

Test Content Outline

Approved Date: August 2022

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	Number of Scored Questions ¹
A. Procurement	5
B. Project Management	7
C. Operations	16
D. Communications	7
E. Training and Education	5
F. Image Management	23
G. Information Technology	16
H. Systems Management	20
I. Clinical Engineering	13
J. Medical Imaging Informatics	18
Total	130

The Test Content Outline lists the areas to be covered and the weightings reflecting their relative importance. Content outlines are developed by determining what imaging informatics staff at entry level are required to do on the job, and then defining the knowledge and skills necessary to perform those tasks.²

A detailed *Test Content Outline* continues on the following pages.

Note: The abbreviation “e.g.,” is used in this document to indicate examples of the topics covered, but the examples are not a complete list.

1 Each exam includes an additional 40 unscored (pilot) questions.

2 A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents, and reviewers.

A. Procurement (5)

1. Project Definition
 - a. Justification
 1. Total cost of ownership (TCO)
 2. Return on investment (ROI)
 - b. Procurement goals
 - c. Scope of solution
 - d. Preliminary budget
 - e. Procurement policies
 - f. Evaluation and selection process
 - g. Governance definition
 - h. Project plan (milestones, dates)
2. Needs Assessment – Methods of Needs Collection, Documentation, Analysis, Prioritization, and Validation
3. Vendor Identification and Quantification
4. Finalize and Distribute Procurement Request (e.g., RFP)
5. Solution Evaluation
 - a. Information collection and analysis
 - b. System demonstrations
 - c. Evaluation collection and analysis
 - d. Client reference checks and site analysis
6. Vendor Selection
7. Vendor Contracts
 - a. Contract development
 - b. Contract negotiation

B. Project Management (7)

1. Goals, Scope, and Risks
 - a. Identify goals
 - b. Identify scope
 - c. Scope change control
 - d. Identify risks
1. Internal to project

2. External to project
- e. Quantify risks and defining mitigation strategies
- f. Identify dependencies

2. Project Plan
 - a. Work breakdown structure (WBS)
 - b. Resource identification and effort estimates
 - c. Project milestones and dependencies
3. Project Implementation
 - a. Documentation of readiness, planning, initiating, executing, monitoring, and closing processes (e.g., Gantt charts, time-and-task tracking)
 - b. Status reporting (budget, cost schedule, resource, quality)
4. Project Completion and Assessment
 - a. Project retrospective
 - b. Post go-live lessons learned

C. Operations (16)

1. Quality Improvement (QI) Procedures
 - a. Philosophical basis of QI
 - b. Process improvement strategies (e.g., Six Sigma, LEAN)
 - c. Problem identification analysis and tools (e.g., clear communication through SBAR form, fishbone chart)
2. Policies and Procedures
 - a. System management (e.g., downtime, incidents, back-up and recovery, privacy and security)
 - b. User management (e.g., access, roles)

- c. Compliance with applicable regulations (e.g., HIPAA, MQSA, HITECH Act, radiation dose tracking)
- 3. Operational Budgeting
- 4. Systems Change Control
- 5. **Operational Reporting and Data Analytics** (e.g., data mining methods, statistical analysis, information presentation)
 - a. Key performance indicators (KPIs) uptime, capacity, exceptions, unread exams, lost studies)
 - b. Data visualization (e.g., pivot table, bar chart, scatter plot)
- 6. **Vendor Management**
 - a. Statement of work (SOW)
 - b. Support and maintenance agreement (SMA)
 - c. Service level agreement (SLA)
 - d. Contract renewal
 - e. End of service life (EOSL)

D. Communications (7)

- 1. Roles and Relationships in Healthcare Settings
 - a. Healthcare roles (e.g., CMIO, department chair, section chief, resident)
 - b. Healthcare settings (e.g., ambulatory, academic, private practice, pediatrics, research)
 - c. Medical specialties (e.g., radiology, pediatrics, orthopedics, neurology, oncology)
- 2. Medical Terminology
 - a. Anatomy, physiology, and pathology
 - b. Common imaging positions
 - c. Imaging planes
 - d. Modality-specific terminology

- e. Coding with: ICD, CPT®, SNOMED, RADLEX™, LOINC
- 3. System Availability Issues or Changes, Notifications to Business Units
 - a. Change management communications (e.g., who, what, when, why, how)
 - b. Notifications (e.g., downtime, upgrades, changes in workflow)
 - c. Plans and techniques based on user roles
- 4. Strategic Planning and Reporting
 - a. Aligning department goals with organizational strategic plan
 - b. Feedback mechanisms
 - 1. Reporting tools
 - 2. **Measurement** methods (e.g., surveys)

E. Training and Education (5)

- 1. Needs Assessment
 - a. **Training need** (e.g., new system, workflow change, system upgrade)
 - b. Audience (e.g., size, location, role) and instructional objectives
 - c. **Training delivery method**
 - d. Measurement methods (e.g., surveys, task analysis)
- 2. Training Programs
 - a. Training delivery methods
 - 1. Settings (e.g., in-person, virtual)
 - 2. Presentation (e.g., written, graph, video)
 - b. Training assessment

F. Image Management (23)

- 1. Environmental Design for Viewing and Interpreting Images
 - a. Ergonomics
 - b. Environmental factors

- c. Room layout and physical considerations
- 2. The Human-Computer Interface
 - a. EMR/RIS/PACS/ reporting integration
 - b. Input devices
 - c. Display devices
- 3. Workflow Processes
 - a. Postprocessing workflow
 - b. Data compression (e.g., images)
 - c. Image workflow (e.g., display protocols, read-ready)
 - d. Key image selection and image annotation
 - e. Teaching files
 - f. Research and/or clinical trials (e.g., de-identification)
 - g. Image acquisition and display terminology
 - h. Technologist exam QC workflow (e.g., confirm image count in PACS)
 - i. Reporting and results communication
 - 1. Report status (e.g., preliminary, final, addended)
 - 2. structured versus narrative
 - j. Exam data integrity QC checks (e.g., storage commitment, order reconciliation, DICOM modality worklist)
 - k. Workflow optimization
 - l. Remote interpretations (e.g., telehealth, teleradiology)
- 4. Image Exchange
 - a. Policies and procedures
 - b. Import and reconciliation workflow
 - c. Data integrity
- d. Export workflow (e.g., portable media, cloud-based solution)
- e. Standards of file exchange
- f. Cross enterprise image exchange
- 5. Imaging Data Archiving (e.g., retention, deletion policies)
- 6. Enterprise Imaging
 - a. Visible light (e.g., pathology, dermatology, wound care, endoscopy)
 - b. Radiology
 - c. Cardiology

G. Information Technology (16)

- 1. Storage and Archive Technology and Architecture
 - a. Storage types (e.g., NAS, SAN, SSD)
 - b. Storage network protocols (e.g., iSCSI, fiber channel, SATA, S3, CIFS, SMB, NFS)
 - c. Archive strategies
 - 1. Online
 - 2. Nearline
 - 3. Data throughput (e.g., IOPS)
 - 4. Methods for storage management (e.g., virtualization, replication, mirroring)
 - 5. Storage metrics (e.g., capacity, consumption)
 - 6. Cloud-based solutions
- d. Vendor neutral archives (VNA)
- 2. Network Architecture
 - a. Network protocols (e.g., ethernet, wireless, bluetooth, OSI model, TCP/IP)
 - b. Transmission protocols (e.g., DICOM, FTP, HTTP, SSH)

- c. Load balancing, fault tolerance, and redundancy
- d. Network components and hardware (e.g., hubs, switches, routers, gateways, trunks, CAT-5e, CAT 6, fiber)
- e. Network configuration (e.g., IP address, virtual IP, LAN, WAN, VLAN, VPN, DNS, ARP, NAT, firewall, TLS/SSL, ports)
- f. Network metrics/dashboard (e.g., capacity, bandwidth, latency, performance, cost)

3. Hardware and Software Components

- a. Hardware components
 - 1. GPU, video card
 - 2. CPU
 - 3. Memory (e.g., RAM)
 - 4. Hard drive
 - 5. Network interface card (NIC)
 - 6. Motherboard connectivity (e.g., PCI, USB, SCSI, AGP)
 - 7. Removable media hardware (e.g., CD, DVD, USB/SSD)
- b. Software components
 - 1. Operating systems (OS)
 - 2. Run time (e.g., .NET, Java)
 - 3. Browser
 - 4. Remote system management tools (e.g., RDP, VNC)
 - 5. Authentication mechanisms
 - a. Active directory
 - b. LDAP, LDAPS
 - c. Group policy
 - d. Single sign on (SSO) (e.g., Kerberos, SAML, OAuth 2.0)
 - e. Two-factor authentication
 - 6. Role based access control (RBAC)
- c. Server hardware

- d. Virtual machine platform (e.g., Citrix®, VMware®)
- e. Virtual desktop infrastructure (VDI)
- f. Mobile devices

4. Data Retrieval for Operations, Quality Assurance, and Planning Purposes

- a. Structured query language (SQL) concepts
- b. Database design, management, and maintenance concepts (e.g., keys, normalization, table joining, performance)

5. General IT Data Standards

- a. Data interchange formats (e.g., CSV, XML, JSON)
- b. Human-readable document formats (e.g., RTF, PDF)

6. System Lifecycle Management Planning (technology lifecycle and adoption)

H. Systems Management (20)

- 1. Planning for System Capacity and Throughput
 - a. Imaging exam and object size calculations
 - b. Exam counts by modality or procedure type over a period (e.g., annual)
- c. System scalability considerations
 - 1. Database
 - 2. Storage
 - 3. Server
 - 4. Networking
- d. Cloud-based system deployments
- e. Impact of new modality types (e.g., 256 slice CT, breast tomosynthesis)

- f. Software licensing models (e.g., subscription, enterprise, concurrent, named user)
- 2. System Test Planning and Execution
 - a. Developing a test strategy (e.g., approach)
 - b. Building a test environment
 - c. Compiling test data
 - d. Identifying test resources (testers)
 - e. Defining testing types to develop (e.g., functional, integration, workflow, user acceptance, scalability/stress, security)
 - f. Developing test cases/scripts and suites
 - g. Executing testing
 - h. Documenting test results
 - i. Maintaining test cases and suites
- 3. Disaster Recovery Plans and Business Continuity Strategies
 - a. Policies and procedures
 - 1. Data protection
 - 2. System downtime
 - 3. System failover and failback
 - b. System failure, risk analysis, and system design resiliency
 - 1. Redundant system components
 - 2. High availability (HA)
 - 3. Business continuity (BC)
 - 4. Disaster recovery (DR)
 - 5. Data replication
- 4. Incident Tracking and Problem Management
 - a. Availability monitoring and problem detection
 - 1. Incident reporting procedures
 - 2. Automated system monitoring (e.g., dashboard)
 - 3. Alerts
 - 4. SNMP
- b. Troubleshooting/problem diagnosis (e.g., network protocol analysis, DICOM simulation, system log aggregation and analysis)
- c. Root cause analysis
 - 1. Problem definition
 - 2. Data collection
 - 3. Possible causal factor identification
 - 4. Root cause(s) identification
 - 5. Solution recommendation(s) and implementation
- d. Status reports to management
- 5. Data Migration Procedures- Definition of Scope of Data to be Migrated
 - a. Strategies for migration
 - b. Physical data transfer considerations
 - c. Data standardization and data integrity
 - d. Record quality identification, evaluation, and correction
 - e. System-proprietary data considerations (e.g., custom migration method, conversion to standard data representation)
 - f. Cost and performance models
 - g. User impact
 - h. Progress monitoring and reporting
- 6. Data Security and Individual Privacy

- a. Jurisdictional-relevant laws, regulations, standards, policies, and guidelines
 - 1. HIPAA (U.S.)
 - 2. GDPR (EU)
 - 3. PIPEDA (Canada)
 - 4. ACR-AAPM-SIIM Practice Parameter for Electronic Medical Information Privacy and Security
 - 5. NIST
- b. Security strategies
 - 1. Physical
 - 2. System
 - 3. Network
 - 4. Endpoint (devices)
 - 5. Application
 - 6. Data encryption
- c. Privacy

I. Clinical Engineering (13)

- 1. Imaging Modality Workflow and Data
 - a. Radiography/fluoroscopy/ tomography
 - b. Breast imaging
 - c. Magnetic resonance imaging (MRI)
 - d. Computed tomography (CT)
 - e. Ultrasound
 - f. Nuclear medicine and molecular imaging
 - g. Cardiology
 - h. Radiation therapy
 - i. Interventional radiology (IR)
 - j. Visible light
- 2. Ancillary Services Workflow and Data
 - a. Oncology (e.g., tumor tracking)
 - b. Surgical planning (e.g., ortho templating, 3D printing)
 - c. Stereotactic imaging

- d. Intraoperative imaging
- e. Point of care imaging (e.g., point of care ultrasound, medical image capture, wound care)
- f. Digital pathology
- 3. Imaging Modality Integration
 - a. DICOM configuration
 - 1. Configuration parameters (e.g., AE title, port)
 - 2. Modality worklist
 - 3. Performed procedure step
 - 4. Storage commitment
 - b. DICOM services
 - c. DICOM objects
 - d. DICOM validation
 - e. DICOM transfer syntax
 - f. DICOM tools
 - g. Other types of integration
- 4. Image Display Quality Control
 - a. DICOM Grayscale Standard Display Function (GSDF) part 14
 - b. AAPM TG18 report
 - c. Quality assurance programs
- 5. Clinical Awareness
 - a. Electrical hazards
 - b. Ionizing radiation and radiopharmaceuticals
 - c. Magnetic fields
 - d. Infection/biohazards
 - e. Sterile field procedures (e.g., operating room)

J. Medical Imaging Informatics (18)

- 1. Medical Imaging Workflow Solutions
 - a. Definition
 - b. Implementation
 - c. Evaluation/process improvement
- 2. Systems Integration
 - a. EMR/web portals

- b. RIS
- c. PACS
- d. Enterprise image viewer
- e. CAD (e.g., breast, lung, prostate)
- f. Reporting systems
- g. Postprocessing software or systems
- h. Radiation dose management
- i. Contrast dose management
- j. Modality content structured reporting (e.g., ultrasound, DXA)
- k. Decision support
 - 1. Order entry
 - 2. Exam protocols
 - 3. Interpretation, case comparisons
- l. Critical/urgent results communication
- m. Discordant findings notification
- n. Peer review
- o. Clinical analytics
- p. Integration methods (e.g., API, web services)
- q. Scanned documents
- r. Enterprise image (e.g., dermatology, wound care, surgical video) devices

- 3. Medical Imaging Standards
 - a. DICOM
 - b. HL7 (e.g., v2.x, FHIR)
 - c. ICD, CPT®, SNOMED CT, LOINC
- 4. Role of Medical Imaging and Other Healthcare Groups (e.g., ACR, AAPM, SIIM, The Joint Commission)
- 5. IHE Integration Profiles and Guidelines
- 6. Align Image Management Strategy with Organization's Strategic Plan