits of Skill Standards?

Technology has not replaced workers as was once feared, but it has, for many, altered the way people do their jobs and relate to their coworkers and their organization. To ensure U.S. companies can be globally competitive and still have access to a skilled and technologically literate workforce, a new and closer partnership among business, education and government has emerged.

As former Secretary of Labor Robert Reich stated:

> *Our mission is far too vital, the stakes far too high, for anything but the most dispassionate analysis to guide decisions about how Americans learn and how Americans work.*
>
> *If we are to restore our heritage of shared prosperity, American workers need every bit of assistance we can give them in adapting to the new economy.*

*Many of the old factory jobs that once formed the gateway to the middle class are gone. Such manufacturing jobs accounted for more than one third of all American employment in the 1950s; now no more than 16 percent. Many of the old service jobs have disappeared too. Telephone operators have been replaced by automatic switching equipment, bank tellers by automatic teller machines, gas station attendants by self service pumps that now even accept credit cards, and secretaries by computers and voice mail. Any job that can be done more cheaply by a machine is either gone, or pays far less than before.*

*The right education and skills don't guarantee a good job in the new economy, and certainly not job security. But it is getting harder to have either without education and skills.*

*In this new economy – a knowledge economy – skills matter more. Skills are what allow people to navigate change successfully.*

*And for workers to be highly productive, they must have the education and training necessary to keep them in tune with the onward march of technology. As America moves further into this age of information and global competition, it becomes increasingly important that we make critical investments in our "human capital"-that is, in the knowledge, education, and skills of our workers. Today, tomorrow, and far into the future, a highly-skilled workforce is and will be our competitive advantage.*

Voluntary skill standards provide the framework within which U.S. companies can rebuild a competitive advantage in the global economy.

- Industry-identified skill standards will serve as a vehicle for companies to communicate their performance expectations for workers. Skill standards will provide a common framework for communication of workplace expectations among business, education, workers, students and government.
- Voluntary skill standards will facilitate the reform of education to match curriculum development to workplace requirements. Competency-based standards will assure the employability of students who have completed programs based on those standards. National recognition of skill standards in career fields will provide a common basis for certifying achievement against those standards, thereby allowing for portability of skills across companies and careers.
- Skill standards will close the qualification gap by linking industry expectations for knowledge, skills and abilities to the education provided to students. Skill standards will provide workplace expectations, so students will know what they need to be able to do to meet those expectations, workers understand what is expected in order to perform and advance in their field and educators can identify the competencies on which curriculum can be developed or revised.

## Who Benefits from Skill Standards?

Skill standards benefit industry, students, educators and government. Each group has a major stake in the education of our students and in the efficient development of a productive workforce. Particularly in fast-changing fields like information technology, relevant data that accurately reflects current and future knowledge and skills enables timely direction of resources, development and revision of industry-relevant curriculum and efficient development of career information and job profiles. Skill standards occupy an indispensable position in any dialog concerning education or training in technical fields.

| *Industry can use skill standards to:* | *Students can use skill standards to:* | *Educators can use skill standards to:* | *Government can use skill standards to:* |
|---|---|---|---|
| • Develop or modify training.<br>• Communicate effectively with educators, students, parents and government.<br>• Develop skill-centered work teams.<br>• Assess and place new hires.<br>• Develop performance appraisals.<br>• Write job descriptions.<br>• Develop recruiting methods, instruments and strategies.<br>• Profile jobs and determine skill needs and gaps.<br>• Forecast human resource needs.<br>• Determine or modify supervisory roles or organizational structure.<br>• Effectively benefit from vendor-neutral and professional certifications.<br>• Compare and evaluate skills across divisions or departments. | • Research career pathways.<br>• Understand skills requirements and employment characteristics of different jobs.<br>• Plan educational programs.<br>• Prepare resumes and other credentials to seek employment.<br>• Evaluate and compare educational programs.<br>• Prepare for industry and professional certifications.<br>• Gain an understanding of the full range of technical knowledge and employability skills needed to succeed in a chosen field.<br>• Help determine the application of prior learning or previous experience.<br>• Obtain certification of their skills.<br>• Improve the mobility and portability of their credentials.<br>• Earn higher wages and experience greater security and opportunity.<br>• Contribute to the success of their organizations. | • Develop or review curriculum, courses and courseware.<br>• Communicate effectively with industry, parents, students and government.<br>• Develop or enhance cross-curricular and interdisciplinary communication.<br>• Determine current and future equipment requirements.<br>• Develop professional development or inservice training plans.<br>• Develop institutional response priorities.<br>• Request or allocate human, physical and capital resources.<br>• Research curriculum and instruction issues.<br>• Advise students on career choices and educational options.<br>• Develop internships, school-to-work, Tech Prep and other articulated programs.<br>• Develop or highlight transfer pathways and inter-institutional programs.<br>• Bridge technical and academic programs.<br>• Assess prior learning.<br>• Provide targeted instruction.<br>• Start or improve the function of local advisory committees. | • Help develop a highly skilled, competitive workforce.<br>• Forecast educational resource requirements and allocate resources using a gender-neutral, bias-free and vendor-neutral set of criteria.<br>• Forecast workforce demands.<br>• Develop training requirements.<br>• Increase opportunities for underrepresented populations.<br>• Develop educational, training and workforce policies.<br>• Develop or enhance links among national efforts such as school-to-work, technical and vocational education, and other programs for targeted populations.<br>• Research skills characteristics of fast-moving technology-based industries.<br>• Effectively communicate with other institutions and stakeholders. |

# What's New in the 2003 Edition

Welcome to the 2003 Edition of *Building a Foundation for Tomorrow: Skill Standards* for In formation Technology. We have tried to retain the familiar look and feel of the Millennium Edition while incorporating the changes and updates suggested by our many educational and business users, and by the expert panels and national organizations that provided input.

Some things you'll notice:

- Increased emphasis on security and data assurance across all clusters
- Compliance with National Skill Standards Board (NSSB) terminology and taxonomy
- More emphasis on soft skills and "whole job" thinking
- Supporting documentation moved to the web to make the printed book lighter and easier to handle
- Cybersecurity Skill Standards added in the Appendix
- Streamlined look and feel
- All cluster titles retained from the Millennium Edition
- Updated and expanded sample job titles
- Uniform language and terminology validated by industry
- Every data element reviewed by subject matter experts
- Regional re-validation of key data

We have tried to ensure that the technical information is conveniently accessible and presented in a form that can be useful to both educators and business.

An electronic version of this document is also available by subscription from the NWCET website at *www.nwcet.org.*

## Methodology

The 2003 Edition of *Building a Foundation for Tomorrow: Skill Standards for Information Technology* is the result of national review and critical updating of the Millennium Edition published in 1999. New material has been added reflecting increased emphasis on job roles and advancement. This continues the trend observed in the Millennium Edition where employers clearly expressed a desire to see a longitudinal range of skills, not just entry level.

Data gathering for the 2003 Edition was accomplished efficiently using the following method:

- A national panel of industry thought leaders was assembled to provide critical input and direction. This group provided vital information on: changes in relevancy and emphasis; future trends; measures of competency; and existing or projected skill needs
- Results from regional re-validation studies undertaken by industry and educational organizations in Wisconsin, Connecticut, Northern Virginia, Maryland, Colorado, South Carolina and Texas were integrated with the thought leader data
- Expert panels of practitioners and supervisors were identified and interviewed extensively
- Resulting output was checked with subject matter experts
- Further expert input ensured consistent terminology and vocabulary
- NWCET data was shared with NSSB to ensure consistency with ICT standards

# Trends in Information Technology



Research conducted to gather data for the 2003 Edition yielded information on new trends in Information Technology which are set forth below. Some may appear obvious, others more subtle, but all reflect the changing IT picture and may contribute to a greater understanding of current and future IT workforce needs.

## Security

Even before 9/11 security and data assurance were clearly emerging as important critical work functions and technical knowledge elements. Pre-9/11 the concern was almost completely on fraud prevention and the security of electronic transactions. While this concern continued unabated, post-9/11 (as may be expected) the added threat of cyber terrorism and infrastructure protection added elements of cyber forensics, user education and physical security to discussions previously focused on perimeter defenses and secure transaction servers. A clear shift toward preemptive and anticipatory approaches to security emerged after 9/11 and continues to be a major focus of technical discussions especially among IT professionals involved in networking, database administration and systems analysis. Moreover, it is clear that security is "everybody's business," from the technician who installs a new workstation on a clerk's desktop to the analyst/integrator planning the next major system upgrade. The implications for educators are inescapable: "Security across the Curriculum" is the new theme of IT program development.

## The Back Office

For many IT-using companies, the tools of information technology were about doing traditional tasks faster, better and cheaper. IT was about getting payroll checks disbursed, keeping track of inventory, processing orders and handling the other routine tasks of business. However, as the tools of IT have become more capable and sophisticated, IT is not just about automating and accelerating routine business operations. Increasingly, IT is also about competitive advantage and profit and loss. The tools of IT not only allow greater business efficiency, but now also offer closer tracking of customers, better management of suppliers and more effective real-time business decision support. For many businesses, the web has changed the nature of sales and marketing. Price competition is severe in many areas of commerce. Increasingly, it is these back office tools that managers turn to in order to achieve desired margins and returns.

## Outsourcing

Old (manufacturing) economic models assumed capital was immobile and labor was mobile. Capital (the means of production) had to be located near power sources such as rivers or water falls, or near raw materials such as wood or iron ore. Over time, people who wanted jobs would travel to wherever the factories were. In the knowledge economy (based primarily on intellectual property and know-how) capital can go wherever labor is cheapest. This trend started with call centers and transaction processing centers locating in areas of the US with abundant inexpensive labor. However, the availability of highly educated and capable workers in emerging nations has made outsourcing an increasingly attractive possibility for any IT job, from systems analysis and programming to technical call centers, especially in times of depressed profits and cost cutting. Since most of the products of IT can be transported anywhere in microseconds, it is unlikely that this trend will be abated by greater local productivity alone.

Certainly it does not suggest there will be no future for IT workers in the US, but it probably does imply that we are unlikely to see a sellers' market for those with IT skills as we experienced at the turn of the millennium.

## Enterprise Thinking

In the environment in which the Millennium Edition was published, employers were anxious to hire anyone with immediately applicable skills. Students and recareering workers were just as anxious to acquire immediately marketable skills and get hired. As the pace of hiring has slowed, both employers and potential employees are taking a more measured look: employers at whom they hire and why, and potential employees at what the job really requires of them. Employers clearly state that turnover is costly, and they often voice frustration at being presented with candidates who may possess technical skills but don't understand the nature of the business. Employers in our data gathering groups have told us they'd like it more if candidates understood not only their own job, but the company and the industry better.

## Soft Skills

While it may be a stretch to say that technical skills are "assumed," many employers place a greater emphasis on soft skills than may be first appreciated by students and job seekers. Many HR professionals say that if the candidate does not pass the soft skill part of the interview, they won't even pass the candidate on to the technical part of the interview. The ability to read, write, compute, communicate, work productively with others, empathize with customers, find common ground for cooperation, seek mutually beneficial solutions, and work efficiently and ethically far outweigh any technical skill in the minds of most employers. As technical skills become more ubiquitous and widely distributed, what will increasingly differentiate candidates will be these critical academic and employability or soft skills attributes.

## Contracting and Consulting

The trend toward focusing on core businesses and core competencies that started with large firms is being adopted by smaller firms as well. For information technology, this trend has resulted in increasing numbers of long-term contract positions at the technician level and large growth in consulting services at the professional level.

Firms for whom information technology is not a core competency may contract for computing infrastructure, hardware, maintenance, website hosting, transaction processing, data warehousing and employee training in the use of technology. This trend has created opportunities for full-time employment with the contractors supplying these services, rather than with the end-user of the services. Contract workers often do not have permanent status. Although many assignments extend for the duration of the contract (and are therefore considered "long-term"), they are temporary because there is no assurance the contract will be renewed or extended. Because of the explosive growth of the information technology industry and the shortage of skilled workers, relatively few proficient individuals have experienced periods of unemployment, and this is expected to be the case for the foreseeable future.

Many firms also employ consultants in short- and long-term positions to help provide implementation and integration guidance, and to research and provide strategic input, especially in technology forecasting and deployment. Firms both large and

small also seek consultants with specific skills in current or emergent technologies as they apply to their business needs. Consultants may work independently but are often part of skilled groups whose services are arranged through large firms specializing in consulting services. Persons working for these firms often acquire valuable worldwide enterprise perspective as they work through their assignments, and bring their technical expertise and aggregated experience to each new assignment.

## Specialists versus Generalists

An interesting divergent trend seems to be emerging in the structure of the information technology workforce in large versus small companies. Larger firms seem to gravitate more toward specialization at both the technical and management level. Some technical workers support relatively small groups dedicated to one project that is narrow in scope. As a result, there is a tendency to develop extreme experts in a very tightly focused area.

In contrast, smaller concerns express strong interest in finding individuals with a range of skills, knowledge and abilities. This implies that the employee is able to determine when the firm needs to seek external resources, and to make the case for justifying their use when necessary. It also means the employee is more effective when able to communicate not only laterally, but to all organizational levels. Since students and re-careering adults often start with small concerns, this trend implies that educational and training efforts include activities and assessments that build the student's ability to integrate a range of skills and abilities.

## Nontraditional Degree Paths

The nature of information technology work and the explosive growth of the field has created opportunities for rapid career progression and salary advancement. The iterative and project-based nature of the work creates means experienced persons will have increasing responsibilities in project management, planning and coordination. There is a trend toward 'upside down" degrees. Technician-level persons are acquiring additional business education which qualifies them for increasing management responsibility.

Four-year schools, especially those who cater to working adults, are willing to evaluate technical education and professional development in partial fulfillment of academic degree requirements, and are increasingly willing to design individualized study and flexible cohort-based learning groups to facilitate degree completion.

Information technology workers at all levels value their education, strive to stay current and are often among the most willing employees to take advantage of professional development and career advancement opportunities. This trend implies that employers must continue to provide professional development and career advancement opportunities, and also suggests that there will be continued growth in non-traditional undergraduate and graduate education for information technology workers.

# Information Technology Skill Standards

On the following pages, you will find skill standards for eight career clusters in information technology. Career clusters are groupings of representative job titles, related by a close association with a common set of technical skills, knowledge and abilities. The career cluster approach was used because it more closely reflects how work is organized today, especially in illustrating mobility and progression among representative job titles.

## Career Cluster Titles

The skill standards for the eight career clusters researched for this project are:

- Database Development and Administration
- Digital Media
- Enterprise Systems Analysis and Integration
- Network Design and Administration
- Programming/Software Engineering
- Technical Support
- Technical Writing
- Web Development and Administration

These career clusters represent a broad range of job titles, from entry level through senior management. We have attempted to capture, at a high level, skill sets that are reflective of the range of work represented by the cluster, thereby helping to illustrate pathways for mobility and progression. With this approach, we hope the skill standards will be useful to educators at every level, and to human resource professionals, training, certification and assessment developers, students and job seekers, and organizations and individuals conducting research into information technology workforce issues.

## Common Elements Across Career Clusters

There are several elements that appear in all clusters. This commonality reflects the desire of virtually all employers for employees with a set of common qualities that support specific technical knowledge and skills.

### *Project Management, Task Management and Problem-Solving/ Troubleshooting Standards*

One set of common categories includes project management, task management and problem-solving/troubleshooting. To avoid redundancy and improve usability, these elements have not been repeated at the end of every cluster, but are included in the Appendices. Users of the skill standards should assume that these core elements are part of every cluster.

### *Cybersecurity Skill Standards*

See the Appendices for the NWCET's cybersecurity skill standards, first published in December 2002. These standards were developed in part with a grant from the National Science Foundation (NSF).

Draft standards were presented and reviewed at the NSF Cybersecurity Summit in June 2002 in Washington, DC. This summit verified the need for technician-level cybersecurity skill standards to support cybersecurity workforce development to assure the integrity of the nation's IT infrastructure.

These cybersecurity skill standards will find application in IT education and training program development, certification and technician reskilling. Although presented here as separate data elements, cybersecurity skills are increasingly important across all career clusters.

### *Process Skills*

Either explicitly or implicitly, certain other process skills appear repeatedly across all eight clusters. These skills include: analysis, design, development, testing, implementation and documentation.

The nature of each of these skills differs depending on the job level, and from cluster to cluster. By inference, however, employers want employees who can:

- apply a systematic, methodical approach to solving problems;
- research to see who else knows about the problem;
- develop a rational set of possible solutions;
- test the solutions in a cost-effective and efficient manner;
- verify that the problem is truly solved
- document the solution for others.

### *Additional Skills*

Regardless of the career cluster, certain other skills appear to be "givens" in today's workplace. The ability to use common software applications such as word processing and email, knowledge of Internet terminology and a basic understanding of computing hardware, infrastructure and networks are virtually foregone conclusions in the minds of the majority of employers.

## About the Skill Standards Templates

There is a wealth of information presented in a very compact form in the skill standards that follow. The information includes:

- Career cluster descriptions and sample job titles.
- A one-page summary template for each cluster listing critical work functions and key activities
- A detailed template listing the supporting performance indicators; technical skills, knowledge and abilities; and the foundation/ employability skills associated with each key activity

### *Critical Work Functions*

Critical work functions represent the general areas of responsibility within a career cluster. Functions state what must be done to fulfill the key areas of responsibility within the career cluster.

### *Key Activities*

Key activities are duties related to the functional areas of a career cluster. Key activities are a listing of the tasks performed by workers. Key activities are observable, measurable work tasks with a definite beginning and end, and which result in a product, service or decision.

### *Performance Indicators*

Performance indicators answer the question: "How do we know when a task is performed well?" They are specific evidence of the competent completion of a task, or the achievement of a defined skill or knowledge level. While critical work functions and key activities help define the general work requirements of a career cluster, performance indicators help complete the picture by describing the employer-defined level of competent performance.

### *Technical Knowledge, Skills, Abilities and Tools*

This category lists the specific items of technical knowledge, skills, abilities, attributes and use of tools associated with a function or task. This information is presented at a high level and avoids reference to specific vendors, versions or equipment. This allows maximum flexibility in adapting the skill standards to local specifications while preserving the general requirements of employers for specific skills.

### *Employability/Foundation Skills*

These skills are general requirements associated with a function or key activity. They reinforce the performance indicators and are the competencies that allow workers to interact and participate in the high-performance workplace. Employability/foundation skills reflect the SCANS terminology and may be thought of as the competencies that allow one to put technical knowledge to work. They include basic skills in reading, writing and arithmetic, as well as thinking/reasoning skills, interpersonal skills and the abilities required to interact productively with complex and dynamic systems.

# Database Development and Administration

As a database administrator, you will first gather data to determine user requirements. You may also gather the information to design reports, forms and application interfaces so users can create data queries and interpret the results. You will participate in the creation of corporate data models, as well as determining the enterprise's data requirements. You may be involved with prototyping a database system, creating system models and simulating all aspects of the data system. You will take part in the selection of appropriate database design tools. You will be involved with decisions concerning the choice of platforms as well as the evaluation and selection of Database Management Systems (DBMS). You will participate in the conceptual and logical database design phases. You will have a major role in the physical database design phase and the physical implementation of database designs using a selected DBMS. You will oversee and monitor information exchange between database designers and application interface developers. You may be involved with data conversion operations and will load data into new or existing systems. You may determine needed changes either to new systems or existing systems as they grow. You will develop testing strategies and thoroughly test the entire data system before and after it is put into operation. To keep data secure and protected from catastrophic events, you will create security procedures and implement backup and recovery processes. You will be responsible for operational maintenance and fine tuning after a database system is in place and functional. You may be involved with training users at various levels. You will create documentation and other necessary materials. You will also need to keep abreast of hardware and software developments, associated costs and updates that may be available for existing software and hardware. You need to be creative in your approach to problems and willing to help everyone get the data they need while maintaining system security and reliability.

## SAMPLE TITLES

- Data Administrator
- Data Analyst
- Data Architect
- Data Management Associate
- Data Modeler
- Data Modeling Specialist
- Data System Application Programmer
- Database Administration Associate
- Database Administrator
- Database Analyst
- Database Consultant
- Database Developer
- Database Engineer
- Database Manager
- Database Modeler
- Database Security Expert
- DSS (Decision Support Services)
- Knowledge Architect
- Logical Database Designer
- Physical Database Designer
- Senior Database Administrator
- Senior Systems Analyst
- Systems Administrator
- Systems Analyst
- Tester

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Summary of Critical Work Functions*

| A. Analyze and Design Database | B. Develop and Implement Database | C. Perform Administration and Maintenance | D. Provide Data Assurance | E. Provide Client and User Services | F. Perform Database Test |
|---|---|---|---|---|---|
| A1 Perform research and analyze requirements | B1 Develop physical database characteristics and define user interface | C1 Develop and implement monitoring plan | D1 Gather and document security requirements and specifications | E1 Provide and support development and production environments | F1 Develop test plans |
| A2 Determine target environment/platform | B2 Create database objects | C2 Analyze monitoring data | D2 Design and document security plan | E2 Plan and deliver user training | F2 Develop test procedures |
| A3 Create and refine conceptual and logical data models | B3 Select unique identifiers and normalize the data model | C3 Manage onsite and offsite backup and recovery | D3 Implement and enforce security requirements | E3 Identify additional requirements | F3 Perform tests |
| A4 Identify high-level business rules for data model | B4 Support population of database | C4 Create and implement maintenance plan for regular integrity checks | D4 Maintain and improve security in response to industry developments and user experience | E4 Adapt existing structure to new business environments | F4 Document test results and make recommendations |
| A5 Adapt conceptual and logical data models to enterprise model | B5 Integrate high-level business rules with code | C5 Maintain physical organization of database objects | D5 Protect enterprise/client data | | F5 Test database components |
| A6 Validate conceptual and logical data models with clients | B6 Develop backend and frontend connectivity | C6 Upgrade databases and migrate to new versions | | | F6 Implement performance testing |
| A7 Identify backup and recovery requirements and create recovery plan | B7 Develop and validate database implementation plan | C7 Plan and manage current and future physical resource requirements and enhancements | | | |
| A8 Identify access and concurrency requirements | B8 Install and deploy database | C8 Administer and enforce standards | | | |
| A9 Design distributed model | B9 Produce business and technical documents | C9 Audit database systems | | | |
| A10 Analyze database relative to other databases | B10 Tune database and optimize performance | | | | |

KEY ACTIVITIES

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Analyze and Design Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Perform research and analyze requirements** | • Business objectives and goals for the project are well defined by all stakeholders<br>• Necessary project background, including legacy, is complete and accurate<br>• Sources of information are reliable and current<br>• Customer requirements are thoroughly understood and documented<br>• Final requirements are documented and approved<br>• Third-party tools are identified and agreed upon by all parties<br>• Client/users are properly educated regarding requirements, technology and tools<br>• Research and analysis are effectively coordinated with team members<br>• Business needs with respect to ROI are thoroughly analyzed | • Knowledge of basic business objectives and requirements analysis<br>• Knowledge of database software, design tools and design principles<br>• Knowledge of operating systems and third-party tools<br>• Knowledge of business needs and project investment analysis requirements in usability<br>• Knowledge of systems legacy integration rules | • Ability to identify key sources of information<br>• Ability to analyze information for accuracy and consistency<br>• Ability to work cooperatively with others and contribute ideas, suggestions and assistance<br>• Ability to ask relevant questions<br>• Ability to accurately summarize and document information<br>• Ability to resolve conflicts in available information and expressed needs |
| **A2. Determine target environment/platform** | • Available hardware, software and implementation options are researched, analyzed and documented<br>• Scope of the project is balanced with financial equipment and personnel constraints<br>• Target environment/platform is agreed upon by key stakeholders<br>• Database technology is properly selected based on modeling criteria<br>• Platforms and environments are reviewed, and options and recommendations are effectively communicated to appropriate personnel | • Knowledge of computer platforms and environments<br>• Knowledge of platform capabilities and limitations<br>• Knowledge of platform implications on database design, performance and usability issues<br>• Knowledge of installed base and preferred products<br>• Knowledge of database software<br>• Knowledge of web-based data environments | • Ability to synthesize information<br>• Ability to compare multiple viewpoints<br>• Ability to generate alternative solutions<br>• Ability to analyze alternatives, consider tradeoffs and make decisions<br>• Ability to work with a diverse group of issues and people |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Analyze and Design Database*

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|---|---|---|---|
| **A3. Create and refine conceptual and logical data models** | • Conceptual model is documented accurately and thoroughly<br>• Entities, attributes and relationships are identified and defined in a complete and accurate form within scope<br>• Client/users are consulted during conceptual data modeling process as appropriate | • Knowledge of data modeling and database software and tools<br>• Ability to translate client/user requirements into data model<br>• Ability to define attributes and align to entities<br>• Ability to resolve discrepancies in different/ multiple models<br>• Ability to relate user specifications to data model | • Ability to create, store and distribute documentation according to requirements<br>• Ability to recognize and resolve conflicting specifications<br>• Ability to work cooperatively with others and contribute ideas, suggestions and assistance<br>• Ability to ask relevant questions<br>• Ability to accurately summarize and document information |
| **A4. Identify high-level business rules for data model** | • Pertinent business rules are identified or defined during modeling<br>• High-level business rules are documented<br>• Data ownership is clearly defined<br>• Data definitions are fully developed and agreed upon in accordance with company procedures<br>• High-level business rules are integrated within the data model<br>• Validation rules are identified and documented<br>• Design gaps are identified and resolved | • Knowledge of business structure and processes<br>• Knowledge of business entities and relationships<br>• Knowledge of business policies and procedures<br>• Knowledge of validation rules and data constraints<br>• Knowledge of business intelligence models and high-level organizational environments | • Ability to synthesize information<br>• Ability to analyze structure and relevance of information<br>• Ability to create detailed supporting documentation<br>• Ability to visually analyze relationship between parts/whole |
| **A5. Adapt conceptual and logical data models to enterprise model** | • Conceptual and logical data models are consistent with enterprise model<br>• Possible adaptations of enterprise model are considered<br>• Company data and objects standards and standardization policies are thoroughly followed<br>• Business process changes/adaptations are researched and evaluated | • Knowledge of company modeling policies and company development standards<br>• Ability to communicate modeling issues to a variety of audiences<br>• Ability to visualize and integrate conceptual and logical model to conform with the enterprise model<br>• Knowledge of database software and database modeling techniques | • Ability to examine data for relevance and accuracy<br>• Ability to pay attention to detail<br>• Ability to analyze structure and organization of information<br>• Ability to negotiate and resolve conflicts<br>• Ability to present technical information clearly |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Analyze and Design Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A6. Validate conceptual and logical data models with clients** | • Data model and prototypes are presented clearly and completely and approved as appropriate<br>• Issues are resolved and recommendations are fed back into the modeling process<br>• Conceptual and logical models are reconciled with appropriate level process models<br>• Conceptual and logical data models are validated by client<br>• Changes or modifications to all models and validation process and outcomes are accurately, concisely and completely documented<br>• Data ownership and reuse are properly validated | • Knowledge of validation procedures and processes<br>• Ability to recognize and resolve conflicts between models<br>• Ability to read and understand process model<br>• Ability to negotiate changes or modifications in models with a variety of audiences<br>• Knowledge of database software, operating systems and the particular business or domain<br>• Knowledge of prototyping processes<br>• Ability to assess system impacts on the organization | • Ability to understand and respond to client/user concerns<br>• Ability to negotiate and resolve conflicts and compare multiple viewpoints<br>• Ability to use word processing and database software<br>• Ability to analyze structure and organization of information<br>• Ability to examine data for relevance and accuracy |
| **A7. Identify backup and recovery requirements and create recovery plan** | • Backup and recovery requirements are consistent with corporate policy and business needs<br>• Requirements are specific to database and are documented completely<br>• Users are appropriately consulted and educated regarding backup and recovery methods<br>• Recovery plan is consistent with insurance and governmental regulatory requirements | • Knowledge of corporate policy and business data requirements<br>• Knowledge of backup and recovery technology of platform<br>• Knowledge of user needs and skill levels<br>• Knowledge of insurance and government regulatory requirements<br>• Knowledge of database recovery procedures | • Ability to create detailed supporting documentation and write technical documents for a variety of audiences<br>• Ability to integrate multiple items of data and synthesize information<br>• Ability to analyze system configuration/ stability<br>• Ability to analyze goals and constraints<br>• Ability to use word processing and database software |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Analyze and Design Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A8. Identify access and concurrency requirements** | • Specifications are specific to database and are documented completely<br>• Access requirements include input, output and volume of every user view<br>• Access plan is integrated with backup and recovery plan<br>• User views are categorized by type of transaction<br>• Security access levels have been identified and met<br>• Record locking mechanism is selected and provides maximum data integrity and acceptable performance<br>• Locking alternatives are examined, analyzed and documented and locking granularity is documented and justified<br>• Users are appropriately consulted and educated regarding access and concurrency procedures | • Knowledge of corporate policy and business data requirements<br>• Knowledge of alternative concurrency control methods<br>• Knowledge of user views and user access requirements<br>• Knowledge of locking mechanisms and tradeoffs between lock types<br>• Knowledge of applicable security methodologies | • Ability to write technical documents for a variety of audiences<br>• Ability to analyze and synthesize information<br>• Ability to analyze system configuration/ stability<br>• Ability to analyze goals and constraints<br>• Ability to use word processing and database software |
| **A9. Design distributed model** | • Each site has the appropriate datasets<br>• Autonomous sites are appropriately administered<br>• Access to fragments is seamless<br>• Accuracy of data and response meet client/ user needs<br>• Distribution model meets security concerns<br>• Remote access issues are identified and resolved | • Knowledge of network structure and protocols<br>• Ability to use appropriate modeling tools and methodologies<br>• Ability to document decisions about database distribution<br>• Knowledge of database software<br>• Ability to plan adequately distributed model | • Ability to analyze organization of information<br>• Ability to create detailed technical documentation<br>• Ability to identify and resolve technical issues<br>• Ability to communicate clearly to a variety of audiences<br>• Ability to visually analyze relationship between parts/whole |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Analyze and Design Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A10. Analyze database relative to other databases** | • Critical dependencies on other databases are identified and analyzed<br>• Design, maintenance and administration planning takes extensibility into account<br>• Application interface and business requirements are analyzed<br>• Original sources of data are identified to eliminate redundancy of data<br>• Data from different databases is seamlessly and securely integrated | • Knowledge of extensibility and data typing<br>• Knowledge of database interactions and interoperability<br>• Knowledge of data warehouse and data mining technology<br>• Ability to use database monitoring tools<br>• Knowledge of critical business requirements and priorities | • Ability to analyze structure and organization of information<br>• Ability to identify issues and resolve technical conflicts<br>• Ability to analyze and synthesize information<br>• Ability to determine variables and constraints<br>• Ability to monitor and interpret trends |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Develop and Implement Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Develop physical database characteristics and define user interface** | • Attributes have uniform structure<br>• Table and file names follow naming conventions<br>• Data types are identified for attributes<br>• Physical design and user interface are reconciled with processing requirements of performance characteristics<br>• Entities are uniformly and logically linked throughout the database structure<br>• Connectivity factors are taken into account, including connecting the database to frontend tools and applications to backend data<br>• User interface meets client/user requirements<br>• Database characteristics and user interface are completely documented | • Knowledge of naming conventions and standards<br>• Ability to recognize and resolve conflicts between models<br>• Ability to read and understand logical model<br>• Knowledge of data types and attributes<br>• Knowledge of user interface requirements and standards<br>• Knowledge of platforms and operating systems<br>• Knowledge of middle-tier interfaces and applications | • Ability to create detailed documentation<br>• Ability to analyze and synthesize information and write clearly and concisely<br>• Ability to compare multiple viewpoints and negotiate changes<br>• Ability to apply logic to structures and processes<br>• Ability to examine data for relevance/accuracy<br>• Ability to pay attention to detail |
| **B2. Create database objects** | • Database objects are created/deleted and tested in a timely manner<br>• Database objects are created in accordance with best practices and/or company procedures<br>• Database objects are created to meet user requirements and usability specifications | • Knowledge of database object design and testing procedures<br>• Ability to relate database usability and user requirements to object design<br>• Ability to present data and database tools in a user-friendly manner<br>• Knowledge of user preferences and expertise levels<br>• Knowledge of data retention requirements | • Ability to attend to detail in checking model/database<br>• Ability to clarify, interpret and influence communication<br>• Ability to work with minimal supervision<br>• Ability to identify and resolve conflicts in data and requirements |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Develop and Implement Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Select unique identifiers and normalize the data model** | • Logical model is consistent with conceptual model<br>• Logical and data models and identifiers have been validated by client<br>• Identifiers are selected and documented and primary and foreign keys are properly identified<br>• Rationale behind selection is documented<br>• Data model is normalized to match user specifications<br>• Attributes of entities and relationships between entities are defined in a complete and accurate form | • Ability to transform conceptual model into logical model<br>• Ability to identify and define attributes and align attributes to entities<br>• Knowledge of operating systems and database software and principles<br>• Ability to choose and document identifiers and relate identifier selection to business domain<br>• Knowledge of normalization rules and processes | • Ability to organize data in a usable form<br>• Ability to track information efficiently and effectively<br>• Ability to use logic to draw conclusions from available information<br>• Ability to analyze structure and organization of information<br>• Ability to identify issues and resolve technical constraints |
| **B4. Support population of database** | • Data entry is complete and accurate<br>• Data conversion is complete and accurate<br>• Data transfer strategies are applied effectively<br>• Users are consulted to determine new database content and format | • Knowledge of database software<br>• Knowledge of database querying methods<br>• Knowledge of various database attributes<br>• Ability to re-engineer off-the-shelf databases<br>• Knowledge of operating systems and the domain | • Ability to generate/evaluate solutions<br>• Ability to devise/implement plan of action<br>• Ability to organize information and reports<br>• Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to pay attention to detail and follow up on assigned tasks |
| **B5. Integrate high-level business rules with code** | • Pertinent business rules are examined and their impact on database is accurately determined<br>• Database triggers and procedures are implemented to reflect business rules<br>• Database code supports high-level business rules | • Knowledge of business structure and rules<br>• Knowledge of business entities and relationships<br>• Knowledge of user interface and database rules<br>• Knowledge of database code development | • Ability to synthesize information<br>• Ability to create detailed supporting documentation<br>• Ability to visually analyze relationship between parts/whole<br>• Ability to integrate multiple items of data and research additional information sources<br>• Ability to organize technical reports and select methods of communication |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Develop and Implement Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B6. Develop backend and frontend connectivity** | • Connectivity requirements are clearly determined and communicated<br>• Connectivity issues are identified and appropriately resolved<br>• Customer performance and connectivity requirements are met<br>• Transactions are processed seamlessly and database interactions are successful | • Knowledge of connectivity<br>• Knowledge of data communications protocols<br>• Knowledge of web interfaces<br>• Knowledge of operating systems and networks<br>• Knowledge of user interface and human factors | • Ability to identify underlying issues and resolve technical conflicts<br>• Ability to communicate technical concepts to a variety of audiences<br>• Ability to set and adjust goals as necessary<br>• Ability to work independently and be responsible for project outcomes |
| **B7. Develop and validate database implementation plan** | • Implementation plan development involves key team members<br>• Database implementation plan is completed in a timely manner<br>• Clients/users are consulted as required<br>• Implementation plan is complete and congruent with project plan<br>• Implementation plan meets user specifications and timeline<br>• Transition plan is implemented with minimal impact on overall productivity | • Knowledge of implementation and transition process<br>• Knowledge of productivity factors and risk management techniques<br>• Knowledge of contingency procedures<br>• Ability to evaluate overall system performance and productivity<br>• Knowledge of database software | • Ability to synthesize and organize information<br>• Ability to create detailed supporting documents<br>• Ability to manage resources and timelines to maximize effectiveness<br>• Ability to identify underlying issues and resolve technical conflicts to client/user satisfaction<br>• Ability to assume responsibility for accomplishing team goals<br>• Ability to provide feedback to relevant personnel |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Develop and Implement Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B8. Install and deploy database** | • Software and dataset are installed according to implementation plan<br>• Internal and external feedback and user issues are presented clearly and concisely, and user questions about conversion are completely and professionally answered<br>• New database management system is fully operational, users have proper access to data and database is accessible through the network, where applicable<br>• Issues and questions concerning acceptance and validation are resolved to user satisfaction<br>• Post-implementation reviews are thoroughly conducted in accordance with company procedures<br>• Nonpressing issues are documented for next design upgrade<br>• Database is thoroughly tested to ensure proper installation | • Knowledge of appropriate validation process and database system error resolution procedures<br>• Ability to evaluate acceptance testing plan<br>• Knowledge of feedback generation techniques and procedures<br>• Ability to evaluate overall system performance and productivity<br>• Knowledge of data domains and database organization | • Ability to relate intent to desired results<br>• Ability to evaluate/adjust plan of action<br>• Ability to judge effectiveness and efficiency of solution<br>• Ability to evaluate and summarize user input, recognize critical issues and analyze communication<br>• Ability to make recommendations for intervention |
| **B9. Produce business and technical documents** | • Business and technical documents are accurate and complete<br>• Business and technical documents meet user requirements<br>• Business and technical documents are created, stored and distributed according to company procedures<br>• Business and technical documents are updated and disseminated as needed | • Ability to use advanced word processing features<br>• Ability to translate technical information into user-appropriate formats<br>• Knowledge of technical document update procedures<br>• Knowledge of publishing processes | • Ability to create and organize business and technical reports<br>• Ability to use effective communication and presentation methods<br>• Ability to document technical procedures for users<br>• Ability to use integrated/multiple software applications |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Develop and Implement Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B10. Tune database and optimize performance** | • Users access data without delays<br>• Database operation does not adversely affect other applications<br>• Database can be scaled without undue penalties<br>• Database is tuned for effective dynamic response | • Knowledge of networking and operating systems<br>• Knowledge of database tuning and optimization techniques<br>• Knowledge of traffic analysis and system performance metrics | • Ability to monitor and analyze system data<br>• Ability to judge system effectiveness and efficiency<br>• Ability to evaluate performance data patterns and trends |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Administration and Maintenance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Develop and implement monitoring plan** | • Monitoring criteria are identified and agreed upon with design and user groups, and are consistent with applicable requirements<br>• Monitoring criteria are documented completely and accurately<br>• Monitoring plan is congruent with project scope and resources<br>• Monitoring information is captured in a timely manner<br>• System configuration parameters are properly calibrated to tune database design for optimum performance and meet client/user requirements<br>• System down time is minimized<br>• Capacity issues are communicated to management proactively and in a timely manner | • Knowledge of monitoring methods<br>• Ability to evaluate plan for completeness and congruency<br>• Knowledge of database principles, performance factors, monitoring tools and tuning procedures<br>• Knowledge of production resources and company production processes<br>• Knowledge of database software performance and availability<br>• Knowledge of business requirements | • Ability to create detailed supporting documents<br>• Ability to evaluate alternative solutions<br>• Ability to formulate plan of action<br>• Ability to create data gathering processes<br>• Ability to judge system effectiveness and efficiency<br>• Ability to evaluate impact of resource distribution |
| **C2. Analyze monitoring data** | • Problem criticality is relevant and properly documented<br>• Monitoring data is analyzed completely<br>• Solutions to problems are clearly identified and implemented in a timely manner with minimal disruption to productivity<br>• Database performance meets design specifications and client/user requirements<br>• Continuous efforts are made to identify and address problems before they become critical<br>• Error, performance and availability metrics are accurately documented and demonstrate a trend of improvements<br>• Capacity issues are communicated to management proactively and in a timely manner | • Ability to identify solutions to technical and application problems<br>• Knowledge of productivity factors<br>• Knowledge of solution implementation planning procedures<br>• Knowledge of monitoring and tuning processes and procedures<br>• Knowledge of quality assurance methods and practices<br>• Ability to understand and mitigate operational and performance issues | • Ability to analyze data<br>• Ability to document analysis in appropriate detail<br>• Ability to demonstrate innovative thinking and resourcefulness in solving problems |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Administration and Maintenance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C3. Manage backup and recovery both onsite and offsite** | • Backup and recovery plans are identified and agreed upon by technical support group and users<br>• Backup and recovery plans are documented completely and accurately, and include both onsite and offsite installations<br>• Backup procedures are implemented on a regular schedule and according to plan<br>• Recovery plan meets client/user needs<br>• Unforeseen outages and data loss are effectively resolved<br>• Production environment is supported to minimize system down time and ensure system availability | • Knowledge of backup and recovery procedures<br>• Ability to identify user needs for backup and recovery<br>• Knowledge of testing tools and procedures and productivity factors<br>• Knowledge of database software and operating systems<br>• Knowledge of resources required to implement backup and recovery plans<br>• Knowledge of insurance and regulatory requirements | • Ability to analyze information to solve problems<br>• Ability to systematically organize information<br>• Ability to evaluate criticality of problems, identify possible causes and propose solutions<br>• Ability to communicate effectively with clients/users<br>• Ability to evaluate impact of resource distribution |
| **C4. Create and implement maintenance plan for regular integrity checks** | • Maintenance plan documents procedures for updates and upgrades<br>• Integrity checks are performed according to plan and corrective action initiated when needed<br>• Production environment is supported to minimize system down time and ensure system availability<br>• Criteria for determining integrity problems are agreed upon with design and user groups, and are accurately and completely documented | • Knowledge of maintenance tools and processes<br>• Knowledge of fault detection and resolution processes<br>• Ability to translate client/user needs into maintenance requirements<br>• Knowledge of resources required to implement regular integrity checks | • Ability to devise and implement plan of action<br>• Ability to create plan to monitor and correct system<br>• Ability to evaluate impact of resource distribution |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Administration and Maintenance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C5. Maintain physical organization of database objects** | • Database performs efficiently with no unacceptable lags in response<br>• Fragmentation of database is addressed in a timely manner<br>• Integrity errors are measured, documented and demonstrate a trend of improvement<br>• Plan for the detection of integrity problems is congruent with project scope and resources<br>• Database organization is updated and corrected according to technical specifications, user input and business priorities/requirements | • Knowledge of how to query and report system objects<br>• Knowledge of system model<br>• Knowledge of database software<br>• Knowledge of storage options<br>• Knowledge of optimization techniques | • Ability to devise/implement plan of action<br>• Ability to visually analyze relationship between parts/whole and process/ procedure<br>• Ability to analyze client/user needs and evaluate effectiveness of solutions |
| **C6. Upgrade databases and migrate to new versions** | • Software upgrades are applied in a timely manner<br>• System operation is restored with no unintended consequences<br>• Software upgrades are based on tangible benefits to clients and business<br>• Software upgrades are applied with minimal disruptions to clients/users and service | • Knowledge of system models<br>• Knowledge of impacts of upgrades<br>• Knowledge of database software<br>• Knowledge of operating systems and system administration | • Ability to integrate systems technology<br>• Ability to analyze operational problems and recommend solutions<br>• Ability to predict technological results<br>• Ability to adapt rules/principles to new applications<br>• Ability to formulate new approaches and generate unique solutions |
| **C7. Plan and manage current and future physical resource requirements and enhancements** | • Resource requirements are accurately and completely defined<br>• Resource utilization is optimized and meets software, client and business needs<br>• Access issues are properly addressed<br>• Risk analysis is properly applied<br>• Trends of resource requirements are correctly measured and documented, and appropriate forecasts are generated | • Knowledge of resource constraints and capacity planning<br>• Knowledge of resource acquisition<br>• Knowledge of system hardware, network and operating systems<br>• Knowledge of database software<br>• Knowledge of physical resource planning | • Ability to determine variables and constraints<br>• Ability to monitor safe and efficient use of materials<br>• Ability to coordinate acquisition, storage and distribution<br>• Ability to responsibly challenge existing policies |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Administration and Maintenance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C8. Administer and enforce standards** | • Standards are identified and agreed to by applications design groups<br>• Standards are clearly documented and readily accessible<br>• Database production applications meet applicable standards<br>• Clients and users are educated regarding the standards<br>• Process, procedures and environment configuration comply with standards<br>• Automated controls are used whenever possible | • Ability to monitor database<br>• Knowledge of requirements and parameters<br>• Knowledge of how to develop standards<br>• Knowledge of evolving industry standards | • Ability to evaluate system performance and diagnose performance deviations<br>• Ability to distinguish between facts and inferences, and analyze underlying issues to resolve technical issues<br>• Ability to create detailed supporting documents<br>• Ability to analyze and integrate information<br>• Ability to responsibly challenge existing policies |
| **C9. Audit database systems** | • Audits confirm compliance or result in increased compliance with standards<br>• Audits are properly documented and results are reported to appropriate personnel<br>• Platform and system audits are properly performed<br>• Vendor and other support resources are appropriately utilized | • Knowledge of database audit procedures<br>• Knowledge of audit reporting procedures<br>• Knowledge of performance standards<br>• Ability to utilize vendor and other support resources | • Ability to recommend ethical course of action<br>• Ability to create detailed supporting documents<br>• Ability to use appropriate principles and previous training to predict outcomes |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Provide Data Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Gather and document security requirements and specifications** | • Security requirements are derived from business rules, system specifications and standards<br>• Security concerns of all participants have been addressed<br>• Proposed security specifications are complete<br>• Security specifications are documented, and have been reviewed and comply with appropriate standards and practices<br>• Potential security risks are identified and resolved according to risk management practices | • Knowledge of security system tools<br>• Ability to identify and resolve potential security conflicts<br>• Knowledge of security issues<br>• Knowledge of database software and systems<br>• Knowledge of applicable business rules<br>• Knowledge of security standards and practices | • Ability to create detailed supporting documents<br>• Ability to synthesize information<br>• Ability to apply principles to procedures and use logic to draw conclusions<br>• Ability to encourage cooperation and negotiation among all participants<br>• Ability to follow organizational processes and procedures |
| **D2. Design and document security plan** | • Strategies are thoroughly reviewed and analyzed<br>• Security design and features are selected to meet client, user and business needs, and conform to relevant standards<br>• Security plan is developed and documented completely and accurately<br>• Security plan is accessible | • Knowledge of security standards, strategies and advisories<br>• Ability to select security design<br>• Knowledge of client, user and business needs<br>• Knowledge of security plan documentation procedures<br>• Ability to relate requirements to user privileges | • Ability to identify and resolve conflicting data<br>• Ability to analyze information and formulate proposals<br>• Ability to write detailed supporting documents |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Provide Data Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D3. Implement and enforce security requirements** | • Levels of access and security are clearly identified, standardized and communicated<br>• Overall plan is considered when implementing and enforcing security requirements<br>• Implementation of security measures minimizes unauthorized access and addresses security tradeoffs and risks<br>• Users are notified about changes in their security access in accordance with company procedures<br>• Accounts are properly audited to determine that security requirements are being met<br>• Security breaches are identified, communicated to appropriate personnel or agencies and effectively mitigated | • Knowledge of database security procedures and implementation<br>• Ability to collect security breach details and communicate to appropriate personnel<br>• Knowledge of network and operating systems<br>• Knowledge of appropriate legal actions and escalation/mitigation pathways and processes | • Ability to present practical alternatives<br>• Ability to responsibly challenge unethical practices/decisions<br>• Ability to write detailed supporting documents<br>• Ability to analyze and respond to client/user needs<br>• Ability to present security tradeoffs and risks and pose critical questions |
| **D4. Maintain and improve security in response to industry developments and user experience** | • User input and practices are analyzed and documented to assess security issues<br>• Training results in continuous improvement in security awareness<br>• Security needs are forecast and incorporated in recommendations for system upgrades and/or redesign<br>• Industry and technology trends are continually monitored and incorporated to support system security | • Knowledge of business, industry and technology security trends<br>• Ability to use forecasting methods and tools<br>• Ability to gather user input and observe user practices<br>• Knowledge of instructional design principles<br>• Ability to provide technical training on security procedures | • Ability to analyze and respond to client/user needs<br>• Ability to identify issues and resolve technical conflicts<br>• Ability to organize and present technical information to nontechnical users<br>• Ability to monitor and interpret trends in technology and industry |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Provide Data Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D5. Protect enterprise/ client data** | • Data housing retention policies and procedures are clearly understood and followed<br>• Data is protected in usage and access according to applicable policies<br>• Policies are updated according to changes in the business and legal environment<br>• Relevant standards are effectively applied<br>• Security threats are analyzed and mitigated | • Knowledge of data usage, access and retention policies and procedures<br>• Knowledge of data protection standards<br>• Ability to monitor changes in the business and legal environment<br>• Knowledge of dynamic threat environment and mitigation practices | • Ability to follow protection policies and procedures<br>• Ability to adhere to standards<br>• Ability to review approaches and recommend improvements |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Provide Client and User Services*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Provide and support development and production environments** | • Guidelines for database application development are identified and application of methodology and modeling techniques are effectively communicated<br>• Support to client/user is delivered effectively and efficiently<br>• Changes are transparent to users and implemented with minimal adverse impact<br>• Solutions that improve functionality/ performance are effectively proposed and implemented<br>• Implementation, enhancements and modifications are thoroughly tested against user specifications | • Knowledge of database applications, software, operations and limitations<br>• Knowledge of user applications and ability to assess user impact<br>• Ability to define and solve application problems<br>• Knowledge of change documentation procedures<br>• Knowledge of project management, scheduling and tracking<br>• Knowledge of web-based data environments | • Ability to organize and analyze data<br>• Ability to work with and demonstrate commitment to the client/user<br>• Ability to understand goals and constraints, generate alternatives, consider risks and evaluate options |
| **E2. Plan and deliver user training** | • Training is designed to meet user needs<br>• User skill levels are identified and assessed<br>• Training materials are developed to meet user specifications<br>• User training sessions are scheduled and conducted according to client/user plan<br>• Training sessions are presented in a clear, concise and user-friendly manner<br>• Feedback is gathered to determine additional training and support needs | • Knowledge of user training process<br>• Knowledge of user level of expertise<br>• Knowledge of instructional design principles<br>• Knowledge of database, presentation and word processing software<br>• Knowledge of the organization and culture | • Ability to assess performance of others and provide constructive feedback and reinforcement<br>• Ability to work cooperatively with others and contribute ideas, suggestions and assistance<br>• Ability to analyze and respond to client/ user needs<br>• Ability to extract information and use logic to draw conclusions<br>• Ability to help others learn and apply concepts<br>• Ability to assess user learning needs and conduct user training |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Provide Client and User Services*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E3. Identify additional requirements** | • Additional requirements meet evolving user needs<br>• New requirements are documented and compared to current specifications<br>• Access and security trends are assessed and accommodated<br>• New transactional needs are identified and incorporated<br>• Requirements are continuously analyzed and appropriate recommendations are made | • Ability to translate client/user needs into technical requirements<br>• Knowledge of data-gathering methods<br>• Knowledge of user community, needs and skill levels<br>• Knowledge of requirements analysis | • Ability to clarify, interpret and influence communication<br>• Ability to identify and resolve conflicts in data and requirements<br>• Ability to use logic to draw conclusions from available information<br>• Ability to compare multiple viewpoints and negotiate changes<br>• Ability to present complex information regarding changes in models |
| **E4. Adapt existing structure to new business environments** | • Current database structure is assessed for its ability to support changes<br>• Upgrade schedules are analyzed and forecast<br>• Client services and vendor reviews are continually evaluated and updated<br>• Cost/benefit, ROI and risk analysis are conducted to support recommendations | • Knowledge of business structure, policies and procedures<br>• Ability to use forecasting tools and methods<br>• Ability to identify trends and relate them to current system<br>• Ability to present technical recommendations in a user-friendly manner | • Ability to predict technological impacts and results<br>• Ability to analyze and assess technical information from a variety of sources<br>• Ability to generate and evaluate solutions<br>• Ability to relate intent to desired results |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Database Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Develop test plans** | • Test plan is completely documented in accordance with accepted policies<br>• Test plan is relevant to application and test requirements are in compliance with legal requirements, policies, procedures and customer requirements<br>• Test system accurately mimics external interfaces<br>• Test scenarios are automated where feasible<br>• Comprehensive set of test cases and expected results are developed<br>• Testing resources are identified and schedule is established<br>• Test plan ensures compliance with SDL (System Development Life Cycle) | • Knowledge of user application<br>• Knowledge of testing impact on timeline and budget<br>• Knowledge of external interfaces<br>• Knowledge of test domain and ability to distinguish edges and critical points<br>• Knowledge of operating systems and testing tools<br>• Knowledge of legal requirements, policies, procedures and customer requirements | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to write technical documents and detailed supporting documents<br>• Ability to consider risk implications and compile multiple viewpoints<br>• Ability to use word processing tools and techniques |
| **F2. Develop test procedures** | • Test procedures explicitly verify specifications<br>• Test procedures define test conditions<br>• Test procedures are documented in detail<br>• Regression tests are properly developed and performed to thoroughly exercise the software according to plan and schedule | • Knowledge of external interfaces<br>• Knowledge of test domain and ability to distinguish edges and critical points<br>• Knowledge of specifications<br>• Ability to construct automated test sequences and recognize errors in test procedure and system<br>• Knowledge of testing methodology and metrics | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to consider risk implications<br>• Ability to analyze technology output and examine task/technology relationship<br>• Ability to interpret, clarify and influence communication |
| **F3. Perform tests** | • Test process includes appropriate team members<br>• System is tested according to plan and schedule<br>• Test results are documented completely and communicated as appropriate<br>• System integration testing and volume/ performance testing are performed when appropriate | • Knowledge of system test procedures and test systems<br>• Knowledge of system and ability to recognize problems identified by test procedure<br>• Knowledge of testing methodology<br>• Ability to recognize errors in test procedure and test system | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to analyze technology output and examine task/technology relationship<br>• Ability to appropriately refer complaint/ discrepancy<br>• Ability to identify and evaluate system performance |

# DATABASE ADMINISTRATION AND DEVELOPMENT

## *Critical Work Function: Perform Database Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F4. Document test results and make recommendations** | • Errors and preceding conditions are clearly documented<br>• Recommendations for modification are included in documentation<br>• Problems are identified and corrected | • Knowledge of documentation procedures<br>• Knowledge of testing tools and methodologies | • Ability to understand system organization/hierarchy<br>• Ability to respond to system demand<br>• Knowledge of word processing software, networks and operating environments<br>• Ability to evaluate system performance and devise plan to monitor and/or correct system<br>• Ability to modify process/procedure |
| **F5. Test database components** | • Acceptance testing and regression testing are satisfactorily completed based on specification criteria<br>• Benchmarking is carried out in accordance with proper procedures<br>• Components are systematically and thoroughly tested<br>• Testing methods follow company guidelines<br>• Testing process is clearly documented<br>• Testing is completed according to schedule<br>• Technical conflicts are identified and resolved | • Knowledge of acceptance testing and regression testing procedures<br>• Knowledge of database testing methods, tools and processes<br>• Knowledge of contingency procedures<br>• Knowledge of benchmarking procedures<br>• Ability to evaluate defect impact on overall system performance and integrity<br>• Knowledge of appropriate validation process and database system error resolution procedures<br>• Ability to evaluate importance of defect and communicate to relevant personnel | • Ability to work with minimal supervision<br>• Ability to attend to detail in testing database components<br>• Ability to identify and resolve technical conflicts<br>• Ability to organize and communicate technical ideas/information |
| **F6. Implement performance testing** | • Performance testing is conducted according to appropriate standards and schedules<br>• Database is proactively monitored for performance<br>• Performance improvements are identified and prioritized<br>• Problems are corrected based on performance testing recommendations<br>• Testing reflects user and business performance expectations | • Knowledge of testing standards and practices<br>• Knowledge of database monitoring techniques and performance parameters<br>• Ability to interpret system performance metrics<br>• Ability to evaluate user performance expectations | • Ability to follow procedures and processes<br>• Ability to identify and resolve issues related to testing<br>• Ability to monitor implementation of testing practices<br>• Ability to evaluate criticality of problems and propose applicable solutions |

# Digital Media

Information only has value when someone wants to read it. A riveting presentation is vital to getting your company's message across whether you're creating a hot web site, a training video or designing the latest computer game. As a digital media specialist you bring ideas to life through technology. During the initial stages of a project, you estimate the costs and the length of the job and determine what resources will be needed to bring the project to completion on time. You want the best tools to design and format your presentation, but the size of the project and budget sometimes put limits on how far you can go. When designing, you determine the look and feel, select colors and create a visually appealing layout. The tools you use change at an incredible pace, so you're constantly learning about the latest developments, often through word of mouth, books, magazines, tutorials and classes. You get the latest software as it comes out and teach yourself new skills. "Mindshare," the attention customers pay to your company's name and products, is often determined by the visions you create through your designs. Your visions need to create a compelling image of your company's products, using multiple media types while adhering to copyright on each piece of media you use.

## SAMPLE TITLES

22D/3D Artist
Animator
Audio Designer
Audio/Video Engineer
Content Editor
Creative Director
Designer
Graphic Designer
Illustrator
Information Architect
Interaction Designer
Media Specialist
Media/Instructional Designer
Multimedia Author
Multimedia Authoring Specialist
Multimedia Design Specialist
Multimedia Developer
Multimedia Specialist Producer (Associate, Senior, Executive)
Product Designer
Production Artist
Production Assistant
Programmer
Streaming Media Specialist
User Interface Designer
User Interface Developer
Virtual Reality Specialist
Web Designer
Web Developer
Web Media Developer
Web Producer
Web Specialist

# DIGITAL MEDIA

## *Summary of Critical Work Functions*

| A. Perform Analysis | | B. Produce Visual and Functional Design | | C. Perform Media Production and Acquisition | | D. Implement Design | | E. Test and Deliver Product | |
|---|---|---|---|---|---|---|---|---|---|
| A1 | Gather data to identify internal and external customer requirements | B1 | Determine media types and delivery platform | C1 | Develop, evaluate and revise text and scripts | D1 | Create and produce finished content | E1 | Develop and perform usability and functionality tests |
| A2 | Define scope of work | B2 | Complete basic design and storyboard | C2 | Create prototypes | D2 | Implement and refine navigation and interactive design | E2 | Identify and resolve defects |
| A3 | Develop, present and test concepts | B3 | Develop and produce drafts and rough cuts | C3 | Identify available media and content sources | D3 | Implement database connectivity | E3 | Document testing process and test results |
| A4 | Create preliminary design | B4 | Design and evaluate user interface, visual appeal and functional design | C4 | Produce or acquire content elements | D4 | Create and incorporate application components | E4 | Conduct customer acceptance testing and deliver product |
| A5 | Research content | B5 | Develop, evaluate and refine simulations | C5 | Map project to design specifications and timelines | D5 | Optimize design for maintainability | E5 | Conduct periodic reviews and gather data for revisions |
| A6 | Present cost and benefit data | B6 | Select appropriate software and hardware tools | C6 | Substantiate make-or-buy decisions | D6 | Document implementation process | | |
| A7 | Prepare and present functional requirements | B7 | Document design process | C7 | Participate in iterative development with clients and team members | | | | |
| A8 | Identify technical constraints and prepare specifications and project plan | B8 | Coordinate with design team to ensure design meets business goals | C8 | Ensure media productions and acquisitions meet legal and copyright requirements | | | | |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather data to identify internal and external customer requirements** | • Sources and methods for gathering requirements are affordable and relevant<br>• Sources of requirements are reliable and current<br>• Information is accurate and complete<br>• Information gathering interviews and focus groups are conducted according to appropriate company practices<br>• Information is gathered continuously in a cost-effective manner | • Ability to identify and locate key sources of information regarding customer requirements<br>• Knowledge of information gathering methods<br>• Knowledge of quantity of data/ information required<br>• Knowledge of iterative nature of development work<br>• Knowledge of applicable technology and business rules | • Ability to pose critical questions and analyze group/individual responses<br>• Ability to compile multiple viewpoints<br>• Ability to select/obtain data relevant to the task<br>• Ability to encourage cooperation<br>• Ability to summarize information and requirements<br>• Ability to analyze systems, scenarios and structures<br>• Ability to appropriately modify goals while aggressively pursuing goal attainment |
| **A2. Define scope of work** | • Project objectives and scope are identified and agreed upon<br>• Criteria for successful completion are identified<br>• Major project tasks and interdependencies are identified and ranked<br>• Schedule is prepared based on resource availability and project timeline<br>• Scope of work is documented in an accurate, complete and succinct form<br>• Time, technology and resource constraints are accurately defined, and conflicts, risks, tradeoff analysis and contingency plans are discussed with key stakeholders | • Knowledge of project management tools, multimedia software, hardware and systems technology capabilities and constraints<br>• Knowledge of risk analysis techniques<br>• Ability to set priorities and maintain schedules | • Ability to create detailed supporting documents and summarize information and requirements<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to analyze information for accuracy and consistency<br>• Ability to visualize tasks sequentially and identify interdependencies<br>• Ability to analyze customer needs, make exceptional effort on behalf of customer and resolve conflicts to customer satisfaction<br>• Ability to plan according to resource needs and constraints |

# DIGITAL MEDIA

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Develop, present and test concepts** | • Project concepts are developed and tested<br>• Concepts meet overall customer requirements and fit technology constraints<br>• Concepts are congruent with scope of project and resources<br>• Concepts are presented to and approved by relevant team members and by customer<br>• Alternatives are clearly identified, ranked and evaluated | • Knowledge of concept design tools and procedures<br>• Knowledge of simulation and testing procedures for feasibility models<br>• Ability to use rapid prototyping tools to develop concept alternatives | • Ability to create/develop and test new concepts<br>• Ability to value differences of opinion<br>• Ability to analyze underlying issues and resolve technical issues<br>• Ability to pose critical questions and analyze group/individual responses<br>• Ability to apply self-management skills and pursue goal attainment |
| **A4. Create preliminary design** | • Initial design is in agreement with approved concepts<br>• Design prototype meets design specifications, project requirements and latest research on usability<br>• Design specifications are congruent with project scope and resources<br>• Preliminary design is tested<br>• Preliminary design is presented to and approved by relevant team members and by customer | • Knowledge of multimedia design tools and procedures<br>• Knowledge of simulation and testing procedures for prototypes<br>• Knowledge of the impact of technical limitations and resources on project design<br>• Knowledge of latest research on usability issues<br>• Ability to design alternatives and make recommendations<br>• Knowledge of graphics packages and other software design tools | • Ability to apply creative solutions to new situations<br>• Ability to demonstrate creative thinking while solving problems<br>• Ability to identify and resolve technical conflicts<br>• Ability to formulate new ideas/designs |
| **A5. Research content** | • Supplied or required editorial pieces are analyzed and qualified for appropriateness<br>• Rights of usage, intellectual property rights and legal issues related to the ownership and use of information and copyrights for content are thoroughly researched<br>• Readability and usability are considered when selecting content<br>• Content sources are evaluated based on cost and value to target audience<br>• Content is secured from reliable and respected sources<br>• Content is organized into manageable sections | • Knowledge of research techniques and tools<br>• Knowledge of writing and editorial processes and procedures<br>• Knowledge of organizational and departmental practices<br>• Ability to analyze readability and usability of content<br>• Knowledge of rights of usage, intellectual property rights and legal issues related to the ownership and use of information and copyrights for content | • Ability to use word processing and editing tools<br>• Ability to select/obtain data relevant to task, identify the need for data and contrast conflicting data<br>• Ability to analyze, synthesize and summarize research results |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A6. Present cost and benefit data** | • Analysis is prepared comparing make-and-buy options for each element<br>• Recommendations are reviewed by relevant personnel and key stakeholders<br>• Decisions made are congruent with project goal, scope and budget<br>• Cost and benefit data results are quantified for decision makers<br>• All media necessary for the application can be accessed<br>• Outsource requirements are accurately identified and include an evaluation of benefits and risks | • Knowledge of the multimedia industry<br>• Knowledge of range of multimedia tools<br>• Knowledge of cost/benefit analysis and ROI tools and procedures<br>• Knowledge of multimedia software and hardware trends<br>• Knowledge of outsourcing procedures | • Ability to evaluate alternative solutions<br>• Ability to analyze the situation and consider risks/implications<br>• Ability to identify sources of information and gather data relevant to the task<br>• Ability to present information clearly and concisely |
| **A7. Prepare and present functional requirements** | • All functional requirements are complete and free of conflicts<br>• Functional requirements are documented in an accurate and complete form<br>• Functional requirements are prepared in accordance with overall project and customer requirements<br>• Functional requirements are presented effectively | • Knowledge of multimedia system capabilities<br>• Ability to translate customer requirements into functional requirements<br>• Ability to identify and resolve conflicting functional requirements<br>• Knowledge of multimedia software and hardware | • Ability to generate/evaluate solutions<br>• Ability to analyze information for accuracy and consistency<br>• Ability to accurately summarize and document information<br>• Ability to recognize patterns and relationships and use imagination to visualize events and outcomes<br>• Ability to organize, communicate and present required information |

# DIGITAL MEDIA

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A8. Identify technical constraints and prepare specifications and project plan** | • Technological constraints are identified accurately and completely<br>• Appropriate hardware and software are identified<br>• Functional specifications are complete and approved by all relevant parties<br>• Specifications are free of conflicts<br>• Specifications are assessed for feasibility<br>• Specifications meet overall user requirements and are documented completely and accurately<br>• Resources are identified and matched to the tasks at hand<br>• Project plan includes all necessary elements | • Ability to identify technological constraints of development and delivery platforms<br>• Knowledge of multimedia hardware and software<br>• Knowledge of multimedia requirements and specification procedures<br>• Knowledge of implementation procedures and user needs<br>• Ability to analyze and resolve conflicts in specifications<br>• Knowledge of project planning techniques | • Ability to apply rules/principles to situation<br>• Ability to gather and analyze information<br>• Ability to use logic to draw conclusions from available information<br>• Ability to clearly present complex information<br>• Ability to resolve technical issues with team members and customer<br>• Ability to generate/evaluate solutions |

## *Critical Work Function: Produce Visual and Functional Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Determine media types and delivery platform** | • Chosen media elements and delivery platform support the project goals and scope<br>• Chosen media elements can be acquired and developed within the allotted budget and with available resources and expertise<br>• Media elements are compatible with the project's intended feel, look and message<br>• Media elements meet specifications<br>• Platform supports the selected media elements and is congruent with user environment | • Knowledge of media types and capabilities<br>• Knowledge of media element costs and hardware requirements<br>• Knowledge of computer platform performance and limitations<br>• Knowledge of copyright laws and licenses | • Ability to present technical information<br>• Ability to resolve technical issues with team members and customer<br>• Ability to use previous experience to predict outcomes and visualize the integration of separate elements<br>• Ability to generate/evaluate solutions and formulate plan of action |
| **B2. Complete basic design and storyboard** | • Design elements and principles are used appropriately<br>• User interface elements are functional and aesthetically pleasing<br>• Design is usability tested and performance is checked against requirements<br>• Design and navigation conform to functional and interface requirements and organizational standards<br>• Storyboards are detailed and complete<br>• Storyboard supports functional design, selected media types and navigation schema<br>• Storyboard, design concepts and navigation schema are created with input from relevant team members, and are reviewed and approved by stakeholders | • Knowledge of multimedia design elements, principles and testing procedures<br>• Knowledge of storyboarding techniques and tools<br>• Knowledge of navigation approaches<br>• Ability to evaluate graphic designs and assess visual impact and effectiveness<br>• Ability to use wide range of computer graphic tools<br>• Ability to relate design to performance predictions<br>• Knowledge of user interface design principles<br>• Knowledge of delivery methods and platforms | • Ability to manipulate technology for desired results and evaluate application of technology<br>• Ability to encourage/support team members and assume responsibility for accomplishing team goals<br>• Ability to apply creative solutions to new situations<br>• Ability to formulate new processes<br>• Ability to evaluate alternative solutions<br>• Ability to organize and clearly present ideas |

# DIGITAL MEDIA

## *Critical Work Function: Produce Visual and Functional Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Develop and produce rough cuts** | • All media elements are properly integrated<br>• Multimedia product meets specifications and accurately portrays the desired concept, message and image<br>• A coordinated color scheme is used throughout the product<br>• The color scheme adheres to color rules for legibility and readability<br>• The color scheme demonstrates a consideration of cultural and contextual meanings<br>• Color usage meets specifications of hardware and software<br>• 3D shapes and textures are represented in both simplified and complex renderings as appropriate | • Knowledge of multimedia integration software, tools and techniques<br>• Ability to evaluate product for look and feel<br>• Ability to assess visual and impact effectiveness<br>• Knowledge of principles of color and the cultural and contextual uses of color<br>• Knowledge of hardware and software color specifications and ability to use palette color manipulation tools<br>• Ability to create 3D shapes and textures on paper and by using technology | • Ability to generate unique solutions and demonstrate creative thinking while solving problems<br>• Ability to evaluate alternative solutions<br>• Ability to recognize patterns/relationships of colors<br>• Ability to create comprehensive model/simulation, mentally picture familiar actions and outcomes and visualize new concept/design |
| **B4. Design and evaluate user interface, visual appeal and functional design** | • Design and interface specifications are complete, free of conflicts and properly approved<br>• Different design solutions are developed, tested and evaluated prior to selecting and refining the solution<br>• Evaluation process includes appropriate team members and project stakeholders<br>• Visual design supports human factors and user interface specifications as outlined in the functional design | • Knowledge of design elements and principles and interface requirements<br>• Ability to assess visual impact and effectiveness<br>• Knowledge of multimedia software<br>• Knowledge of specification and implementation procedures<br>• Knowledge of usability testing methodologies<br>• Ability to analyze and resolve for conflicts in specifications<br>• Knowledge of human factors and user interface research | • Ability to analyze visual appeal and recommend solutions<br>• Ability to apply appropriate principles/laws/theories to situations<br>• Ability to visually analyze relationship between parts/whole, process/procedure<br>• Ability to consider risks/implications, generate and evaluate alternative solutions and formulate plan of action<br>• Ability to develop and apply creative solutions to new situations<br>• Ability to justify user interface design |

## *Critical Work Function: Produce Visual and Functional Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B5. Develop, evaluate and refine simulations** | • Simulation accurately represents the phenomena it portrays<br>• Simulation is clearly recognizable and easily understood<br>• Simulation adheres to good design, interface and human factors principles<br>• Simulation evaluation includes strengths and weaknesses<br>• Simulations are tested for usability<br>• Different design solutions are developed, tested and evaluated prior to selecting and refining the solution | • Ability to produce simulations on paper and by using technology<br>• Knowledge of the capabilities and limitations of simulation hardware and software<br>• Knowledge of good design, interface and human factors principles<br>• Ability to analyze strengths and weaknesses of multimedia software capabilities<br>• Ability to develop and administer usability tests | • Ability to use imagination to visualize events/activities, mentally picture outcomes and visually analyze relationship between parts/whole, process/procedure<br>• Ability to create comprehensive model/simulation and evaluate concept/simulation<br>• Ability to evaluate/adjust plan of action |
| **B6. Select appropriate software and hardware tools** | • Software and hardware support all functional and delivery specifications<br>• Software and hardware are easy to use and meet appropriate performance metrics and specifications<br>• Design supports different software and hardware options when appropriate<br>• Security issues are considered when selecting software and tools<br>• Website performance goals are specified and verified | • Ability to use multimedia authoring tools, media editing tools and software design tools<br>• Knowledge of appropriate hardware<br>• Knowledge of industry trends and standards<br>• Ability to use web-based data resources<br>• Knowledge of security issues<br>• Knowledge of performance metrics and specifications | • Ability to integrate multiple items of data and reconcile conflicting information<br>• Ability to develop creative solutions and demonstrate resourcefulness<br>• Ability to predict outcomes and results of selection of tools<br>• Ability to consider risks and implications |
| **B7. Document design process** | • Design process is documented accurately and completely<br>• Design process document reflects the project goals, scope and budget<br>• Design process document is reviewed and approved by all relevant team members and customers<br>• Design process document includes programming, instrumentation and appropriate testing environments and phases | • Knowledge of testing and quality assurance criteria and processes<br>• Ability to anticipate how users will interact with the product<br>• Knowledge of programming and instrumentation | • Ability to communicate clearly<br>• Ability to analyze and organize ideas and information<br>• Ability to use word processing tools<br>• Ability to resolve conflicts and present accurate results<br>• Ability to use previous training/experience to predict outcomes |

# DIGITAL MEDIA

## *Critical Work Function: Produce Visual and Functional Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B8. Coordinate with design team to ensure design meets business goals** | • Design team has clear understanding of project goals and customer expectations<br>• Project plan and specific steps are presented in detail to team<br>• Team member roles and responsibilities are clearly defined<br>• Communication with team is timely and accurate<br>• Analysis is complete and incorporates all aspects of design<br>• Design concepts support business goals | • Knowledge of project planning, practices and methods<br>• Knowledge of team member roles and responsibilities<br>• Knowledge of applicable business goals<br>• Ability to coordinate project teams and meet objectives | • Ability to compile multiple viewpoints and analyze design criteria<br>• Ability to formulate plan of action and predict outcomes<br>• Ability to organize ideas and information<br>• Ability to communicate clearly<br>• Ability to plan according to resource needs and constraints |

## *Critical Work Function: Perform Media Production and Acquisition*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Develop, evaluate and revise text and scripts** | • Text and scripts are complete, relevant and congruent with the application domain and flow<br>• Text content is free of conflicts and inaccuracies<br>• Script flow is congruent with story<br>• Scripts reflect iterative and dynamic aspects of application and development processes | • Knowledge of script development techniques and tools<br>• Ability to organize flows according to a predetermined scheme<br>• Knowledge of media design | • Ability to synthesize information<br>• Ability to evaluate consistency of written material<br>• Ability to write for the appropriate audience<br>• Knowledge of word processing software |
| **C2. Create prototypes** | • Prototypes accurately reflect the design and meet customer needs<br>• Prototypes are created in a cost-effective and timely manner<br>• Prototypes are reviewed and approved by the customer | • Ability to produce and develop multimedia applications<br>• Ability to use rapid prototyping tools<br>• Knowledge of prototyping standards<br>• Knowledge of multimedia software<br>• Knowledge of media production | • Ability to demonstrate creative thinking while problem solving<br>• Ability to identify goals and constraints<br>• Ability to generate and evaluate alternative solutions<br>• Ability to formulate and implement a plan of action<br>• Ability to present ideas effectively |
| **C3. Identify available media and content sources** | • Sources are identified and located in a timely manner<br>• Available content is matched to project needs and technical specifications<br>• Selected media and content sources are appropriate and effective<br>• Content is accurate and complete<br>• Media and content sources are reliable, current and affordable<br>• Permission and clearances are obtained for the use of copyrighted material and intellectual property | • Knowledge of information search and acquisition techniques and ability to use effective search skills for content and media<br>• Ability to select the most appropriate media type or combination of media types to communicate the content area<br>• Ability to evaluate the effectiveness of communication for selected media and content sources<br>• Ability to evaluate media preferences of customer<br>• Knowledge of copyright laws and licenses | • Ability to interpret and apply new knowledge and experience<br>• Ability to revise plan as indicated by investigation of media sources<br>• Ability to implement new technologies and new applications<br>• Ability to research additional information sources<br>• Ability to analyze data and evaluate accuracy and appropriateness<br>• Ability to follow rules and procedures |

# DIGITAL MEDIA

## *Critical Work Function: Perform Media Production and Acquisition*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C4. Produce or acquire content elements** | • Graphic, animation, audio and video content are complete and relevant to message and script<br>• Content is free of conflict and inaccuracies<br>• Content style is congruent with customer image and project goals<br>• Permission to use acquired elements is secured<br>• Simulations create the feel of the real environment | • Knowledge of copyright laws and licenses<br>• Knowledge of graphic, animation, audio and video development tools and multimedia software<br>• Knowledge of graphic, animation, audio and video industries and vendors<br>• Knowledge of virtual reality technology, simulation tools and video production<br>• Ability to use 3D graphic simulations to build virtual world | • Ability to mentally picture outcomes<br>• Ability to think creatively while solving problems<br>• Ability to analyze effectiveness of graphics, animation, audio and video content<br>• Ability to analyze content and form and reconcile to overall project image<br>• Ability to compile multiple viewpoints and formulate plan of action<br>• Ability to generate and evaluate alternative solutions |
| **C5. Map project to design specifications and timelines** | • Each media element is uniquely identified using appropriate naming conventions<br>• Project map includes contingency plan<br>• Constraints and interdependencies are completely and accurately identified | • Knowledge of critical path scheduling<br>• Knowledge of multimedia software<br>• Knowledge of industry standards<br>• Knowledge of media indexing<br>• Ability to develop and understand project management charts and work flow diagrams | • Ability to consider risks and implications<br>• Ability to formulate plan of action and predict results<br>• Ability to organize information according to company procedures<br>• Ability to understand relevance of media components to various situations<br>• Knowledge of project management scheduling software |
| **C6. Substantiate make-or-buy decisions** | • Make-or-buy decision includes product quality and cost<br>• Substantiation document includes vendor selection criteria<br>• Make-or-buy decision making includes appropriate people | • Knowledge of basic business principles<br>• Knowledge of contract management<br>• Knowledge of multimedia software | • Ability to analyze situation/information and consider risks/implications<br>• Ability to compare and evaluate alternative solutions<br>• Ability to justify purpose/result |

## *Critical Work Function: Perform Media Production and Acquisition*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C7. Participate in iterative development with clients and team members** | • Design and production elements meet specifications<br>• Multiple prototypes and evaluations are completed<br>• Prototypes have a positive effect on the development process<br>• Each iteration solves a problem and supports project goals<br>• Stakeholders review and sign off on critical iterative development steps | • Knowledge of the iterative process<br>• Ability to use a variety of development strategies<br>• Knowledge of development and delivery platforms<br>• Ability to present technical information clearly<br>• Knowledge of multimedia software | • Ability to analyze group/individual response and pose critical questions<br>• Ability to analyze alternatives and make tradeoffs and decisions<br>• Ability to resolve technical issues<br>• Ability to encourage others to adopt new ideas |
| **C8. Ensure media productions and acquisitions meet legal and copyright requirements** | • Clearances, usage rights and licenses are obtained for all content as required<br>• Model releases are obtained as required<br>• Intellectual property is protected and secured appropriately<br>• Legal issues and concerns are reviewed by legal and contract personnel | • Knowledge of requirements and procedures relating to clearances, usage rights and licenses<br>• Knowledge of copyright and intellectual property protection issues<br>• Knowledge of ethical issues relating to acquisition and use of intellectual property | • Ability to follow company policies, procedures and standards<br>• Ability to identify and resolve conflicts<br>• Ability to analyze information and consider risks/implications<br>• Ability to organize and present complex information |

# DIGITAL MEDIA

## *Critical Work Function: Implement Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Create and produce finished content** | • Content meets design specifications and effectively communicates intended message<br>• Content is reviewed for clarity, structure and accuracy<br>• Integration of media elements is consistent with design and intended outcomes<br>• Themes and styles are aligned with customer and audience preferences | • Knowledge of media production and acquisition processes<br>• Knowledge of research and content organization techniques<br>• Ability to use the Internet and multimedia software<br>• Knowledge of media format conversion principles and tools<br>• Knowledge of themes, styles and audience preferences | • Ability to apply creative thinking to new situations<br>• Ability to examine task and technology relationship<br>• Ability to implement new technologies and applications<br>• Ability to predict technological results<br>• Ability to visualize integrated media product |
| **D2. Implement and refine navigation and interactive design** | • Specified functions and features are available to user through appropriate interface<br>• Visual and functional design specifications address human factors<br>• Design meets budgetary requirements<br>• Interactivity and navigation are user-friendly and support project goals | • Knowledge of user interface design principles<br>• Knowledge of human factors issues<br>• Knowledge of navigation design and implementation techniques<br>• Ability to apply cost/benefit analysis to media designs | • Ability to compile multiple viewpoints and analyze design criteria<br>• Ability to develop predictions based on available information<br>• Ability to formulate plan of action and predict outcomes |
| **D3. Implement database connectivity** | • Connectivity provides optimum interactive experience<br>• Connectivity increases product functionality<br>• User interface supports database connectivity<br>• Connectivity methods ensure integrity and security of database | • Knowledge of database connectivity issues and principles<br>• Ability to optimize database connectivity in an interactive environment<br>• Knowledge of user interface design principles<br>• Knowledge of database integrity and security issues and principles | • Ability to examine task and technology relationship<br>• Ability to apply creative thinking to new situations<br>• Ability to implement new technologies and applications<br>• Ability to integrate system technology and predict technological results |

## *Critical Work Function: Implement Design*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Create and incorporate application components** | • Application operates in designated delivery environment in a manner acceptable to customer<br>• Application components meet design specifications and conform to operational rules and constraints<br>• Application enhances interactivity without compromising performance | • Knowledge of authoring tools, languages and development principles<br>• Knowledge of applicable standards, conventions and constraints<br>• Ability to develop designs in an interactive operating environment | • Ability to devise/implement plan of action and judge effectiveness of plan<br>• Ability to examine information/data for relevance and accuracy<br>• Ability to analyze possible causes/reasons and recommend action<br>• Ability to monitor/adjust task sequence<br>• Ability to analyze operational problems and adjust system operation |
| **D5. Optimize design for maintainability** | • Content and media elements can be easily updated without major structure redesign<br>• Code is developed using object-based principles to facilitate changes<br>• Code and design documentation is thorough and accurate to facilitate changes | • Knowledge of software design principles and practices<br>• Knowledge of object-based languages and support tools<br>• Knowledge of documentation principles and practices | • Ability to adapt technology<br>• Ability to follow proper procedures<br>• Ability to analyze possible causes and reasons<br>• Ability to generate and evaluate solutions, and devise and implement appropriate actions |
| **D6. Document implementation process** | • Results of implementation are clearly and concisely communicated<br>• Implementation process and results are reviewed by appropriate team members and stakeholders<br>• Implementation documentation includes steps for improvement | • Knowledge of documentation standards and practices<br>• Ability to document and communicate technical information | • Ability to effectively organize, analyze and synthesize information<br>• Ability to communicate information and ideas clearly and succinctly<br>• Ability to use word processing tools |

# DIGITAL MEDIA

## *Critical Work Function: Test and Deliver Product*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Develop and perform usability and functionality tests** | • Test plans are efficient and effective and follow appropriate company procedures<br>• Usability and functionality tests are designed to include customer expectations<br>• Usability and functionality tests are directed toward appropriate audiences, done in adequate numbers and use appropriate procedures<br>• Methods for testing are affordable and relevant and include summative evaluation<br>• Testing results in accurate information that can be used in the iterative development process<br>• Deviations from specifications are clearly identified | • Knowledge of company testing procedures<br>• Knowledge of iterative development process<br>• Knowledge of testing software and ability to track and resolve defects<br>• Knowledge of usability testing procedures and cost considerations in testing<br>• Knowledge of multimedia software and hardware<br>• Knowledge of specifications and ability to assess customer satisfaction | • Ability to devise/implement plan of action and judge effectiveness of test plan<br>• Ability to examine information/data for relevance and accuracy<br>• Ability to analyze possible causes/reasons and recommend action plan<br>• Ability to monitor/adjust task sequence<br>• Ability to analyze operational problems and adjust system operation<br>• Ability to follow processes/procedures<br>• Ability to develop and ensure compliance to quality standards |
| **E2. Identify and resolve defects** | • Design process identifies approaches to finding, managing and prioritizing errors<br>• Defects are identified completely and accurately<br>• Timely documentation of errors includes current status and person responsible for resolving<br>• A systematic testing program is implemented to identify hardware compatibility problems<br>• Navigation is mapped and checked for all links<br>• Critical error areas are identified and error trapping is embedded into product<br>• A debugging program is in place as the components are developed<br>• Previously identified errors have been resolved within allotted time and budget | • Ability to use debugging tools<br>• Ability to analyze design, hardware and software problems<br>• Ability to use resources to resolve bugs<br>• Knowledge of version and revision control practices<br>• Ability to manage errors and use tracking software | • Ability to adapt technology for alternative uses<br>• Ability to follow proper procedures and apply technology in an effective manner<br>• Ability to make recommendations for a higher quality product<br>• Ability to analyze possible causes and reasons<br>• Ability to generate and evaluate solutions, and devise and implement plan of action |

## *Critical Work Function: Test and Deliver Product*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E3. Document testing process and test results** | • Testing process is accurately and thoroughly documented<br>• Test results are clearly and concisely communicated<br>• Testing process and results are reviewed by appropriate team members and stakeholders<br>• Steps for improvement in the testing process are outlined | • Knowledge of testing methods, tools and procedures<br>• Knowledge of company and departmental practices<br>• Ability to identify and track critical implementation milestones and deadlines | • Ability to effectively organize, analyze and synthesize information<br>• Ability to communicate information and ideas clearly and succinctly<br>• Ability to use word processing tools |
| **E4. Conduct customer acceptance testing and deliver product** | • Testing plan is complete and well coordinated<br>• Testing results in feedback that can be used in the iterative development process<br>• Appropriate people are included in acceptance testing<br>• Delivered product meets customer expectations<br>• Training needs are addressed and training is provided as appropriate | • Knowledge of customer expectations<br>• Ability to assess acceptance testing for efficiency and effectiveness<br>• Ability to identify training needs and develop appropriate solutions and responses | • Ability to interpret and clarify communication<br>• Ability to predict and communicate outcomes to the customer<br>• Knowledge of word processing software<br>• Ability to resolve conflicts to customer satisfaction<br>• Ability to organize acceptance testing procedure |
| **E5. Conduct periodic reviews and gather data for revisions** | • Post-delivery review is conducted with client/customer<br>• Performance and usability issues are documented and prioritized<br>• Change request log is implemented and maintained<br>• Change requests and performance issues are communicated to design team | • Knowledge of performance monitoring methods and practices<br>• Ability to document and communicate change requests<br>• Ability to gather and document customer satisfaction data<br>• Knowledge of change requests and revision control processes and procedures | • Ability to adapt technology for alternative uses<br>• Ability to follow proper procedures and apply technology in an effective manner<br>• Ability to make recommendations<br>• Ability to analyze possible causes and reasons<br>• Ability to generate and evaluate solutions, and devise and implement appropriate action |

# Enterprise Systems Analysis and Integration

As society increasingly depends on information technology for commerce, education, communication and entertainment, the smooth functioning and proper interaction of complex information technology systems become increasingly important. The increase in e-business and digital commerce will put even more emphasis on the interoperability, usability and security of separate systems. Enterprise systems analysts and integration specialists will often oversee the installation of necessary software, programming of databases and configuration of networks to allow efficient and secure transactions among computer systems. Professional opportunities exist for those with technical backgrounds plus business and/or management experience and education to perform high-level design and system integration functions either as a member of the enterprise team or as a consultant.

## SAMPLE TITLES

Application Integrator
Business Applications Analyst
Business Architect
Business Consultant
Business Continuity Analyst
Business Systems Analyst
Cross-Enterprise Integrator
Data Systems Designer
Data Systems Manager
Data Warehouse Designer
Delivery System Architect
E-Business Specialist
E-Commerce Business Analyst
E-Commerce Design Specialist
Electronic Transaction Analyst
Enterprise Architect
Information Systems Architect
Information Systems Planner
Information Technology Architect
Infrastructure Manager
Project Executive
Project Principal
Systems Analyst
Systems Architect
Systems Integrator
Systems Manager
Technical Consultant

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Summary of Critical Work Functions*

| A. Define Customer Requirements | B. Determine Solutions for New and Existing Systems | C. Provide Strategic Direction for Systems Configuration and Interoperability | D. Provide High-level Technology Management | E. Implement Systems | F. Manage Systems Quality Assurance and Testing |
|---|---|---|---|---|---|
| A1 Identify and document customer requirements | B1 Evaluate proven and emerging tools and technologies | C1 Evaluate company's current IT framework and technology strategies | D1 Define systems goals and performance metrics | E1 Guide and direct systems implementation projects | F1 Define and develop test plan and test procedures |
| A2 Define security requirements | B2 Perform risk and opportunity analysis | C2 Make recommendations regarding company's investment in technology | D2 Audit systems performance | E2 Ensure quality of routine systems monitoring | F2 Manage and perform systems testing |
| A3 Assess and document current systems capabilities and usage trends | B3 Make fiscal recommendations regarding technology | C3 Define data warehousing requirements | D3 Provide capacity planning and risk analysis | E3 Perform implementation readiness review | F3 Document test results and make recommendations |
| A4 Develop and document data and business process models | B4 Define systems security specifications | C4 Provide integration for legacy systems | D4 Provide long-term strategic and change management consulting | E4 Coordinate systems user training | F4 Develop and manage integration |
| A5 Define documentation and training requirements | B5 Define delivery strategies | C5 Provide systems consulting to user groups | D5 Evaluate new technologies, applications and products | E5 Put systems into service | F5 Evaluate systems development frame-work and recommend improvements |
| A6 Identify performance metrics | B6 Define systems interfaces | C6 Develop internal standards to guide enterprise in design of technical solutions | | E6 Review and evaluate systems documentation | |
| A7 Perform ROI (Return on Investment) analysis to justify concept | B7 Define implementation strategies | | | E7 Develop plans and processes for ongoing systems support | |
| | B8 Define maintenance and enhancement strategies | | | | |

KEY ACTIVITIES

## *Critical Work Function: Define Customer Requirements*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Identify and document customer requirements** | • Inputs, outputs and constraints are properly identified<br>• Customer requirements are complete, accurate and documented in a timely manner<br>• Requirements are approved by user in accordance with company procedures<br>• Changes are incorporated as appropriate<br>• Configuration management and change control processes are applied to documentation | • Knowledge of continuous quality improvement tools<br>• Knowledge of company procedures regarding document approval<br>• Ability to incorporate changes to customer requirements<br>• Knowledge of configuration management and change control processes<br>• Ability to draw requirements from customers and infer technological implications<br>• Knowledge of systems requirements and modeling | • Ability to compare multiple viewpoints and analyze communication<br>• Ability to integrate multiple items of data, contrast conflicting data and research additional information sources<br>• Ability to establish rapport with co-workers and customers<br>• Ability to detect underlying issues and resolve technical conflicts<br>• Ability to present complex ideas/ information and pose critical questions |
| **A2. Define security requirements** | • Security requirements are complete and accurate<br>• Security requirements are consistent with company standards and all applicable laws and regulations<br>• Security requirements are consistent with stakeholder requirements and transaction procedures<br>• Risk areas are identified and addressed | • Knowledge of company standards and applicable laws and regulations regarding security<br>• Knowledge of risk identification and security limitations<br>• Knowledge of networking, systems and applications security<br>• Knowledge of data integrity issues<br>• Knowledge of security requirements and transaction procedures<br>• Knowledge of industry-standard security technology, tools and practices | • Ability to follow policies and procedures, pay attention to detail and follow up on assigned tasks<br>• Ability to compare multiple viewpoints<br>• Ability to examine information for relevance and accuracy and adapt principles/rules to new applications |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Define Customer Requirements*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Assess and document current systems capabilities and usage trends** | • Assessment accurately reflects current systems capabilities and external dependencies<br>• Proper tools and metrics are used to measure usage trends<br>• Assessment includes infrastructure capacity trends<br>• Documentation is completed according to company procedures<br>• Documentation includes stakeholder requirements and transaction procedures | • Knowledge of analysis tools and metrics to measure usage trends<br>• Knowledge of company procedures regarding documentation<br>• Ability to measure infrastructure capacity<br>• Ability to audit usage against systems capabilities<br>• Knowledge of usage requirements and transaction procedures | • Ability to summarize and translate mathematical data<br>• Ability to create detailed supporting documents<br>• Ability to convert numerical data and predict arithmetic results<br>• Ability to analyze organization of information<br>• Ability to utilize networks and organize information and reports |
| **A4. Develop and document data business process models** | • Appropriate diagramming methodologies and modeling techniques are used<br>• Data and business process models accurately reflect current operation<br>• Documentation is complete and accurate<br>• Documented process is validated by the customer in accordance with company procedures | • Knowledge of diagramming methodologies and the ability to utilize modeling tools and techniques<br>• Knowledge of company procedures regarding customer validation<br>• Knowledge of business process and data models<br>• Knowledge of networks and systems infrastructure<br>• Knowledge of distributed computing | • Ability to summarize and translate mathematical data<br>• Ability to convert numerical data and predict results<br>• Ability to integrate and analyze information and organize technical reports<br>• Ability to actively participate in team activities and encourage/support team members<br>• Ability to respond to customer needs, relate to concerns and resolve conflicts to customer satisfaction |
| **A5. Define documentation and training requirements** | • Documentation and training requirements are developed in accordance with company procedures and culture<br>• End-user skill level is accurately evaluated<br>• Documentation and training strategies are appropriate and cost-effective<br>• Training is relevant and timely<br>• Documentation and training are effectively communicated and delivered | • Knowledge of company procedures regarding documentation and training<br>• Knowledge of just-in-time training methods<br>• Ability to evaluate training materials and delivery methods<br>• Knowledge of instructional design principles<br>• Knowledge of documentation access and delivery platforms and methods | • Ability to identify training needs<br>• Ability to analyze application of learning tools and investigate new learning techniques<br>• Ability to assess individual knowledge and skills<br>• Ability to develop appropriate training procedures and conduct task-specific training<br>• Ability to demonstrate honesty and trustworthiness |

## *Critical Work Function: Define Customer Requirements*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A6. Identify performance metrics** | • Service levels and critical performance requirements are clearly identified<br>• Performance metrics are documented in accordance with company procedures<br>• Performance metrics are validated by customer<br>• Performance metrics accurately reflect system performance | • Knowledge of performance metrics documentation procedures<br>• Knowledge of company procedures regarding customer validation<br>• Ability to translate customer requirements into quantifiable entities<br>• Ability to identify, collect and interpret metrics<br>• Knowledge of statistical process control methods<br>• Ability to draw performance metrics from customers and infer technological implications | • Ability to detect underlying issues and resolve technical conflicts<br>• Ability to compare and interpret multiple viewpoints<br>• Ability to convert numerical data and predict arithmetic results<br>• Ability to summarize and translate mathematical data<br>• Ability to understand continuous improvement process and analyze goals/constraints |
| **A7. Perform ROI (Return on Investment) analysis to justify concept** | • All pertinent costs are identified<br>• Significant improvements and efficiencies are identified, analyzed and reviewed<br>• Alternative cost-benefit models are developed and analyzed<br>• ROI effectively supports decisions | • Ability to identify and document all relevant costs<br>• Ability to perform ROI analysis<br>• Ability to develop and analyze financial models<br>• Knowledge of decision support strategies and practices | • Ability to summarize, interpret and present mathematical data<br>• Ability to convert numerical data and predict arithmetic results<br>• Ability to detect underlying issues and resolve technical conflicts |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Determine Solutions for New and Existing Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Evaluate proven and emerging tools and technologies** | • Evaluation is complete, accurate and timely<br>• Alternative technologies and features are evaluated against requirements and standards<br>• Appropriate information sources for proven and emerging technologies are explored<br>• Selection criteria are developed and documented<br>• Emerging trends are identified and integrated into solutions as warranted | • Knowledge of sources of information for proven and emerging technologies<br>• Knowledge of requirements and standards<br>• Knowledge of tools and technologies<br>• Knowledge of programming languages<br>• Knowledge of distributed computing and platforms<br>• Knowledge of vendor evaluation criteria and techniques | • Ability to research additional information sources and create data gathering processes<br>• Ability to analyze operational problems, evaluate computer utilization and judge information accuracy<br>• Ability to evaluate effectiveness of solutions for customer and forecast future customer needs<br>• Ability to adapt principles to new applications |
| **B2. Perform risk and opportunity analysis** | • Existing resources are properly audited in accordance with company procedures<br>• Appropriate options are considered and alternative analyses performed<br>• Cost/benefit and ROI analyses are properly conducted and presented<br>• Risk assessment is correctly documented<br>• Additional uses for the technology are identified to leverage development costs<br>• Opportunity evaluation is presented to appropriate personnel in accordance with company procedures<br>• Needs and solutions are well matched | • Ability to perform cost/benefit and/or ROI analysis<br>• Ability to perform risk assessment<br>• Knowledge of options for technology use<br>• Knowledge of company procedures<br>• Knowledge of business processes<br>• Knowledge of internal customer competency/literacy | • Ability to justify systems modification and ensure quality control<br>• Ability to adapt technology for alternative uses<br>• Ability to evaluate effectiveness of solutions for customer and forecast future customer needs<br>• Ability to project technology needs<br>• Ability to analyze, summarize and integrate information |

## *Critical Work Function: Determine Solutions for New and Existing Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Make fiscal recommendations regarding technology** | • Recommendations are in accordance with company procedures<br>• Recommendations are documented and communicated appropriately<br>• Risk assessments are appropriately considered<br>• Recommendations are included in the business plan and meet strategic goals<br>• Recommendations are based on ROI and lifecycle costs<br>• Budget considerations are reviewed and resolved | • Knowledge of risk assessment and ROI analysis techniques<br>• Knowledge of business plan and strategic goals<br>• Knowledge of recommendation procedures and documentation<br>• Knowledge of lifecycle costs<br>• Knowledge of financial concepts | • Ability to implement technological improvements and generate technological solutions<br>• Ability to design programs, networks and systems, evaluate computer utilization and judge information accuracy<br>• Ability to support positions/policies<br>• Ability to develop alternative systems designs<br>• Ability to compose well organized presentations and discuss issues<br>• Ability to develop formal and informal relationships with leaders in the enterprise |
| **B4. Define systems security specifications** | • Requirements for systems security are properly identified<br>• Security policy and procedures are correctly identified<br>• Systems security meets minimum standards identified by customer and required by all applicable laws and regulations<br>• Systems security procedures are properly documented and approved in accordance with company guidelines | • Knowledge of database and systems security issues<br>• Ability to interpret and apply security policies and procedures<br>• Knowledge of customer security requirements and all applicable laws and regulations<br>• Knowledge of security procedures and techniques<br>• Knowledge of company procedures regarding documentation<br>• Knowledge of security audit requirements | • Ability to formulate new ideas/approaches<br>• Ability to generate and evaluate alternative solutions<br>• Ability to create and develop rules/principles<br>• Ability to recognize organizational strengths/limitations and evaluate processes |
| **B5. Define delivery strategies** | • Delivery strategies meet documented customer schedule requirements and business conditions<br>• Delivery methods meet cost, schedule and customer requirements<br>• Delivery strategies are consistent with system architecture and business goals | • Knowledge of customer schedule requirements<br>• Knowledge of delivery strategies and methods<br>• Knowledge of prevailing business conditions<br>• Knowledge of system architecture<br>• Ability to adjust project plans and timelines | • Ability to resolve conflicts to customer satisfaction and obtain additional resources to meet customer needs<br>• Ability to resolve technical issues<br>• Ability to accept constructive criticism and responsibility for own actions<br>• Ability to create new rules/principles<br>• Ability to formulate new approaches and establish new processes/procedures |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Determine Solutions for New and Existing Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B6. Define systems interfaces** | • All interfaces are accurately specified and documented<br>• Agreements are established with all appropriate departments and/or personnel regarding delivery and exchange of data<br>• Access issues are appropriately resolved<br>• Collateral impacts are identified<br>• User requirements are accurately identified | • Knowledge of systems and interfaces<br>• Knowledge of requirements regarding exchange of data<br>• Knowledge of access issues<br>• Knowledge of graphical user interface design and platforms<br>• Knowledge of middleware and user applications | • Ability to generate and evaluate alternative solutions<br>• Ability to create and develop new rules/ principles<br>• Ability to recognize organizational strengths/limitations<br>• Ability to propose new technology and predict results<br>• Ability to detect underlying issues and resolve technical conflicts |
| **B7. Define implementation strategies** | • Service levels and implementation strategies meet customer priorities and prevailing business conditions<br>• Implementation strategies are properly coordinated with all customer schedules<br>• Implementation strategies make efficient use of available resources<br>• Full advantage is taken of iterative implementation processes<br>• Implementation is effectively coordinated with training schedule<br>• Data integrity is properly protected | • Knowledge of service levels and implementation strategies<br>• Knowledge of customer priorities and schedules<br>• Knowledge of efficient strategies for use of resources<br>• Knowledge of data integrity issues and protection techniques<br>• Knowledge of prevailing business conditions | • Ability to formulate new ideas/approaches and establish new processes/procedures<br>• Ability to generate and evaluate alternative solutions<br>• Ability to create and develop new rules/principles<br>• Ability to recognize organizational systems strengths/limitations<br>• Ability to propose new technology applications and predict results |
| **B8. Define maintenance and enhancement strategies** | • System availability specifications are established and agreed upon<br>• Required resources are identified<br>• Maintenance and enhancement policies are defined and documented<br>• Major system releases and enhancements are scheduled appropriately<br>• Maintenance and enhancements are handled in a timely and cost-effective manner<br>• System changes are appropriately managed and controlled | • Knowledge of business objectives and customer requirements<br>• Knowledge of change control and system management techniques<br>• Knowledge of service assurance and system upgrading practices and techniques | • Ability to generate and evaluate alternative solutions<br>• Ability to recognize organizational systems strengths/limitations<br>• Ability to analyze and adjust goals<br>• Ability to propose new solutions and predict results |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Provide Strategic Direction for Systems Configuration and Interoperability*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Evaluate company's current IT framework and technology strategies** | • Appropriate strategies are thoroughly explored<br>• Appropriate personnel and departments are included in the evaluation process<br>• Technology and data strategies are incorporated into company's strategic plan<br>• Technology gaps are identified and solutions are developed<br>• Strategic technical plan directly supports the company's business plan | • Knowledge of technology strategies<br>• Knowledge of strategic plan, business conditions and future goals<br>• Knowledge of the nature of data and data communication strategies<br>• Knowledge of distributed computing<br>• Knowledge of current communication protocols and programming languages<br>• Knowledge of systems architecture and frameworks | • Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to adapt rules/principles to new applications<br>• Ability to responsibly challenge unethical practices/decisions and formulate ethical course of action<br>• Ability to evaluate application of technology<br>• Ability to create mental models |
| **C2. Make recommendations regarding company's investment in technology** | • Recommendations are complete and relevant<br>• Recommendations are communicated appropriately<br>• Risk assessments are appropriately considered<br>• Recommendations meet strategic goals and are included in the business plan<br>• Alternatives are provided based on customer requirements and solutions available<br>• Recommendations include required supporting documents, plans and scenarios | • Knowledge of risk assessment analysis techniques<br>• Knowledge of business plan, strategic goals and business conditions<br>• Knowledge of recommendation procedures<br>• Knowledge of systems architecture and frameworks<br>• Knowledge of financial concepts | • Ability to generate unique solutions and formulate new ideas, plans and approaches<br>• Ability to analyze information and formulate proposals<br>• Ability to present complex ideas/ information and pose critical questions<br>• Ability to create original documents<br>• Ability to evaluate computer utilization<br>• Ability to analyze goals/constraints and examine proposed modifications and improvements |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Provide Strategic Direction for Systems Configuration and Interoperability*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C3. Define data warehousing requirements** | • Warehousing requirements are thoroughly evaluated<br>• Requirements are properly documented and meet company standards and all applicable laws and regulations<br>• Appropriate departments and personnel are included in the process<br>• Warehousing requirements include computing platform considerations and geographic access needs<br>• Warehousing requirements meet customer needs<br>• Reports are specified to meet customer, user or business needs | • Knowledge of decision support strategies and data modeling<br>• Knowledge of company standards and applicable laws and regulations<br>• Knowledge of warehousing strategies<br>• Knowledge of company data systems<br>• Knowledge of computing platforms<br>• Knowledge of customer needs and specification development | • Ability to generate and evaluate alternative solutions<br>• Ability to create and develop new rules/principles<br>• Ability to recognize organizational systems strengths/limitations and evaluate process/procedure<br>• Ability to propose new technology applications and predict results<br>• Ability to detect and summarize underlying issues and resolve technical conflicts |
| **C4. Provide integration for legacy systems** | • Legacy systems are thoroughly evaluated for interoperability and security<br>• Cross-platform technologies are used appropriately and effectively<br>• Interfaces effectively accommodate file conversions and interchanges<br>• Interfaces are interoperable and secure<br>• Integration and testing are performed according to project and company schedules, priorities and guidelines | • Knowledge of legacy systems<br>• Knowledge of interoperability issues and constraints<br>• Knowledge of cross-platform technologies, tools and security considerations<br>• Knowledge of human factors principles and interface design | • Ability to propose new applications and predict technological results<br>• Ability to evaluate customer requirements and pose critical questions<br>• Ability to analyze goals/constraints and examine proposed modifications and improvements<br>• Ability to resolve conflicts to customer satisfaction |

## *Critical Work Function: Provide Strategic Direction for Systems Configuration and Interoperability*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C5. Provide systems consulting to user groups** | • Existing applications are supported and enhanced<br>• Custom applications are researched and recommended<br>• Systems options and solutions are analyzed, evaluated and recommended<br>• Enterprise IT units function together effectively<br>• Technical knowledge and solutions are provided as necessary<br>• Change process is facilitated throughout the lifecycle | • Knowledge of existing systems, applications and infrastructure<br>• Knowledge of business and change processes<br>• Knowledge of application support and development processes<br>• Knowledge of information sources for gathering and assessing customer requirements, specifications, solution alternatives and training and documentation needs<br>• Ability to provide technical knowledge and support to a variety of customer groups | • Ability to establish rapport with users<br>• Ability to detect and summarize underlying issues and resolve technical conflicts<br>• Ability to generate, evaluate and recommend alternative solutions<br>• Ability to communicate complex technical information effectively to users<br>• Ability to stay current on cutting edge technologies and processes |
| **C6. Develop internal standards to guide enterprise in design of technical solutions** | • Standards are identified, documented and maintained<br>• Standards support cost and performance goals and expectations<br>• Change control processes support technical solution development and implementation<br>• Standards support solutions that meet organizational goals<br>• Standards are effectively integrated into technology management and solutions development | • Knowledge of data systems architecture<br>• Knowledge of standards development<br>• Knowledge of change management processes<br>• Knowledge of business rules and requirements<br>• Knowledge of systems technology management and strategic planning | • Ability to communicate technical information to a variety of audiences<br>• Ability to analyze goals/constraints and examine proposed modifications and improvements<br>• Ability to formulate new approaches and establish new processes/procedures<br>• Ability to develop and disseminate standards |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Provide High-level Technology Management*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Define systems goals and performance metrics** | • Systems goals and critical performance requirements are clearly defined<br>• Performance metrics are properly documented in accordance with company procedures<br>• Performance metrics are validated by customer<br>• Performance metrics are reflected in service level documentation<br>• Performance metrics are analyzed relative to meeting systems goals | • Knowledge of systems goals and performance metrics<br>• Ability to match performance metrics to customer requirements and service levels<br>• Ability to identify, collect and interpret metrics<br>• Knowledge of descriptive statistics and process control methods | • Ability to summarize and translate mathematical data<br>• Ability to convert numerical data and predict results<br>• Ability to create detailed supporting documents<br>• Ability to evaluate computer utilization<br>• Ability to make exceptional effort on behalf of customer and resolve conflict to customer satisfaction |
| **D2. Audit systems performance** | • Audits are conducted in accordance with company audit schedule and procedures<br>• Audit results are thoroughly documented<br>• Exceptions are properly reported according to company procedures<br>• Escalation process is correctly followed<br>• Performance reports are reviewed as appropriate | • Knowledge of audit procedures and schedules<br>• Knowledge of audit results documentation processes<br>• Ability to identify exceptions<br>• Knowledge of exception reporting procedures<br>• Knowledge of escalation processes<br>• Knowledge of systems performance and capacities | • Ability to analyze systems operation and determine changes in performance<br>• Ability to interpret and evaluate data<br>• Ability to verify data accuracy<br>• Ability to research additional information sources<br>• Ability to summarize, integrate and analyze information |
| **D3. Provide capacity planning and risk analysis** | • Systems availability and utilization are properly monitored and recorded<br>• Plans are developed to accommodate future capacity with respect to data and user-growth needs, data assurance and security<br>• Capacity planning utilizes the appropriate performance metrics and risk evaluation criteria<br>• Global IT units are evaluated and organized for efficiency and effectiveness<br>• Risks are effectively assessed and analyzed<br>• Risk management plans are developed and implemented | • Ability to plan and forecast<br>• Knowledge of availability and utilization specifications and future workloads<br>• Knowledge of monitoring procedures<br>• Knowledge of performance metrics techniques<br>• Knowledge of internal, external and global customer needs<br>• Knowledge of risk analysis, management and evaluation processes<br>• Knowledge of data assurance and security practices | • Ability to analyze systems operation and determine changes in systems performance<br>• Ability to propose new technology applications and predict technological results<br>• Ability to examine proposed modifications and improvements<br>• Ability to evaluate utilization |

## *Critical Work Function: Provide High-level Technology Management*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Provide long-term strategic and change management consulting** | • Enterprise systems operation, infrastructure and performance are evaluated and forecast in light of emerging technologies and business trends<br>• Strategic and tactical technology plans are developed and implemented<br>• Enterprise marketing, sales and service strategies and campaigns are integrated and supported<br>• Revenue and product analysis forecasts are researched in light of emerging technologies and business trends | • Knowledge of systems operation, infrastructure and performance<br>• Ability to track and interpret emerging technology and business trends<br>• Ability to develop, implement and update strategic and tactical plans<br>• Knowledge of enterprise marketing, sales and service requirements<br>• Ability to produce meaningful revenue and product analysis forecasts | • Ability to adapt technology for alternative uses<br>• Ability to formulate new ideas/ approaches and organize new processes/procedures<br>• Ability to create new rules/principles<br>• Ability to recognize and evaluate enterprise systems strengths/limitations |
| **D5. Evaluate new technologies, applications and products** | • Strategic technology use and deployment are evaluated in response to emerging technologies, enterprise goals and market trends<br>• Customer services, vendor reviews and revenue-generation strategies are continually evaluated and updated<br>• Sales and marketing strategies are continually revised to exploit emerging technologies and maximize competitive advantage<br>• Plans for evaluating and managing new technologies, applications and products are developed and implemented | • Knowledge of technology use and deployment strategies appropriate to enterprise<br>• Knowledge of business processes<br>• Ability to identify and evaluate technology, applications and business trends<br>• Knowledge of market and competitive forces<br>• Knowledge of research and analysis techniques | • Ability to generate, evaluate and communicate alternative solutions<br>• Ability to predict technological impacts and results<br>• Ability to propose new technology applications and integrate systems technology<br>• Ability to compare multiple viewpoints<br>• Ability to implement strategies successfully |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Implement Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Guide and direct systems implementation projects** | • Project phases, sequence and milestones are identified and communicated<br>• Project scope and cost are approved by all stakeholders, and revised when necessary<br>• Human, physical and financial resources are mapped to project<br>• Project management plan is accepted, implemented and updated<br>• Systems performance criteria are established and service level agreements are implemented | • Ability to use project management tools and techniques<br>• Knowledge of company approval procedures<br>• Knowledge of systems technology, performance metrics and implementation issues<br>• Knowledge of business and technology management<br>• Knowledge of financial concepts<br>• Knowledge of resource planning and mapping | • Ability to organize and present complex ideas/information and pose critical questions<br>• Ability to identify enterprise systems strengths/limitations<br>• Ability to plan effectively and integrate multiple perspectives<br>• Ability to encourage/support team members<br>• Ability to solicit and accept feedback<br>• Ability to align resources with project needs<br>• Ability to prepare and implement project management plan |
| **E2. Ensure quality of routine systems monitoring** | • Systems tests are conducted and the results measured against performance goals<br>• Monitoring procedures are developed and followed<br>• Monitoring reports are reviewed relative to business goals and systems performance expectations<br>• Monitoring reports are timely, reliable and complete | • Knowledge of business goals and company procedures<br>• Knowledge of monitoring tools and techniques<br>• Knowledge of quantitative analysis methods and performance metrics<br>• Knowledge of hardware and software<br>• Ability to analyze reports for quality and reliability | • Ability to identify enterprise systems strengths/limitations and evaluate process/procedure<br>• Ability to predict technological impacts and results<br>• Ability to analyze, summarize and translate monitoring data<br>• Ability to identify and resolve conflicts |
| **E3. Perform implementation readiness review** | • All procedures and documentation are thoroughly reviewed<br>• Systems are tested and approved for use<br>• Schedules are confirmed<br>• Risks are communicated to the customer<br>• Decisions are made in a timely manner<br>• Customer support documents are reviewed and approved | • Knowledge of procedures and documentation<br>• Knowledge of computing infrastructure<br>• Knowledge of stakeholder needs and expectations<br>• Knowledge of implementation schedule<br>• Knowledge of risk assessment procedures | • Ability to detect underlying issues and resolve technical conflicts<br>• Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to present complex ideas/ information and pose critical questions<br>• Ability to generate and evaluate alternative solutions and predict outcomes based on prior knowledge/experience |

## *Critical Work Function: Implement Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E4. Coordinate systems user training** | • User documentation is complete and accurate<br>• Resources are available to support training needs<br>• Training schedule is communicated to the customer effectively in a timely manner<br>• Training is updated based on user feedback and evolving needs | • Knowledge of user documentation<br>• Knowledge of just-in-time training<br>• Ability to identify and procure resources for training<br>• Ability to evaluate training materials and delivery methods<br>• Knowledge of instructional design principles | • Ability to analyze work assignments and delegate responsibilities<br>• Ability to manage timelines and recommend timeline adjustments<br>• Ability to accept responsibility for own actions and understand impact on others<br>• Ability to identify training needs |
| **E5. Put systems into service** | • Specifications are validated and approved by customer<br>• Discrepancies and exceptions are completely and accurately documented<br>• Defects are quickly corrected<br>• Systems ownership is transferred in accordance with established agreements<br>• Security and user access parameters are confirmed<br>• Systems support agreement fulfills contract obligations | • Knowledge of customer approval processes<br>• Ability to identify discrepancies and exceptions<br>• Knowledge of documentation procedures<br>• Knowledge of systems ownership transfer guidelines<br>• Knowledge of customer requirements, company procedures regarding access and business conditions<br>• Ability to create and document customer support policies | • Ability to diagnose performance deviations and distinguish trends in performance<br>• Ability to integrate systems technology<br>• Ability to relate to customer concerns and make appropriate efforts on behalf of customer |
| **E6. Review and evaluate systems documentation** | • Documentation conforms to established standards and is updated as needed<br>• Documentation completely represents the architecture<br>• Information is organized effectively<br>• Appropriate delivery medium is selected for the documentation<br>• Documentation is evaluated for currency, accuracy and usability | • Knowledge of established standards for technical writing and systems documentation<br>• Knowledge of systems architecture<br>• Ability to select and evaluate delivery media and organization methods | • Ability to analyze organization of information and transfer information between formats<br>• Ability to pay attention to details, monitor performance standards and follow up on assigned tasks<br>• Ability to create detailed supporting documents<br>• Ability to demonstrate commitment to excellence and adhere to standards |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Implement Systems*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E7. Develop plans and processes for ongoing system support** | • Systems support processes and procedures are defined and developed<br>• Staff development requirements are identified<br>• Staff recruiting and development plans are implemented<br>• Support requirements and service level review procedures are established and implemented<br>• Support plan and processes are aligned with business goals and budgets | • Knowledge of support processes and procedures<br>• Ability to develop technical plans<br>• Knowledge of business planning and budgets<br>• Knowledge of technical staff development requirements | • Ability to identify requirements, goals and processes in a technical context<br>• Ability to diagnose performance deviations and trends<br>• Ability to generate and propose solutions<br>• Ability to document, update and disseminate plans to all stakeholders |

## *Critical Work Function: Manage Systems Quality Assurance and Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Define and develop test plan and test procedures** | • Test plan includes systems and component testing<br>• Test scripts are developed based on use cases<br>• Appropriate testing tools and methods are identified<br>• Test success criteria are defined for all levels of testing<br>• Costs, schedules and resources are defined and agreed upon | • Knowledge of test plan and test procedure development and implementation<br>• Knowledge of testing tools and methods<br>• Knowledge of budgets and business goals | • Ability to integrate multiple items of data, contrast conflicting data and research additional information sources<br>• Ability to examine information for relevance and adapt principles/rules to new applications<br>• Ability to document and communicate plan and procedures |
| **F2. Manage and perform systems testing** | • Test scope and schedule are properly developed<br>• Testing resources are properly identified and in place as required<br>• Systems testing is conducted as appropriate<br>• Test results are documented in accordance with company procedures<br>• Test results are distributed to appropriate personnel | • Knowledge of pertinent required resources<br>• Knowledge of testing process development<br>• Knowledge of test documentation procedures<br>• Knowledge of test results dissemination procedures<br>• Knowledge of automated testing tools | • Ability to analyze problems and set goals<br>• Ability to encourage/support team members<br>• Ability to integrate multiple items of data and contrast conflicting data<br>• Ability to create original documents and write in a clear and concise style |
| **F3. Document test results and make recommendations** | • Testing provides for early error detection and problem resolution<br>• Test results are analyzed and defects identified<br>• Test results are compared to service level criteria and recommendations are developed<br>• Recommendations meet strategic goals and are communicated appropriately<br>• Recommendations include required supporting documents, plans and scenarios | • Knowledge of test results analysis and documentation<br>• Ability to prioritize and evaluate systems test results<br>• Knowledge of recommendation procedures | • Ability to analyze test results and translate into recommendations<br>• Ability to create comprehensive and clear supporting documentation<br>• Ability to align resources with project and system needs |

# ENTERPRISE SYSTEMS ANALYSIS AND INTEGRATION

## *Critical Work Function: Manage Systems Quality Assurance and Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F4. Develop and manage integration** | • Integration design and specifications are established<br>• Integration tools and methods are researched and applied as appropriate<br>• Interdependencies are identified and resolved<br>• Systems interfaces are tested and function correctly<br>• Integration plan provides for early error detection and problem resolution | • Knowledge of systems, interfaces and integration<br>• Knowledge of integration tools and methodologies<br>• Ability to identify and mitigate integration problems | • Ability to identify enterprise systems strengths/limitations<br>• Ability to coordinate and align resources for optimum results<br>• Ability to assess integration goals, outcomes and results<br>• Ability to identify, prioritize and resolve technical conflicts |
| **F5. Evaluate systems development framework and recommend improvements** | • Hardware and software meet current and projected requirements<br>• Staffing processes meet current needs and projected growth<br>• Development and integration milestones are achieved on schedule and within budget<br>• Supporting tools and operational systems meet quality and service level expectations<br>• Development environment is managed for team satisfaction and high productivity<br>• Internal, external and global customer requirements and goals are identified and achieved<br>• Recommendations are relevant, feasible and clearly communicated | • Knowledge of systems development frameworks, tools and methodologies<br>• Knowledge of systems quality assurance and testing<br>• Ability to manage large scale development and integration projects<br>• Ability to research, propose and present technical recommendations<br>• Ability to plan and forecast<br>• Knowledge of customer requirements and goals | • Ability to examine information for relevance and accuracy<br>• Ability to adapt principles/rules to new applications<br>• Ability to assess systems effectiveness in relation to goals and objectives<br>• Ability to develop and communicate appropriate recommendations<br>• Ability to support implementation and monitor progress |

# Network Design and Administration

Network designers are responsible for developing a plan that allows a business or organization to use a network to further its goals. This network may be a simple Local Area Network (LAN), or may be a complex, enterprise-grade Wide Area Network (WAN). Responsibilities include conducting a needs analysis and providing detailed reports concerning any proposed design. Network design technicians consult with responsible members of the organization, research the latest equipment and software developments and spend time troubleshooting the design once it is in place. A solid grounding in security concepts is also vital as it is likely network design technicians will be involved in providing network access to remote users. In the area of network administration, network technicians confirm that network hardware and software are operating properly so people in the organization get the information they need when they need it. A network technician is responsible for maintaining individual elements of the organization's LAN, WAN or Intranet. A network technician thoroughly understands networking technology for LANs and for connecting to larger networks and the Internet. They must learn to quickly identify, document and solve problems. Because technicians work with users all the time, they understand their needs and can recommend improvements based on user input and technology advances. Technicians also spend time measuring network performance. This includes charting network usage and downtime to help plan for the future. Technicians document the network configuration and prepare backup plans and procedures. They are responsible for adding users and ensuring that they have access to the files and network-connected equipment they need to do their job, while maintaining security and confidentiality of other files and data. Finally, technicians install upgrades with a minimum of disruption.

## SAMPLE TITLES

Communications Analyst/Engineer
Data Communications Analyst
Information Security Manager
Information Security Specialist
Information Systems Administrator
Information Technology Engineer
Infrastructure Engineer
Internet Systems Administrator
Internetworking Engineer
Internetworking Professional
IT Security Officer
Network Administrator
Network Analyst
Network Architect
Network Consultant
Network Engineer
Network Manager
Network Operations Analyst
Network Security Analyst
Network Security Consultant
Network Security Manager
Network Security Specialist
Network Server Administrator
Network Support Technician
Network Technician
Security Administrator
Security Analyst
Security Consultant
Security Manager
Security Professional
Security Specialist
Server Administrator
Systems Administrator
Systems Manager
Web Administrator

# NETWORK DESIGN AND ADMINISTRATION

## *Summary of Critical Work Functions*

| A. Perform Analysis | B. Design Network | C. Configure and Deploy Network | D. Perform Testing | E. Manage Network | F. Maintain Network and Manage Growth | G. Perform Security Administration |
|---|---|---|---|---|---|---|
| A1 Gather data to identify customer requirements | B1 Participate in design reviews | C1 Plan and document system configuration | D1 Define and document test specifications | E1 Set up and maintain user accounts | F1 Develop maintenance and upgrade plans | G1 Gather and document security requirements |
| A2 Identify, interpret and evaluate system, network and security requirements | B2 Prepare integration plan for new processes, protocols and equipment | C2 Implement new system configuration | D2 Develop test plan and procedures | E2 Coordinate, communicate and document changes | F2 Coordinate maintenance for computer, web server and telecommunications networks | G2 Design and document security plan |
| A3 Define scope of work | B3 Recommend selection of architecture, topology, hardware and software | C3 Perform workstation configuration and software loading | D3 Schedule and perform testing | E3 Manage inventory | F3 Apply maintenance upgrades, security enhancements and process changes | G3 Implement and enforce system and user security requirements |
| A4 Review network architecture, topology, interdependencies and constraints | B4 Prepare capacity and throughput plan | C4 Support, track and document change implementation | D4 Document, interpret and report test results | E4 Analyze system performance to baseline | F4 Perform system backups and restore data | G4 Maintain, improve and enhance security in response to industry developments and user experience |
| A5 Research technical alternatives and analyze technical options | B5 Specify servers and supporting hardware | C5 Implement deployment | D5 Perform final tests and gain customer acceptance | E5 Monitor and report component and connectivity problems | F5 Troubleshoot and maintain client, server and network systems | G5 Detect, monitor and report security problems |
| A6 Develop project plan | B6 Specify wired and wireless facilities | C6 Manage contract personnel | D6 Perform functional verifications and system audits | E6 Make recommendations for system optimization, improvement and security | F6 Develop growth and capacity plans and make recommendations | G6 Contribute to and develop recommendations for long range security plans |
| | B7 Integrate network components | C7 Install hardware | | E7 Generate and present reports | F7 Implement growth plans and long range solutions | |
| | | C8 Perform network fault management | | E8 Monitor capacity to ensure required service levels | | |
| | | | | E9 Manage and implement contingency and emergency recovery plans | | |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather data to identify customer requirements** | • Requirements data are reliable and current<br>• Information is accurate, complete, relevant and pertinent to business goals and objectives<br>• Information gathering activities follow appropriate company practices<br>• Information is gathered systematically in a cost-effective manner<br>• Current configuration and existing environment are evaluated and documented appropriately | • Knowledge of key sources of information with respect to customer requirements<br>• Knowledge of information gathering methods/procedures and practices<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of the goals and scope of the research<br>• Knowledge of networking design principles and constraints | • Ability to analyze group/individual responses<br>• Ability to select/obtain data relevant to the task and identify the need for data<br>• Ability to encourage cooperation<br>• Ability to ask open-ended and confirming questions<br>• Ability to organize and summarize information and requirements |
| **A2. Identify, interpret and evaluate system, network and security requirements** | • System and design requirements are complete and free of conflicts<br>• Requirements are documented accurately<br>• Requirements mesh with overall project requirements<br>• Requirements have been checked for compatibility and interdependencies<br>• Appropriate information and data analysis techniques are applied<br>• Priority needs are defined clearly for the customer and team<br>• Complete set of requirements is communicated to and approved by customer | • Ability to translate organizational computing requirements into system requirements<br>• Ability to identify and resolve conflicting requirements<br>• Knowledge of system capabilities and systems integration<br>• Knowledge of network architecture, topology, hardware and software | • Ability to analyze information for accuracy and consistency<br>• Ability to resolve technical issues<br>• Ability to evaluate system configuration<br>• Ability to create detailed supporting documents<br>• Ability to compile multiple viewpoints<br>• Ability to relate intent to desired results<br>• Ability to formulate short, medium and long-term plans |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Define scope of work** | • Project objectives and costs are identified and agreed upon<br>• Scope and specifications are identified accurately<br>• Criteria for successful completion of the work are identified<br>• Major project tasks and interdependencies are identified<br>• Estimates of time, materials and resources are accurately identified<br>• Schedule includes resource availability and project timeline data<br>• Scope of work is documented accurately and completely | • Knowledge of networking and operating environments<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of resource availability and project timeline<br>• Ability to coordinate technical resources based on project scope, timeline and cost constraints | • Ability to create detailed supporting documents<br>• Ability to relate intent to desired results<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to plan resource needs and constraints<br>• Ability to visualize tasks sequentially or in parallel and to identify interdependencies<br>• Ability to negotiate success criteria<br>• Ability to think nonsequentially and globally |
| **A4. Review network architecture, topology, interdependencies and constraints** | • Constraints and potential conflicts are accurately identified and clearly communicated<br>• Risk analysis and contingency plans are developed and clearly communicated<br>• Actual and projected future technical and human resources requirements are reviewed and analyzed<br>• Product and vendor architecture and equipment specifications/limitations are thoroughly researched | • Knowledge of key sources of information with respect to architecture and topology<br>• Knowledge of risk analysis techniques<br>• Knowledge of technology constraints, and hardware and software standards and processes<br>• Knowledge of network architecture, topology, hardware and software | • Ability to create detailed supporting documents<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to analyze information and develop theories about interdependencies<br>• Ability to present technical information clearly and concisely using appropriate tools<br>• Ability to plan resource needs and constraints |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A5. Research technical alternatives and analyze technical options** | • Alternative technical and design scenarios are outlined, compared and evaluated with regard to technical and business goals, impacts and desirability<br>• Cost/benefit tradeoffs and risk analysis of technical alternatives are completed and evaluated | • Knowledge of key sources of information regarding technical options<br>• Knowledge of system design concepts and techniques<br>• Knowledge of research techniques and procedures and cost/benefit analysis techniques regarding technical options<br>• Ability to translate technical features into development and user benefits<br>• Ability to assess sources of information for new technologies and calculate risks of implementation<br>• Knowledge of hardware and software standards and processes<br>• Knowledge of network architecture, topology, hardware and software | • Ability to present alternative solutions in concise, clear language<br>• Ability to accurately summarize and document information<br>• Ability to use previous training/experience to forecast how documentation will be used by others<br>• Ability to gather, synthesize and interpret data |
| **A6. Develop project plan** | • Plan accurately identifies project requirements, including project schedules, resource allocations, dependencies and milestones<br>• Plan includes functional and technical specifications, data models, site maps, fiscal assumptions, constraints and risks<br>• Plan is accurately documented and updated<br>• Plan includes initial feasibility and benchmarking processes for meeting deadlines and monitoring costs | • Knowledge of risk analysis techniques<br>• Knowledge of project management tools<br>• Knowledge of computer systems and computer technologies<br>• Knowledge of functional and technical specifications, data models, site maps, assumptions, constraints, risks and cost control practices | • Ability to analyze organization of information<br>• Ability to summarize/integrate information<br>• Ability to work with minimal supervision and pay attention to detail<br>• Ability to prepare and organize multiple schedules<br>• Ability to assess individual knowledge/ skills and analyze work assignments |

## *Critical Work Function: Design Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Participate in design reviews** | • Project phases have been thought out and addressed<br>• Outcomes of design reviews are accurately documented<br>• Appropriate representatives from all constituencies develop and approve the design | • Knowledge of design review procedures and process<br>• Knowledge of networking and operating environments<br>• Knowledge of network architecture, topology, hardware and software<br>• Ability to identify and coordinate key representatives of all constituencies | • Ability to suggest modifications to technological systems<br>• Ability to recommend tradeoffs and negotiate to resolve technical issues<br>• Ability to responsibly challenge the status quo to achieve quality design<br>• Ability to respond appropriately to others |
| **B2. Prepare integration plan for new processes, protocols and equipment** | • Design takes into account relevant technical and human resources<br>• Design is complete and approved by stakeholders<br>• Integration plan is developed and approved by relevant parties<br>• Design and integration plans are optimized for ease and quality of implementation<br>• Design and integration plans are documented completely, clearly and accurately | • Knowledge of architecture design tools and methods, integration methods and traffic analysis tools<br>• Knowledge of implementation process and user impact<br>• Knowledge of networking and operating environments<br>• Knowledge of network architecture, topology, hardware and software | • Ability to collect and analyze information<br>• Ability to present technical information in a clear and concise form<br>• Ability to interpret and summarize results<br>• Ability to manipulate information and integrate multiple platforms<br>• Ability to analyze situation/information and formulate a plan of action that is in line with business and financial constraints |
| **B3. Recommend selection of architecture, topology, hardware and software** | • Recommended solutions are practical, cost-effective and meet system specifications<br>• Recommendations are clearly documented and justified<br>• Recommendations are communicated effectively to stakeholders<br>• Alternatives are evaluated in light of system use and configuration | • Knowledge of networking standards and processes<br>• Knowledge of network architecture, topology, hardware and software<br>• Ability to separate actual requirements from technical desires<br>• Ability to apply forecasting methodology and complete a trend analysis<br>• Ability to optimize recycling and redeployment of existing hardware | • Ability to communicate technical information to a variety of audiences<br>• Ability to analyze and present technical information in a clear and precise way<br>• Ability to give and accept constructive criticism |

## *Critical Work Function: Design Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B4. Prepare capacity and throughput plan** | • Plan reflects requirements, expectations and business goals<br>• Plan accurately depicts current conditions and provides for growth<br>• Plan is coordinated with business forecasts and strategic objectives<br>• Plan accurately describes physical configuration, software requirements and usage<br>• Plan includes system specifications, performance monitoring and system optimization | • Knowledge of network planning, design and configuration<br>• Knowledge of network architecture, topology, hardware and software<br>• Ability to generate, read and interpret vendor specifications<br>• Knowledge of network optimization practices and methods | • Ability to present complex technical terms and concepts<br>• Ability to propose/formulate new processes<br>• Ability to evaluate system configuration and capacity issues and impacts<br>• Ability to analyze, interpret and summarize information |
| **B5. Specify servers and supporting hardware** | • Servers and supporting hardware system design and functional criteria are clearly documented<br>• Specifications provide for anticipated growth<br>• Interface and interoperability requirements are properly specified<br>• Physical and environmental aspects of installation are appropriately specified | • Knowledge of server hardware and software specifications<br>• Knowledge of network architecture topology<br>• Knowledge of server and supporting hardware systems and protocols<br>• Ability to create system and installation specifications | • Ability to suggest system modifications and improvements and analyze goals and constraints<br>• Ability to present specifications in a clear, concise manner<br>• Ability to organize and present technical terms and concepts |
| **B6. Specify wired and wireless facilities** | • Specifications make appropriate use of wired and wireless technologies and capabilities<br>• Specifications include appropriate standards, practices and codes<br>• Specifications allow for migration and growth<br>• Wireless specifications conform to coverage plan and system load expectations<br>• Installation specifications reflect applicable physical and environmental factors<br>• Specifications include applicable physical and system security requirements and practices | • Knowledge of wired and wireless systems attributes and capabilities<br>• Knowledge of appropriate standards, practices and codes<br>• Ability to interpret and apply planning data and business goals to development of specifications | • Ability to interpret and evaluate technical data and concepts<br>• Ability to present specifications in a clear, concise manner<br>• Ability to suggest system modifications and improvements and analyze goals and constraints |

## *Critical Work Function: Design Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B7. Integrate network components** | • Servers, supporting hardware and other components function according to system design plan and installation specifications<br>• Network achieves specified functionality<br>• Network accommodates expected traffic and future growth with specified grade of service<br>• Final integration provides for specified growth and expansion | • Knowledge of network operating system, topology, hardware and software<br>• Ability to interpret and execute system design plan to achieve stipulated outcome<br>• Ability to integrate system components to achieve design goals | • Ability to monitor quality standards<br>• Ability to follow proper procedures and processes<br>• Ability to identify and evaluate system performance trends and deviations<br>• Ability to communicate complex technical information |

## *Critical Work Function: Configuration and Deploy Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Plan and document system configuration** | • Configuration is clearly articulated and effectively documented<br>• Configuration uses appropriate resources to perform the current task and provides resources for future growth<br>• Configuration documents meet user needs<br>• Maintenance procedures are documented<br>• System specifications are clearly and completely documented | • Ability to use flow charting and diagramming tools<br>• Knowledge of business systems<br>• Ability to identify user expectations<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of operating systems<br>• Knowledge of system configuration procedures | • Ability to predict outcomes/results based on prior knowledge<br>• Ability to plan and coordinate activities<br>• Ability to visually analyze relationship between parts/whole, process/procedure<br>• Ability to recommend and implement plan of action<br>• Ability to present complex ideas/information<br>• Ability to use word processing tools<br>• Ability to apply technical documentation standards and procedures |
| **C2. Implement new system configuration** | • Problems are identified and resolved in a timely and appropriate manner<br>• Implementation schedule and expectations are communicated to users, vendors and implementation team<br>• Configuration plan is successfully implemented with minimal disruption<br>• New configuration is fully and accurately documented<br>• Configuration meets user needs | • Knowledge of network architecture, topology, hardware and software<br>• Knowledge of standard roll-out practices and recovery procedures<br>• Knowledge of hardware and software standards and processes<br>• Knowledge of system configuration procedures | • Ability to analyze situation/information, consider risks/implications, generate alternative solutions and formulate a plan of action<br>• Ability to understand technology applications<br>• Ability to follow proper procedures<br>• Ability to manipulate technology for desired results<br>• Ability to document work process flow in detailed supporting documents |
| **C3. Perform workstation configuration and software loading** | • Software is loaded and configured with minimum disruption to process flow<br>• Conversion of data is performed and compatibility issues are addressed in a timely manner<br>• Software is configured appropriately for system and user application<br>• Software and hardware configurations are standardized<br>• User satisfaction is assessed after new installation and/or configuration | • Knowledge of software loading and configuration procedures<br>• Knowledge of data conversion issues and procedures<br>• Knowledge of compatibility issues and resolution procedures<br>• Ability to understand user applications and relate user needs to configuration<br>• Knowledge of network and operating systems<br>• Knowledge of workstation hardware configuration | • Ability to evaluate computer utilization<br>• Ability to analyze operational problems<br>• Ability to implement new applications<br>• Ability to present complex information to users<br>• Ability to listen attentively and respond to verbal/nonverbal communications |

## *Critical Work Function: Configuration and Deploy Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C4. Support, track and document change implementation** | • Relevant stakeholders agreed to changes in accordance with company procedures<br>• Implementation timelines are formulated and revised as needed<br>• Activities among workgroups are coordinated<br>• Changes are documented in a timely manner and in accordance with applicable controls, policies and practices | • Knowledge of group dynamics<br>• Knowledge of documentation policies and practices<br>• Knowledge of tracking and documentation procedures | • Ability to pose critical questions and ask open-ended and confirming questions<br>• Ability to identify the need for information<br>• Ability to encourage cooperation<br>• Ability to analyze and summarize information<br>• Ability to use word processing, project management and spreadsheet software<br>• Ability to follow company procedures and support organization processes |
| **C5. Implement deployment** | • Deployment plan is developed and documented<br>• Deployment is congruent with project scope, timeline and installation plan<br>• Deployment is synchronized with training schedule<br>• Deployment has minimal disruptive impact on users | • Knowledge of installation processes and procedures<br>• Knowledge of enterprise-wide deployment practices and standards<br>• Knowledge of network architecture, topology, hardware and software | • Ability to use continuous improvement strategies and tools<br>• Ability to resolve conflicts in a timely manner<br>• Ability to prepare and organize multiple schedules, manage timelines and recommend adjustments<br>• Ability to visualize and coordinate productivity impacts<br>• Ability to follow company procedures and support organization processes |
| **C6. Manage contract personnel** | • Contract personnel are identified and selected according to appropriate criteria<br>• Contract personnel are oriented effectively and assigned appropriately<br>• Performance is monitored to assure compliance with project schedules, costs and goals<br>• Need for contract personnel is appropriately justified | • Ability to identify and justify contingency workforce requirements<br>• Ability to clearly specify job requirements<br>• Knowledge of complete procedures and policies regarding contract personnel<br>• Knowledge of security issues pertaining to selection and use of contingent workers | • Ability to accurately summarize and document information<br>• Ability to follow company procedures and practices<br>• Ability to formulate action plans that align with business and financial goals<br>• Ability to plan resource needs, adjust schedules accordingly and communicate requisite changes clearly |

## *Critical Work Function: Configuration and Deploy Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C7. Install hardware** | • Cabinet, peripheral equipment and power/grounding are properly installed<br>• Cabling and wiring are correctly installed<br>• Final assembly is properly performed and conforms to applicable codes and practices<br>• Initial turn on and functional test are performed after installation<br>• Test reports are documented appropriately and approved as required | • Ability to install cabinet, peripheral equipment and power/grounding<br>• Knowledge of cabling and wiring installation procedures<br>• Knowledge of hardware testing procedures<br>• Knowledge of applicable codes and practices<br>• Ability to document test results<br>• Ability to acquire necessary approvals | • Ability to follow standard installation procedures and practices<br>• Ability to troubleshoot and test system and components<br>• Ability to create detailed supporting documentation<br>• Ability to recommend tradeoffs and negotiate to resolve technical issues |
| **C8. Perform network fault management** | • Local and remote fault reporting and diagnostic systems are configured properly<br>• Fault reporting and diagnostic systems are routinely tested and monitored in accordance with applicable specifications<br>• Diagnostic reports are routinely analyzed and referred for appropriate resolution | • Ability to perform fault analysis and resolution<br>• Knowledge of local and remote network management systems and procedures<br>• Knowledge of diagnostic systems operation and testing<br>• Ability to analyze and dispatch diagnostic reports | • Ability to collect and analyze technical information<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to evaluate effectiveness of process<br>• Ability to create detailed supporting documents |

## *Critical Work Function: Perform Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Define and document test specifications** | • Appropriate test specifications are identified with agreement from key personnel<br>• Applicability of test is clearly established<br>• Scope of testing plan assures quality results<br>• Acceptance criteria are well defined | • Ability to perform system analysis<br>• Knowledge of testing tools and procedures<br>• Knowledge of business requirements<br>• Knowledge of networking environments | • Ability to communicate and interpret information<br>• Ability to propose/formulate test process<br>• Ability to analyze system structure and organization |
| **D2. Develop test plan and procedures** | • Test plan is developed and documented<br>• System test plan uses standard procedures<br>• Test plan identifies appropriate resources, personnel and schedules<br>• Network impact, including systems integration impact, is clearly defined and assessed<br>• Security procedures are included in test plan<br>• End-user/customer testing is included in test plan | • Knowledge of testing tools, procedures and equipment<br>• Ability to relate errors to system functionality<br>• Knowledge of financial requirements and organization structure and ability to conduct business case analysis<br>• Knowledge of operating systems<br>• Knowledge of network architecture, topology, hardware and software | • Ability to analyze possible causes/reasons for problems and recommend action plan<br>• Ability to analyze data<br>• Ability to recognize patterns and relationships<br>• Ability to justify business case and system structure/organization<br>• Ability to negotiate for resource allocations<br>• Ability to recognize system strengths and limitations |
| **D3. Schedule and perform testing** | • Test environment is clearly defined and prepared appropriately<br>• Tests are planned and conducted at appropriate stages of development and production<br>• Testing is on schedule and within budget | • Ability to use tracking and scheduling tools<br>• Knowledge of testing methodologies and procedures<br>• Knowledge of network architecture, topology, hardware and software | • Ability to follow processes and procedures<br>• Ability to critically analyze details<br>• Ability to record testing results<br>• Ability to initiate corrective processes<br>• Ability to manage timelines<br>• Ability to encourage/support team members and assume responsibility for accomplishing team goals |

## *Critical Work Function: Perform Testing*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Document, interpret and report test results** | • Reports are completed in a timely manner<br>• Errors are described so as to be reproducible<br>• Reports include failure analysis when appropriate<br>• Reports are accurate and complete<br>• Reports include recommendations for required corrections<br>• System is ready for customer acceptance in all respects | • Knowledge of system capabilities and interdependencies in testing environment<br>• Knowledge of networking and operating system environments<br>• Knowledge of continuous improvement processes regarding testing<br>• Knowledge of customer acceptance criteria | • Ability to apply rules/principles to process/ data and use logic to draw conclusions<br>• Ability to present complex ideas/ information<br>• Ability to generate creative solutions and formulate new plans/approaches<br>• Ability to compile, interpret and communicate test results<br>• Ability to select and use appropriate office software tools |
| **D5. Perform final tests and gain customer acceptance** | • Customer agrees to test and acceptance criteria<br>• System meets design specifications and planned performance objectives<br>• Customer accepts system | • Knowledge of systems acceptance test procedures and criteria<br>• Ability to interpret and present specifications and planning data<br>• Knowledge of effective acceptance practices and procedures | • Ability to follow standard procedures, processes and practices<br>• Ability to identify problems and recommend possible solutions<br>• Ability to record testing results accurately<br>• Ability to gain customer acceptance in appropriate manner |
| **D6. Perform functional verifications and system audits** | • Functional testing is performed on schedule and according to accepted procedures<br>• Test results are collected, verified and accurately documented<br>• System changes and remedial actions are communicated to appropriate personnel<br>• System audits are performed in accordance with established procedures<br>• System audits provide basis for developing future system requirements, specifications and procedures | • Knowledge of system performance and operation<br>• Knowledge of system audit procedures<br>• Knowledge of company practices and standards<br>• Ability to gather, analyze and disseminate audit information appropriately | • Ability to ask open-ended and confirming questions<br>• Ability to identify need for information<br>• Ability to encourage cooperation<br>• Ability to analyze, interpret and summarize information |

## *Critical Work Function: Manage Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Set up and maintain user accounts** | • User accounts are set up following standard operating practices<br>• Users are provided with timely access to required systems and resources<br>• Security for user accounts is maintained across all systems | • Knowledge of corporate policies and procedures<br>• Knowledge of network security tools and practices<br>• Knowledge of operating systems and network systems | • Ability to apply rules/procedures to documents and accounts<br>• Ability to outline maintenance procedures<br>• Ability to follow rules, policies and procedures<br>• Ability to pay attention to details<br>• Ability to identify and resolve issues |
| **E2. Coordinate, communicate and document changes** | • Conflicts are addressed and resolved<br>• Change management documents address existing and future personnel and technical resources<br>• Appropriate stakeholders are involved and approve the changes<br>• Documentation is clear, understandable and distributed appropriately | • Knowledge of company change management processes<br>• Knowledge of network architecture, topology, hardware and software<br>• Ability to use software tools to support change implementation<br>• Knowledge of escalation procedures | • Ability to negotiate agreements and consolidate viewpoints<br>• Ability to present complex technical terms and concepts and debate issues<br>• Ability to analyze, interpret and summarize information<br>• Ability to use word processing tools<br>• Ability to understand organizational structure/hierarchy |
| **E3. Manage inventory** | • Inventory of parts includes accurate identification, tagging and location information<br>• Accurate documentation of relevant information is consistently maintained<br>• Appropriate individuals are notified of inventory issues as appropriate<br>• Physical security of inventory is established and maintained | • Knowledge of inventory systems access and organization<br>• Ability to use computerized inventory databases<br>• Knowledge of corporate procedures for acquisition and asset management<br>• Knowledge of security practices and methods | • Ability to create detailed supporting documents<br>• Ability to monitor safe and efficient utilization of materials<br>• Ability to coordinate storage and distribution<br>• Ability to monitor configuration and efficient utilization of assets |

## *Critical Work Function: Manage Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E4. Analyze system performance to baseline** | • Baseline is updated as system configuration changes<br>• Systematic ongoing measurement data is collected and documented<br>• Deviations are identified<br>• System metrics are identified and updated | • Ability to use networking measurement tools<br>• Ability to complete system analysis<br>• Ability to use testing tools<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of monitoring procedures<br>• Ability to use documentation tools and follow standards and procedures<br>• Ability to use common network troubleshooting tools, techniques and practices | • Ability to analyze data and to assess information accuracy<br>• Ability to integrate multiple items and resolve conflicting data<br>• Ability to analyze system operation<br>• Ability to distinguish trends in performance<br>• Ability to diagnose performance deviations |
| **E5. Monitor and report component and connectivity problems** | • System is closely monitored and outages are recognized in a timely manner<br>• Problems are escalated according to company procedures<br>• Security violations are detected and reported in a timely manner<br>• System outages have minimal impact on business processes | • Knowledge of network architecture, topology, hardware and software<br>• Knowledge of interoperability requirements<br>• Knowledge of corporate security policies and procedures<br>• Knowledge of documentation, storage and security tools<br>• Ability to identify and use appropriate reporting channels | • Ability to interpret and evaluate data<br>• Ability to troubleshoot system malfunction and/or failure<br>• Ability to distinguish trends in performance and diagnose performance deviations<br>• Ability to use project management software<br>• Ability to analyze system operation and analyze system effectiveness/efficiency |
| **E6. Make recommendations for system optimization, improvement and security** | • Unmet requirements are identified<br>• System performance is assessed accurately<br>• Recommendations result in improvement of processes<br>• Required modifications are anticipated and fixes are implemented prior to adverse impact<br>• Security and data assurance plans are continually monitored and optimized | • Knowledge of systems tools<br>• Knowledge of company resources and constraints<br>• Knowledge of systems monitoring processes and procedures<br>• Ability to use modeling and simulation tools<br>• Knowledge of system security, data assurance and deterrence strategies | • Ability to predict results<br>• Ability to evaluate/adjust plan of action<br>• Ability to suggest system modifications and improvements and analyze goals/ constraints<br>• Ability to present recommendations in a clear, concise and persuasive manner |

## *Critical Work Function: Manage Network*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E7. Generate and present reports** | • Reports are accurate and complete<br>• Reports follow applicable policies and procedures<br>• Reports capture current and potential problems and improvement recommendations<br>• Reports fairly present pros and cons<br>• Reports are distributed to appropriate personnel/departments<br>• Reports include cost analysis and operational measurements | • Knowledge of company evaluation, monitoring and reporting procedures and policies<br>• Knowledge of software operations principles, components and connectivity<br>• Knowledge of report generating tools<br>• Knowledge of documentation standards and dissemination procedures within company | • Ability to write detailed supporting documents<br>• Ability to analyze and synthesize information<br>• Ability to identify improvements<br>• Ability to use word processing software<br>• Ability to monitor quality standards<br>• Ability to follow proper procedures<br>• Ability to present well-organized reports to a variety of audiences |
| **E8. Monitor capacity to ensure required service levels** | • Systems performance conforms to specified levels<br>• Growth plan is reviewed to keep pace with traffic demands<br>• Capacity levels of network usage are analyzed to determine upgrade and improvement needs<br>• Network traffic is continuously monitored for variations to baseline statistics<br>• Service level agreements are monitored for compliance | • Knowledge of network performance monitoring tools and practices<br>• Ability to monitor web server, computer and telecommunication systems<br>• Knowledge of grade of service and service level prediction and measurement tools and methods<br>• Knowledge of service level agreement terms, conditions and remedies<br>• Knowledge of networked systems, topology, architecture, software and evaluation methods | • Ability to evaluate system configuration/stability<br>• Ability to identify and communicate capacity issues and impacts<br>• Ability to interpret data gathered and formulate appropriate plan of action<br>• Ability to follow proper procedures and practices |
| **E9. Manage and implement contingency and emergency recovery plans** | • Contingency and emergency recovery plans are routinely tested and practiced for operational readiness<br>• Emergency recovery plans include key internal and external systems and resources<br>• Emergency plan procedures and practices are clearly communicated and regularly reviewed and updated | • Knowledge of emergency recovery plans and procedures<br>• Ability to accurately simulate emergency scenarios and plan for effective recovery<br>• Knowledge of documentation and dissemination practices and procedures | • Ability to create detailed supporting documents<br>• Ability to gather, analyze and interpret technical information<br>• Ability to apply rules/principles to process/data and use logic to draw conclusions<br>• Ability to communicate effectively to a variety of audiences |

## *Critical Work Function: Maintain Network and Manage Growth*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Develop maintenance and upgrade plans** | • Plans are clearly documented and effectively communicated<br>• Plans identify appropriate resources for current and future tasks<br>• Plans balance issues of reliability/stability versus innovation<br>• Plans are successfully implemented with minimal disruption<br>• Plans and changes meet needs and goals<br>• Conversion and compatibility issues are addressed<br>• Maintenance and upgrade procedures are tested adequately prior to implementation | • Ability to use configuration management tools<br>• Knowledge of business systems<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of operating systems and system interdependencies<br>• Knowledge of backup procedures<br>• Ability to take appropriate financial and system integrity risks<br>• Ability to identify user needs and expectations | • Ability to predict outcomes/results based on prior knowledge<br>• Ability to recommend and implement plan of action<br>• Ability to present complex ideas and information<br>• Ability to use project management and scheduling software<br>• Ability to evaluate system configuration/ stability<br>• Ability to keep informed on new products |
| **F2. Coordinate maintenance for computer, web server and telecommunications networks** | • Maintenance is scheduled according to scope, schedule and system availability requirements<br>• Maintenance requirements are clearly documented and communicated in a timely manner to appropriate parties<br>• Necessary changes are implemented in a timely manner<br>• Minimal disruption to productivity occurs<br>• Tasks are performed within scheduled guidelines | • Knowledge of maintenance tools, applications and procedures<br>• Ability to evaluate importance of errors<br>• Knowledge of company operating procedures<br>• Knowledge of network and operating system environments | • Ability to document information clearly in detailed supporting documents<br>• Ability to negotiate agreements<br>• Ability to predict technological results<br>• Ability to interpret data and present information to different audiences persuasively and objectively |

## *Critical Work Function: Maintain Network and Manage Growth*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F3. Apply maintenance upgrades, security enhancements and process changes** | • Upgrades are installed with minimal disruption to process flow<br>• Upgrade installation meets user needs<br>• Conversion of data is performed and compatibility issues are resolved<br>• Maintenance procedures are reassessed for applicability<br>• Changes are implemented using appropriate procedures<br>• Security enhancements meet intended outcomes for data assurance, access control and deterrence | • Knowledge of upgrade installation procedures<br>• Knowledge of elements required to justify upgrade<br>• Knowledge of data conversion issues and procedures, compatibility issues and resolution procedures<br>• Knowledge of network architecture, topology, hardware and software<br>• Knowledge of requirements for and impacts of security enhancements and upgrades | • Ability to implement technological improvements/changes<br>• Ability to analyze organization of information<br>• Ability to propose/formulate new processes<br>• Ability to evaluate system configuration/ stability<br>• Ability to plan implementation processes |
| **F4. Perform system backups and restore data** | • System backups are performed according to schedule and procedure<br>• Backup operations are documented accurately and completely<br>• Problems are assessed for criticality and reported to appropriate personnel in a timely manner<br>• Revisions to system backups are incorporated in the change management process<br>• Data is restored in a timely and effective manner | • Knowledge of system backup and restoration procedures<br>• Ability to identify system problems and evaluate for criticality<br>• Knowledge of network architecture, topology, hardware and software | • Ability to follow procedures<br>• Ability to organize and document information and processes in detailed supporting documents<br>• Ability to evaluate effectiveness of process |

## *Critical Work Function: Maintain Network and Manage Growth*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F5. Troubleshoot and maintain client, server and network systems** | • System and network problems are identified and reported in a timely manner<br>• Maintenance, security and troubleshooting activities are documented appropriately<br>• Troubleshooting and restoration are performed according to established procedures and practices<br>• Maintenance logs are updated and maintenance data is communicated effectively<br>• Routine tests are performed to identify potential problems and apply remedies proactively<br>• Systems are maintained for optimum security and availability | • Knowledge of general and equipment-specific troubleshooting methods, practices and techniques<br>• Knowledge of maintenance documentation systems, standards and practices<br>• Knowledge of pre-emptive failure prevention strategies, tools and methods<br>• Ability to apply maintenance practices to ensure optimal system security and availability<br>• Knowledge of network architecture, topology, hardware and software | • Ability to use continuous improvement strategies and tools<br>• Ability to identify and resolve conflicts in a timely manner<br>• Ability to follow standard procedures, processes and practices<br>• Ability to maintain appropriate logs and detailed supporting documentation<br>• Ability to communicate system changes to users |
| **F6. Develop growth and capacity plans and make recommendations** | • Plans are developed to accommodate future capacity with respect to system and user growth needs<br>• Plans utilize appropriate business analysis tools and system performance data<br>• Plans reflect varying organizational and operational needs and impacts<br>• Plans are feasible and implementable within time, personnel and budget constraints<br>• Plans are clearly documented and effectively communicated | • Knowledge of system metrics and business analysis tools<br>• Knowledge of network architecture, topology, hardware and software<br>• Ability to anticipate and analyze actual and hypothetical technology scenarios<br>• Ability to identify and analyze business trends and impacts | • Ability to set well defined, realistic goals<br>• Ability to identify and communicate necessary system changes and improvements<br>• Ability to examine information for relevance and accuracy<br>• Ability to manage time and tasks effectively |

## *Critical Work Function: Maintain Network and Manage Growth*

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|---|---|---|---|
| **F7. Implement growth plans and long range solutions** | • Implementation is conducted according to plan<br>• Implementation issues are identified and resolved prior to deadline<br>• System performance is verified after implementation and compared against specifications<br>• Implementation is conducted with minimum disruption to users | • Ability to plan according to resource constraints and requirements<br>• Knowledge of technical specifications<br>• Knowledge of relevant indicators of system performance<br>• Ability to effectively manage technological change within the organization | • Ability to analyze and interpret technical data<br>• Ability to create and maintain detailed planning documents<br>• Ability to develop appropriate responses and propose solutions to specified technical problems and issues<br>• Ability to generate creative solutions and formulate new plans/approaches |

## *Critical Work Function: Perform Security Administration*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **G1. Gather and document security requirements** | • Security requirements are derived from system specifications and industry practices<br>• Security concerns of all stakeholders have been addressed<br>• Proposed security requirements are comprehensive and include a variety of scenarios<br>• Security requirements are documented and have been reviewed and approved<br>• Potential security risks are evaluated and addressed | • Knowledge of security specifications and practices<br>• Ability to identify and resolve potential security conflicts<br>• Knowledge of security requirements, planning and risk evaluation<br>• Knowledge of network operating systems, software and security practices | • Ability to create detailed supporting documents<br>• Ability to synthesize information<br>• Ability to apply principles to procedures and use logic to draw conclusions<br>• Ability to encourage cooperation and negotiation among participants<br>• Ability to follow organizational processes and procedures |
| **G2. Design and document security plan** | • Strategies and implementation procedures are thoroughly reviewed and analyzed<br>• Security design includes features selected to meet client, user and business needs<br>• Security plan is developed and documented completely and accurately<br>• Security plan is accessible and actively disseminated to stakeholders | • Knowledge of security strategies<br>• Ability to evaluate security plans and designs<br>• Knowledge of impact of client, user and business security issues<br>• Knowledge of security plan documentation procedures<br>• Ability to balance user privileges with security requirements | • Ability to identify and resolve conflicting data<br>• Ability to analyze information and formulate proposals<br>• Ability to write detailed supporting documents |
| **G3. Implement and enforce system and user security requirements** | • Levels of user access, system specifications and security are clearly identified, standardized and communicated<br>• Implementation of security measures minimizes unauthorized access and security risks<br>• Security breaches are accurately and swiftly identified, communicated and resolved<br>• Master plans are developed and implemented to provide for security requirements<br>• Company procedures are regularly reviewed for security measures and compliance with applicable standards, practices and laws | • Knowledge of database security procedures and implementation<br>• Knowledge of network and operating systems<br>• Ability to detect and resolve security breaches<br>• Knowledge of system security data assurance and deterrence strategies | • Ability to present practical alternatives<br>• Ability to responsibly challenge unethical practices/decisions<br>• Ability to write detailed supporting documents<br>• Ability to analyze and respond to client/user needs<br>• Ability to present security tradeoffs and risks and pose critical questions |

## *Critical Work Function: Perform Security Administration*

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|---|---|---|---|
| **G4. Maintain, improve and enhance security in response to industry developments and user experience** | • Data and user practices are analyzed and documented to assess security issues<br>• Training is regularly provided which results in continuous improvement in security awareness<br>• Potential security risks and threats are anticipated, security needs are forecast and incorporated in recommendations for system upgrades and/or redesign<br>• Industry and technology trends are continually monitored, analyzed and incorporated to support system security | • Knowledge of business, industry and technology security trends, issues and practices<br>• Ability to use forecasting methods and tools<br>• Ability to gather user data and observe user practices<br>• Knowledge of instructional design principles<br>• Ability to provide technical training on security procedures | • Ability to analyze and respond to client/ user needs<br>• Ability to identify issues and resolve technical conflicts<br>• Ability to organize and present technical information to nontechnical users<br>• Ability to monitor and interpret trends in technology and industry |
| **G5. Detect, monitor and report security problems** | • Problems are identified, reported, escalated and resolved according to applicable procedures<br>• Security violations are detected and reported in a timely manner<br>• Network is continuously monitored for potential security threats<br>• Overall physical security plan is developed and maintained to support security of the IT infrastructure<br>• Company procedures are regularly reviewed and updated for security effectiveness | • Knowledge of network architecture, topology, hardware and software<br>• Knowledge of corporate security policies and procedures<br>• Knowledge of documentation, storage and security tools<br>• Ability to identify and use appropriate reporting channels<br>• Knowledge of physical plant and infrastructure security requirements | • Ability to interpret and evaluate data<br>• Ability to troubleshoot system malfunction and/or failure<br>• Ability to distinguish trends in performance and diagnose performance deviations<br>• Ability to use project management software<br>• Ability to analyze system operation |
| **G6. Contribute to and develop recommendations for long range security plans** | • System audits are routinely conducted for the purpose of planning future system development<br>• Planning accounts for network growth, new technology and future business development<br>• Plans are scalable and provide for enhancements to processes and technology<br>• Anticipated scenarios are included in plan development | • Knowledge of system audit procedures and long range planning processes<br>• Ability to analyze and project technology trends<br>• Knowledge of continuous improvement methods and strategies<br>• Knowledge of network architecture, topologies, applications and systems | • Ability to analyze and interpret technical data<br>• Ability to create and maintain detailed planning documents<br>• Ability to develop appropriate responses and propose solutions to specified technical problems and issues<br>• Ability to generate creative solutions and formulate new plans/approaches |

# Programming/ Software Engineering

Computer programmers design, create and maintain software. You may analyze, design, develop, test and maintain computer and Internet-based applications. Possibly you'll write specialized applications or make custom programs to satisfy a user's particular needs. You'll probably write software programs that interface with commercial off-the-shelf software or application systems that the organization has installed. You may be required to know more than one programming language and possibly more than one operating system. Not all programmers write code all day. You may evaluate the project requirements, participate in design meetings or determine the best solution to a problem or approach to a new feature. You may develop and refine detailed design specifications. You will use development tools and programming languages in creating and testing the software. You must also be proficient at documenting your work so others will know what you did and how. Finally, you must test your work with real users to make sure it is free of errors and meets user specifications. You will likely be required to analyze and fix software problems and errors on programs that were written by other programmers who may not be available at the time the correction is required.

## SAMPLE TITLES

Application Developer
Applications Analyst
Applications Engineer
Business Analyst
Computer Engineer
Configuration Management Engineer
Data Modeler
Database Specialist
Enterprise Developer
Enterprise Specialist
Java Developer
Java Enterprise Developer
Maintenance Programmer
Operating System Designer/Engineer
Operating System Programmer/Analyst
Program Manager
Programmer
Programmer/Analyst
Project Lead
Project Manager
Software Applications Specialist
Software Architect
Software Configuration Management Engineer
Software Design Engineer
Software Design Engineer and Tester
Software Development Engineer
Software Engineer
Software QA Specialist
Software Tester
Systems Administrator
Systems Analyst
Test Engineer
Tester

## Summary of Critical Work Functions

| A. Perform Analysis | B. Develop Structure | C. Design/Develop Program | D. Implement Program | E. Test and Validate Program | F. Release Product |
|---|---|---|---|---|---|
| A1 Gather data to identify customer requirements | B1 Choose an architecture | C1 Develop design and interface specifications | D1 Write code | E1 Develop test plan and system | F1 Participate in development of release plan |
| A2 Define scope of work | B2 Identify major subsystems and interfaces | C2 Identify system platform, components and dependencies | D2 Perform unit testing | E2 Develop test procedures | F2 Train technical support staff |
| A3 Define system and software requirements | B3 Assist with selecting design tools | C3 Develop appropriate data model and database scheme | D3 Integrate subsystems | E3 Perform tests | F3 Participate in development of user training plan |
| A4 Identify measurable performance and reliability requirements | B4 Develop models | C4 Prepare and conduct design review | D4 Lead and/or participate in peer code review | E4 Document test results and make recommendations | F4 Transition to new system |
| A5 Develop test requirements | B5 Validate design scheme and models | C5 Identify maintenance requirements | D5 Resolve defects and revise and adapt existing code | E5 Modify code based on approval of recommendations | F5 Evaluate, correct and document defects |
| A6 Develop high-level systems and functional specifications | | C6 Create and test prototypes | | E6 Perform acceptance testing | F6 Evaluate, implement and document enhancements |
| A7 Identify risks and determine security requirements and risk reduction strategies | | C7 Review and provide input to user documentation | | E7 Perform post-project analysis and validation | |
| | | C8 Incorporate security requirements into design | | | |

## *Critical Work Function: Perform Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather data to identify customer requirements** | • Sources and methods for gathering requirements are affordable and relevant<br>• Sources of requirements are reliable and current<br>• Information is accurate and complete<br>• Information gathering interviews follow appropriate company practices<br>• Information is gathered continuously in a cost-effective manner<br>• Requirements are documented to prescribed legal, regulatory and organizational standards | • Knowledge of problem domain<br>• Knowledge of information and requirements gathering techniques<br>• Knowledge of applicable requirements and standards<br>• Knowledge of software development methodology and configuration management processes<br>• Ability to determine relevant information | • Ability to identify and prioritize the need for data<br>• Ability to pose critical questions and analyze and prioritize group/individual responses<br>• Ability to summarize information and requirements<br>• Ability to encourage cooperation<br>• Ability to gather and present cost data |
| **A2. Define scope of work** | • Project objectives and scope are identified and agreed upon<br>• Major project tasks and interdependencies are identified<br>• Project plan is prepared based on resource availability and project timeline<br>• Estimates of time, materials and capabilities needed to meet customer requirements are clearly presented<br>• Life of product or application is accurately estimated and includes impacts of future technology developments<br>• Time, technology and resource constraints are defined, alternatives are presented and risk analysis and contingency plans are developed<br>• Requirements are properly interpreted and evaluated, and conflicting requirements are identified and resolved<br>• Scope of work includes assessment of the maintainability and feasibility of solutions | • Ability to define measurable criteria for completion of work<br>• Knowledge of technology constraints<br>• Knowledge of risk analysis techniques<br>• Knowledge of the market, product history and user needs<br>• Ability to analyze competing products<br>• Knowledge of operating systems, networking and problem domain<br>• Ability to assess the maintainability and feasibility of solutions | • Ability to create both detailed supporting documents and cogent summaries appropriate to the audience<br>• Ability to relate key strategies and actions to desired results<br>• Ability to plan resource needs and constraints<br>• Ability to visualize tasks sequentially, identify interdependencies and predict outcomes/results based on experience, prior knowledge or expert input<br>• Ability to resolve conflicts to customer satisfaction<br>• Ability to analyze product/service quality |

## *Critical Work Function: Perform Analysis*

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|---|---|---|---|
| **A3. Define system and software requirements** | • System and software requirements are free of conflicts and thoroughly documented<br>• System and software requirements are in accordance with overall project requirements<br>• Overall system and software requirements are integrated<br>• Overall requirements have been checked for compatibility, scalability, and interdependencies<br>• Technical specifications are assessed for feasibility<br>• Specifications include assessment of the maintainability and feasibility of solutions | • Knowledge of system capabilities and operations<br>• Knowledge of software capabilities<br>• Knowledge of system and software integration<br>• Ability to transfer customer, security, legal and regulatory requirements into system and software requirements<br>• Knowledge of development process<br>• Knowledge of human factors principles<br>• Ability to assess the maintainability and feasibility of solutions | • Ability to identify and resolve conflicting requirements<br>• Ability to analyze information for accuracy and consistency<br>• Ability to accurately summarize and document information, and to write clearly and succinctly<br>• Ability to respond to system demands and apply technology in an effective manner |
| **A4. Identify measurable performance and reliability requirements** | • Criteria for adequate system performance level are defined<br>• Criteria for customer satisfaction and acceptance are defined<br>• Performance requirements are documented in an accurately and completely | • Knowledge of system requirements, performance metrics and standards<br>• Ability to determine attainable performance levels<br>• Ability to extract performance requirements from system and software requirements<br>• Knowledge of software development methodology and configuration management processes | • Ability to assess performance requirements<br>• Ability to formulate proposals<br>• Ability to effectively communicate performance expectations and actual results<br>• Ability to examine the situation, analyze possible causes/reasons and recommend plan of action |
| **A5. Develop test requirements** | • Appropriate internal and external test participants are identified<br>• Testing methodology is selected<br>• Scope of testing is clearly identified<br>• Testing acceptance criteria are defined<br>• End-to-end testing methodologies and procedures are determined | • Knowledge of testing tools<br>• Knowledge of company operating procedures<br>• Knowledge of databases and tools to track and resolve test results<br>• Knowledge of acceptance testing practices and procedures | • Ability to create detailed supporting documents<br>• Ability to examine information/data for relevance and accuracy<br>• Ability to analyze logical consistency |

## *Critical Work Function: Perform Analysis*

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|---|---|---|---|
| **A6. Develop high-level systems and functional specifications** | • Specifications adhere to relevant, current performance and operational standards<br>• Systems and functional specifications meet customer, security, legal and regulatory requirements<br>• High-level subsystems are identified accurately and documented completely | • Knowledge of internal systems and their relationship to project goals<br>• Ability to write detailed and accurate functional specifications following organizational standards<br>• Knowledge of current industry design and performance standards | • Ability to synthesize information<br>• Ability to propose new technology applications<br>• Ability to integrate systems technology<br>• Ability to predict technological results |
| **A7. Identify risks and determine security requirements and risk reduction strategies** | • Types of risk exposure are identified<br>• Security policies are regularly updated and routinely communicated<br>• Security plans and options are continuously analyzed and improved<br>• Security plan is documented and updated | • Knowledge of security risks<br>• Knowledge of current security policies<br>• Knowledge of security tools<br>• Knowledge of network protocols<br>• Ability to analyze risks and effectively implement strategies and solutions | • Ability to analyze data<br>• Ability to integrate multiple items of data and contrast conflicting data<br>• Ability to analyze possible causes of problems and recommend action plans for resolution |

## *Critical Work Function: Develop Structure*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Choose an architecture** | • Main alternatives are researched<br>• Alternative technical and design scenarios are outlined and presented<br>• Analysis of tradeoffs and risks is complete including cost and performance considerations<br>• Alternatives are documented and rated according to best match with current project and future scalability<br>• Selected alternative has been reviewed and approved by management and key stakeholders<br>• Selected alternative meets functionality, timeline, budget requirements and long range organizational objectives<br>• Selected alternative is documented in a clear, accurate and detailed form<br>• Impact of potential future technology is evaluated | • Knowledge of research techniques and procedures and ability to identify key sources of information with respect to architectures<br>• Knowledge of design concepts, techniques, processes and tradeoffs<br>• Ability to translate technical features into performance functionality, project timeline and budget impacts<br>• Knowledge of risk analysis techniques<br>• Ability to translate technical features into development and user benefits<br>• Knowledge of operating systems and hardware architecture<br>• Knowledge of cost versus performance tradeoffs | • Ability to evaluate options and formulate a plan of action<br>• Ability to present complex issues and analyze responses<br>• Ability to identify and resolve conflicts<br>• Ability to accurately summarize and document information |
| **B2. Identify major subsystems and interfaces** | • All major subsystems and interfaces are clearly delineated<br>• Minimum of overlap and interaction exists between major subsystems<br>• Major subsystems and interfaces are clearly documented<br>• Interface alternatives are evaluated as to cost and performance | • Knowledge of overall system<br>• Knowledge of interface design principles<br>• Ability to classify related components into a subsystem<br>• Knowledge of connectivity and systems issues<br>• Ability to arrange and organize components<br>• Knowledge of cost and performance considerations related to interface alternatives | • Ability to analyze logical consistency<br>• Ability to research additional information sources<br>• Ability to analyze system configuration/stability<br>• Ability to recognize system strengths/limitations |

## *Critical Work Function: Develop Structure*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Assist with selecting design tools** | • Design tools are cost-effective and adequate for scope of work<br>• Necessary resources are available within the scope and budget of project<br>• Design tools are appropriate for available level of expertise<br>• Recommendations regarding design tools are communicated effectively to appropriate personnel in a timely manner<br>• Tools provide appropriate security and audit trail capabilities | • Knowledge of design tools and tradeoffs<br>• Knowledge of company tool selection procedures<br>• Knowledge of key sources of information regarding design tools<br>• Knowledge of security issues | • Ability to evaluate options and make decisions<br>• Ability to present complex issues and analyze responses<br>• Ability to determine resources required<br>• Ability to resolve technical conflicts<br>• Ability to project timeline and budget requirements |
| **B4. Develop models** | • Scope and purpose of models are defined<br>• Models are developed cost-effectively and according to schedule<br>• Models are representative of design and functionality<br>• Models are exercised and tested for performance<br>• Model development procedures, test results and recommendations are documented<br>• Appropriate business, physical, interface and logical data models are developed<br>• Models include security and audit trail features | • Knowledge of model development options and methodologies<br>• Knowledge of model testing procedures<br>• Ability to work within the constraints of simulations and models<br>• Knowledge of security and audit trail features | • Ability to develop new/alternative system designs<br>• Ability to integrate system technology<br>• Ability to interpret/evaluate data<br>• Ability to create comprehensive models and simulations<br>• Ability to create original documents<br>• Ability to prioritize results and generate and present recommendations |
| **B5. Validate design scheme and models** | • Design scheme meets specifications<br>• Design scheme and models meet customer, marketing, legal, regulatory, audit and peer review requirements<br>• Deficiencies are clearly documented<br>• Security and reliability implications are documented | • Knowledge of design scheme and models<br>• Ability to compare models and design scheme to specifications<br>• Knowledge of cost and performance considerations for design scheme and model alternatives<br>• Knowledge of security and information assurance tools and techniques | • Ability to analyze system effectiveness and efficiency<br>• Ability to analyze system structure and organization<br>• Ability to follow rules/principles<br>• Ability to analyze logical consistency<br>• Ability to clearly explain the design scheme |

## *Critical Work Function: Design/Develop Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Develop design and interface specifications** | • Design and interface specifications are complete and approved by all relevant parties<br>• Design and interface specifications are checked and corrected for conflicts<br>• Design and interface specifications are assessed for ease and quality of implementation<br>• Design and interface specifications are documented in a complete and accurate form and consistent with company standards<br>• Interface is consistent with industry, company and product standards<br>• Entity relationships are developed properly and diagrams are prepared accurately | • Knowledge of interface requirements, specification procedures and operating systems<br>• Knowledge of implementation procedures and user needs, and ability to analyze and resolve conflicts in specifications<br>• Knowledge of industry, company, government and product standards<br>• Ability to perform entity-relationship analysis<br>• Knowledge of normalization, relational theory and data modeling tools | • Ability to recall and apply basic rules/ principles<br>• Ability to analyze organization of information<br>• Ability to analyze system configuration/ stability<br>• Ability to apply creative solutions to new situations<br>• Ability to analyze and prioritize customer needs and concerns<br>• Ability to construct an efficient sequence of actions to accomplish a task |
| **C2. Identify system platform, components and dependencies** | • Rationale for choices is clearly stated<br>• System platform, components and dependencies are clearly delineated<br>• Reasons for constraints are documented<br>• Subsystems clearly delineate all components and interfaces to ensure a minimum of overlap and effective interaction between components | • Knowledge of available platforms<br>• Knowledge of components and their compatibility with platform<br>• Ability to evaluate alternate configurations for capabilities, costs and performance<br>• Knowledge of system configurations<br>• Ability to identify isolated but related functions and evaluate degree of connectivity | • Ability to analyze system configuration/ stability and organization/hierarchy and recognize system strengths/limitations<br>• Ability to compile multiple viewpoints<br>• Ability to use logic to draw conclusions<br>• Ability to apply appropriate processes/ procedures |

## *Critical Work Function: Design/Develop Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C3. Develop appropriate data model and database scheme** | • Database schematics are developed and approved<br>• Data model is laid out clearly<br>• All functionality in the logical data model is present in the physical data model<br>• There are no unnecessary functions in the physical data model<br>• Performance criteria for the data model have verifiable assumptions<br>• Business process model contains user workflow analysis and accurate data flow diagram<br>• User processes are optimized<br>• Data model supports audit requirements | • Knowledge of data techniques and tools<br>• Knowledge of CASE and/or data modeling tools<br>• Ability to transform logical data model into physical data model<br>• Knowledge of object-oriented design and principles<br>• Knowledge of general business principles<br>• Knowledge of database design tools | • Ability to apply rules/principles to process/procedure<br>• Ability to extract information and use logic to draw conclusions<br>• Ability to apply technology for desired results<br>• Ability to understand system organization/hierarchy<br>• Ability to respond to system demand<br>• Ability to design programs, networks and graphics<br>• Ability to interpret symbols, diagrams and schematics |
| **C4. Prepare and conduct design review** | • Appropriate personnel participate in design review<br>• Appropriate information is gathered from other parts of the system<br>• Review is complete, follows operating procedures and is conducted in accordance with the project flow chart<br>• Internal and external design reviews are performed in a regular and timely manner<br>• Design reviews are called when team decisions need to be made and/or when a major issue is encountered<br>• Overview summaries are complete, concise and prepared for the particular audience<br>• Design reviews are consistent with all approved requirements of the project including functional, legal, regulatory and performance considerations | • Knowledge of operating procedures and the existing system<br>• Knowledge of the design review process<br>• Knowledge of personnel/process requirements for meetings<br>• Ability to determine system scope, objectives and goals | • Ability to analyze/integrate information and prepare basic summaries/reports<br>• Ability to present complex ideas/ information, pose critical questions and analyze group/individual response<br>• Ability to clarify, interpret and influence communication<br>• Ability to encourage others to adopt new concepts<br>• Ability to use office productivity tools |

## *Critical Work Function: Design/Develop Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C5. Identify maintenance requirements** | • Maintenance requirements and resources are identified<br>• Maintenance requirements are documented and communicated to user and support groups<br>• Maintenance requirements are congruent with application and customer requests<br>• Potential add-ons and enhancements are identified from both customer and development team perspectives | • Knowledge of software maintenance requirements and procedures<br>• Knowledge of customer/user groups<br>• Knowledge of structured design principles of programming | • Ability to define maintenance procedures, evaluate performance of technology and analyze operational anomalies<br>• Ability to follow specified maintenance and release schedules and procedures<br>• Ability to identify, classify and document symptoms<br>• Ability to summarize/paraphrase information and compose/edit correspondence and documentation<br>• Ability to generate/evaluate solutions and devise/implement a plan of action |
| **C6. Create and test prototypes** | • Scope and purpose of prototypes are defined and meet customer expectations<br>• Prototypes are created cost-effectively and according to schedule<br>• Prototypes are tested and performance checked against models<br>• Prototype performance is checked against specifications<br>• Prototype development procedure, test results and recommendations are documented<br>• Impact on existing systems is correctly identified, integrated test systems are developed and problems are resolved | • Knowledge of prototype design methodologies and prototyping tools<br>• Knowledge of prototype building and testing processes<br>• Ability to relate prototype test results to model performance predictions<br>• Knowledge of existing system and new system requirements<br>• Knowledge of research and testing tools and online resources<br>• Knowledge of version and revision control practices and procedures | • Ability to analyze task/technology relationship<br>• Ability to propose technological solutions<br>• Ability to consider risks/implications and compile multiple viewpoints<br>• Ability to generate/evaluate solutions and devise/implement plan of action<br>• Ability to recognize system strengths/ limitations |
| **C7. Review and provide input to user documentation** | • Product features are communicated to the technical documentation group<br>• Documentation needs and timelines are identified<br>• Documentation is created in accordance with company standards | • Knowledge of documentation process<br>• Ability to translate technical specifications and requirements for specific audience<br>• Knowledge of company documentation standards | • Ability to interpret information<br>• Ability to prepare basic summaries and reports<br>• Ability to select methods of communication<br>• Knowledge of office productivity software |

## *Critical Work Function: Design/Develop Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C8. Incorporate security requirements into design** | • Obvious security matters are identified<br>• Latent security risks are anticipated<br>• Security matters are presented to users and designers<br>• User security requirements are specified in the design<br>• All aspects of physical security and system security are addressed<br>• Security addresses access, confidentiality, legal and ethical factors as appropriate | • Knowledge of design and programming techniques that provide security<br>• Ability to translate customer security requirements into functional specifications<br>• Knowledge of physical and system security factors<br>• Knowledge of security tools, processes, products and procedures<br>• Knowledge of security cost and performance issues | • Ability to evaluate system performance and suggest improvements<br>• Ability to examine task/technology relationship and integrate systems technologies<br>• Ability to generate unique solutions<br>• Ability to predict outcomes based on prior experience<br>• Ability to collect, interpret, synthesize and communicate information to stakeholders |

## *Critical Work Function: Implement Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Write code** | • Code is developed using efficient software design processes<br>• Objects and reusable components are employed whenever possible<br>• Code is well documented so that it can be understood by other software engineers<br>• Code is developed and documented in accordance with applicable company standards and procedures | • Knowledge of object-oriented development principles, processes and procedures<br>• Knowledge of programming language required for application<br>• Knowledge of reusable component programming processes<br>• Knowledge of code documentation process<br>• Ability to evaluate alternatives in code implementation and make decisions<br>• Knowledge of company coding standards and procedures | • Ability to write simple documents<br>• Ability to generate and evaluate alternative solutions and formulate plan of action<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions<br>• Ability to manipulate technology for desired results<br>• Ability to understand system organization/hierarchy<br>• Ability to interpret symbols, diagrams and schematics |
| **D2. Perform unit testing** | • Units are tested using standard and appropriate testing procedures<br>• Testing on each unit is repeated until the unit is free of errors<br>• Errors are correctly analyzed and resolved<br>• Errors and solutions are documented in a complete and concise form<br>• Test data and testing techniques are documented | • Knowledge of unit testing procedures<br>• Knowledge of iteration process<br>• Knowledge of error analysis and resolution processes<br>• Knowledge of software testing practices and procedures | • Ability to analyze system configuration/ stability and recognize system strengths/limitations<br>• Ability to use logic to draw conclusions<br>• Ability to document errors and code modifications in detailed supporting documents<br>• Ability to examine the situation, analyze possible causes/reasons and recommend action plan<br>• Ability to identify, troubleshoot and correct malfunctions/failures |
| **D3. Integrate subsystems** | • Subsystems are tested for compatibility<br>• Conflicts are resolved<br>• Subsystems are integrated iteratively until integration is complete<br>• Conflicts and solutions are documented<br>• Comprehensive system testing occurs to resolve all conflicts<br>• Subsystems are tested to ensure data integrity and satisfy audit requirements | • Knowledge of subsystem integration processes and interdependencies<br>• Knowledge of subsystem conflict analysis and resolution<br>• Knowledge of system testing procedures<br>• Knowledge of operating systems<br>• Knowledge of continuous improvement processes for subsystem integration | • Ability to interpret and manipulate information<br>• Ability to integrate multiple platforms<br>• Ability to utilize networks<br>• Ability to understand system organization/hierarchy<br>• Ability to organize and document process and outcomes in detailed supporting documents |

## *Critical Work Function: Implement Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Lead and/or participate in peer code review** | • Code reviews are conducted in accordance with the project flow chart<br>• Code reviews are called when major team decisions need to be made<br>• Appropriate personnel are present at reviews<br>• Meetings are well organized and allow for individual contribution<br>• Code reviews ensure compliance with applicable standards, practices and specifications | • Knowledge of peer code review process and procedures<br>• Ability to use project flow chart<br>• Knowledge of software testing practices and procedures<br>• Knowledge of personnel/process requirements for meetings<br>• Knowledge of programming standards, practices and specifications | • Ability to compare multiple viewpoints<br>• Ability to analyze situation/information, generate solutions and formulate action plans<br>• Ability to establish rapport with colleagues and customers and resolve conflicts<br>• Ability to present complex information/data<br>• Ability to work effectively in groups under deadline<br>• Ability to communicate effectively using a variety of media and methods |
| **D5. Resolve defects and revise and adapt existing code** | • Timely documentation of defects includes current status and person responsible for resolution<br>• Systematic testing is implemented to find and resolve hardware and software compatibility problems<br>• Navigation is mapped and checked for all links<br>• Critical error areas are identified and error trapping is embedded into product<br>• A debugging program is in place as the components are developed<br>• Defects are evaluated for impact on functionality and recommendations are formulated<br>• Defects are fixed or logged for input into next design iteration depending on impact<br>• Solutions are documented completely and concisely<br>• Continuous improvement processes are effectively utilized regarding new code | • Ability to use debugging tools<br>• Ability to analyze and evaluate design, hardware and software problems<br>• Knowledge of resources available to resolve defects<br>• Knowledge of system error resolution processes and procedures<br>• Knowledge of procedures for documenting and tracking problems and resolutions<br>• Knowledge of version and revision control practices<br>• Knowledge of software testing practices and procedures | • Ability to follow proper procedures and apply technology effectively<br>• Ability to determine system components to be modified or improved<br>• Ability to demonstrate sensitivity to customer concerns/interests<br>• Ability to analyze problems and recommend solutions<br>• Ability to identify, troubleshoot and correct malfunctions/failures<br>• Ability to document errors and code modifications in detailed supporting documents |

## *Critical Work Function: Test and Validate Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Develop test plan and system** | • Test plan is completely documented in accordance with approved policies<br>• Test plan is relevant to application and test requirements are in compliance with legal requirements, policies, procedures and customer requirements<br>• Test system accurately mimics external interfaces<br>• Test scenarios are automated where feasible<br>• Comprehensive set of test cases and expected results are developed and approved<br>• Testing resources are identified and schedule is established<br>• User participation in the creation of test data and test cases is acknowledged in the project plan | • Knowledge of user application<br>• Knowledge of testing impact on timeline and budget<br>• Knowledge of external interfaces<br>• Knowledge of test domain and ability to distinguish edges and critical points<br>• Knowledge of operating systems and testing tools<br>• Knowledge of legal requirements, policies, procedures and customer requirements<br>• Knowledge of project scheduling methods relative to testing requirements | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to write technical documents and detailed supporting documents<br>• Ability to consider risk implications and compile multiple viewpoints |
| **E2. Develop test procedures** | • Test procedures explicitly verify specifications<br>• Test procedures define test conditions<br>• Test procedures are documented in detail<br>• Regression tests are properly developed and performed to thoroughly exercise the software according to plan and schedule | • Knowledge of external interfaces<br>• Knowledge of test domain and ability to distinguish edges and critical points<br>• Knowledge of specifications<br>• Ability to construct automated test sequences and recognize errors in test procedure and system<br>• Knowledge of test discipline, testing methodology and documentation standards | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to consider risk implications<br>• Ability to analyze technology output and examine task/technology relationship<br>• Ability to interpret, clarify and influence communication |

## *Critical Work Function: Test and Validate Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E3. Perform tests** | • Test process includes appropriate team members<br>• System is tested according to plan and schedule<br>• Test results are documented completely and communicated as appropriate<br>• System integration testing and volume/ performance testing are performed when appropriate | • Knowledge of system test procedures and test systems<br>• Knowledge of system and ability to recognize problems identified by test procedure<br>• Knowledge of testing methodology<br>• Ability to recognize errors in test procedure and test system | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to analyze technology output and examine task/technology relationship<br>• Ability to appropriately refer complaint/discrepancy<br>• Ability to identify and evaluate system performance |
| **E4. Document test results and make recommendations** | • Errors and preceding conditions are clearly documented<br>• Recommendations for modification are included in documentation<br>• Problems are identified and corrected<br>• Test data is utilized to update and revise program features and functions | • Knowledge of documentation procedures<br>• Knowledge of testing tools and methodologies<br>• Ability to interpret and apply test data results<br>• Knowledge of software metrics | • Ability to understand system organization/hierarchy<br>• Ability to respond to system demand<br>• Knowledge of networks and operating environments<br>• Ability to evaluate system performance and devise plan to monitor and/or correct system<br>• Ability to modify process/procedure |
| **E5. Modify code based on approval of recommendations** | • Code changes accurately reflect shifts in legal and regulatory requirements<br>• Code changes reflect changes in technology and new releases<br>• Continuous improvement processes are effectively utilized<br>• Code changes reflect shifts in customer requirements or scope of project<br>• Code changes incorporate test results and tester feedback | • Knowledge of legal and regulatory requirements<br>• Ability to monitor changes in technology and platform environments<br>• Knowledge of continuous improvement techniques applicable to software development | • Ability to present complex ideas/ information and pose critical questions<br>• Ability to understand system organization/hierarchy<br>• Ability to track changes in detailed supporting documents |

## *Critical Work Function: Test and Validate Program*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E6. Perform acceptance testing** | • Test procedures and reports are prepared and documented for customer<br>• System performance is tested according to plan and schedule<br>• Test results are documented completely<br>• Recommendations are communicated to development team and customer<br>• Documentation is complete, accurate and easy to use<br>• Product and documentation meet user requirements and are accepted by customer | • Knowledge of acceptance test procedures and documentation<br>• Knowledge of application environment and user requirements<br>• Knowledge of software quality assurance practices<br>• Knowledge of user level of expertise<br>• Knowledge of validation and acceptance procedures | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to interpret, clarify and influence communication<br>• Ability to identify major issues and make recommendations |
| **E7. Perform post-project analysis and validation** | • User and customer data is periodically gathered and analyzed<br>• Data is prioritized with respect to revision schedules and change requests<br>• Project management data and documentation are maintained according to control procedures<br>• Changes and revisions are tested and validated prior to integration | • Knowledge of software performance data gathering and analysis<br>• Knowledge of software change and revision processes and procedures<br>• Knowledge of technical documentation maintenance and control<br>• Ability to test and validate software revisions in operational environment | • Ability to integrate multiple items of data and contrast conflicting data<br>• Ability to document findings in detailed supporting documents<br>• Ability to interpret, analyze and communicate technical information<br>• Ability to manage project tasks, timelines and deliverables |

## *Critical Work Function: Release Product*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Participate in development of release plan** | • Release plan is outlined in detail, with necessary phases, timeline and decision points<br>• Release procedures and fallback processes are defined and agreed upon by decision makers<br>• Test groups are identified and relevant to the application<br>• Test feedback is clearly documented and reviewed by appropriate personnel<br>• Results are communicated to design team for design modification as necessary | • Knowledge of release procedures<br>• Knowledge of feedback processes<br>• Knowledge of fallback and contingency plan considerations<br>• Knowledge of customer business requirements | • Ability to consider risks/implications<br>• Ability to compile multiple viewpoints<br>• Ability to present complex ideas/ information<br>• Ability to analyze group/individual responses<br>• Ability to interpret, clarify and influence communication |
| **F2. Train technical support staff** | • Training procedures are developed and documented<br>• Training sessions are scheduled and conducted according to plan<br>• Feedback system from technical support staff to design group is in place<br>• Technical staff is able to fully support the product<br>• Training alternatives are identified and assessed | • Knowledge of design of technical training processes<br>• Knowledge of requirements of technical support groups<br>• Ability to design, organize and present technical material to a technical audience<br>• Ability to identify important technical training issues and provide feedback to appropriate personnel<br>• Knowledge of evaluation techniques for technical training effectiveness | • Ability to identify training needs<br>• Ability to conduct task-specific training<br>• Ability to coach others to apply related concepts<br>• Ability to present complex ideas/ information<br>• Ability to analyze group/individual responses |
| **F3. Participate in development of user training plan** | • Training materials are clear, effective and satisfy training objectives<br>• Training is adjusted for learning needs<br>• Training plan adequately addresses the effective operation of the software and system in accordance with the system requirements<br>• Training plan addresses who, when, where and how the training will be delivered | • Knowledge of instructional design principles<br>• Knowledge of training objectives<br>• Knowledge of user needs and skill levels<br>• Knowledge of training tools and delivery methods | • Ability to assess and analyze training needs and conduct effective training<br>• Ability to present complex information<br>• Ability to develop appropriate training procedures and materials<br>• Ability to encourage learner independence<br>• Ability to assess and recommend training alternatives<br>• Knowledge office productivity software and online resources |

## *Critical Work Function: Release Product*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F4. Transition to new system** | • Transition alternatives are evaluated relative to cost, time and effectiveness in meeting the organizational operational requirements<br>• Transition plan is outlined in detail with necessary phases and timeline<br>• Contingency plan and fallback procedures are in place<br>• Impact on productivity has been analyzed and communicated to appropriate personnel<br>• Transition plan is implemented with minimal impact on overall productivity<br>• New system is fully operational | • Knowledge of transition process<br>• Knowledge of productivity factors<br>• Knowledge of contingency procedures<br>• Knowledge of transition alternatives for new system implementation | • Ability to respond to customer needs<br>• Ability to demonstrate sensitivity to customer concerns/interests<br>• Ability to moderate discussion<br>• Ability to interpret complaints and concerns<br>• Ability to evaluate system performance and productivity<br>• Ability to examine situation, analyze possible causes/reasons and recommend plan of action |
| **F5. Evaluate, correct and document defects** | • Feedback procedure is in place and adequate to meet user needs<br>• Defects are documented and communicated effectively to appropriate personnel in a timely manner<br>• Defects are evaluated for impact on functionality and recommendations are formulated<br>• Defects are corrected or logged for input into next design iteration depending on impact | • Knowledge of system error analysis and resolution procedures<br>• Ability to evaluate importance of defect<br>• Knowledge of system requirements relative to organizational goals and objectives<br>• Ability to analyze design, hardware and software problems<br>• Knowledge of procedures for documenting and tracking problems and resolutions<br>• Knowledge of version and revision controls | • Ability to respond to verbal/nonverbal communication<br>• Ability to demonstrate sensitivity to customer concerns/interests<br>• Ability to determine system components to be modified or improved and adjust system operation<br>• Ability to troubleshoot system malfunction/failure<br>• Ability to present complex/technical information/data |

## *Critical Work Function: Release Product*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F6. Evaluate, implement and document enhancements** | • Proposed enhancements are congruent with technical support and user feedback<br>• Recommendations for enhancements are documented<br>• User comments are accurately recorded, evaluated and prioritized<br>• Recommendations are implemented or logged for input into next design iteration | • Ability to translate available feedback into recommended system enhancements<br>• Ability to formulate tradeoffs regarding enhancements<br>• Knowledge of operating systems<br>• Knowledge of data gathering methods/ procedures for enhancements<br>• Knowledge of document and revision control practices<br>• Knowledge of organizational goals and business objectives | • Ability to demonstrate sensitivity to customer concerns/interests<br>• Ability to write summaries and reports<br>• Ability to suggest system modifications/ improvements and determine system components to be modified or improved<br>• Ability to analyze impact of modification on overall system performance |

# Technical Support

As a technical support representative, you are a vital part of the contact between customers and your company. Educating users is part of your job, as well as solving hardware or software operation and application problems. Experience with the problems users face in daily operation is a valuable asset. When a problem occurs, you listen carefully, ask the appropriate questions to gather needed information and then take steps to solve it. Dealing directly with customer issues, you are one of the best sources of information on the product, and are consulted for information about what customers want and what gives them the most trouble. You may start out at the call center or help desk, walking users through the steps required to solve a problem over the telephone. As your experience and training increase, you may work with hardware and software installation, configuration and upgrading processes.

## SAMPLE TITLES

Analyst
Application Programmer
Call Center Support Manager
Call Center Support Representative
Client/Customer Liaison
Customer Service Representative
Customer Support Professional
Desktop Support Engineer
Hardware Test Engineer
Help Desk Analyst
Help Desk Specialist
Help Desk Technician
Maintenance Technician
PC Support Specialist
PC Systems Coordinator
PC Systems Manager
PC Systems Technician
Product Support Engineer
Quality Assurance Specialist
Sales Support Technician
Software Test Engineer
Systems Analyst
Technical Account Manager
Technical Support Engineer
Technical Support Representative
Test Engineer

# TECHNICAL SUPPORT

## *Summary of Critical Work Functions*

| A. Perform Troubleshooting | B. Provide Facilitation and Customer Service | C. Perform Hardware and Software Installation, Configuration, Upgrades and Network Support | D. Perform System Operations, Monitoring and Maintenance |
|---|---|---|---|
| A1 Analyze problem and research solutions | B1 Gather and analyze customer input | C1 Identify and interpret customer requirements | D1 Operate computer system and run system applications |
| A2 Query existing knowledge base | B2 Manage working relationships with customers | C2 Evaluate present software and system configuration | D2 Perform system and network diagnostics |
| A3 Identify, test and implement solutions | B3 Perform negotiated services | C3 Develop installation plan | D3 Monitor and analyze system performance |
| A4 Manage problem resolution | B4 Act as liaison between groups | C4 Install, configure and test system hardware and peripherals | D4 Develop and implement preventative maintenance plan |
| A5 Communicate technical solutions and implementation processes | B5 Provide training in hardware and software to peers, and to internal and external customers | C5 Install, configure and test new operating systems, applications and upgrades | D5 Evaluate maintenance processes and outcomes |
| A6 Implement long-range solutions | B6 Manage and prioritize demands from multiple customers | C6 Optimize system performance | D6 Communicate and document maintenance procedures and system status |
| A7 Document hardware and software problems and resolutions | B7 Solicit customer feedback and apply input to improve quality of service | C7 Perform quality checks on work outcomes | D7 Make recommendations to address recurring customer issues |
| | B8 Document, communicate and resolve customer feedback and requests | C8 Prepare and maintain systems documentation | D8 Make recommendations and support internal processes and operations |
| | B9 Manage customer experience and satisfaction through multiple tiers of the escalation process | C9 Develop contingency and recovery plans | |

## *Critical Work Function: Perform Troubleshooting*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Analyze problem and research solutions** | • Problem is correctly identified<br>• Problem causes are isolated<br>• Solutions are thoroughly researched and possible escalation pathways are identified<br>• Solutions are practical and relevant to problems<br>• Risk analysis is conducted for potential solutions<br>• Customer interaction results in problem resolution and customer satisfaction obtained in a responsive manner | • Knowledge of troubleshooting methods<br>• Knowledge of sources of relevant technical data<br>• Ability to prioritize possible solutions based on technical criteria<br>• Knowledge of escalation procedures<br>• Ability to identify and resolve technical conflicts | • Ability to analyze and prioritize information<br>• Ability to use written and electronic documentation<br>• Ability to gather information<br>• Ability to troubleshoot failures<br>• Ability to recognize and respond to customer needs and demonstrate commitment to customer |
| **A2. Query existing knowledge base** | • Searches are effective through use of proper key words<br>• Potential solutions are correctly identified<br>• Relevant data is retrieved<br>• Appropriate databases are used<br>• Problem resolutions are effectively tracked and documented | • Knowledge of how data is gathered, stored and manipulated in a database<br>• Knowledge of Boolean techniques applied to search engines<br>• Knowledge of how to query a database and interpret responses<br>• Knowledge of networks and online tools and resources<br>• Ability to read and interpret technical diagrams and decision trees | • Ability to select appropriate information<br>• Ability to identify basic concepts and elicit relevant details<br>• Ability to clarify communication<br>• Ability to qualify/analyze information<br>• Ability to interpret and summarize information |

## *Critical Work Function: Perform Troubleshooting*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Identify, test and implement solutions** | • Solutions are clearly defined and analyzed for possible impact to system<br>• Solutions are selected based on technical benefits and cost effectiveness<br>• Solutions are tested in a complete and realistic manner<br>• Test scenarios are representative of actual use and environment<br>• Test process results in permanent solution to problem reported or diagnosed<br>• Customer interaction results in end user problem resolution and closure is obtained in a timely and responsive manner<br>• Solutions are recorded properly upon resolution of problem | • Knowledge of test instruments<br>• Knowledge of test methods<br>• Knowledge of systematic methods of solving technical problems<br>• Ability to replace components when appropriate<br>• Ability to remove, repair or replace modules and subassemblies as appropriate<br>• Knowledge of applications and diagnostic programs<br>• Knowledge of basic networking components, equipment, protocols and troubleshooting practices<br>• Knowledge of relevant safety and environmental rules | • Ability to interpret information<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions<br>• Ability to approach problem in a logical and systematic manner<br>• Ability to read and follow written instructions<br>• Ability to interpret pictures and diagrams<br>• Ability to analyze situations and formulate task sequence<br>• Ability to predict outcomes based on experience<br>• Ability to think creatively while analyzing problems |
| **A4. Manage problem resolution** | • Relevant and available technical resources are identified<br>• Technical expertise is sought when appropriate<br>• Problems are escalated or referred when appropriate<br>• Resources are requested and organized to optimize use and results<br>• Problem resolution occurs within time, financial and resource constraints | • Knowledge of relevant technical data<br>• Knowledge of resolution tools and processes<br>• Knowledge of relevant physical inventory access and control procedures<br>• Knowledge of escalation procedures<br>• Knowledge of change control procedures | • Ability to present complex technical information<br>• Ability to follow proper procedures and work within established guidelines<br>• Ability to apply technology in an effective manner<br>• Ability to create original documents and detailed supporting documents<br>• Ability to be an advocate for the customers within the organization |

## *Critical Work Function: Perform Troubleshooting*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A5. Communicate technical solutions and implementation processes** | • Technical solutions and implementation processes are communicated in a timely manner<br>• Technical solutions and implementation processes are communicated in a form understandable to users and peers<br>• User concerns are considered and addressed in the implementation process<br>• Communication is clear, accurate and targeted appropriately<br>• Communication results in problem resolution and customer satisfaction is obtained in a timely and responsive manner<br>• Solutions are recorded properly upon resolution of problem | • Knowledge of technical communications processes<br>• Ability to communicate appropriately to different audiences and organizational levels<br>• Ability to record data in knowledge bases using proper key words | • Ability to analyze and consider multiple viewpoints<br>• Ability to demonstrate awareness of diversity issues<br>• Ability to work in a team environment<br>• Ability to recognize and respond to customer needs and demonstrate commitment to customer<br>• Ability to interpret information, prepare basic summaries and reports and select method of communication<br>• Ability to present complex technical ideas/information<br>• Ability to demonstrate commitment to team goals, work to improve team skills and encourage/support team members |
| **A6. Implement long-range solutions** | • Implementation is conducted according to plan<br>• Problems are identified and resolved in a timely and effective manner<br>• System performance is verified after implementation and compared to specifications<br>• Implementation is conducted with minimum disruption to users<br>• Implementation is properly documented | • Knowledge of technical specifications<br>• Knowledge of relevant indicators of system performance<br>• Knowledge of documentation procedures<br>• Ability to compare and analyze sets of technical data | • Ability to analyze situations and predict outcomes based on knowledge or prior experience<br>• Ability to plan according to resource constraints and requirements<br>• Ability to prioritize tasks<br>• Ability to examine the situation, analyze possible causes and recommend action |

## *Critical Work Function: Perform Troubleshooting*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A7. Document hardware and software problems and resolutions** | • Documentation is clear and accurate<br>• Documentation follows organization format and procedures<br>• Hardware and software problems are clearly identified<br>• Resolutions are documented to the appropriate level of detail<br>• Documentation is organized for most efficient access by other users | • Knowledge of documentation tools<br>• Knowledge of technical presentation tools<br>• Knowledge of technical terms<br>• Knowledge of documentation processes and procedures | • Ability to create detailed supporting documents<br>• Ability to consider abstract technical situations<br>• Ability to use appropriate language and terminology<br>• Ability to accurately summarize and document information<br>• Ability to communicate effectively with diverse audiences<br>• Ability to organize and present technical information in a logical and consistent manner |

## *Critical Work Function: Provide Facilitation and Customer Service*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Gather and analyze customer input** | • Questions to users are relevant and clearly defined<br>• Input is analyzed for important and underlying issues<br>• Input is organized and summarized in an effective manner<br>• Recommendations based on customer input are developed and presented to key personnel | • Ability to determine relevant sources of information<br>• Ability to analyze and interpret customer input for expressed and implied issues<br>• Knowledge of information gathering methods and techniques<br>• Knowledge of applicable documentation procedures | • Ability to analyze information<br>• Ability to probe for underlying issues and pose critical questions<br>• Ability to contribute to an open communication environment<br>• Ability to identify the need for data and select/obtain information appropriate to the task |
| **B2. Manage working relationships with customers** | • Relationships are managed so that customers are satisfied with level of service<br>• Relationships are managed so that customers would voluntarily return for additional service<br>• Interactions with customers reflect an understanding of their key satisfaction criteria<br>• Internal, external and global customer expectations are met in a timely manner<br>• Customer concerns are accurately communicated and documented | • Knowledge of escalation procedures<br>• Knowledge of customer support methodology<br>• Knowledge of operating environments, office suite applications, networks, hardware tools and online resources<br>• Knowledge of practices of internal, external and global customers | • Ability to accept responsibility for own actions and impact on others<br>• Ability to demonstrate commitment to personal improvement<br>• Ability to recognize and analyze customer needs and resolve conflicts to customer satisfaction<br>• Ability to resolve technical issues and obtain customer approval<br>• Ability to respond appropriately to others and modify behavior to the situation |
| **B3. Perform negotiated services** | • Current resources are balanced against internal, external and global customer needs<br>• Negotiated agreement stays within budget and time constraints<br>• Acceptable options are consistently presented for review and approval<br>• Customer acceptance is obtained and documented | • Knowledge of available resources and customer needs<br>• Knowledge of negotiation variables<br>• Knowledge of negotiated agreement parameters | • Ability to detect underlying issues<br>• Ability to apply creative thinking to new situations<br>• Ability to distinguish between facts<br>• Ability to redirect customer to appropriate resources for solutions to needs outside the bounds of assigned responsibilities<br>• Ability to recognize and analyze customer needs and resolve conflicts to customer satisfaction |

## *Critical Work Function: Provide Facilitation and Customer Service*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B4. Act as liaison between groups** | • Liaison communication includes updating all stakeholder groups<br>• Groups agree on decision-making process<br>• Consensus is established between groups<br>• All involved groups are fairly represented<br>• All stakeholder groups are clearly identified | • Knowledge of each group's functions and responsibilities<br>• Knowledge of ultimate goal<br>• Knowledge of organizational communication processes<br>• Knowledge of interrelations between different organizational groups | • Ability to analyze group responses<br>• Ability to detect underlying issues<br>• Ability to compare multiple viewpoints<br>• Ability to summarize/paraphrase information<br>• Ability to encourage cooperation/ negotiation |
| **B5. Provide training in hardware and software to peers, and to internal and external customers** | • Internal, external and global customer requirements for training are correctly identified, interpreted and evaluated<br>• Scope of work is correctly defined to meet customer training requirements<br>• Resources are accurately and completely identified and utilized<br>• Customer requirements, scope of work, resources required, content and evaluations are appropriately and completely documented<br>• Content developed contains appropriate amount of information and is consistent with learning objectives<br>• Training is effectively presented<br>• Effectiveness of service delivered is evaluated<br>• Training assists customer in troubleshooting<br>• Peer training outcomes meet established goals | • Ability to identify key sources of information<br>• Knowledge of information gathering methods and company procedures and processes<br>• Knowledge of available resources<br>• Knowledge of required technical information and ability to organize technical material for ease of learning<br>• Ability to create appropriate presentation visuals for technical material<br>• Ability to accommodate different learning styles | • Ability to recognize and analyze customer needs and resolve conflicts to customer satisfaction<br>• Ability to visualize task sequentially and identify interdependencies<br>• Ability to document "lessons learned" succinctly and accurately and create detailed supporting documents<br>• Ability to speak clearly and concisely, and to compose and present well-organized presentations<br>• Ability to use teaching/learning tools<br>• Ability to perform appropriate learning needs assessments and write learning objectives<br>• Ability to plan resource needs and constraints |

## *Critical Work Function: Provide Facilitation and Customer Service*

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|---|---|---|---|
| **B6. Manage and prioritize demands from multiple customers** | • All internal, external and global customers are serviced in timely manner<br>• Size and age of queue are within departmental and company guidelines<br>• Assignment of priorities follows departmental guidelines<br>• Customers needs are mutually assessed and priority is determined | • Knowledge of departmental and company guidelines<br>• Knowledge of availability of company and customer resources, and ability to access them<br>• Knowledge of practices of internal, external and global customers | • Ability to prioritize daily tasks, prepare schedule and monitor/adjust task sequence<br>• Ability to set and adjust well defined/ realistic goals<br>• Ability to resolve conflicts to customer satisfaction<br>• Ability to communicate appropriate verbal/nonverbal messages<br>• Ability to define and communicate workload limits<br>• Ability to apply self-management skills and analyze and adjust goals |
| **B7. Solicit customer feedback and apply input to improve quality of service** | • Customers are surveyed on a regular basis on important technical issues<br>• Input is analyzed for immediate and underlying concerns<br>• Service delivery procedures are analyzed in light of customer input<br>• Recommendations for continuous quality improvement are developed, presented to key personnel and implemented<br>• Customer feedback is regularly audited for follow-up and closure | • Knowledge of customer contact and survey processes regarding technical support<br>• Ability to analyze and interpret expressed and implied needs<br>• Knowledge of service delivery methods and practices<br>• Knowledge of customer quality issues<br>• Knowledge of continuous quality improvement | • Ability to evaluate quality and effectiveness of processes<br>• Ability to develop recommendations based on information<br>• Ability to summarize/integrate and present information<br>• Ability to actively participate in discussions and present complex technical information<br>• Ability to select/obtain data/information relevant to the task |

## *Critical Work Function: Provide Facilitation and Customer Service*

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|---|---|---|---|
| **B8. Document, communicate and resolve customer feedback and requests** | • Documentation includes customer-oriented problem solution summary<br>• Documentation is clear, concise and published/distributed appropriately<br>• Customer feedback and requests are communicated effectively to appropriate personnel in a timely manner<br>• Customer issues and concerns are resolved efficiently | • Knowledge of communication procedures for customer feedback and requests<br>• Knowledge of organization chart and roles/responsibilities of company personnel/departments<br>• Knowledge of escalation procedures and processes<br>• Knowledge of tracking systems and software | • Ability to summarize/paraphrase information<br>• Ability to create original documents<br>• Ability to explain concepts and present technical information<br>• Ability to use word processing, database tools and presentation software<br>• Ability to be an advocate for customers within the organization |
| **B9. Manage customer experience and satisfaction through multiple tiers of the escalation process** | • Escalation procedures are clearly established and followed<br>• Problem status is continually monitored for quality indications to assume customer satisfaction<br>• Customer is effectively informed and updated on problem resolution<br>• Customer acceptance is obtained and documented | • Knowledge of escalation procedures and processes<br>• Knowledge of quality indicators relating to customer satisfaction<br>• Ability to communicate complex technical issues and business implications<br>• Knowledge of organization chart and roles/responsibilities of company personnel/departments | • Ability to be an advocate for customers within the organization<br>• Ability to explain and present technical concepts and issues<br>• Ability to evaluate quality and effectiveness of processes<br>• Ability to identify and resolve customer issues to established and expected levels of service |

## *Critical Work Function: Perform Hardware and Software Installation, Configuration, Upgrades and Network Support*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Identify and interpret customer requirements** | • Requirements are complete and accurate<br>• Requirements reflect current customer expectations<br>• Information is effectively gathered, organized and analyzed<br>• Internal, external and global customers are consulted | • Knowledge of installation processes<br>• Ability to query existing knowledge base<br>• Knowledge of hardware, software, operating system and networking principles<br>• Knowledge of technologies and cultural variables of internal, external and global customers | • Ability to pose critical questions<br>• Ability to compile multiple viewpoints<br>• Ability to identify and prioritize need for data<br>• Ability to analyze data and contrast conflicting data<br>• Ability to communicate clearly about options and priorities with customers |
| **C2. Evaluate present software and system configuration** | • Accurate and complete description of software and system configuration is obtained<br>• Gathered data is verified against optimal configuration<br>• Deficiencies in configuration are clearly and concisely identified<br>• Information is effectively and correctly gathered, organized and analyzed | • Ability to identify system components<br>• Knowledge of multiple operating systems, applications and hardware<br>• Knowledge of networks and online resources, both internal and external<br>• Knowledge of system configurations and performance characteristics<br>• Knowledge of multiple standard configurations within the organization | • Ability to examine information/data for relevance and accuracy<br>• Ability to pose specific technical questions<br>• Ability to understand, interpret and recognize the accuracy of information |

## *Critical Work Function: Perform Hardware and Software Installation, Configuration, Upgrades and Network Support*

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|---|---|---|---|
| **C3. Develop installation plan** | • Installation plan is appropriate and timely, and documentation is complete and accurate<br>• Installation plan includes input from key stakeholders and is designed for minimal impact on workflow and productivity<br>• Installation plan includes progress reporting system and procedures and processes for final delivery and acceptance<br>• Installation plan includes adequate beta testing and production testing<br>• Recovery plan is designed and in place<br>• Internal, external and global customers are consulted, and plan is reviewed by stakeholders<br>• Information is effectively gathered, organized and analyzed, and documentation is complete and accurate | • Ability to identify installation-related tasks and sequence them accordingly<br>• Ability to reference knowledge base and online and other information resources<br>• Ability to utilize and create technical documentation<br>• Knowledge of practices of internal, external and global customers<br>• Ability to conceive, implement and track technological solutions<br>• Knowledge of system network security<br>• Knowledge of recovery theories and practices | • Ability to generate solutions and devise action plans<br>• Ability to create detailed supporting documents<br>• Ability to interpret, synthesize and summarize information<br>• Ability to respond to customer needs and demonstrate commitment to customer<br>• Ability to interpret and clarify communication<br>• Ability to prioritize tasks, prepare schedules and monitor task sequences |
| **C4. Install, configure and test system hardware and peripherals** | • System hardware and peripherals are installed and configured according to specifications, schedule and budget<br>• System configuration is refined to meet user needs<br>• System hardware is configured for optimum efficiency<br>• System and network components and peripherals are tested for performance and compatibility | • Knowledge of hardware and peripheral installation and configuration<br>• Knowledge of technical specifications<br>• Ability to use test equipment to analyze system operation<br>• Knowledge of hardware and software troubleshooting and adjustment techniques and practices<br>• Knowledge of system and network test procedures | • Ability to read and follow written instructions<br>• Ability to interpret pictures and diagrams<br>• Ability to examine the situation, analyze possible causes/reasons and recommend action plan<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions |

## *Critical Work Function: Perform Hardware and Software Installation, Configuration, Upgrades and Network Support*

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|---|---|---|---|
| **C5. Install, configure and test new operating systems, applications and upgrades** | • Operating and application software, and upgrades are installed and configured according to specifications<br>• Software configuration is refined to meet user network needs<br>• Software is configured for optimum system and user efficiency<br>• System is tested for performance and compatibility<br>• Accurate assessment is made of the impact of changes on the technical support workload and business processes | • Knowledge of software installation and configuration practices<br>• Ability to use test programs and other aids to analyze system operation<br>• Knowledge of hardware and software troubleshooting and adjustment techniques and practices<br>• Knowledge of applications programs<br>• Knowledge of network optimization practices | • Ability to read and follow written instructions<br>• Ability to interpret pictures and diagrams<br>• Ability to examine the situation, analyze possible causes/reasons and recommend action plan<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions |
| **C6. Optimize system performance** | • Impacts of different configurations on performance are evaluated<br>• User input is considered in making configuration decisions<br>• Hardware and software are configured for optimum performance | • Knowledge of hardware and software interaction and compatibility<br>• Ability to detect and resolve hardware and software conflicts<br>• Ability to identify operational and performance issues<br>• Ability to generate and apply system and network performance data<br>• Knowledge of configuration documentation and control | • Ability to compare and contrast information<br>• Ability to analyze situations and formulate task sequence<br>• Ability to identify and isolate problems and develop theory on possible cause<br>• Ability to create detailed supporting documentation |

## *Critical Work Function: Perform Hardware and Software Installation, Configuration, Upgrades and Network Support*

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|---|---|---|---|
| **C7. Perform quality checks on work outcomes** | • Quality checks and metrics are defined and applied during installation and configuration processes<br>• Outcomes are analyzed and problems are identified<br>• Recommendations for improvement in processes are developed and communicated<br>• Customer acceptance is obtained and documented | • Knowledge of operational and performance specifications<br>• Knowledge of performance checking tools and testing procedures<br>• Knowledge of acceptable quality and performance standards<br>• Knowledge of quality indicators relating to customer satisfaction | • Ability to read and follow written instructions<br>• Ability to recognize patterns/relationships and visually analyze relationship between parts/whole and process/procedure<br>• Ability to interpret, analyze and summarize/integrate information<br>• Ability to prioritize tasks, prepare schedule and monitor task sequence<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions |
| **C8. Prepare and maintain systems documentation** | • Documentation properly reflects installation, configuration and changes to hardware, software, systems and network<br>• Documentation is clear and accurate<br>• Documentation follows organization format and standards<br>• Documentation has appropriate level of detail<br>• Documentation clearly identifies changes and impact of changes | • Knowledge of technical documentation tools, procedures and practices<br>• Knowledge of document control procedures and practices<br>• Knowledge of configuration standards and terminology<br>• Knowledge of appropriate levels of detail for procedures and configuration | • Ability to create detailed supporting documentation<br>• Ability to interpret information, prepare basic summaries and reports and select methods of communication<br>• Ability to present complex ideas/ information<br>• Ability to analyze data, integrate multiple items of data and contrast conflicting data<br>• Ability to use logic to draw conclusions and examine information for relevance and accuracy |
| **C9. Develop contingency and recovery plans** | • Contingency and recovery requirements are identified and communicated<br>• Plans accommodate diverse secure storage locations<br>• Plans are developed in response to company needs and practices<br>• Connectivity alternatives are available<br>• Plans provide for required levels of service | • Knowledge of data assurance and data security techniques and practices<br>• Knowledge of connectivity theories and practices<br>• Knowledge of systems interoperability<br>• Knowledge of hardware, software and networks<br>• Knowledge of contingency and recovery planning theories and practices | • Ability to create detailed supporting documentation<br>• Ability to present complex ideas/ information effectively to a variety of audiences<br>• Ability to identify contingencies and propose appropriate steps for system recovery |

## *Critical Work Function: Perform System Operations, Monitoring and Maintenance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Operate computer system and run system applications** | • System is started and shut down following procedures<br>• Problems during operations are identified and resolved<br>• System backup is implemented according to plan and schedule<br>• Optimization applications are run according to schedule and need<br>• Agreed upon service levels are achieved and maintained<br>• User and client jobs run as agreed | • Knowledge of systems and application startup and shut down procedures<br>• Knowledge of applicable backup and restoration procedures<br>• Knowledge of system optimization and diagnostic routines<br>• Knowledge of applicable batch processing and job control processes and procedures | • Ability to read and follow written instructions and procedures<br>• Ability to identify problems and develop theory on possible cause<br>• Ability to appropriately communicate critical operational needs |
| **D2. Perform system and network diagnostics** | • Diagnostics are completed in a timely manner<br>• Diagnosis is complete, accurate and documented<br>• Diagnostics follow a logical process<br>• Diagnostics follow established schedules | • Knowledge of diagnostic procedures and processes<br>• Ability to use hardware and software diagnostic tools<br>• Knowledge of operating environments and networks<br>• Knowledge of available resources and troubleshooting methodologies | • Ability to select information appropriate to the task<br>• Ability to pose critical questions<br>• Ability to apply rules and principles to diagnostics and use logic to draw conclusions<br>• Ability to analyze information<br>• Ability to use word processing |
| **D3. Monitor and analyze system performance** | • System performance is monitored according to procedures and specifications<br>• Problems are identified and resolved or reported in a timely manner<br>• System performance is compared to baseline performance for discrepancies | • Knowledge of system monitoring and diagnostic tools and procedures<br>• Ability to detect, evaluate and appropriately escalate problems<br>• Knowledge of performance measurement tools and procedures | • Ability to read and follow written instructions<br>• Ability to identify problems and develop theory on possible cause<br>• Ability to analyze key data, resolve conflicts and communicate outcomes to users and stakeholders |

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|---|---|---|---|
| **D4. Develop and implement preventative maintenance plan** | • Plan includes appropriate level of detail<br>• Plan development includes key people<br>• Plan is documented and communicated effectively to internal, external and global customers and appropriate personnel in a timely manner<br>• Plan is consistent with organizational objectives<br>• Plan is implemented with minimal adverse effects | • Knowledge of preventative maintenance procedures and processes<br>• Knowledge of company practices for maintenance<br>• Knowledge of practices of internal, external and global customers<br>• Knowledge of roles and responsibilities of company personnel and departments | • Ability to organize information<br>• Ability to create detailed supporting documents<br>• Ability to use word processing, database tools and spreadsheet software<br>• Ability to analyze customer needs and demonstrate commitment to customer |
| **D5. Evaluate maintenance processes and outcomes** | • Evaluation includes all relevant internal, external and global customers<br>• Evaluation includes appropriate follow-up action and new plan/solution based on reassessed needs<br>• Evaluation is documented clearly and concisely<br>• Evaluation information is effectively gathered, organized and analyzed<br>• Outcomes are analyzed and compared with availability goals and institutional objectives | • Knowledge of preventative maintenance procedures and processes<br>• Knowledge of company practices for maintenance<br>• Knowledge of practices of internal, external and global customers<br>• Knowledge of evaluation documentation procedures<br>• Knowledge of relevant sources for evaluation input | • Ability to analyze and summarize information and identify interdependencies<br>• Ability to compare multiple viewpoints<br>• Ability to pose critical questions<br>• Ability to identify own strengths/ limitations and accept constructive criticism<br>• Ability to evaluate installation processes and suggest modifications |
| **D6. Communicate and document maintenance procedures and system status** | • Documentation includes customer-oriented problem solution summary<br>• Documentation is clear, concise and published/distributed appropriately<br>• Status is communicated effectively to internal, external and global customers and appropriate personnel in a timely manner<br>• Users are informed of changes in status in a timely and consistent manner | • Knowledge of internal and external communication procedures<br>• Knowledge of organization chart and roles and responsibilities of company personnel and departments<br>• Knowledge of practices of internal, external and global customers | • Ability to summarize/paraphrase information<br>• Ability to create original documents<br>• Ability to explain concepts and present technical information<br>• Ability to use word processing, database tools and presentation software |

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|---|---|---|---|
| **D7. Make recommendations to address recurring customer issues** | • Recommendations are based on trend data regarding requests for support<br>• Support processes are analyzed and updated<br>• Recurring issues are researched and resolved | • Ability to collect and interpret technical data<br>• Knowledge of customer support processes and practices<br>• Knowledge of problem resolution practices and procedures | • Ability to analyze, summarize and present information to a variety of audiences<br>• Ability to identify and prioritize issues and problems<br>• Ability to generate and communicate appropriate recommendations |
| **D8. Make recommendations and support internal processes and operations** | • Technical support operations effectively support organizational goals and customer requirements<br>• Hardware and software are evaluated for proper support of organizational goals<br>• Software and hardware inventory systems are effectively developed and maintained<br>• Software licenses are maintained according to contractual terms and organizational policy | • Knowledge of technical support operations, issues and constraints<br>• Knowledge of software and hardware inventory systems and methodology<br>• Ability to research and evaluate software and hardware options<br>• Knowledge of business issues regarding software licensing | • Ability to develop effective support responses and actions<br>• Ability to identify and implement needed improvements<br>• Ability to monitor operational effectiveness<br>• Ability to communicate changes in support of internal processes |

# Technical Writing

As a technical writer, you make technical information accessible and easy to understand. Technical manuals, detailed specifications, online help, web content and training materials are just a few examples of the types of documents you create. You define the audience and purpose of your document; determine the technical level, tone and organization; and choose your document's delivery method (print and/or electronic). You are accurate. You thoroughly research your subject by interviewing experts and users. You also test the product you're writing about. You use page layout, word processing programs and online publishing tools to create your documents and design graphics. Your creativity, time management and communication skills and ability to understand and simplify complex material are valuable assets to your readers and to your future.

## SAMPLE TITLES

Content Manager

Copy Editor

Desktop Publisher

Document Specialist

Documentation Specialist

Editor

Electronic Publications Specialist

Electronic Publisher

Information Developer

Instructional Designer

Managing Editor

Online Publisher

Technical Communicator

Technical Editor

Technical Publications Manager

Technical Writer

# TECHNICAL WRITING

## *Summary of Critical Work Functions*

| A. Analyze Project Requirements | B. Perform Research | C. Design Document | D. Develop and Write Document | E. Publish and Package |
|---|---|---|---|---|
| A1 Gather data to identify customer requirements | B1 Define research questions | C1 Select design and publication tools | D1 Select, synthesize and organize pertinent information to meet user needs | E1 Collaborate with graphics specialists |
| A2 Interpret, evaluate and confirm requirements | B2 Identify and evaluate sources of information | C2 Plan layout and document design | D2 Create content of document | E2 Coordinate with printer and/ or media production house |
| A3 Define scope of work | B3 Gather background information | C3 Select style and tone | D3 Develop feedback/ validation vehicles | E3 Provide advice regarding delivery media and methodology |
| A4 Identify time, technology and resource constraints and delivery options | B4 Interview subject matter experts | C4 Determine information flow and level of detail | D4 Obtain feedback on information and technical accuracy | E4 Tailor composition and layout for delivery media |
| A5 Review and refine document plan | B5 Interview and/or observe target audience | C5 Identify appropriate visuals | D5 Edit for readability, grammar and usage | E5 Coordinate with web site developer or administrator |
| A6 Define purpose, standards and use of documentation | B6 Interpret and report research results | C6 Provide feedback to development team/individuals | D6 Test, validate and verify for usability | |
| A7 Determine method of publication | | | | |

## *Critical Work Function: Analyze Project Requirements*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather data to identify customer requirements** | • Sources and methods for gathering requirements are affordable and relevant<br>• Information is accurate and complete<br>• Information gathering interviews follow standard company practices<br>• Appropriate subject matter experts are identified<br>• Sources are reliable, available and current<br>• Target audience/user groups are identified and used as key information sources | • Ability to identify key sources of information<br>• Knowledge of interview techniques with respect to customer requirements and delivery options<br>• Knowledge of information gathering methods and quantity of information required<br>• Knowledge of workplace and industry vocabulary<br>• Knowledge of industry standards | • Ability to pose critical questions<br>• Ability to compile and analyze multiple viewpoints<br>• Ability to respond appropriately to others<br>• Ability to identify and prioritize the need for data<br>• Ability to encourage cooperation and keep an open mind to new data and opinions<br>• Ability to consolidate and summarize a variety of options<br>• Ability to apply creative solutions to new situations |
| **A2. Interpret, evaluate and confirm requirements** | • Customer needs are clearly defined and prioritized<br>• Conflicting requirements and gaps in information are identified and resolved<br>• Complete set of requirements is communicated to and approved by customer<br>• Mechanism for signing off on requirements is developed and followed<br>• Requirements are properly interpreted, evaluated and confirmed<br>• Realistic schedule is established for ongoing reviews throughout the project | • Ability to define requirements in appropriate business terms<br>• Ability to present and refine requirements as necessary with customer approval<br>• Ability to adapt information to customer requirements and style<br>• Knowledge of outlining and conceptualizing tools<br>• Ability to negotiate with customer and other personnel to establish clearly defined, achievable and cost-effective requirements and goals | • Ability to select/obtain information relevant to task<br>• Ability to relate intent to desired results<br>• Ability to analyze information for accuracy, consistency and relevance<br>• Ability to use word processing, desktop publishing, online publishing and graphics software<br>• Ability to obtain customer approval of requirements |

## *Critical Work Function: Analyze Project Requirements*

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|---|---|---|---|
| **A3. Define scope of work** | • Project objectives, including size, format and other specifics of the proposed deliverables, are correctly identified and agreed upon<br>• Criteria for successful completion of the work are accurately identified<br>• Major project tasks and interdependencies are correctly identified<br>• Estimate of time, materials and capabilities needed to meet customer requirements is accurate<br>• Schedule is based on resource availability and project timeline<br>• Scope of work is documented, approved and accurately meets customer requirements | • Ability to identify technical and human resource interdependencies<br>• Ability to evaluate work procedures for effectiveness and efficiency<br>• Knowledge of hardware and software capabilities/constraints<br>• Knowledge of project management tools<br>• Ability to apply previous project experience to current situation | • Ability to create detailed supporting documents<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to negotiate alternatives<br>• Ability to prioritize conflicting work demands<br>• Ability to identify the theme, purpose and scope of the assignment<br>• Ability to visualize sequence of events/activities<br>• Ability to estimate required resources and schedule |
| **A4. Identify time, technology and resource constraints and delivery options** | • Constraints are accurately identified and documented<br>• Constraints are communicated to appropriate personnel and customers effectively and in a timely manner<br>• Contingency plans are developed with plausible alternatives<br>• Delivery options meet customer needs and project specifications<br>• Delivery options are appropriately applied to specifications | • Ability to identify appropriate resources<br>• Knowledge of key sources of information<br>• Knowledge of technology and resource constraints<br>• Knowledge of various delivery options and industry standards<br>• Knowledge of operating systems, application software and Internet capabilities<br>• Ability to set and communicate project parameters | • Ability to create detailed supporting documents<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to apply creative solutions to new situations<br>• Ability to understand constraints, generate alternatives, consider risks, evaluate options and formulate action plans<br>• Ability to present complex information and recommendations |

## *Critical Work Function: Analyze Project Requirements*

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|---|---|---|---|
| **A5. Review and refine document plan** | • Information needs are identified and communicated to appropriate people in a timely manner<br>• Necessary and sufficient information is gathered to meet project goals<br>• Inconsistencies, contradictions and discrepancies between the information given and information needed are identified<br>• Document plan is accurate and complete<br>• Realistic schedules are developed and communicated to customer | • Knowledge of identification and recruitment of subject matter experts<br>• Ability to facilitate interviews to obtain technical and nontechnical information<br>• Knowledge of appropriate workplace vocabulary and concepts<br>• Knowledge of quantity and characteristics of information required<br>• Knowledge of logical flow of information for document creation | • Ability to evaluate relevance and consistency of written material<br>• Ability to verify data accuracy<br>• Ability to summarize information and requirements<br>• Ability to select and evaluate appropriateness of existing information<br>• Ability to pose critical questions<br>• Ability to listen attentively and interpret and clarify communication |
| **A6. Define purpose, standards and use of documentation** | • Definition of purpose meets customer requirements for delivering useful content to users<br>• Audience for document is clearly identified<br>• Document meets acceptable industry standards for readability and presentation | • Knowledge of customer requirements<br>• Knowledge of documentation standards<br>• Ability to identify audience and purpose of document | • Ability to compare and analyze multiple viewpoints<br>• Ability to pose critical questions<br>• Ability to demonstrate sensitivity to customer concerns and interests<br>• Ability to present complex ideas/information<br>• Ability to create agreement and/or consensus on document use and purpose |
| **A7. Determine method of publication** | • All potential methods are thoroughly investigated and the pros and cons of each are determined<br>• Accurate Return on Investment (ROI) analysis is performed to determine the costs and benefits of each method<br>• If multiple methods are selected, coordination between the modalities is included in the project plan<br>• All appropriate stakeholders are consulted<br>• Company policies and procedures are consulted prior to selection of method of publication | • Knowledge of methods of publication including print and online<br>• Ability to perform ROI analysis<br>• Knowledge of issues of coordination between various publication media<br>• Knowledge of stakeholders<br>• Knowledge of company policies and procedures regarding selection of publication method<br>• Knowledge of how to leverage existing information into multiple publication formats | • Ability to analyze and compare various publication media<br>• Ability to summarize information and present recommendations<br>• Ability to reconcile conflicting data<br>• Ability to listen attentively and interpret and clarify communication |

## *Critical Work Function: Perform Research*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Define research questions** | • Research questions are clearly focused and succinctly defined<br>• Research questions are organized appropriately<br>• Research questions are relevant to project and customer requirements and goals | • Ability to synthesize information into clear research questions which are relevant to project goals<br>• Knowledge of research interview questionnaire development<br>• Knowledge of project and customer requirements and goals | • Ability to interpret information<br>• Ability to compare multiple viewpoints<br>• Ability to pose critical questions<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions |
| **B2. Identify and evaluate sources of information** | • Sources of information are timely, credible and can provide relevant information<br>• Sources of information include subject matter experts, target audience and appropriate documents<br>• Sources of information are evaluated based on project requirements | • Knowledge of copyright issues and laws<br>• Knowledge of obtaining permissions for using or crediting information<br>• Knowledge of research methods<br>• Knowledge of online and other sources of information | • Ability to pose critical questions<br>• Ability to identify and prioritize the need for information<br>• Ability to evaluate relevancy of sources of information<br>• Ability to be creative in identifying and locating sources of information |
| **B3. Gather background information** | • Priorities regarding what information should be gathered are correctly determined<br>• Information gathered is relevant, accurate and complete<br>• Information provides the contextual background needed<br>• Information gathering processes follow appropriate company practices | • Knowledge of a variety of research tools and technologies<br>• Ability to integrate various information technologies<br>• Knowledge of company policies and procedures<br>• Knowledge of online resources | • Ability to pose critical questions, and to understand and interpret both verbal and nonverbal responses<br>• Ability to identify and prioritize the need for information<br>• Ability to analyze and synthesize information |

## *Critical Work Function: Perform Research*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B4. Interview subject matter experts** | • Interview questions are relevant, succinct and directed to appropriate contacts<br>• Information interviews are conducted in a cost-effective manner<br>• Information gathering interviews follow appropriate company practices<br>• The purpose, processes and expectations of the interview are effectively explained to interviewees<br>• Interviews result in a multifaceted view of the information | • Knowledge of key sources of information for subject matter experts<br>• Knowledge of research interview methods<br>• Knowledge of workplace and industry vocabulary<br>• Knowledge of group interview facilitation techniques for information technology subject matter experts<br>• Ability to apply systematic approach to exploring novel products, processes and concepts | • Ability to identify and prioritize the need for data<br>• Ability to summarize information<br>• Ability to encourage cooperation<br>• Ability to pose critical questions and analyze responses<br>• Ability to listen, interpret and respond to communication appropriately<br>• Ability to interview a diverse population<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions |
| **B5. Interview and/or observe target audience** | • Interview questions are relevant, succinct and directed to appropriate contacts<br>• Information interviews are conducted in a cost-effective manner<br>• Information gathering interviews follow appropriate company practices<br>• The purpose, processes and expectations of the interview are effectively explained to interviewees<br>• Target audience is consulted or observed to obtain required information<br>• Interviews result in a multifaceted view of the information | • Knowledge of research interview methods<br>• Knowledge of workplace and industry vocabulary<br>• Knowledge of company and departmental practices and procedures | • Ability to identify and prioritize the need for data<br>• Ability to summarize information<br>• Ability to encourage cooperation<br>• Ability to pose critical questions and analyze responses<br>• Ability to apply rules/principles to process/procedure and use logic to draw conclusions<br>• Ability to listen, interpret and respond to communication appropriately<br>• Ability to interview a diverse population |

## *Critical Work Function: Perform Research*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B6. Interpret and report research results** | • Research reports are concise and timely<br>• Research reports are relevant<br>• Research reports communicate results clearly and accurately<br>• Research reports contribute to refinement of document plan<br>• Research reports are prepared and communicated in accordance with company procedures | • Ability to relate research results to purpose of the project<br>• Knowledge of company procedures regarding research reporting techniques | • Ability to probe for meaning<br>• Ability to present results clearly and concisely<br>• Ability to interpret information, prepare basic summaries/reports and select method of communication<br>• Ability to analyze and integrate multiple data items<br>• Ability to create original documents and detailed supporting documentation |

## *Critical Work Function: Design Document*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Select design and publication tools** | • Tools meet task purpose<br>• Tools are cost-effective and readily available<br>• Tools selected are in accordance with company practices and standards | • Knowledge of design and publication tools<br>• Knowledge of company practices and standards<br>• Knowledge of graphics tools | • Ability to resolve technical issues<br>• Ability to understand organizational hierarchy and follow procedures<br>• Ability to utilize word processing, desktop publishing, online publishing and online tools |
| **C2. Plan layout and document design** | • Appropriate information is presented in a logical sequence<br>• Layout is formatted and document is designed to meet customer requirements<br>• Principles of effective design are applied<br>• Design follows intended use<br>• Graphics, layout and web designers are consulted during development of design | • Knowledge of subject matter<br>• Knowledge of the psychological impacts of layout<br>• Knowledge of company documentation guidelines<br>• Knowledge of principles of design<br>• Ability to select and apply technical information to meet user needs | • Ability to visually analyze relationship between parts/whole<br>• Ability to demonstrate creative thinking<br>• Ability to simplify, summarize and paraphrase complex material<br>• Ability to use advanced word processing and publishing tools |
| **C3. Select style and tone** | • Style and tone are appropriate for purpose, medium and audience<br>• Style and tone conform to customer requirements | • Knowledge of different writing styles<br>• Knowledge of audience characteristics<br>• Knowledge of strengths/limitations of media options | • Ability to demonstrate sensitivity to diversity issues<br>• Ability to communicate appropriate verbal and nonverbal messages<br>• Ability to present information persuasively and objectively |
| **C4. Determine information flow and level of detail** | • Appropriate level of detail is determined for purpose<br>• Level of detail meets customer expectations<br>• All stakeholders are included in design process<br>• Information flow is logical and supports purpose of document<br>• Information is appropriately organized for audience, task complexity and target publication media | • Knowledge of customer expectations<br>• Ability to adjust level of detail to meet customer/user needs<br>• Knowledge of document design tools<br>• Knowledge of effective flow of information in technical documents<br>• Ability to effectively organize complex information | • Ability to use logic to draw conclusions<br>• Ability to use previous training/experience to predict outcomes<br>• Ability to organize information logically |

## *Critical Work Function: Design Document*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C5. Identify appropriate visuals** | • Visuals conform to customer requirements<br>• Visuals enhance, illustrate, amplify and explain the concepts, processes and procedures described in the document<br>• Visuals are appropriate in style and tone<br>• Visuals are cost-effective<br>• Visuals are appropriate for delivery option | • Knowledge of media choices<br>• Ability to match visuals to style and tone<br>• Ability to select and use visuals to communicate effectively<br>• Knowledge of document size constraints when using visuals<br>• Ability to create basic visuals | • Ability to use imagination to visualize events and activities<br>• Ability to adhere to goals and constraints<br>• Ability to use presentation and graphics software |
| **C6. Provide feedback to development team/ individuals** | • Feedback is clear, concise and timely<br>• Feedback includes recommendations for improvement<br>• Feedback is documented clearly and accurately<br>• Feedback is disseminated to appropriate parties, including project sponsors, development team and decision makers | • Knowledge of company documentation procedures<br>• Knowledge of design process and principles | • Ability to understand continuous improvement processes<br>• Ability to relate intent to desired results<br>• Ability to value differences of opinion<br>• Ability to assess performance of others and provide constructive feedback<br>• Ability to make clear, concise and compelling presentations |

## *Critical Work Function: Develop and Write Document*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Select, synthesize and organize pertinent information to meet user needs** | • Information is selected for relevance and appropriateness<br>• Information is accurate<br>• Information meets user needs<br>• Information is synthesized and well organized | • Knowledge of user requirements<br>• Knowledge of company standards and practices<br>• Knowledge of the procedures, processes and/or products being documented<br>• Knowledge of logical document organization procedures | • Ability to recognize and organize information most relevant and important to the situation<br>• Ability to compile and analyze multiple viewpoints and items<br>• Ability to use computers to process information<br>• Ability to simplify complex information<br>• Ability to use inferential knowledge and to synthesize information based on past experience and industry knowledge |
| **D2. Create content of document** | • Content is presented clearly and concisely to the intended audience<br>• Technical terminology is redefined for lay readers where appropriate<br>• Appropriate presentation tools are used<br>• Style and tone are consistent<br>• Content is presented in proper media and communicates necessary information<br>• Content meets stated specifications and standards in a timely fashion as set forth in the document plan<br>• Content is geared to the appropriate technical level of intended audience<br>• Test user can perform the stated tasks in a literal manner and obtain the desired result | • Knowledge of the principles of technical writing and presentation<br>• Knowledge of company standards and specifications<br>• Knowledge of technical writing tools, methods and delivery options<br>• Ability to translate technical terminology and concepts<br>• Ability to create templates and style guide for information technology content<br>• Ability to maintain positive and productive relationship with development team | • Ability to use word processing, desktop publishing, online publishing and graphics tools<br>• Ability to interpret and summarize research information<br>• Ability to create clear, concise original documents<br>• Ability to analyze and synthesize information<br>• Ability to use appropriate language, style, organization and format |

## *Critical Work Function: Develop and Write Document*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D3. Develop feedback/ validation vehicles** | • Document is distributed and scheduled feedback is actively solicited<br>• Review process and timelines are identified and followed<br>• Steering committees, advisory groups or panels are consulted as appropriate<br>• Opportunities for user input are provided<br>• Appropriate reviewers are identified and may include subject matter experts, support and/or quality assurance staff | • Knowledge of group communication aids<br>• Knowledge of methods and tools for gathering useful feedback<br>• Knowledge of company guidelines for obtaining feedback | • Ability to use word processing, desktop publishing, online publishing, email, net conferencing, telephone, video and graphics tools<br>• Ability to gather, analyze and categorize information<br>• Ability to present complex ideas/ information and analyze responses<br>• Ability to listen attentively and compare multiple viewpoints<br>• Ability to respond assertively while understanding impact on others |
| **D4. Obtain feedback on information and technical accuracy** | • Available information resources are identified and confirmed<br>• Feedback is requested in a timely manner<br>• Appropriate feedback is collected from subject matter experts<br>• Review/revision process follows company procedures<br>• Appropriate feedback is incorporated into the final document<br>• An extensive, iterative process is followed with multiple revisions until the goals of all reviewers are met and/or resolved | • Knowledge of location of subject matter experts<br>• Knowledge of company and departmental review processes and procedures | • Ability to solicit and accept constructive feedback<br>• Ability to demonstrate composure<br>• Ability to listen attentively<br>• Ability to respond appropriately to others<br>• Ability to evaluate feedback for accuracy and relevance<br>• Ability to create data gathering processes<br>• Ability to recognize job tasks, distribute work assignments and monitor performance |
| **D5. Edit for readability, grammar and usage** | • Document is free of grammatical errors<br>• Document meets customer expectations for readability, usage and usability<br>• Document meets standards of style identified in the document plan | • Knowledge of grammar, readability and usability standards consistent with design<br>• Knowledge of advanced word processing and editing tools<br>• Ability to apply professional editing principles | • Ability to evaluate consistency of written material<br>• Ability to judge the accuracy, appropriateness and style of document |

## *Critical Work Function: Develop and Write Document*

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|---|---|---|---|
| **D6. Test, validate and verify for usability** | • Document is pertinent, accurate and usable<br>• Document contains appropriate information and is organized conveniently for the user<br>• Inappropriate style or tone is identified and eliminated<br>• Missing elements required to meet user and business needs are identified and addressed<br>• Validation is performed by the subject matter experts and usability is confirmed by the target audience or an appropriate proxy<br>• Document meets technical standards and customer expectations | • Knowledge of basic research reporting for information technology<br>• Knowledge of interview, observation and other data gathering techniques for information technology<br>• Ability to plan and conduct usability tests<br>• Ability to interpret test results correctly<br>• Ability to ask appropriate questions, identify appropriate test subjects and employ the comments made to improve the document | • Ability to gather, evaluate and categorize information<br>• Ability to synthesize appropriate solutions<br>• Ability to respond appropriately to others and demonstrate empathy<br>• Ability to interpret and clarify communication |

## *Critical Work Function: Publish and Package*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Collaborate with graphics specialists** | • Document meets mechanical specifications<br>• Document meets graphics standards<br>• Document is usable, readable and meets standards of production and layout as stated in the document plan | • Knowledge of graphics terminology and standards<br>• Knowledge of printing and production concepts<br>• Knowledge of desktop publishing concepts and tools<br>• Knowledge of online publishing concepts | • Ability to effectively interpret, clarify and influence communication<br>• Ability to present complex ideas/ information and analyze group/ individual responses<br>• Ability to use computer networks and email |
| **E2. Coordinate with printer and/or media production house** | • Scope of work is developed, documented and approved<br>• Production schedule is developed, updated and communicated to stakeholders<br>• Costs and benefits of various production alternatives are analyzed and presented<br>• Production decisions are made and communicated in a timely manner | • Knowledge of printing and graphics production terminology<br>• Knowledge of project planning techniques and tools<br>• Knowledge of vendor strengths and weaknesses | • Ability to present complex ideas/information<br>• Ability to prioritize tasks, prepare schedule and monitor/adjust task sequences |
| **E3. Provide advice regarding delivery media and methodology** | • Proposals presenting delivery alternatives are developed<br>• Technical impact of media and methodology alternatives are determined, analyzed and communicated<br>• Costs and benefits of media and methodology alternatives are analyzed and presented<br>• Recommendations are clearly documented and distributed to appropriate personnel | • Knowledge of proposal development techniques<br>• Knowledge of technical and financial advantages and limitations of media and methodologies | • Ability to analyze situation/information, consider risks/implications and compile multiple viewpoints<br>• Ability to synthesize and summarize information<br>• Ability to present alternatives and recommendations with adequate supporting data<br>• Ability to present complex information/ ideas and analyze responses |

## *Critical Work Function: Publish and Package*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E4. Tailor composition and layout for delivery media** | • Technical specifications and scope of work are developed based on the delivery media selected<br>• Critical project steps, specifications and deliverables are approved<br>• Specifications and project requirements are effectively communicated to all stakeholders | • Knowledge of technical and financial advantages and limitations of media and methodologies<br>• Knowledge of project analysis and presentation techniques | • Ability to present complex data/ information to internal and external customers and vendors<br>• Ability to listen attentively and interpret communication<br>• Ability to organize information for specific audience, purpose and media<br>• Ability to use writing, publishing, graphics and design tools |
| **E5. Coordinate with web site developer or administrator** | • Technical specifications and requirements are clearly documented and approved<br>• Scope of work and project milestones are approved<br>• Information easily shared between departments<br>• Data is easily ported to web format<br>• Schedules and schedule changes are communicated to team members and stakeholders | • Knowledge of web terminology, markup languages and web site construction and layout<br>• Knowledge of web page delivery methods and limitations<br>• Knowledge of web design technologies and tools | • Ability to synthesize complex and technical specifications<br>• Ability to evaluate and reassign priorities<br>• Ability to coordinate scheduling changes efficiently<br>• Ability to listen attentively<br>• Ability to interpret and clarify information |

# Web Development and Administration

You will play a vital role in your company's presence on the world wide web. You may use web page development software to create or change web pages, inserting text content, graphics and interactive modules that are often supplied by others in your organization. Before you start, you will probably talk to the many stakeholders in your company who depend on the organization's web presence. You'll also look at successful models and research software tools to help design the look, feel and navigation. In some organizations you may be responsible for making sure the web pages and updates get installed, and work with the servers associated with the web pages. As you gain experience, your web development activities may include working with legacy systems and understanding database technology, programming processes and application architecture.

## SAMPLE TITLES

Application Developer
Communications Specialist
Content Developer
Content Editor
Content Manager
E-Business Application Administrator
E-Commerce Designer
Information Architect
Site Designer
Usability Tester
User Interface Designer
Web Administrator
Web Applications Designer/Developer
Web Architect
Web Designer
Web Developer
Web Page Developer
Web Producer
Web Program Manager
Web Programmer
Web Site Developer
Web Site Manager
Web Specialist
Web Strategist
Web Writer
Webmaster

# WEB DEVELOPMENT AND ADMINISTRATION

## *Summary of Critical Work Functions*

| A. Perform Technical Analysis | B. Perform Web Programming | C. Develop, Deliver and Manage Content | D. Implement and Maintain Site and Applications | E. Manage Web Environment | F. Manage Enterprise-wide Web Activities | G. Perform Testing and Quality Assurance | H. Develop and Implement Web Database |
|---|---|---|---|---|---|---|---|
| A1 Gather data to identify customer requirements and capacity | B1 Develop site map application models and user interface specifications | C1 Research content and information architecture | D1 Plan rollout | E1 Evaluate and recommend web hardware, software and third-party solutions | F1 Define and manage development standards | G1 Develop test and acceptance plan | H1 Develop physical database characteristics and create database objects |
| A2 Define scope of work | B2 Choose a site plan | C2 Coordinate content development from multiple contributors | D2 Facilitate move to production system | E2 Set up server software and hardware | F2 Train designers and developers | G2 Develop test procedures | H2 Select unique identifiers and normalize the data model |
| A3 Prepare and present functional and technical specifications | B3 Select programming languages, design tools and applications | C3 Develop and present concept alternatives | D3 Hand off to customer or user | E3 Manage server | F3 Evaluate web technologies and standards | G3 Develop and perform usability and integration testing | H3 Support population of database |
| A4 Prepare preliminary application | B4 Write supporting code | C4 Create or adapt content | D4 Integrate customer feedback | E4 Support systems recovery | F4 Provide quality customer service | G4 Perform tests | H4 Integrate high-level business rules |
| A5 Create and refine preliminary design or mockup | B5 Identify major subsystems and interfaces | C5 Produce graphics, layout elements and applicable code | D5 Perform application maintenance | | F5 Perform ROI (Return on Investment) analysis to ensure business goals are met | G5 Document test results and take corrective actions | H5 Plan implementation and deploy database |
| A6 Review technical considerations and constraints | B6 Develop models | C6 Update content | D6 Recommend optimization and facilitate upgrades and improvements | | F6 Design and document security plan | G6 Recommend and implement performance improvements | H6 Define and implement user interface |
| A7 Develop project plan | B7 Develop design and interface specifications | | D7 Document application and site changes | | F7 Implement and enforce security requirements | | |
| | B8 Identify system platform, components and dependencies | | D8 Develop and implement contingency plans | | F8 Maintain and improve security in response to industry developments and user experience | | |
| | B9 Develop appropriate data model | | | | F9 Develop enterprise-wide legal and international privacy guidelines | | |

KEY ACTIVITIES

## *Critical Work Function: Perform Technical Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather data to identify customer requirements and capacity** | • Audience and mission of project/product are well defined and appropriately researched<br>• Sources and methods for gathering requirements are affordable and relevant<br>• Information is accurate and complete<br>• Information gathering follows appropriate practices<br>• Sources of requirements are reliable and current<br>• Aspects of capacity and global usage (time zones, language, cultural sensitivities) are considered | • Knowledge of customer interview techniques regarding requirements<br>• Ability to identify key sources of information<br>• Knowledge of the subject matter<br>• Knowledge of global usage and cultural considerations | • Ability to identify and prioritize the need for data<br>• Ability to pose critical questions<br>• Ability to analyze group/individual responses<br>• Ability to summarize information and requirements<br>• Ability to encourage cooperation |
| **A2. Define scope of work** | • Features and functions of the product are complete and properly prioritized<br>• Project objectives are identified and agreed upon in accordance with applicable procedures<br>• Scope and specifics of the work involved are identified accurately<br>• Criteria for successful completion of the work are identified and agreed upon<br>• Work is documented accurately and completely | • Knowledge of the types of features and functions and their implementation<br>• Ability to define measurable criteria for completion of work<br>• Ability to identify key sources of information<br>• Ability to determine resources required for scope of work | • Ability to create detailed supporting documents and summarize information and requirements<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to analyze information for accuracy and consistency<br>• Ability to compile multiple viewpoints<br>• Ability to visualize task sequentially and identify interdependencies<br>• Ability to negotiate success criteria |

## *Critical Work Function: Perform Technical Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Prepare and present functional and technical specifications** | • Functional and technical specifications are presented in a clear and concise manner<br>• Functional and technical specifications are complete<br>• Functional and technical specifications are published, distributed to stakeholders and updated regularly<br>• Functional specifications detail all product features and activities<br>• Technical specifications fully and properly describe the operating system software and hardware, client side support and server side software | • Knowledge of the role of functional and technical specifications<br>• Ability to analyze functional and technical data and specifications<br>• Ability to translate features and activities into functional specifications<br>• Knowledge of the basics of operating system hardware, client side support and server side software<br>• Knowledge of methods and tools to present functional and technical specifications | • Ability to summarize, integrate and analyze information<br>• Ability to present complex ideas and information<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to interpret information, prepare basic summaries and select methods of communication |
| **A4. Prepare preliminary application** | • Content information is organized to meet application objectives<br>• Consensus is developed among stakeholders regarding the organization of information<br>• Consensus is developed among stakeholders regarding look and feel of the product<br>• Preliminary application follows company guidelines and practices | • Ability to design and structure content<br>• Knowledge of tools and techniques to create look and feel of an application/site<br>• Knowledge of site mapping and information mapping techniques<br>• Knowledge of graphical user interface design<br>• Knowledge of data modeling tools<br>• Knowledge of basic database management techniques<br>• Knowledge of basic programming techniques | • Ability to analyze organization of information and transfer information between formats<br>• Ability to summarize/paraphrase issues and resolve technical conflicts<br>• Ability to summarize and interpret mathematical data<br>• Ability to convert numerical data and predict results<br>• Ability to demonstrate creative thinking while problem solving and apply creative solutions to new situations |
| **A5. Create and refine preliminary design or mockup** | • Mockup is representative of required design features<br>• Mockup is completed in a timely manner<br>• Mockup includes representative functional features<br>• Mockup is reviewed and refined based on customer feedback | • Knowledge of mockup development options and methodologies<br>• Knowledge of mockup testing procedures<br>• Ability to synthesize information from different tests<br>• Ability to translate functional features into application/site design | • Ability to analyze task/technology relationship<br>• Ability to consider risks/implications and compile multiple viewpoints<br>• Ability to generate/evaluate solutions and devise/implement plan of action<br>• Ability to recognize system strengths/ limitations<br>• Ability to demonstrate creative thinking and problem solving |

## *Critical Work Function: Perform Technical Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A6. Review technical considerations and constraints** | • Technical environmental factors are considered<br>• Technological relationships are reviewed<br>• Technical considerations and constraints are properly documented<br>• Feasibility and usability issues are appropriately addressed<br>• Budget and equipment constraints are accurately assessed | • Knowledge of technical environmental factors and technological relationships<br>• Knowledge of selected technologies and their limitations<br>• Ability to assess budget and equipment constraints | • Ability to select/obtain data relevant to the task, integrate multiple items of data and contrast conflicting data<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to examine information and recommend action plan<br>• Ability to willingly help others and establish rapport with coworkers and customers |
| **A7. Develop project plan** | • Plan accurately identifies stakeholder requirements<br>• Plan includes project schedules and resource allocations, dependencies and milestones<br>• Plan includes functional and technical specifications, data models, site maps, assumptions, constraints and risks<br>• Plan is accurately documented and updated throughout the project life cycle<br>• Project feasibility is accurately evaluated | • Knowledge of risk analysis techniques<br>• Knowledge of benefit management tools<br>• Knowledge of basic computer systems, programming, database and web technologies<br>• Knowledge of functional and technical specifications, data models, site maps, assumptions, constraints and risks<br>• Knowledge of project planning, timelines and budgets | • Ability to analyze organization of information<br>• Ability to summarize/integrate information<br>• Ability to work with minimal supervision and pay attention to detail<br>• Ability to prepare and organize multiple schedules<br>• Ability to assess individual knowledge/ skills and analyze work assignments |

## *Critical Work Function: Perform Web Programming*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Develop site map application models and user interface specifications** | • Site map and application models are developed to meet project goals and application objectives<br>• Site map and application models are developed according to company standards and practices<br>• Consensus is developed among stakeholders regarding the organization of information<br>• Consensus is developed among stakeholders regarding look and feel of the product | • Ability to structure content<br>• Knowledge of tools and techniques to create look and feel of an application/site<br>• Knowledge of site mapping and information mapping techniques<br>• Knowledge of graphical user interface design<br>• Knowledge of data modeling tools<br>• Knowledge of basic database management techniques<br>• Knowledge of basic programming techniques | • Ability to analyze organization of information and transfer information between formats<br>• Ability to summarize/paraphrase issues and resolve technical conflicts<br>• Ability to demonstrate creative thinking and problem solving |
| **B2. Choose a site plan** | • Plan alternatives are researched<br>• Technical and design scenarios are outlined and presented<br>• Tradeoffs and risks are analyzed<br>• Alternative plans are documented and rated<br>• Selected alternatives are reviewed and approved by stakeholders<br>• Selected alternatives meet functionality, timeline and budget requirements<br>• Selected alternatives are documented in a clear, accurate and detailed form<br>• Final site plan is selected and approved | • Knowledge of research techniques and procedures and ability to identify key sources of information<br>• Knowledge of design concepts, techniques, processes and tradeoffs<br>• Ability to translate technical features into performance functionality, project timeline and budget impacts<br>• Knowledge of risk analysis techniques<br>• Ability to translate technical features into development and user benefits<br>• Knowledge of operating systems and hardware<br>• Knowledge of website plan development processes | • Ability to evaluate options and formulate a plan of action<br>• Ability to present complex issues and analyze responses<br>• Ability to identify and resolve conflicts<br>• Ability to accurately summarize and document information |

## *Critical Work Function: Perform Web Programming*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Select programming languages, design tools and applications** | • Programming tools and applications are selected based on functional requirements and technical specifications<br>• Third-party applications are properly tested and evaluated for applicability<br>• Tools and applications meet usability requirements | • Knowledge of programming tools and applications<br>• Knowledge of applicable resource selection procedures<br>• Knowledge of third-party applications<br>• Ability to document tools, applications and third-party applications<br>• Knowledge of programming languages and databases | • Ability to evaluate options and make decisions<br>• Ability to project timeline and budget requirements<br>• Ability to integrate multiple items of data and reconcile conflicting information<br>• Ability to develop creative solutions and demonstrate resourcefulness<br>• Ability to predict outcomes and results of selection of tools |
| **B4. Write supporting code** | • Code meets project objectives and functional specifications<br>• Code is designed so the application performs efficiently<br>• Code is properly documented to ensure maintainability<br>• Prior work is reviewed for applicability and maintainability | • Knowledge of code development procedures<br>• Knowledge of programming languages required for application<br>• Knowledge of reusable component programming process<br>• Knowledge of code documentation process<br>• Ability to develop code or rework to meet applicable requirements | • Ability to write clear documents<br>• Ability to evaluate alternatives and formulate action plans<br>• Ability to use logic to draw conclusions<br>• Ability to manipulate technology for desired results<br>• Ability to understand system organization/hierarchy |
| **B5. Identify major subsystems and interfaces** | • All major subsystems and interfaces are clearly delineated<br>• Minimum of overlap and interaction exists between major subsystems<br>• Major subsystems and interfaces are clearly documented | • Knowledge of overall system<br>• Ability to classify related components into a subsystem<br>• Ability to evaluate degree of connectivity of system components<br>• Ability to rearrange systems<br>• Ability to analyze system configuration/stability | • Ability to analyze logical consistency<br>• Ability to research additional information sources<br>• Ability to evaluate alternatives and formulate action plans |

## *Critical Work Function: Perform Web Programming*

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|---|---|---|---|
| **B6. Develop models** | • Scope and purpose of models are defined<br>• Models are developed cost-effectively and according to schedule<br>• Models accurately reflect design and functionality requirements<br>• Models are exercised and tested for performance<br>• Model development procedures, test results and recommendations are documented<br>• Appropriate business, physical, interface, logical and data models are developed | • Knowledge of model development options and methodologies<br>• Knowledge of model testing procedures<br>• Ability to work with simulations and models | • Ability to develop new/alternative system designs<br>• Ability to integrate system technology<br>• Ability to interpret/evaluate data<br>• Ability to create comprehensive models and simulations<br>• Ability to create original documents<br>• Ability to prioritize results and generate and present recommendations<br>• Ability to synthesize information from different tests |
| **B7. Develop design and interface specifications** | • Design and interface specifications are complete and approved by relevant stakeholders<br>• Design and interface specifications are checked and corrected for conflicts<br>• Design and interface specifications are assessed for ease and quality of implementation<br>• Design and interface specifications are documented completely and accurately<br>• Interface is consistent with industry, company and product standards<br>• Entity relationships are developed properly and diagrams are prepared accurately | • Knowledge of interface requirements, specification procedures and operating systems<br>• Knowledge of implementation procedures and user needs, and ability to analyze and resolve conflicts in specifications<br>• Knowledge of industry, company and product standards<br>• Ability to perform entity-relationship analysis<br>• Knowledge of normalization, relational theory and data modeling tools | • Ability to analyze information<br>• Ability to analyze systems<br>• Ability to apply creative solutions to new situations<br>• Ability to gather, analyze and resolve user needs and requirements<br>• Ability to construct an efficient sequence of actions to accomplish a task |
| **B8. Identify system platform, components and dependencies** | • Rationale for choices is clearly stated<br>• System platform, components and dependencies are clearly delineated<br>• Constraints are documented and analyzed<br>• Subsystems are clearly delineated and all components and interfaces are verified to ensure a minimum of overlap and conflict between components | • Knowledge of available platforms<br>• Knowledge of components and their compatibility<br>• Ability to evaluate alternate configurations<br>• Knowledge of system configurations<br>• Ability to identify related functions, evaluate connectivity and determine degree of conflict or interaction | • Ability to analyze systems and recognize system strengths/limitations<br>• Ability to compare multiple viewpoints<br>• Ability to use logic to draw conclusions<br>• Ability to apply processes/procedures appropriately |

## *Critical Work Function: Perform Web Programming*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B9. Develop appropriate data model** | • Data model is laid out clearly<br>• All functionality in the logical data model is present in the physical data model<br>• Performance criteria for the data model have verifiable assumptions<br>• Business process model contains user workflow analysis and accurate data flow diagram<br>• User processes are optimized | • Knowledge of data model development techniques and tools<br>• Knowledge of CASE tools<br>• Ability to transform logical data model into physical data model<br>• Knowledge of object-oriented database principles<br>• Knowledge of business practices and principles | • Ability to apply rules/principles to process/procedure<br>• Ability to extract information and use logic to draw conclusions<br>• Ability to apply technology for desired results<br>• Ability to understand system organization/hierarchy<br>• Ability to respond to system demand<br>• Ability to design programs, networks and graphics<br>• Ability to interpret symbols, diagrams and schematics |

## *Critical Work Function: Develop, Deliver and Manage Content*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Research content and information architecture** | • Content is properly indexed and prioritized<br>• Content is mapped to customer requirements<br>• Content is reviewed for relevance to the mission<br>• Content clearly conveys required information<br>• Effective user interactions with content are clearly identified<br>• Site resources are organized to facilitate usability | • Knowledge of content indexing and organization techniques<br>• Knowledge of mapping techniques<br>• Knowledge of content sources<br>• Ability to relate content to mission<br>• Knowledge of information organization such as key words, intuitive pathways and navigation aids<br>• Knowledge of web site architecture<br>• Ability to organize information for maximum usability | • Ability to interpret communication and compare multiple viewpoints<br>• Ability to apply creative thinking to new situations<br>• Ability to examine task and technology relationships<br>• Ability to implement new technologies and applications<br>• Ability to visualize integrated events and outcomes |
| **C2. Coordinate content development from multiple contributors** | • Consensus regarding content elements is achieved and maintained<br>• Content development is effectively coordinated with appropriate organizational units<br>• Design goals and standards are met through application of consistent graphic and technical elements<br>• Development environment facilitates maximum value from contributors' efforts<br>• Standards and frameworks for content development are established and maintained | • Knowledge of group dynamics and collaboration methods<br>• Knowledge of organizational structure<br>• Ability to apply graphic and technical elements with consistency<br>• Ability to create and maintain productive working environment<br>• Knowledge of content development practices and frameworks | • Ability to interpret, communicate and compare multiple viewpoints<br>• Ability to think creatively while solving problems<br>• Ability to set well defined, realistic goals that align with project needs and follow proper procedures<br>• Ability to willingly help others and establish rapport |
| **C3. Develop and present concept alternatives** | • A variety of concepts is presented to relevant stakeholders<br>• Concepts incorporate the organization of information and look and feel as determined by stakeholders<br>• Conflicts among stakeholders are effectively resolved | • Knowledge of concept development options and methodologies<br>• Ability to implement features and functions<br>• Knowledge of content organization methods<br>• Knowledge of web technology<br>• Knowledge of web-safe palettes and colors<br>• Knowledge of graphic design and layout principles | • Ability to demonstrate creative thinking while problem solving and apply creative solutions to new situations<br>• Ability to evaluate alternative solutions and formulate a plan of action<br>• Ability to present complex ideas and information<br>• Ability to summarize/paraphrase issues and resolve technical conflicts |

## *Critical Work Function: Develop, Deliver and Manage Content*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C4. Create or adapt content** | • Content sources are thoroughly researched<br>• Subject experts, writers, editors and producers are consulted as required<br>• Drafts are produced in a timely manner<br>• Content is reviewed in accordance with company procedures<br>• Content meets customer requirements<br>• Content is clear, concise, consistent and grammatically correct<br>• Content is reviewed according to agreed upon specifications | • Knowledge of sources for content<br>• Knowledge of company procedures and specification for content review<br>• Ability to manage specialized and expert resources<br>• Knowledge of information mapping techniques<br>• Knowledge of web technology and its capabilities | • Ability to create original documents and synthesize information<br>• Ability to follow policies/procedures and work with minimal supervision<br>• Ability to interpret and clarify communication<br>• Ability to paraphrase, summarize and generalize existing ideas and demonstrate creative thinking process while problem solving<br>• Ability to prioritize daily tasks and monitor/adjust task sequences |
| **C5. Produce graphics, layout elements and applicable code** | • Graphical user interface meets technical specifications<br>• Information is presented clearly and contextually<br>• Artistic elements are aesthetically pleasing<br>• Graphics meet customer requirements and company standards<br>• Sources of graphic images are researched and make-or-buy decisions are made appropriately<br>• Required code is functional and free of errors | • Knowledge of graphical applications and sources of graphic images<br>• Knowledge of principles of graphical layout<br>• Ability to test and refine usability<br>• Knowledge of user requirements and web development<br>• Knowledge of content clearance and copyright considerations<br>• Ability to develop and test supporting code | • Ability to mentally picture outcomes<br>• Ability to think creatively and solve problems<br>• Ability to judge aesthetics of graphics, animation, audio and video content<br>• Ability to judge content and form and reconcile to overall project image<br>• Ability to compare multiple viewpoints and formulate plan of action<br>• Ability to generate and evaluate alternative solutions |
| **C6. Update content** | • Site/application is tested and staged after content is updated to ensure integrity<br>• Updates occur according to established processes and schedules<br>• Updates are performed in accordance with application requirements<br>• Updated content is timely and accurate<br>• Links are periodically reviewed and updated | • Knowledge of website maintenance and updating methods and tools<br>• Knowledge of work flow<br>• Knowledge of application requirements<br>• Knowledge of website development rollout and logistics<br>• Ability to develop and implement update processes and schedules | • Ability to follow rules/policies/procedures and work with minimal supervision<br>• Ability to efficiently manage time and prioritize daily tasks<br>• Ability to follow specified maintenance procedures and correct malfunctions/ failures<br>• Ability to identify and recommend system modifications/improvements<br>• Ability to set well defined, realistic goals and apply self-management skills |

## *Critical Work Function: Implement and Maintain Site and Applications*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Plan rollout** | • Rollout plans are communicated to stakeholders in a timely manner<br>• Final reviews and approvals are conducted according to company standards<br>• All elements for a successful rollout are clearly identified and effectively implemented<br>• Rollout is planned to meet overall project goals and timelines<br>• Contingency plans are outlined<br>• Support staff training needs are identified and accommodated within the plan<br>• Rollout plan addresses business and operational requirements | • Knowledge of customer and company communication requirements<br>• Knowledge of review and approval practices and procedures<br>• Knowledge of support staff training needs and requirements<br>• Knowledge of strategies and promotional tools<br>• Knowledge of registration security and certification requirements and processes | • Ability to analyze technology output and examine task/technology relationship<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to suggest and examine system modifications/improvements<br>• Ability to willingly help others and establish rapport with coworkers and customers<br>• Ability to identify and project resource needs |
| **D2. Facilitate move to production system** | • Product is release-tested in the production environment<br>• Support staff is properly trained to respond to customer calls<br>• Application is moved from the development server to the production environment<br>• All features and components are fully functional in a live environment | • Knowledge of release test procedures<br>• Knowledge of support staff training requirements and techniques<br>• Ability to move application from development server to production environment | • Ability to identify training needs and conduct task-specific training<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to suggest and examine system modifications/improvements<br>• Ability to accept responsibility for own actions and accept feedback |
| **D3. Hand off to customer or user** | • Documentation is completed and updated<br>• Application meets customer/user requirements<br>• Application is fully functional for the customer/user<br>• Appropriate final approvals and signatures are secured<br>• User support and training materials are finalized and delivered<br>• Procedures for gathering user feedback are put into place | • Knowledge of company documentation procedures and standards<br>• Knowledge of user support and training needs<br>• Knowledge of organizational practices for securing final approvals and signatures<br>• Knowledge of instructional design principles | • Ability to identify training needs and provide appropriate support materials<br>• Ability to organize and present technical information<br>• Ability to gather and analyze customer/user feedback<br>• Ability to willingly help others and establish rapport with coworkers and customers |

## *Critical Work Function: Implement and Maintain Site and Applications*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Integrate customer feedback** | • Customer feedback is systematically<br>• Feedback is analyzed, prioritized and acted upon<br>• Changes are clearly and thoroughly documented<br>• Customers are kept informed of application changes and updates | • Knowledge of data gathering techniques<br>• Knowledge of practices of internal, external and global customers<br>• Knowledge of the application or server being supported<br>• Knowledge of user level of expertise | • Ability to accept responsibility for own actions and impact on others<br>• Ability to demonstrate commitment to personal/social improvement<br>• Ability to be flexible and cooperative<br>• Ability to recognize and analyze customer needs and resolve conflicts<br>• Ability to resolve technical issues and obtain customer approval |
| **D5. Perform application maintenance** | • Problems are properly identified and resolved in a timely manner<br>• Application is modified to improve performance<br>• Enhancements are made effectively<br>• Internal, external and global customer expectations are met in a timely manner<br>• Problems are correctly identified and referred to appropriate personnel in a timely manner | • Knowledge of problem escalation and resolution process<br>• Knowledge of code development and software maintenance procedures<br>• Ability to evaluate alternatives and make decisions in code implementation<br>• Knowledge of programming techniques and database management systems | • Ability to devise/implement plan of action<br>• Ability to visually analyze relationship between parts/whole, process/procedure<br>• Ability to identify the problem, analyze possible causes and recommend action plan<br>• Ability to understand the requirements of the task and propose technological solutions<br>• Ability to perform specified maintenance, identify problems and correct malfunctions/failures |
| **D6. Recommend optimization and facilitate upgrades and improvements** | • Customer feedback is gathered, documented and evaluated<br>• Recommendations on site improvements are developed within associated budget<br>• Recommendations are made to appropriate stakeholders in accordance with company procedures<br>• Risk assessments are appropriately considered<br>• System operates as specified under traffic and load conditions<br>• Performance metrics are applied to system optimization | • Knowledge of risk assessment analysis techniques<br>• Knowledge of business plan and strategic goals<br>• Ability to perform feasibility evaluations<br>• Knowledge of budget considerations and evaluation techniques<br>• Ability to use performance optimization tools<br>• Ability to develop and analyze performance metrics | • Ability to implement technological improvements and generate technological solutions<br>• Ability to analyze operational problems<br>• Ability to develop new/alternative system designs<br>• Ability to compose well-organized presentations and debate issues<br>• Ability to develop formal and informal relationships with leaders in the enterprise |

## *Critical Work Function: Implement and Maintain Site and Applications*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D7. Document application and site changes** | • Changes are completely and accurately documented<br>• Change documentation is distributed in a timely manner to appropriate personnel and/or departments<br>• Documentation procedures and standards are followed<br>• Change procedure is developed and followed | • Knowledge of change procedure development and implementation<br>• Knowledge of change documentation procedures and standards<br>• Ability to review, evaluate and prioritize change requirements and requests | • Ability to create detailed supporting documents<br>• Ability to select/obtain data relevant to the task, integrate multiple data items and contrast conflicting data<br>• Ability to set realistic goals and apply self-management skills<br>• Ability to follow rules and policies and work with minimal supervision<br>• Ability to efficiently manage time |
| **D8. Develop and implement contingency plans** | • Contingency plans are developed according to appropriate needs, requirements and guidelines<br>• Alternative physical locations/sites are considered and selected<br>• Backup hardware, software and facilities are configured and operational<br>• Appropriate security procedures are developed and periodically tested and reviewed | • Knowledge of contingency plan development and implementation<br>• Ability to evaluate and select physical sites<br>• Knowledge of backup design and operation<br>• Knowledge of system recovery procedures and methods<br>• Knowledge of security procedure development, implementation and testing | • Ability to develop new/alternative system designs<br>• Ability to create detailed supporting documents<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to research additional information sources and create data gathering processes<br>• Ability to propose new technology applications and predict technological results |

## *Critical Work Function: Manage Web Environment*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Evaluate and recommend web hardware, software and third-party solutions** | • Relevant resources are identified and reviewed<br>• Evaluation criteria are developed<br>• Evaluation criteria are prioritized and agreed to by customer<br>• Evaluations and recommendations meet company, customer and budgeting requirements<br>• Evaluation and recommendation processes are completed in accordance with company procedures and guidelines<br>• Recommendations are communicated appropriately<br>• Risk assessments are appropriately considered | • Knowledge of risk assessment methods<br>• Knowledge of sources of information regarding web server hardware, software and third-party solutions<br>• Knowledge of company web objectives<br>• Ability to use programming tools, web server software and content management software<br>• Ability to use search engines, web server statistics packages and authoring tools<br>• Ability to use digital commerce applications and data conversion tools<br>• Knowledge of application of evaluation criteria | • Ability to evaluate effectiveness of solutions for customer and forecast future customer needs<br>• Ability to adapt principles to new applications and judge logical consistency<br>• Ability to stay current on cutting edge technologies and processes<br>• Ability to implement technological improvements and generate technological solutions<br>• Ability to compose well-organized presentations and debate issues<br>• Ability to analyze, interpret, summarize and integrate data/information |
| **E2. Set up server software and hardware** | • Software and hardware are properly installed and configured<br>• Implementation includes security requirements<br>• Directory file names adhere to naming conventions<br>• Server is properly configured for security<br>• Third-party software/extensions are properly loaded and tested<br>• Installation plan includes input from customers and is designed for minimal impact on process flow and productivity<br>• Interoperability requirements are identified and addressed | • Knowledge of the impact of the installation plan on whole system<br>• Ability to use technical documentation<br>• Knowledge of practices of internal, external and global customers<br>• Knowledge of installation obstacles and procedures to resolve them<br>• Knowledge of directory structures and naming conventions<br>• Ability to load and test third-party software/extensions<br>• Ability to effectively manage interoperability and connectivity issues | • Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to implement plan of action<br>• Ability to present complex ideas and information<br>• Ability to integrate system technology and follow proper procedures<br>• Ability to respond appropriately to others |

## *Critical Work Function: Manage Web Environment*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E3. Manage server** | • Performance problems are identified, communicated and resolved in a timely manner<br>• User data input issues are properly managed<br>• Server activity is properly monitored, analyzed and communicated in accordance with company guidelines<br>• Upgrades and patches are effectively implemented when appropriate<br>• System down time is minimized<br>• Loading does not unduly affect system performance | • Ability to use system administration tools<br>• Ability to analyze hardware and software problems<br>• Ability to tune the server to maximum performance<br>• Knowledge of resources available to resolve defects<br>• Knowledge of system error resolution procedures<br>• Knowledge of user data input conventions<br>• Knowledge of monitoring procedures and ability to design and generate reports<br>• Knowledge of Internet topology and bandwidth issues | • Ability to identify and prioritize the need for data<br>• Ability to organize and analyze information<br>• Ability to apply rules and principles to diagnostics and use logic to draw conclusions<br>• Ability to create detailed supporting documents<br>• Ability to use word processing and spreadsheet software<br>• Knowledge of systems performance monitoring tools |
| **E4. Support systems recovery** | • Backups and restores are properly performed and escalation procedures are followed<br>• Criticality of applications is properly determined<br>• Restore times meet company requirements and backup schedules meet application and security requirements<br>• Problems are assessed for criticality and reported to relevant personnel in a timely manner<br>• Recovery plans are identified and agreed upon by technical support group and relevant stakeholders<br>• Recovery plans are documented completely and accurately<br>• Effects of unforeseen outages and data losses are minimized and issues are effectively resolved<br>• Backup and failover systems operate transparently when required | • Knowledge of recovery procedures and their planning and implementation processes<br>• Ability to identify user needs in terms of backup and recovery<br>• Knowledge of operating systems, data assurance and security considerations<br>• Ability to project resources required to implement recovery plans<br>• Knowledge of backup system design and operation | • Ability to analyze information/data and recommend action plan<br>• Ability to identify system problems and evaluate for criticality<br>• Ability to apply rules and principles to process/procedure and use logic to draw conclusions<br>• Ability to follow specified maintenance, evaluate performance of technology and analyze failures<br>• Ability to respond appropriately to others and demonstrate empathy for their concerns<br>• Ability to adhere to standards and lead by example |

## *Critical Work Function: Manage Enterprise-wide Web Activities*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Define and manage development standards** | • Style guides and coding statements are written to meet enterprise objectives<br>• Standards are followed in accordance with company policies<br>• Relevant standards are identified and applied as appropriate | • Knowledge of style guides and coding standards<br>• Knowledge of company policies regarding standards<br>• Knowledge of server and client side capabilities and limitations<br>• Knowledge of user characteristics and practices<br>• Knowledge of company usage standards and branding | • Ability to create detailed supporting documents and write clearly and succinctly<br>• Ability to adhere to standards and encourage others to adopt new concepts<br>• Ability to follow rules/policies and procedures<br>• Ability to recognize ethical issues and recommend appropriate course of action |
| **F2. Train designers and developers** | • Training plan and supporting documentation are developed for designers and developers<br>• Designer and developer requirements for training are correctly identified, interpreted and evaluated<br>• Content contains the appropriate amount of information and is consistent with learning objectives<br>• Training is effectively presented and clearly communicates information in a logical flow<br>• Effectiveness of training is properly evaluated to determine how well customer expectations were met | • Knowledge of information gathering methods and company procedures and processes<br>• Knowledge of instructional design principles<br>• Knowledge of available resources and ability to plan according to needs and constraints<br>• Knowledge of required technical information and ability to organize technical material for ease of learning<br>• Knowledge of online resources | • Ability to visualize task sequentially and identify interdependencies<br>• Ability to create detailed supporting documents<br>• Ability to speak clearly and present well-organized presentations<br>• Ability to analyze and manipulate learning tools, and formulate and adapt learning strategies<br>• Ability to summarize, analyze and integrate information<br>• Ability to create and deliver multimedia presentations<br>• Ability to identify training needs and conduct task-specific training |

## *Critical Work Function: Manage Enterprise-wide Web Activities*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F3. Evaluate web technologies and standards** | • Appropriate information sources for off-the-shelf applications, tools and resources are considered<br>• Alternative technologies are evaluated against customer requirements<br>• Research is conducted on emerging technologies and standards<br>• Make-or-buy decisions are made in collaboration with appropriate personnel/departments<br>• New technologies and standards are communicated to appropriate personnel effectively in a timely manner<br>• Consultation with management/personnel is provided as requested and in accordance with company mission and goals<br>• Security issues are effectively addressed | • Knowledge of sources of information for emerging and current technologies<br>• Knowledge of customer requirements<br>• Knowledge of new and emerging tools and technologies, programming languages, distributed computing and computing platforms<br>• Knowledge of security issues and protocols | • Ability to research additional information sources and create data gathering processes<br>• Ability to analyze operational problems, evaluate computer utilization and judge information accuracy<br>• Ability to evaluate effectiveness of solutions for customer and forecast future customer needs<br>• Ability to adapt principles to new applications<br>• Ability to stay current on cutting edge technologies and processes |
| **F4. Provide quality customer service** | • Relationships and communications are managed so that customers are satisfied with current level of service<br>• Internal, external and global customer expectations are met in a timely manner<br>• Problems are correctly identified and referred to appropriate personnel in a timely manner<br>• Communications are aligned with the audience, particularly when conveying technical information to nontechnical audience | • Knowledge of escalation procedures<br>• Knowledge of support boundaries<br>• Knowledge of operating environments, office suite applications, networks, hardware tools and online resources<br>• Knowledge of practices of internal, external and global customers | • Ability to analyze customer needs and demonstrate commitment to customers<br>• Ability to resolve conflicts to customer satisfaction<br>• Ability to identify the problem, analyze possible causes and recommend action plan<br>• Ability to recognize differences/biases and respect the rights of others<br>• Ability to accept constructive criticism and accept responsibility for own actions<br>• Ability to communicate technical information to nontechnical audiences |

## *Critical Work Function: Manage Enterprise-wide Web Activities*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F5. Perform ROI (Return on Investment) analysis to ensure business goals are met** | • Web traffic and site performance data are monitored and analyzed regularly<br>• Site metrics are analyzed according to business objectives and expectations<br>• Site performance and cost data are analyzed with regard to performance and ROI goals<br>• Financial model is developed and implemented | • Knowledge of website metric tools and procedures<br>• Ability to apply analytical processes to web performance and cost data<br>• Knowledge of financial models and ROI analysis<br>• Ability to use statistical analysis and data presentation applications and tools | • Ability to evaluate effectiveness of solutions for customer and forecast future customer needs<br>• Ability to follow proper procedures and work with established guidelines<br>• Ability to organize and communicate technical information in a logical and consistent manner<br>• Ability to pose critical questions while analyzing problems |
| **F6. Design and document security plan** | • Strategies are thoroughly reviewed and analyzed<br>• Security design and features are selected to meet client, user and business needs<br>• Security plan is developed and documented completely and accurately<br>• Security plan is accessible<br>• Security plan addresses compatibility and interoperability issues | • Knowledge of security strategies<br>• Ability to select security design<br>• Knowledge of client, user and business needs<br>• Knowledge of security plan documentation procedures<br>• Ability to relate requirements to user privileges<br>• Knowledge of compatibility issues | • Ability to identify and resolve conflicting data<br>• Ability to analyze information and formulate proposals<br>• Ability to write detailed supporting documents |

## *Critical Work Function: Manage Enterprise-wide Web Activities*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F7. Implement and enforce security requirements** | • Levels of access and security are clearly identified, standardized and communicated<br>• Overall plan is considered when implementing and enforcing security requirements<br>• Implementation of security measures minimizes intrusion and addresses security tradeoffs and risks<br>• Users are notified about security procedures and changes in access in accordance with company procedures<br>• User accounts and critical access points are properly audited to determine that security requirements are being met<br>• Security breaches are quickly identified, communicated to appropriate personnel and resolved effectively | • Knowledge of security procedures and implementation<br>• Ability to collect security breach details and communicate to appropriate personnel<br>• Knowledge of networks, operating systems and applicable security strategies and solutions | • Ability to present practical alternatives<br>• Ability to responsibly challenge unethical practices/decisions<br>• Ability to write detailed supporting documents<br>• Ability to analyze and respond to client/user needs<br>• Ability to present security tradeoffs and risks and pose critical questions |
| **F8. Maintain and improve security in response to industry developments and user experience** | • User practices are analyzed and input gathered to document and assess security issues<br>• Training results in continuous improvement in security awareness and effective practice<br>• Security needs are forecast and incorporated in recommendations for system upgrades and/or redesign<br>• Industry and technology trends are continually monitored and incorporated to support system security<br>• Internal and external audits are periodically conducted to validate security plans and procedures | • Knowledge of business, industry and technology security trends<br>• Ability to use forecasting methods and tools<br>• Ability to gather user input and observe user practices<br>• Knowledge of instructional design principles<br>• Ability to provide technical training on security procedures | • Ability to analyze and respond to client/user needs<br>• Ability to identify issues and resolve technical conflicts<br>• Ability to organize and present technical information to nontechnical users<br>• Ability to monitor and interpret trends in technology and industry |

## *Critical Work Function: Manage Enterprise-wide Web Activities*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F9. Develop enterprise-wide legal and international privacy guidelines** | • All content receives appropriate attribution, credit and clearance<br>• Procedures are established and followed for required legal reviews<br>• Country-specific copyright and privacy regulations are researched and applied as required<br>• Internal standards are developed with knowledge of domestic and international laws, regulations and cultural considerations<br>• Procedures, standards and legal requirements are documented, communicated and periodically reviewed<br>• Standards are researched and applied to ensure clear and appropriate development of guidelines | • Knowledge of laws pertaining to content development and dissemination<br>• Knowledge of domestic and international network architectures and protocols<br>• Ability to develop appropriate standards, practices and policies<br>• Ability to research and apply country-specific cultural considerations, laws and standards | • Ability to follow proper procedures and work with established guidelines<br>• Ability to understand goals and constraints, generate alternatives, consider risks and evaluate options<br>• Ability to compare multiple viewpoints<br>• Ability to demonstrate honesty and trustworthiness |

## *Critical Work Function: Perform Testing and Quality Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **G1. Develop test and acceptance plan** | • Test and acceptance plan is completely documented in accordance with applicable policies<br>• Test plan is relevant to application and test requirements are in compliance with legal and customer requirements<br>• Test system accurately reflects real world<br>• Testing scenario is automated where feasible<br>• Realistic test cases are developed and results compared with expected performance<br>• Testing resources are identified and scheduled appropriately<br>• Customer acceptance occurs upon successful completion of test plan | • Knowledge of user application<br>• Knowledge of testing impact on timeline and budget<br>• Knowledge of test domain and ability to distinguish edges and critical points<br>• Knowledge of operating systems, interfaces and testing tools<br>• Knowledge of legal and customer requirements<br>• Ability to develop and execute test acceptance plans | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to write technical documents and detailed supporting documents<br>• Ability to consider risk implications and compile multiple viewpoints<br>• Ability to use word processing tools and techniques |
| **G2. Develop test procedures** | • Test procedures explicitly verify specifications<br>• Test procedures define test conditions<br>• Test procedures are documented in detail<br>• Appropriate tests are developed for individual components and end-to-end operations<br>• Test results are reviewed to confirm test validity | • Knowledge of test domain and ability to distinguish edges and critical points<br>• Ability to construct automated test sequences and recognize errors in test procedure and system<br>• Knowledge of test discipline, tools, languages and testing methodology<br>• Ability to develop and apply testing specifications | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to respond to system demand<br>• Ability to consider risk implications<br>• Ability to analyze technology output and examine task/technology relationship<br>• Ability to interpret, clarify and influence communication |

## *Critical Work Function: Perform Testing and Quality Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **G3. Develop and perform usability and integration testing** | • User reactions to test product are accurately observed and documented<br>• Test data is conveyed to development team in a timely manner<br>• Test results are analyzed and applied to problem resolution<br>• Test data and documentation is accurately maintained over time and accessible to development team<br>• Test routines and procedures are periodically reviewed for effectiveness | • Knowledge of test procedures for usability and integration<br>• Knowledge of application environment and user requirements<br>• Ability to translate usability issues into application/site modifications<br>• Knowledge of error analysis and resolution processes | • Ability to understand system organization/hierarchy<br>• Ability to follow processes/procedures<br>• Ability to analyze technology output<br>• Ability to examine task/technology relationship<br>• Ability to appropriately refer complaint/discrepancy<br>• Ability to identify and evaluate system performance |
| **G4. Perform tests** | • Test process includes appropriate team members<br>• System is tested according to plan and schedule<br>• Test results are documented completely and communicated as appropriate<br>• System integration testing and volume/ performance testing are performed when appropriate | • Ability to develop and perform test procedures<br>• Knowledge of system and ability to recognize and resolve problems identified through testing<br>• Knowledge of testing methodology and protocols<br>• Ability to interpret test results and resolve discrepancies appropriately | • Ability to follow processes/procedures<br>• Ability to appropriately refer complaint/discrepancy<br>• Ability to understand system organization/hierarchy<br>• Ability to identify and evaluate system performance<br>• Ability to analyze technology output and examine task/technology relationship |
| **G5. Document test results and take corrective actions** | • Errors and preexisting conditions are clearly documented<br>• Recommendations for corrective action are included in documentation<br>• Problems are identified and resolved<br>• Test results are accurately recorded, analyzed and communicated effectively<br>• Test results are reviewed to confirm test validity | • Knowledge of documentation procedures<br>• Knowledge of testing tools and methodologies<br>• Ability to troubleshoot and correct technical problems<br>• Ability to discern trends, patterns and anomalies | • Ability to understand system organization/hierarchy<br>• Ability to respond to system demand<br>• Knowledge of word processing software, networks and operating environments<br>• Ability to evaluate system performance and devise plan to monitor and/or correct system<br>• Ability to modify process/procedure |

## *Critical Work Function: Perform Testing and Quality Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **G6. Recommend and implement performance improvements** | • Performance metrics are codified, analyzed and presented for effective decision support<br>• Test log information and development team input are regularly integrated into performance reviews<br>• Customer feedback is actively solicited, accurately maintained and applied to performance improvement reviews<br>• Performance improvement reviews result in site improvement plans based on business goals and ROI considerations | • Knowledge of performance tuning and site improvement strategies<br>• Ability to gather, analyze and present performance data<br>• Ability to collect, organize and maintain customer feedback<br>• Knowledge of business goals and ROI processes | • Ability to evaluate/adjust plan of action<br>• Ability to analyze and respond to client/user needs<br>• Ability to write detailed documents<br>• Ability to approach problems in a logical and systematic way |

## *Critical Work Function: Develop and Implement Web Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **H1. Develop physical database characteristics and create database objects** | • Attributes have uniform structure<br>• Table and file names follow naming conventions<br>• Entities are uniformly and logically linked throughout the database structure<br>• Database objects are created and tested in a timely manner<br>• Database objects are created to meet environmental requirements and usability specifications | • Knowledge of naming conventions, standards and structure<br>• Ability to read and understand logical model and resolve conflicts<br>• Knowledge of data types and attributes<br>• Knowledge of user interface, web requirements and standards<br>• Knowledge of database object design and testing procedures<br>• Ability to relate database usability and environmental requirements to object design<br>• Ability to present data and database tools in a web-friendly manner<br>• Knowledge of user preferences and expertise levels | • Ability to create detailed documentation<br>• Ability to apply logic to structures and processes<br>• Ability to examine data for relevance/accuracy<br>• Ability to pay attention to detail<br>• Ability to clarify, interpret and influence communication<br>• Ability to work with minimal supervision<br>• Ability to identify and resolve conflicts in data and requirements |
| **H2. Select unique identifiers and normalize the data model** | • Logical model is consistent with conceptual model<br>• Logical and data models and identifiers have been validated by client<br>• Identifiers are selected and documented and primary and foreign keys are properly identified<br>• Rationale behind selection is documented<br>• Data model is normalized to match user specifications | • Ability to transform conceptual model into logical model<br>• Ability to identify and define attributes and align attributes to entities<br>• Knowledge of operating systems and database software and principles<br>• Ability to choose and document identifiers and relate identifier selection to business domain<br>• Knowledge of normalization rules and processes | • Ability to organize data in a usable form<br>• Ability to track information efficiently and effectively<br>• Ability to use logic to draw conclusions from available information |

## *Critical Work Function: Develop and Implement Web Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **H3. Support population of database** | • Data entry and conversion are complete and accurate<br>• Third-party vendors are used as appropriate<br>• Data transfer strategies are applied effectively | • Knowledge of database software<br>• Knowledge of database querying methods<br>• Knowledge of various database attributes<br>• Ability to customize off-the-shelf databases<br>• Knowledge of operating systems and web environment | • Ability to generate/evaluate solutions<br>• Ability to organize information and reports<br>• Ability to pay attention to detail and follow up on assigned tasks |
| **H4. Integrate high-level business rules** | • Pertinent business rules are examined for relevancy and impact<br>• Procedures are implemented to reflect business rules<br>• Database integrity and security are established and maintained | • Knowledge of business structure<br>• Knowledge of business entities and relationships<br>• Knowledge of user interface and database rules<br>• Knowledge of database code development | • Ability to synthesize information<br>• Ability to create detailed supporting documentation<br>• Ability to visually analyze relationship between parts/whole<br>• Ability to integrate multiple items of data and research additional information sources<br>• Ability to organize technical reports and select methods of communication |
| **H5. Plan implementation and deploy database** | • Implementation plan development involves key team members and reflects good project development practices<br>• Transition plan is implemented with minimal impact on overall productivity<br>• Software and dataset are installed according to implementation plan<br>• Database and/or content management system is fully operational<br>• Post-implementation reviews are thoroughly conducted in accordance with company procedures | • Knowledge of database software<br>• Knowledge of implementation and project planning<br>• Knowledge of appropriate validation process and database system error resolution procedures<br>• Ability to evaluate acceptance testing plan<br>• Knowledge of feedback generation techniques and procedures<br>• Ability to evaluate overall system performance and productivity<br>• Knowledge of the domain | • Ability to synthesize and organize information<br>• Ability to create detailed supporting documents<br>• Ability to manage resources and timelines to maximize effectiveness<br>• Ability to relate intent to desired results<br>• Ability to evaluate/adjust plan of action<br>• Ability to judge effectiveness and efficiency of solution<br>• Ability to evaluate and summarize user input, recognize critical issues and analyze communication<br>• Ability to make recommendations for intervention |

## *Critical Work Function: Develop and Implement Web Database*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **H6. Define and implement user interface** | • Applications can connect to database as required<br>• Web connectivity is transparent to user<br>• Data and parameters are passed without error as required<br>• User interface meets client/user requirements and web constraints<br>• Database characteristics and user interface are completely documented<br>• Database, parameter and user-supplied data security is maintained as required | • Knowledge of connection methodology<br>• Knowledge of database programming and query languages<br>• Knowledge of user interface design and development<br>• Knowledge of web environments and database connectivity conventions, processes and methods<br>• Knowledge of web browser characteristics<br>• Knowledge of secure server practices and methodology | • Ability to use effective communication and presentation methods<br>• Ability to document technical procedures for users<br>• Ability to user integrated/multiple software applications<br>• Ability to evaluate goals and adjust action plans<br>• Ability to listen carefully to user needs and concerns |

# Appendices

## Cybersecurity Skill Standards

The following NWCET cybersecurity skill standards were developed in part with a grant from the National Science Foundation (NSF), first published in December 2002. Draft standards were presented and reviewed at the NSF Cybersecurity Summit in June 2002 in Washington, DC. This summit verified the need for technician-level cybersecurity skill standards to support cybersecurity workforce development to assure the integrity of the nation's IT infrastructure. These standards will find application in IT education and training program development, certification and technician reskilling. Although presented here as separate data elements, cybersecurity skills are increasingly important across all career clusters.

## *Summary of Critical Work Functions*

| A. Provide Data/ Information Assurance | B. Ensure Infrastructure and Network Security | C. Develop, Manage and Enforce Security Policies | D. Perform Security Education and Training | E. Develop and Implement Physical Security, Deterrence and Detection | F. Perform System Design and Analysis |
|---|---|---|---|---|---|
| A1 Gather and document data/information assurance requirements | B1 Gather data and analyze security requirements | C1 Perform research and analyze requirements | D1 Identify and assess education and training requirements for all constituents | E1 Identify and assess current and anticipated security risks and vulnerabilities | F1 Define current systems-level requirements and forecast future needs and trends |
| A2 Develop data/information assurance plans and implementation strategies | B2 Identify, analyze and evaluate infrastructure and network vulnerabilities | C2 Develop, assess and document security policies, practices and procedures | D2 Identify resources and support materials | E2 Research and evaluate alternative current and emerging practices, tools and technologies | F2 Evaluate current and emerging tools and technologies |
| A3 Review and test plans and strategies for compliance with applicable regulations and standards | B3 Develop critical situation contingency plans and disaster recovery plan | C3 Disseminate policies and implementation practices and procedures | D3 Design and develop education and training plans and strategies | E3 Select and apply relevant tools to meet security goals and requirements | F3 Evaluate organization's security strategies |
| A4 Implement data/ information assurance plans and strategies | B4 Implement/test contingency and backup plans and coordinate with stakeholders | C4 Implement, enforce and monitor security policies, practices and procedures | D4 Deliver education and training | E4 Monitor, evaluate and test security conditions and environment | F4 Make recommendations regarding organization's investment in security |
| A5 Monitor performance to ensure integrity and confidentiality | B5 Monitor, report and resolve security problems | | D5 Assess results and determine follow up requirements | E5 Implement, extend and refine physical security plans and practices | F5 Coordinate systems testing and integration |
| A6 Maintain and update data/information assurance plans and strategies as appropriate | | | | | F6 Audit and maintain systems performance and ensure future readiness |

## *Critical Work Function: Provide Data/Information Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A1. Gather and document data/information assurance requirements** | • Relevant information and requirements are completely accurate and thoroughly documented<br>• Sources of information are trustworthy and current<br>• Requirements are attainable within applicable time, technology and cost constraints<br>• Data/information requirements are reviewed and approved by relevant stakeholders<br>• Requirements meet applicable internal and external standards and practices<br>• Requirements are periodically reviewed against performance standards and emerging security specifications | • Knowledge of internal and external data/information assurance standards, recommendations and practices<br>• Knowledge of trustworthy sources and relevant standards<br>• Knowledge of relevant and applicable technologies and business practices<br>• Ability to collect, analyze, interpret and present security specifications in the data assurance environment | • Ability to identify key sources of information<br>• Ability to analyze information for accuracy and consistency<br>• Ability to ask relevant questions<br>• Ability to accurately summarize and document information |
| **A2. Develop data/information assurance plans and implementation strategies** | • Plans address critical confidentiality, integrity and availability requirements<br>• Plans provide realistic methods to meet security specifications and data requirements<br>• Plans identify and prescribe appropriate training and implementation processes and methods<br>• Plans and strategies are consistent with relevant policies, practices and standards<br>• Implementation strategies support customer requirements and business objectives<br>• Plans and strategies support current technologies and accommodate future technological development<br>• Plans and strategies are developed in the context of ethical and societal norms and expectations | • Knowledge of relevant policies, practices and standards<br>• Ability to determine customer requirements in the context of business goals and risk analysis<br>• Knowledge of current and emerging security tools, technologies and practices<br>• Knowledge of security-related ethical and societal norms and expectations<br>• Ability to interpret and present security data assurance plans and strategies in the data assurance environment | • Ability to synthesize and organize information<br>• Ability to manage resources and timelines to maximize effectiveness<br>• Ability to assume responsibility for accomplishing team goals<br>• Ability to create detailed supporting documents |

## *Critical Work Function: Provide Data/Information Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A3. Review and test plans and strategies for compliance with applicable regulations and standards** | • Plans and strategies meet specifications of applicable regulations and standards<br>• Compliance is reviewed in the context of risk analysis, cost benefit analysis and implementation feasibility<br>• Appropriate recommendations follow review and testing processes<br>• Regulations and standards are regularly monitored for updates and revisions | • Knowledge of applicable business policies and analysis tools<br>• Knowledge of applicable security regulations and standards<br>• Ability to perform compliance reviews and analysis<br>• Ability to formulate and present security/ data assurance plans, strategies and recommendations | • Ability to generate/evaluate solutions<br>• Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to identify key sources of information<br>• Ability to pose critical questions |
| **A4. Implement data/ information assurance plans and strategies** | • Data/information assurance plans and strategies are implemented according to requirements, specifications, timelines and relevant decision points<br>• Implementation schedule and expectations are communicated to relevant stakeholders<br>• Implementation includes appropriate transition and contingency plans<br>• Plans and strategies are implemented with minimal disruptions<br>• Implementation includes applicable orientation and training | • Knowledge of implementation planning processes, procedures and requirements<br>• Knowledge of security tools and technologies<br>• Knowledge of training processes and procedures<br>• Ability to develop and implement transition and contingency plans | • Ability to synthesize information<br>• Ability to create detailed supporting documentation<br>• Ability to organize and present information to users and analyze group/ individual response<br>• Ability to create and develop new rules/principles |
| **A5. Monitor performance to ensure integrity and confidentiality** | • Security data is collected, and documented and analyzed<br>• Security breaches are detected and reported according to applicable practices and procedures<br>• Security issues are quickly identified, escalated appropriately and resolved<br>• Monitoring process includes routine and nonroutine self-tests and audits | • Knowledge of data collection and analysis practices and techniques<br>• Knowledge of detection tools and reporting practices<br>• Knowledge of security testing and security auditing methods<br>• Ability to gather, summarize and present performance data | • Ability to establish rapport with co-workers and customers and modify actions to environment<br>• Ability to analyze organization of information<br>• Ability to compare and interpret multiple viewpoints<br>• Ability to pose critical questions<br>• Ability to read and follow written instructions<br>• Ability to recognize ethical issues<br>• Ability to maintain confidentiality |

## *Critical Work Function: Provide Data/Information Assurance*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **A6. Maintain and update data/information assurance plans and strategies as appropriate** | • Plans and strategies are regularly reviewed for update and revision<br>• Plans and strategies are evaluated against current and emerging security criteria, regulations and standards<br>• Revised plans and strategies are appropriately communicated and effectively integrated<br>• Security policies and requirements are regularly reviewed in the maintenance and upgrade process | • Knowledge of applicable security/data assurance regulations, standards and practices<br>• Ability to analyze and recommend changes in security policies and practices<br>• Ability to organize and present technical data | • Ability to create detailed supporting documents<br>• Ability to create data gathering process<br>• Ability to create plan to monitor and correct system<br>• Ability to analyze client/user needs and evaluate effectiveness of solutions<br>• Ability to devise/implement plan of action |

## *Critical Work Function: Ensure Infrastructure and Network Security*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B1. Gather data and analyze security requirements** | • Security data requirements include devices, topology and intrusion detection<br>• Sources and methods for gathering requirements are trustworthy and current<br>• Data is gathered continuously in a cost-effective manner<br>• Security requirements reflect current and emerging data/information assurance standards, regulations and practices<br>• Requirements are analyzed relative to applicable time, technology and cost constraints | • Knowledge of network architecture and applicable security products and practices<br>• Knowledge of security devices, topology and intrusion detection<br>• Knowledge of information gathering methods, procedures and practices<br>• Ability to analyze and apply security standards, regulations and practices | • Ability to identify key sources of information<br>• Ability to ask relevant questions<br>• Ability to accurately summarize and document information<br>• Ability to recommend an ethical course of action<br>• Ability to pose critical questions |
| **B2. Identify, analyze and evaluate infrastructure and network vulnerabilities** | • Infrastructure and network devices and software are benchmarked against known limitations and vulnerabilities<br>• Corrective plan is developed and implemented based on the benchmarking data<br>• Appropriate policies and procedures are developed for access control and authentication<br>• Physical security issues are identified and resolved<br>• Routine updates and upgrades are implemented per established procedures<br>• Relevant infrastructure, topology and hardware information is appropriately logged and maintained | • Knowledge of network architecture, topology, devices and software<br>• Knowledge of access control and authentication methods and protocols<br>• Ability to gather and evaluate technical data and maintain appropriate records<br>• Knowledge of applicable physical security requirements and practices | • Ability to analyze information for accuracy and consistency<br>• Ability to evaluate system configuration<br>• Ability to use prior training/experience to predict outcomes<br>• Ability to analyze, interpret and summarize information<br>• Ability to present complex ideas and information |

## *Critical Work Function: Ensure Infrastructure and Network Security*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **B3. Develop critical situation contingency plans and disaster recovery plan** | • Plans appropriately prioritize criticality, time, cost and human resource requirements<br>• Plans reflect realistic scenarios for recovery and restoration<br>• Plans are effectively disseminated and continuously improved | • Knowledge of contingency and disaster recovery planning processes and practices<br>• Knowledge of network architecture and topology<br>• Ability to understand the IT mission and isolate critical performance elements | • Ability to predict outcomes/results based on prior knowledge<br>• Ability to create detailed supporting documentation and write technical documents for a variety of audiences<br>• Ability to analyze system configuration/stability<br>• Ability to analyze, interpret and summarize information |
| **B4. Implement/test contingency and backup plans and coordinate with stakeholders** | • Contingency and backup plans are validated through successful operational testing<br>• Contingency plans and procedures are routinely practiced, reviewed and refined<br>• Contingency and backup plans are implemented with appropriate participation of, and minimal disruption to, users<br>• Testing results in greater organizational awareness, readiness and responsiveness<br>• Contingency and backup plans are effectively communicated to internal and external stakeholders | • Knowledge of contingency and backup plan development, testing and implementation<br>• Knowledge of networking and general systems security<br>• Ability to analyze technical problems and develop appropriate solutions<br>• Knowledge of local and wide area networking environments<br>• Ability to develop and implement backup communication and coordination plans | • Ability to systematically organize information<br>• Ability to evaluate critically of problems, identify possible causes and propose solutions<br>• Ability to communicate effectively with clients/users<br>• Ability to document findings in detailed supporting documents |
| **B5. Monitor, report and resolve security problems** | • Security problems are detected quickly and reported accurately<br>• Monitoring includes all relevant devices, software and points of access<br>• Security problems are resolved effectively and measures are taken to preclude recurrence<br>• Problem resolutions provide for improved detection and deterrence | • Knowledge of security detection and deterrence methods and strategies<br>• Knowledge of security monitoring practices and procedures<br>• Knowledge of problem escalation and resolution methods | • Ability to integrate multiple items of data and synthesize information<br>• Ability to interpret information, prepare basic summaries/reports and select method of communication<br>• Ability to present results clearly and concisely<br>• Ability to probe for underlying issues and pose critical questions<br>• Ability to determine system components to be modified or improved |

## *Critical Work Function: Develop, Manage and Enforce Security Policies*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C1. Perform research and analyze requirements** | • Sources and methods for gathering requirements are trustworthy and current<br>• Security requirements are consistent with all applicable standards, laws and regulations<br>• Requirements are analyzed relative to applicable time, technology and cost constraints<br>• Requirements include feasibility analysis and recommendations for implementation and enforcement<br>• Requirements are regularly researched, reviewed, updated and approved by relevant stakeholders | • Knowledge of applicable standards, laws and regulations<br>• Knowledge of information gathering methods, procedures and practices<br>• Ability to collect, analyze, interpret and present security requirements in the data assurance environment<br>• Knowledge of applicable conditions and limitations relative to security policy development | • Ability to identify key sources of information<br>• Ability to analyze information for accuracy and consistency<br>• Ability to work cooperatively with others and contribute ideas, suggestions and assistance<br>• Ability to pose critical questions<br>• Ability to accurately summarize and document information |
| **C2. Develop, assess and document security policies, practices and procedures** | • Policies are developed and documented according to applicable practices and procedures<br>• Policies are assessed for feasibility of application and enforcement<br>• Policies reflect system and infrastructure capabilities<br>• Assessment includes accommodation for emerging trends and technologies | • Knowledge of policy development practices and methodology<br>• Knowledge of system and infrastructure architecture and capabilities<br>• Knowledge of emerging tools and technologies in security and data assurance | • Ability to create detailed supporting documents<br>• Ability to use prior training/experience to predict outcomes<br>• Ability to interpret data/information<br>• Ability to present complex information/ideas and analyze group/ individual response |
| **C3. Disseminate policies and implementation practices and procedures** | • Security policies and practices are clear, pertinent and effectively communicated to all staff and stakeholders<br>• Policy implementation includes opportunities for review, feedback and revision<br>• Policy enforcement is visible, fair and consistent with applicable laws, practices and institutional guidelines | • Knowledge of project planning and implementation<br>• Knowledge of cybersecurity policy enforcement methods and practices<br>• Ability to effectively communicate data assurance and information security concepts, procedures and regulations to a variety of audiences<br>• Knowledge of documentation dissemination, revision and control techniques | • Ability to present security tradeoffs and risks and pose critical questions<br>• Ability to willingly help others and establish rapport with coworkers and customers<br>• Ability to identify and project resource needs<br>• Ability to create detailed supporting documents |

## *Critical Work Function: Develop, Manage and Enforce Security Policies*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **C4. Implement, enforce and monitor security policies, practices and procedures** | • Security policies and procedures provide for performance audits and effectiveness reviews<br>• Stakeholders agree to follow security implementation guidelines and procedures<br>• Enforcement is visible, fair and consistently follows applicable laws, practices and regulations<br>• Security policies, practices and procedures are routinely followed and upheld<br>• Data is continuously gathered on the performance and effectiveness of security plans and operations | • Knowledge of performance audit and policy review techniques<br>• Knowledge of system security processes and procedures<br>• Knowledge of organizational, legal and regulatory issues surrounding security policy enforcement<br>• Knowledge of evaluation criteria relevant to information assurance and data systems security<br>• Ability to apply systems performance and audit data for policy compliance | • Ability to formulate plan of action and predict outcomes<br>• Ability to organize and present technical information to nontechnical users and analyze group/individual response<br>• Ability to assess and modify policies/ procedures<br>• Ability to plan according to resource constraints and requirements |

## *Critical Work Function: Perform Security Education and Training*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D1. Identify and assess education and training requirements for all constituents** | • Requirements reflect immediate training and education needs<br>• Requirements include long term and strategic IT workforce development goals<br>• Requirements are periodically reviewed for currency and applicability<br>• Requirements include appropriate assessments and certifications | • Knowledge of training and professional development methods and practices<br>• Knowledge of industry and enterprise IT workforce development trends and needs<br>• Ability to develop and maintain education and training plans<br>• Knowledge of skill and competency assessment methods and tools | • Ability to analyze relationship between parts/whole<br>• Ability to create organized and detailed supporting documents<br>• Ability to assess and recommend training alternatives<br>• Ability to understand constraints, generate alternatives, consider risks, evaluate options and formulate action plans<br>• Ability to predict outcomes/results based on experience or prior knowledge |
| **D2. Identify resources and support materials** | • Resources and source materials are current<br>• Resources and source materials are based on industry-derived standards<br>• Resources and source materials reflect acceptable quality of instructional design<br>• Resources and source materials support desired learner outcomes, competencies, skills assessments and certifications | • Knowledge of sources of applicable training and educational resources and materials<br>• Ability to assess and determine quality and suitability of education and training resources and source materials<br>• Knowledge of outcomes assessment and certification | • Ability to research additional information sources<br>• Ability to follow rules and procedures<br>• Ability to compile multiple viewpoints<br>• Ability to be creative in identifying and locating sources of information |
| **D3. Design and develop education and training plans and strategies** | • Plans and strategies support enterprise skill development needs<br>• Plans and strategies reflect accepted industry practices and policies<br>• Plans and strategies result in consistent outcomes<br>• Plans and strategies support immediate IT workforce skill needs and future IT workforce development goals | • Knowledge of IT workforce professional development planning processes<br>• Ability to accurately determine current and future needs<br>• Knowledge of enterprise and business goals and strategies<br>• Knowledge IT and security policies, methods, practices and strategies<br>• Knowledge of budgetary and contractual aspects of workforce professional development | • Ability to analyze and respond to client/user needs<br>• Ability to work cooperatively with others and contribute ideas, suggestions and assistance<br>• Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to organize and present complex information to users |

## *Critical Work Function: Perform Security Education and Training*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **D4. Deliver education and training** | • Education and training programs are delivered in a timely manner<br>• Education and training programs are delivered within budget<br>• Education and training programs are convenient and accessible<br>• Education and training programs result in expected outcomes, skills and knowledge gains | • Knowledge of education and training program development and delivery<br>• Knowledge of training program budgeting and accounting<br>• Knowledge of learner and environmental variability<br>• Knowledge of education and training program outcomes assessment | • Ability to gather, analyze and categorize information<br>• Ability to present complex ideas/ information and analyze responses<br>• Ability to listen attentively and compare multiple viewpoints<br>• Ability to speak clearly and present well-organized presentations<br>• Ability to identify training needs and conduct task-specific training |
| **D5. Assess results and determine followup requirements** | • Education and training programs result in appropriate or required credentials and/or certifications<br>• Education and training programs are routinely evaluated with regard to needs, outcomes and cost<br>• Education and training program requirements are periodically reviewed with stakeholders and systematically revised as needed | • Knowledge of applicability of appropriate degrees, certificates and certifications<br>• Ability to comprehensively evaluate education and training programs<br>• Knowledge of IT education and training program development, delivery and evaluation<br>• Ability to present and discuss IT workforce education, training and professional development programs to nontechnical audiences | • Ability to use logic to draw conclusions from available information<br>• Ability to analyze information and formulate proposals<br>• Ability to analyze goals/constraints and examine proposed modifications and improvements<br>• Ability to present recommendations in a clear, concise and persuasive manner<br>• Ability to evaluate/adjust plan of action |

## *Critical Work Function: Develop and Implement Physical Security, Deterrence and Detection*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E1. Identify and assess current and anticipated security risks and vulnerabilities** | • Security risks are assessed using appropriate standards and practices<br>• Security risks assessments include a variety of scenarios<br>• Assumptions are tested and verified<br>• Risk assessments include provisions for prevention as well as detection | • Knowledge of IT physical security standards and practices<br>• Ability to apply imagination and abstract reasoning to security problems<br>• Knowledge of theoretical and operational security systems performance and application<br>• Knowledge of prevention strategies and practices relating to IT systems | • Ability to recognize ethical issues<br>• Ability to use prior training/experience to predict outcomes<br>• Ability to troubleshoot system malfunction and/or failure<br>• Ability to distinguish trends in performance and diagnose performance deviations<br>• Ability to analyze possible cause of problems and recommend action plans for resolution |
| **E2. Research and evaluate alternative current and emerging practices, tools and technologies** | • Appropriate resources are continuously reviewed to determine current and emerging practices, tools and technologies<br>• Methods are developed and implemented to routinely share information with appropriate stakeholders<br>• Policies are developed and followed that ensure routine evaluation of currently used technologies and practices<br>• Routine security audits are performed<br>• Security audit findings and outcomes result in appropriate action | • Knowledge of relevant IT security information resources<br>• Knowledge of security systems evaluation and assessment<br>• Ability to develop, monitor and implement IT physical security policies and plans<br>• Knowledge of applicable business practices<br>• Knowledge of enterprise risks, vulnerabilities and budgets | • Ability to formulate approaches and generate unique solutions<br>• Ability to compose well-organized presentations and debate issues<br>• Ability to adapt principles to new applications and judge logical consistency |
| **E3. Select and apply relevant tools to meet security goals and requirements** | • Alternative technologies and methods are explored for effectiveness, benefits and cost<br>• Alternative tools are evaluated completely and accurately<br>• New tools and technologies are evaluated for compatibility with applicable existing systems and practices<br>• All stakeholders agree to selection criteria and selection process | • Knowledge of sources of information on emerging IT and physical security technologies, tools and methods<br>• Ability to perform cost/benefit, ROI and technical evaluations<br>• Knowledge of options for technology use<br>• Knowledge of enterprise IT and physical security systems<br>• Ability to present IT physical and systems security information to diverse stakeholders | • Ability to compare multiple viewpoints<br>• Ability to demonstrate honesty and trustworthiness<br>• Ability to analyze information and formulate proposals<br>• Ability to communicate/present in a clear and concise manner<br>• Ability to critically investigate various security tools |

## *Critical Work Function: Develop and Implement Physical Security, Deterrence and Detection*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **E4. Monitor, evaluate and test security conditions and environment** | • Policies are developed and implemented that allow detection of ordinary and nonordinary occurrences<br>• Policies are developed and disseminated that effectively communicate deterrence and detection practices and procedures<br>• Normal conditions are monitored with minimal intrusion<br>• Periodic tests are conducted to determine effectiveness of monitoring and deterrence practices<br>• Routine environmental scans are conducted to expose need for changes to security practices and procedures | • Knowledge of development and implementation of effective security deterrence and detection policies<br>• Ability to effectively and unobtrusively monitor and enforce IT physical and system security<br>• Knowledge of physical security systems testing and evaluation<br>• Ability to effectively communicate plans and implement procedures across organizational boundaries | • Ability to devise and implement plan of action<br>• Ability to create plan to monitor and correct system<br>• Ability to responsibly challenge unethical practices/decision<br>• Ability to monitor and interpret trends in technology and industry<br>• Ability to evaluate and interpret data |
| **E5. Implement, extend and refine physical security plans and practices** | • Physical security plans are implemented with minimal intrusion<br>• Data regarding effectiveness of physical security practices is routinely gathered from all stakeholders<br>• Physical security plans are regularly reviewed and evaluated against emerging trends and practices<br>• Physical security plans and practices are regularly updated and improved | • Knowledge of security plan development, implementation and extension practices and methods<br>• Ability to gather and present user and stakeholder data<br>• Knowledge of information resources relevant to IT physical security practices and trends<br>• Ability to develop, implement and maintain continuous improvement plans for physical security | • Ability to analyze security problems and recommend solutions<br>• Ability to implement and evaluate/adjust plan of action<br>• Ability to use previous training/ experiences to predict outcomes<br>• Ability to organize and clearly present complex information |

## *Critical Work Function: Perform System Design and Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F1. Define current systems-level requirements, and forecast future needs and trends** | • Current systems-level security requirements are defined according to industry standard terms and metrics<br>• Current systems-level requirements accurately reflect organizational needs and current operational conditions<br>• Current systems-level requirements are complete and accurate and can serve as the foundation for forecasting future needs<br>• Forecasts of future systems-level needs and trends reflect enterprise goals and requirements<br>• Forecasts of future systems-level needs and trends include applicable emerging technologies and practices<br>• Forecasts of future systems-level needs and trends embrace changing legal, agency or policy considerations | • Knowledge of relevant industry terminology and metrics<br>• Knowledge of business rules, budgets and operations<br>• Ability to develop and present systems-level security planning forecasts<br>• Knowledge of relevant resources regarding applicable legal, agency and policy developments and recommendations<br>• Knowledge of relevant resources regarding emerging systems-level IT security technology and trends<br>• Ability to develop and present IT security information to diverse and nontechnical stakeholders | • Ability to follow policies, procedures and regulations, pay attention to detail and follow up on assigned tasks<br>• Ability to compare multiple viewpoints<br>• Ability to examine information for relevance and accuracy and adapt principles/rules to new applications<br>• Ability to develop forecasts and evaluate scenarios |
| **F2. Evaluate current and emerging tools and technologies** | • Current tools and technologies are evaluated according to industry standard benchmarks and metrics<br>• Current tools and technologies adequately meet organizational needs and current operational conditions<br>• Current tools and technologies provide organizational framework for the implementation of emerging technologies and tools<br>• Emerging tools and technologies are evaluated according to industry standard benchmarks and metrics<br>• Evaluation of emerging technologies provides basis for implementation plan | • Knowledge of relevant industry benchmarks and metrics<br>• Knowledge of business rules, budgets and operations<br>• Knowledge of relevant resources regarding emerging IT security tools and technologies<br>• Ability to develop evaluation rationale and develop implementation recommendations or plans | • Ability to examine data for relevance/accuracy and present complex ideas/information<br>• Ability to analyze and understand system organization and configuration<br>• Ability to use logic to draw conclusions from available information and make recommendations<br>• Ability to stay current on cutting edge tools and technologies<br>• Ability to clarify, interpret and influence communication |

## *Critical Work Function: Perform System Design and Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F3. Evaluate organization's security strategies** | • Security strategies reflect relevant technology, tools and practices<br>• Security strategies support organization goals and mission<br>• Security strategies include clearly stated outcomes and evaluation criteria<br>• Security strategies allow for response to unforeseen events<br>• Security strategies conform to applicable laws, agency regulations, relevant recommendations and applicable evaluation criteria | • Knowledge of IT security technology, tools and practices<br>• Knowledge of business rules and practices<br>• Knowledge of criteria used to develop and evaluate IT security strategic plans<br>• Knowledge of security laws, agency regulations and bureaucratic recommendations | • Ability to compare multiple viewpoints and relate intent to desired results<br>• Ability to interpret and analyze information<br>• Ability to adapt rules/principles to new applications<br>• Ability to evaluate and communicate security strategies<br>• Ability to generate unique solutions, formulate new ideas and recommend new directions and processes |
| **F4. Make recommendations regarding organization's investment in security** | • Security recommendations are complete and accurately reflect organizational requirements and goals<br>• Recommendations are communicated appropriately<br>• Recommendations include risk assessment and cost/benefit analysis<br>• Security recommendations are compatible with operational systems and technology strategic plans | • Knowledge of business rules and practices<br>• Knowledge of IT strategic planning<br>• Ability to assess, categorize and rank risks, benefits and costs<br>• Knowledge of systems- and enterprise-level IT systems operation and technology | • Ability to analyze goals/constraints and examine proposed modifications and improvements<br>• Ability to pose critical questions, formulate proposals and create original documents<br>• Ability to adapt technology for complex alternative uses and evaluate application of technology<br>• Ability to forecast future security needs |

## *Critical Work Function: Perform System Design and Analysis*

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **F5. Coordinate systems testing and integration** | • Tests are appropriately designed and accurately measure required operational characteristics<br>• Testers are properly identified and trained<br>• Test results are documented in accordance with applicable procedures<br>• Test results are appropriately disseminated, reviewed and applied to performance improvement processes | • Knowledge of IT security systems testing tools, processes and procedures<br>• Knowledge of system operational characteristics and measurement<br>• Ability to identify and train qualified testers<br>• Knowledge of test documentation practices | • Ability to understand continuous improvement process and analyze goals/constraints<br>• Ability to summarize and translate mathematical data<br>• Ability to detect underlying issues and resolve technical conflicts<br>• Ability to analyze systems operation, monitor systems, distinguish trends in performance and evaluate systems performance<br>• Ability to create detailed supporting documents |
| **F6. Audit and maintain systems performance and ensure future readiness** | • Systems audits are conducted in accordance with organizational procedures<br>• Systems audits reflect applicable industry practices and recommendations<br>• Systems audits are reviewed and acted upon by appropriate stakeholders<br>• Systems readiness plans reflect anticipated growth<br>• Systems readiness considerations are included in IT strategic plans<br>• Readiness plans include all human and capital resource requirements | • Knowledge of systems performance and readiness audit procedures and techniques<br>• Knowledge of applicable industry performance audit standards and practices<br>• Ability to assess and determine anticipated systems growth needs<br>• Knowledge of IT strategic planning and organizational and enterprise-level IT issues and trends<br>• Knowledge of business forecasting processes, tools and techniques<br>• Knowledge of applicable information resources for IT and information assurance strategic planning | • Ability to analyze and adjust goals<br>• Ability to integrated multiple items of data and contrast conflicting data<br>• Ability to align resources with testing and integration needs<br>• Ability to solicit and accept feedback<br>• Ability to plan and communicate effectively |

# Appendices

## Project Management, Task Management and Problem-Solving/Troubleshooting

The following functions and tasks are reproduced from Version 1 of *Building a Foundation for Tomorrow: Skill Standards for Information Technology*. These elements represent core skill areas and may be applied to all career clusters.

## PROJECT MANAGEMENT

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **1. Define scope of project** | • The project's contribution to overall business needs is explicit<br>• Criteria for satisfying customer needs are identified<br>• The size and the specifics of the project are documented accurately and completely<br>• Applicable standards, regulations, and laws are identified | • Ability to use appropriate project management planning tools<br>• Ability to create project scenarios<br>• Knowledge of applicable standards, regulations, and laws | • Ability to analyze situation and formulate plan of action<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to visually analyze relationship between parts/whole and integrate |
| **2. Identify stakeholders, decision-makers and escalation procedures** | • Appropriate people are identified in a timely manner<br>• Escalation procedures are clearly identified and agreed upon | • Knowledge of company policy and procedures<br>• Knowledge of system's hierarchy | • Ability to consider risks and implications<br>• Ability to use logic to draw conclusions from available information<br>• Ability to demonstrate sensitivity to stakeholder's concerns and interests |
| **3. Develop detailed task list (work breakdown structures)** | • The size and specifics of the project are identified and documented<br>• Each task is sized appropriately<br>• Environment is documented accurately and completely | • Ability to use appropriate project management planning tools<br>• Knowledge of work processes | • Ability to formulate plan of action<br>• Ability to create comprehensive model<br>• Ability to identify important aspects of the situation |
| **4. Estimate time requirements** | • Time requirements are realistic<br>• Time estimates accommodate the management approved level<br>• Contingency plans are included in the time estimates | • Ability to create project scenarios<br>• Ability to visualize project time requirements at the task level<br>• Knowledge of spreadsheet and project management software | • Ability to analyze situation and formulate a schedule<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to visually analyze relationship between parts/whole and integrate processes |

## PROJECT MANAGEMENT

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **5. Develop initial project management flow chart** | • Activities contingent on other activities are sequenced appropriately<br>• Approval points, milestones, and go/no go decision points are defined to allow for project review, evaluation, postponement, and cancellation<br>• Tasks requiring long lead times are identified to avoid project delays<br>• Task priorities are assigned | • Ability to use appropriate project management flow charting tools<br>• Ability to create project scenarios<br>• Ability to visualize tasks sequentially<br>• Knowledge of spreadsheet and project management software | • Ability to analyze situation and formulate a plan of action<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to visually analyze relationship between parts/whole and integrate processes |
| **6. Identify required resources and budget** | • Resource and budget estimates are supported with data<br>• Rationale for recommending specific resources is defined<br>• Recommendations are thoroughly documented | • Ability to project resource and budgetary needs<br>• Ability to visualize project resource requirements at the task level<br>• Knowledge of company operating procedures regarding resource allocations<br>• Knowledge of spreadsheet software | • Ability to analyze situations and forecast conclusions regarding resource needs<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to create detailed supporting documents |
| **7. Evaluate project requirements** | • Conflicting or overlapping requirements are identified<br>• Evaluation includes feedback from key customers, management and peers<br>• Evaluation is well documented | • Ability to non-defensively critique project plan<br>• Knowledge of company operating procedures regarding project plan evaluations<br>• Knowledge of spreadsheet and project management software | • Ability to request feedback, both written and oral<br>• Ability to judge project effectiveness/ efficiency<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to create detailed supporting documents |
| **8. Identify and evaluate risks** | • Risk identification is complete and considers impact on whole system<br>• Risk evaluation includes feedback from key customers, management and peers<br>• Risks are well documented | • Ability to project potential risk scenarios<br>• Ability to non-defensively evaluate risks<br>• Knowledge of potential impact on whole system<br>• Knowledge of word processing software | • Ability to determine system components to be modified or improved<br>• Ability to predict potential risks based on experience or prior knowledge<br>• Ability to create detailed supporting documents<br>• Ability to compare multiple viewpoints |

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **9. Prepare contingency plan** | • Alternative ways to accomplish the goals are identified<br>• Limitations and tradeoffs are explicit<br>• Attention is directed to areas of concern and risk<br>• Contingency plan is well documented | • Ability to create alternatives<br>• Ability to forecast potential pitfalls<br>• Knowledge of potential impact on whole system<br>• Knowledge of word processing, spreadsheet and project management software | • Ability to pose critical questions<br>• Ability to identify contingencies based on experience or prior knowledge<br>• Ability to create detailed supporting documents |
| **10. Identify interdependencies** | • Interdependencies are completely and accurately identified<br>• Appropriate information is gathered from other parts of the system<br>• Interdependencies are clearly documented and communicated to those impacted by the project | • Ability to see the "big picture"<br>• Ability to diagram or document interdependencies<br>• Knowledge of potential impact on whole system<br>• Knowledge of word processing and project management software | • Ability to identify interdependencies based on experience or prior knowledge<br>• Ability to evaluate information for accuracy<br>• Ability to integrate multiple items of data and reconcile conflicting information |
| **11. Identify and track critical milestones** | • Milestones and schedules are clearly understood and communicated<br>• Appropriate information is gathered from other parts of the system<br>• Milestones are adjusted appropriately<br>• Documentation provides comprehensive and understandable information | • Ability to use appropriate tracking and milestone tools<br>• Ability to evaluate project progress<br>• Knowledge of potential impact on whole system<br>• Ability and willingness to adjust plans and milestones to changing priorities or customer requirements<br>• Knowledge of word processing, spreadsheet and project management software | • Ability to formulate and organize processes<br>• Ability to identify milestones based on experience or prior knowledge<br>• Ability to evaluate information for accuracy |
| **12. Participate in project phase review** | • Project reviews are timely and include the appropriate team members<br>• Appropriate information is gathered from other parts of the system<br>• Review is complete and follows operating procedures | • Ability to participate in a group review process<br>• Ability to evaluate project progress<br>• Knowledge of potential impact on whole system | • Ability to examine information for relevance and accuracy<br>• Ability to actively participate based on experience or prior knowledge<br>• Ability to interpret and clarify communication |

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **13. Secure needed resources** | • The use of the resources is optimized<br>• Resources are obtained so that tasks and activities occur as planned<br>• People, equipment, supplies, and services are available when needed<br>• The need for substitutions is identified and arranged | • Ability to request resources, both written and oral<br>• Knowledge of company operating procedures regarding resource availability<br>• Knowledge of industry standards and constraints<br>• Knowledge of word processing and spreadsheet software | • Ability to integrate systems technology resources<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to create detailed supporting documents |
| **14. Manage the change control process** | • Necessary changes are identified and evaluated<br>• Appropriate information is gathered from other parts of the system<br>• The impact of the change is factored into project schedule and budget<br>• Appropriate parties are notified of the impact of the changes<br>• Changes are contemplated and approved in a timely manner<br>• Required changes are documented and implemented | • Ability to evaluate impact of changes on project plan<br>• Knowledge of the standard operating procedures regarding project changes<br>• Knowledge of potential impact on whole system<br>• Knowledge of word processing, spreadsheet and project management software | • Ability to examine changes for relevancy and appropriateness<br>• Ability to actively participate based on experience or prior knowledge<br>• Ability to interpret and clarify communication<br>• Ability to adapt to changes |
| **15. Report project status** | • Project outcomes are evaluated against project goals<br>• Complete project phase results are documented and clearly communicated<br>• Lessons learned are clearly documented and communicated<br>• Performance metrics associated with the process are captured and documented<br>• Significant problems are immediately reported<br>• The style and format of the project status document conforms to company requirements | • Ability to evaluate project status and outcomes non-defensively<br>• Knowledge of the standard operating procedures regarding project reviews<br>• Knowledge of the potential impact on whole system<br>• Knowledge of word processing, spreadsheet and project management software | • Ability to accept responsibility for own outcomes<br>• Ability to actively participate based on experience or prior knowledge<br>• Ability to interpret and clarify communication<br>• Ability to present information in a clear, concise and objective manner |

## TASK MANAGEMENT

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **1. Define scope of work to achieve individual and group goals** | • The task's contribution to overall business needs is explicit<br>• The size and the specifics of the task are identified accurately<br>• Criteria for successful completion of the tasks are identified<br>• Multiple tasks are planned simultaneously<br>• Potential problems are identified and contingency plans developed | • Ability to visualize project time requirements at the task level<br>• Ability to use appropriate time management methods<br>• Knowledge of applicable standards, regulations, and laws | • Ability to analyze situation and formulate a task sequence<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to visually analyze relationship between parts/whole and integrate processes |
| **2. Develop time and activity plan to achieve objectives** | • Plan is coordinated with team, cross-functional groups, or individuals<br>• Plan changes are communicated promptly to all those affected<br>• Tasks are prioritized according to business needs<br>• Multiple tasks are managed simultaneously<br>• Contingency plan is developed | • Ability to visualize project time requirements at the task level<br>• Ability to use appropriate time and resource management methods<br>• Knowledge of system procedures and constraints<br>• Knowledge of word processing and spreadsheet software | • Ability to analyze situation and formulate a task strategy<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to visually analyze relationship between parts/whole and integrate processes<br>• Ability to devise and implement plan of action |
| **3. Design and develop work processes and procedures** | • Work processes or procedures reflect customer needs and cost specifications<br>• Work processes or procedures are developed on time<br>• Work processes or procedures are documented clearly and concisely<br>• Work processes or procedures reflect potential risks and dependencies | • Ability to design and develop work flow<br>• Ability to identify impacts on work processes<br>• Ability to see the "whole picture"<br>• Knowledge of standard company work processes and procedures<br>• Knowledge of word processing and spreadsheet software | • Ability to analyze situation and create work plan<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to analyze work assignments<br>• Ability to document work processes |

## TASK MANAGEMENT

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **4. Identify and obtain tools and resources to do the job** | • Necessary supplies and tools are available when needed<br>• Budget guidelines for tools and resources are followed<br>• Documentation for use and maintenance of hardware and software is secured, current and accessible<br>• Material request procedures are followed | • Ability to forecast tools and resources<br>• Ability to access needed tools and resources<br>• Knowledge of material request procedures<br>• Ability to analyze cost and benefit of various tools and resources<br>• Knowledge of word processing and spreadsheet software | • Ability to analyze situation and create a list of required tools and resources<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to coordinate acquisition, storage and distribution of software and hardware |
| **5. Coordinate and implement work processes and procedures** | • All affected parties are informed and updated<br>• Implementation is in accord with all relevant policies and procedures<br>• Implementation conforms to business decision processes<br>• Implementation is completed within established time frame | • Technical issues are resolved<br>• Ability to coordinate with others to meet deadlines<br>• Knowledge of task-related work processes and procedures<br>• Knowledge of business decision processes<br>• Knowledge of word processing and e-mail software | • Ability to stay focused on desired outcomes<br>• Ability to actively participate in team tasks<br>• Ability to implement process plan<br>• Ability to resolve and negotiate issues with others |
| **6. Monitor, analyze, and evaluate work processes and procedures** | • Appropriate monitoring and evaluation systems are utilized<br>• Processes and procedures are reviewed by appropriate customers and manager<br>• Recommendations for improvements in process and procedures are made to customers and management on a continuous basis | • Ability to use standard monitoring and evaluation systems<br>• Ability to schedule process reviews following company standard practices<br>• Knowledge of word processing software | • Ability to determine quality and quantity of workload<br>• Ability to continually improve processes<br>• Ability to assess individual development and improvement needs<br>• Ability to monitor efficient and effective utilization of materials and tools |
| **7. Generate and maintain task status report** | • Documentation/information is accurate, clear, and concise<br>• Document/information is available on time<br>• The style and format of the documentation conforms to customer and management requirements<br>• Information/documents are stored in a timely manner<br>• Storage systems are easily accessible | • Ability to evaluate task outcomes non-defensively<br>• Knowledge of documentation requirements of customer and management<br>• Knowledge of document storage and retrieval tools<br>• Knowledge of word processing software | • Ability to accept responsibility for own outcomes<br>• Ability to make process improvements based on report outcomes<br>• Ability to evaluate relevance of data needed in report<br>• Ability to create concise report |

## PROBLEM-SOLVING / TROUBLESHOOTING

| KEY ACTIVITY | PERFORMANCE INDICATORS<br>*How do we know when the key activity is performed well?* | TECHNICAL KNOWLEDGE<br>*Skills, Abilities, Tools* | EMPLOYABILITY SKILLS<br>*SCANS Skills and Foundation Abilities* |
|---|---|---|---|
| **1. Define the problem** | • The problem definition is oriented and focused toward facts and data<br>• The existing human and system resources are used effectively to determine the problem<br>• The problem definition defines a gap in expectations<br>• Symptoms and background of the problem are identified<br>• Problem definition is documented clearly and concisely | • Knowledge of system norms and operations<br>• Knowledge of problem isolation tools and procedures<br>• Ability to document abnormal events in detail | • Ability to summarize/generalize information<br>• Ability to understand system discrepancies<br>• Ability to examine information/data for relevance and accuracy<br>• Ability to distinguish between problem symptoms and causes<br>• Ability to clarify and frame problems |
| **2. Perform appropriate analysis to identify problem cause** | • Determine appropriate analysis technique<br>• Analysis is complete and documented<br>• Cause(s) of the problem and ramifications are identified and documented<br>• Scope of impacts are identified and documented | • Ability to create and test a theory<br>• Ability to perform causal analysis<br>• Ability to identify the impact of the problem on the whole system<br>• Ability to break down the problem<br>• Ability to think creatively while analyzing problem | • Ability to apply appropriate principles/ laws/theories to situation<br>• Ability to analyze information and identify interdependencies |
| **3. Identify/test possible solutions** | • Solutions reflect concern for cost, schedule, and long-term implications<br>• Measured criteria for evaluation is established<br>• Tests are in compliance with legal requirements, company policy, operating procedure and customer specifications<br>• The appropriate solution is identified and the appropriate action is determined (escalate, fix, or resolve) | • Ability to develop experiments to test a theory<br>• Ability to develop and test alternative solutions (fix the fix)<br>• Knowledge of company operating procedures regarding testing procedures | • Ability to apply reasoning skills to identifying potential solutions<br>• Ability to research additional sources of information<br>• Ability to generate/evaluate solutions with others<br>• Ability to assess the feasibility and relevance of a solution |

## PROBLEM-SOLVING / TROUBLESHOOTING

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|---|---|---|---|
| **4. Develop resolution plan** | • Resolution plan is developed, documented and accepted by all impacted parties<br>• Resolution plan is designed for minimal impact of process flow and productivity<br>• Resolution plan includes appropriate input from customer, key individuals, departments, and outside providers<br>• Contingency plans are developed and made available<br>• Internal and external obstacles are identified and potential resolutions are identified and documented | • Ability to facilitate solution selection<br>• Ability to organize and manage complex processes<br>• Knowledge of the impact of solutions on whole system | • Ability to analyze system configuration<br>• Ability to gather data, analyze, and reach decisions and agreements<br>• Ability to resolve technical issues<br>• Ability to propose options/solutions based on research |
| **5. Implement solution** | • Resolution plan is implemented in an efficient and timely manner<br>• Any changes to the plan are communicated promptly to key individuals<br>• Appropriate change requests are completed according to company requirements<br>• Solution to the problem (including operational adjustments) is documented and communicated to appropriate individuals and groups<br>• Problem solution is written into knowledge base and/or communicated appropriately | • Ability to assess resolution plan on a continuous basis<br>• Knowledge of company change management procedures<br>• Ability to deal with implementation obstacles | • Ability to organize new processes/ procedures<br>• Ability to predict outcomes/results based on experience or prior knowledge<br>• Ability to implement plan of action<br>• Ability to write and edit technical documents<br>• Ability to communicate with a variety of audiences |
| **6. Evaluate problem solving processes and outcomes** | • Evaluation determines whether the outcomes solved the problem in accord with what was intended (and did not cause any unintended or unexpected results)<br>• Evaluation determines whether the process was used efficiently and responsibly<br>• The validity and usefulness of the outcomes is assessed<br>• Any appropriate follow-up action is determined | • Ability to evaluate technical solutions<br>• Knowledge of company procedures for follow-up actions | • Ability to summarize/generalize information<br>• Ability to compare multiple viewpoints<br>• Ability to analyze information and identify interdependencies<br>• Ability to evaluate problem solving processes and suggest continuous improvement |




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*For more information please contact:*

The National Workforce Center for Emerging Technologies
3000 Landerholm Circle SE, N258
Bellevue, WA 98007-6484

Phone: (425) 564-4215
Fax: (425) 564-6193
Email: nwinfo@bcc.ctc.edu
Web: www.nwcet.org