INFORMATION TECHNOLOGY QUALITY CONTROL AND QUALITY ASSURANCE DESIGN, PLANNING, AND SUPPORT

Overview of Quality Control and Quality Assurance Services

Croswell-Schulte provides services for the establishment of standards, specifications, and procedures for information quality control (QC) and quality assurance (QA) for information technology projects and programs. These services cover the following types of services associated with the development and maintenance of software, custom applications, and databases:

→ Definition of quality standards and specifications

→ Preparation of QC and QA plans

→ Creation of QC test cases and scripts

→ Support in procuring QA services

→ Assistance in preparation of contracts for IT development work (with quality specifications and performance criteria

→ Set-up and oversight of QC and QA procedures

Croswell-Schulte follows the concept of quality, as it applies to information technology projects and programs, established by leading professional organizations including the International Organization for Standardization (ISO) and the Project Management Institute (PMI). "Quality" is the degree to which and IT product or service fulfills stated specifications. This implies that the specific IT product, deliverable, or service is well defined with documented specifications for content, format, performance, and accuracy—which constitute quality. Croswell-Schulte works with its clients to establish IT product and service specifications, quality metrics, and procedures for testing and assuring adherence to quality parameters.

"Quality Control" and "Quality Assurance" are related concepts. The term "Quality Control" (QC) refers to procedures and tools used to verify quality and correct errors during the development of an IT product or deliverable "Quality Assurance" (QA) applies to independent checks of IT product or service quality to provide a basis for acceptance or approval. For instance, in the case of a project involving the development, by a contractor, of a custom IT application, the contractor puts in place QC processes designed to meet stated specifications. The client for which the application is being prepared, establishes quality QA checking procedures to verify adherence to specifications as a basis for acceptance of the application.

Software and Application QA and QC

Croswell-Schulte applies established software quality management principles, standards, and methodologies as espoused by the following authorities:

| International Organization for Standardization (ISO) | Institute of Electrical and Electronics Engineers (IEEE) | American National Standards Institute (ANSI) | Carnegie-Mellon Software Engineering Institute (SEI) |

We work with our clients and their vendors and contractors to put in place QC and QA procedures to deliver software and applications that meet required specifications and which are developed and documented in a way that supports efficient software revision and integration with other IT software and databases. Key software quality dimensions, which are the basis for setting up QC and QA procedures, are explained in the table below.

Software/ System Quality Dimensions	Explanation
Functionality/ Correctness	Products (code, database design, interfaces, and documentation) are free from logical or technical errors that result in faults or results that do not conform to specifications.

Reliability	Addresses the robustness of the system including its availability, lack of system crashes, or other problems with limit or impact effective use.
Efficiency/ Performance	How well the system performs with an emphasis on speed of processing and response time for users
Integrity/Security	Software and hardware controls that protect the system from unauthorized access or accidental corruption and which support monitoring and tracking of access.
Usability	Effectiveness of all system elements and products that users with which users will interact. This address the design and efficiency of user interfaces, documentation, help tools, and other features that impact user's ability to access and get needed results from the system.
Maintainability/ Flexibility	The overall structure and design of software and system components that support on-going maintenance, upgrades, and changes over time (after initial deployment). This has to do with good use of coding and design conventions, technical documentation, and tracking tools used by developers
Portability/ Reusability	Ability of the software to be adapted and used in new environments or for code modules to be re-used in other applications. This addresses sound use of standards, documentation, database design conventions, and other design and development factors that facilitate portability and re-use.

Croswell-Schulte sets up software quality checking processes and tools that support a comprehensive testing environment used as software or applications are being developed, reviewed by users, and submitted for acceptance. This includes unit testing, functional/integration testing, regression testing, and peak load testing. Testing occurs at planned milestones in the software/application development process. Testing results are evaluated based on performance criteria and potential "failure points" that help to reveal possible flaws or performance problems that need to be corrected. After delivery of completed software products, we work with our clients and developers to design formal user acceptance testing (UAT) providing an environment for detailed QA evaluation to identify any remaining software problems and leading to formal approval of the products. To support the quality testing work, we design and help configure test scripts and data sets.

Quality Management for Database Development and Maintenance

Data quality defines the degree to which a database meets specifications for content, format, and accuracy. Specific, documented quality parameters are established as a basis for QC and QA checks used during database development and ongoing maintenance. Croswell-Schulte works with clients to define database specifications that meet business needs and quality management procedures to ensure that specifications are met. We design and support QC and QA processes for different types of data including traditional structured databases (tabular databases with defined schema), document data, and geographic information system (GIS) data. Our design of specifications includes a definition of acceptable quality levels associated with the following parameters:

- Naming Standards: Adherence to defined standards and specifications for naming of files, tables, attributes, and other database entities (e.g., feature types in GIS databases) for naming of files and database layers. Also included are checks for proper spelling

- Completeness: Inclusion and population of all files, valid records, population of attribute fields, and inclusion of other database entities (e.g., feature types in GIS databases) to the extent to which available source materials allow.

- Currentness: Measures how up-to-date the database is—relative to the current existence of entities in reality or to a defined authoritative source. Completeness encompasses two related types of possible error: a) errors of omission (should be included but are missed) and b) errors of commission (contains features, records that should not be captured in the database).

- Graphic Quality: A quality parameter applicable to line-based vector database products (e.g., GIS, drawings) calling for proper graphic closure and topology, feature segmentation and connectivity, edgematching, and other graphic concerns.

- Positional Accuracy: For GIS databases, this parameter reflects the positional placement of map features (and their coordinates)—gauging how well those positions correspond to actual positions on the Earth's surface or to defined data sources.

- Attribute Accuracy: The correctness of entered attributes and proper adherence to database format, established domains, and proper values from source material. Also included are checks for proper spelling for text-based data fields.

- Product Format Symbology, Annotation, and Sheet Format: Adherence to defined format and content specifications for products (reports, maps, graphs) generated from the database for hard copy output of digital display. Includes such items as text font and format, colors, text report format, map symbols and line types, etc.

- Image Format and Quality: For document databases with images (e.g., digital photographs, scanned drawings or maps, aerials digital photography). This covers defined format and content parameters including image rotation and cropping, raster file format, pixel resolution, and overall image quality (contrast, speckles, or artifacts, etc.).

As part of the preparation of database specifications—for data capture and development projects to be performed by client staff or by a contractor, we define how the quality parameters listed above apply to the database and acceptable levels (normally expressed as a percent). This is the basis for preparation of a database development work plan and the necessary QC and QA procedures and tools—including automated testing (e.g., for adherence to attribute field domain values). In addition, Croswell-Schulte designs procedures and tools for tracking and reporting on QC and QA status.

Croswell-Schulte plays a support and oversight role with parties tasked with database development work (often a contractor) and recipients of database deliverables with QA and approval responsibilities. Our work includes preparation of contract terms—with performance requirements that include adherence to technical specifications and documented data quality levels. When necessary, Croswell-Schulte will support clients in the case of contractor performance problems or exercising of contract amendments, mediation, or exercise of penalty terms.

Quality Management in IT Services

Quality management is a primary concern for a range of commonly used IT services—including Internet and Web hosting service providers and a range of Cloud-based services. Cloud-based services include a wide array of Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). Croswell-Schulte assists its clients in the preparation of contracts and service level agreements (SLAs). We prepare terms for performance criteria and methods for monitoring and tracking performance to ensure that service specifications have been delivered.

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