/ White Paper

The Importance of Quality in Software Development

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The Importance of Quality in Software Development

Developing the best possible software begins with a commitment to quality. Allscripts is passionate about quality in our healthcare IT solution development, and that quality starts with established processes and metrics. By utilizing the processes laid out in this paper and meeting these metrics, Allscripts ensures exceptional software quality and problem resolution for our clients.

What matters in software quality?

When organizations create software today, there are many key attributes to consider. Some of the most important software quality attributes are security, usability, maintainability, reliability, on-time delivery and portability, interoperability and compatibility. All of those considerations affect the development process in different ways:

- **Security** ensures important information cannot be extracted by hackers, which affects patient safety. This is an important concern, as HHS reports that more than 13 million records were breached in 2018.[1]
- **Usability** ensures the solution will be easy to use without instructions, even for people with disabilities.
- **Maintainability** indicates that maintaining the solution's code and adding amendments will be easy.
- **Reliability** ensures organizations can trust that their software will work and overcome issues.
- **On-time delivery** occurs because the organization continuously monitors scope to ensure that high-priority features are delivered on time.
- **Portability** indicates that the software is easy to install, replace and adapt to new environments.
- **Interoperability** ensures the software and its new features interoperate with, and speak to, other products in the organization.
- **Compatibility** indicates the new software will work with third-party components, or that the impact on downstream systems has been considered.

However, there are other important questions that development teams ask themselves when considering software. They ask questions like: Who is the audience? How do customers use the system? Developers also consider ideas like supportability, auditability, upgradability, reliability, regulatory compliance, configuration management, data integrity and non-repudiation, documentation and internationalizations and localization.

In the user view, quality is the fitness for purpose, or meeting users' needs. In the manufacturing view, quality means conformance to process standards. Key aspects of quality for the customer are good design (i.e., look and feel), durability, consistency, reliability, good functionality, service level and value for money.

1 HIPAA Journal, Healthcare Data Breach Statistics. https://www.hipaajournal.com/healthcare-data-breach-statistics/

What is the software development process?

Ensuring quality is built into the software development lifecycle, Allscripts uses an iterative development process, called the Scaled Agile Framework.[2] This methodology includes a number of key components that all contribute to quality software development practices:

- Small development teams comprised of cross functional skillsets, including developers, quality engineers, business analysts, and user experience designers
- Close partnership with solutions managers throughout development iterations, who represent the voice of the customer, to ensure we are building the right thing and building it right
- Face-to-face quarterly planning events that facilitate not only ensuring that requirements are well understood by all, but also facilitate identification and mitigation of dependencies and project risk
- Frequent retrospective discussions, also known as Inspect and Adapt[3] workshops, to learn from past work so the team can continue to improve over time

In addition to the above activities, Allscripts utilizes a phase-gate framework, which defines the tasks performed at each step during the software development process. Quality is built into the products using a Portfolio and Solution Delivery Framework, which is composed of the following steps (Figure 1): Concept Proposal, Business Case, Plan, Develop, Deploy, Maintain, Retire.

Figure 1: *These steps comprise a Portfolio and Solution Delivery Framework.*

- **Concept Proposal**—The concept commit decision milestone moves a solution from the idea, or concept phase, to business case and may be used to support the concept proposal.
- **Business Case**—This phase defines the business opportunity or problem to be addressed. Typically, this phase involves validating market need and identifying key customer benefits. At this time, the strategic value of the project is evaluated including initial revenue and financial estimates. At the end of this phase, Allscripts should validate strategic value along with general scope.
- **Plan**—The Plan phase elaborates the requirements outlined in the business case to gain a deeper understanding of the scope, tasks, resources and timeline necessary to deliver on the business commitment. During the Plan phase, the Program Team refines and expands the business case to determine if Allscripts should or should not build the product/system.
- **Develop**—During the Develop phase, the team develops the solution and associated method for delivery and support. The objectives of the Develop phase are:
  - Execute cross-functional plans according to established timelines
  - Execute iterations focused on solution/product development, testing, documentation and packaging
  - Manage cross-product, cross-program items
  - Complete solution readiness testing
  - Execute user acceptance testing (if applicable)
  - Create Early Adopter plans with agreed exit criteria
  - Validate organizational readiness for Early Adopter deployment

2 www.scaledagileframework.com
3 https://www.scaledagileframework.com/inspect-and-adapt

- **Deploy**—The goal of the Deploy phase is to release the product/system to the users and turn over responsibility to the services and support teams. This phase often includes Early Adopter testing and field trials to validate the system works in a broader set of configurations. At the end of this phase, the organization decides whether to make the solution generally available to its clients.
- **Maintain**—The goal of the Maintain phase is to perform ongoing maintenance and support of the released solution and regular review of market performance and business value. This phase continues as sustaining work until the end-of-life decision milestone is reached.
- **Retire**—The end-of-life decision milestone determines if Allscripts should retire this product/system so that it is no longer sold or supported. There are three potential outcomes for the decision milestone:
  - Approved execute end-of-life strategy
  - Continue to sell, support and maintain
  - Continue to support and maintain

During the Portfolio and Solution Delivery Framework, developers and product owners ask themselves key questions:

- Are we building the right thing?
- Does the technical design meet the requirements and functional design?
- Does the code meet the design?
- Was the coding done well?

Product owners are also encouraged to think about product quality in the build.

Organizations have several stakeholders involved in the Portfolio and Solution Delivery Framework. The stakeholders involved in creating, reviewing and approving the Portfolio and Solution Delivery Framework can include any or all of the following individuals (as part of a cross-functional program team): solutions management, program management, services, sales, legal, support and the development team.

How can developers ensure quality in their solutions?

Quality management system

The Allscripts Quality Management System (QMS), in use by many Allscripts products, is a system that documents the structure, responsibilities and processes required to achieve effective quality management. With QMS, developers can document what they would like teams to follow for the development process.

The overall goal of the QMS is to:

- Consistently deliver products and services that meet or exceed customers' expectations
- Continuously improve the efficiency and effectiveness of the processes within the QMS.

A development team may have its own QMS that supports and documents how that team specifically meets the requirements of the Allscripts QMS. At Allscripts, the QMS team conducts annual audits of the different teams within the scope of the QMS, to ensure the completion of the Plan-Do-Check-Adjust (PDCA) cycle for continuous improvement. All roles contribute to the QMS.

The Allscripts QMS is based on the ISO 9001:2015 international standard. Our Sunrise™ suite of software applications and the Allscripts® Analytics Platform are ISO 9001:2015 certified. To date, Allscripts is the only health IT software vendor to have achieved this level of quality excellence.

Quality assurance

Quality assurance is a process-centered approach to ensuring that a company or organization is providing the best possible products or services by ensuring they did what they said they would do in the QMS.

Specific to software development, software quality assurance (SQA) incorporates all software development processes starting from defining requirements to coding until release, with the prime goal of ensuring quality. For each release, there are a set of predefined quality criteria, and every release has to meet those measures before it reaches general availability (GA). The SQA process assures that all software engineering processes, methods, activities and work items are monitored and comply with defined standards.

Testing

Software testing is a process of finding any software bugs in a program or application. Testing is the verification and validation process to ensure that a product meets the business and technical requirements.

Allscripts follows the development process in Figure 2: Plan, Do, Check and Adjust.

- **Plan:** Subject matter experts provide input at this stage, ultimately helping to create the test plan.
- **Do:** At this stage, testing is executed per the test plan.
- **Check:** Test results are reviewed and evaluated against expected outcomes..
- **Adjust:** At this stage, any unexpected outcomes are reworked and retested until expectations are met.

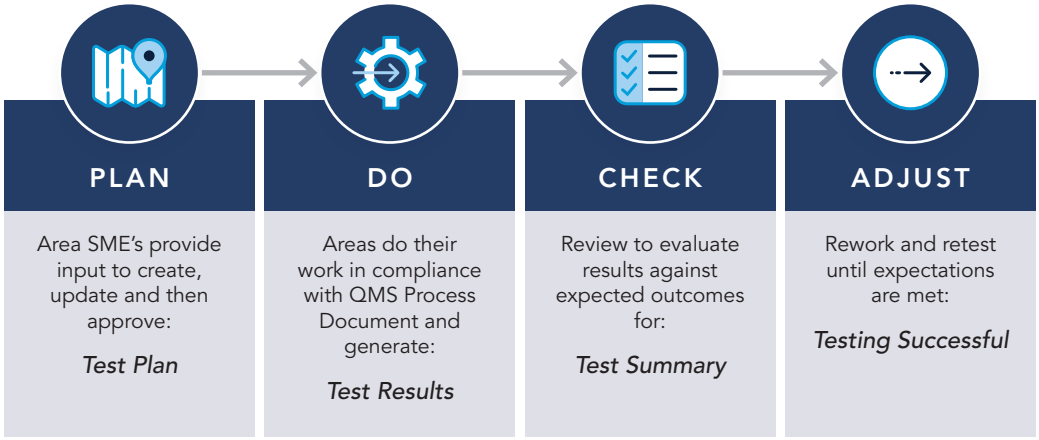

Figure 2: *The PDCA cycle helps Allscripts ensure continuous improvement in software development.*

The Allscripts commitment to quality

Allscripts believes that quality in software development is critical. Our solution development organization (SDO) ensures that quality through the framework, which is composed of product, people, process and tools.

- **Product:** We help ensure quality through products via our quality bar. Every release has a set of quality criteria defined, such as critical and high. Before a product can declare general availability, that product must meet the quality measures defined for the release. We also ensure quality via interoperability, with solutions testing in internal labs, configuring our products to ensure they work together seamlessly at customer sites. Allscripts solutions are all built on open application programming interfaces (APIs), to ensure the solutions' compatibility and interoperability with other solutions.
- **People:** Allscripts is committed to our people through education. We provide our teams with technology training to keep abreast of industry innovations and new technology. We are committed to accountability with our teams and solution teams, setting team and individual goals, and a well-defined review process to ensure individual accountability and leadership support to achieve goals.
- **Process:** Allscripts ensures quality through our established processes, which include the Scaled Agile Framework (SAFe®). SAFe helps businesses address the significant challenges of developing and delivering enterprise-class software and systems within the shortest sustainable lead time. SAFe draws on three primary bodies of knowledge: agile development, systems thinking and lean product development, resulting in continuous improvement.
- **Tools:** Allscripts uses tools like standardized metrics to monitor adherence to vital processes (i.e., code review, defect backlog burnup, unit testing and root cause analysis) and automation, where repetitive test cases are automated, and executed to ensure a new development does not impact existing functionality. We also use modernization, in which we regularly review new technology to replace existing legacy technology, enabling us to update our products to keep up with industry innovation. Together, standard metrics, automation and modernization help Allscripts ensure quality.

How do we know when something is fixed?

Allscripts ensures that any issues are addressed with our Definition of Done. This Definition of Done ensures that the:

- Technical design review passed
- Code was implemented
- Code review passed
- Test cases created, executed and passed
- Impact assessment completed, to identify regression tests necessary during regression testing
- Requirements/specifications revised, as needed
- End-user documentation requirements identified and shared with tech writers
- Impact on other teams communicated
- Product Owner (PO) reviewed and accepted

When the Definition of Done is complete, Allscripts teams know that a solution's bugs or issues have been addressed, and the organization is prepared for success.

How does Allscripts measure success?

Allscripts is focused on success in quality development, and we measure that success with several specific metrics:

- **Code review metrics:** As part of the development process, each part of the code goes through a peer review.
- **Root cause analysis:** For every defect found, the team goes through a root cause analysis process to ensure they know what caused the issue, and that it's fixed, to prevent it moving forward.
- **Velocity/iteration burnup:** Velocity is a measure of the amount of work a team can tackle during a single sprint and is the key metric in agile.
- **Defect Resolution Index (DRI):** The DRI consists of defects resolved out of the total defects found.
- **System Usability Scale (SUS):** The SUS provides a reliable tool for measuring the usability. The scale consists of a 10-item questionnaire with five response options for respondents ranging from strongly agree to strongly disagree.
- **Defect backlog reduction trend:** This measure provides the ability to track reduction of the defect backlog over time against predefined thresholds.

Where is the industry going?

Today's technology has the capacity to make a significant impact on software development moving forward. Disruptive technologies, like artificial intelligence and machine learning, are already making an impact in the healthcare space, and will continue to do so. Let's take a look.

Artificial intelligence (AI)

AI is composed of programs with the ability to learn and reason like humans. Brain–computer interfaces are creating direct interfaces between technology and the human mind, enabling patients with amyotrophic lateral sclerosis (ALS), stroke or locked-in syndrome to work effectively without the need for keyboards, mice or monitors.[4]

Electronic health record (EHR) developers today, including Allscripts, are using AI to create more intuitive interfaces and automate routine processes for users. Allscripts has created AVA, the virtual assistant in the Sunrise™ platform, to help users document more efficiently through AI capabilities.

Machine learning

Machine learning is composed of algorithms with the ability to learn without being explicitly programmed. Machine learning has made headlines recently, with Google developing a machine learning algorithm to identify cancerous tumors on mammograms and Stanford using a deep learning algorithm to identify skin cancer.

Allscripts is deeply committed to machine learning, and our new Avenel™ EHR is a cloud-based solution powered by machine learning. Avenel uses machine learning to integrate clinician treatment patterns, and provide preference reminders, supporting faster clinical documentation and more informed decision-making.

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4 Bresnick, Jennifer. "Top 12 Ways Artificial Intelligence Will Impact Healthcare." Health IT Analytics. April 30, 2018.

Deep learning

Deep learning is a subset of machine learning in which artificial neural networks adapt and learn from vast amounts of data. EHR developers build deep learning techniques into analytics solutions, enabling users to identify novel connections between seemingly unrelated datasets. With deep learning techniques, healthcare organizations can more successfully perform risk scoring and stratification, enabling them to better focus on at-risk populations.

Public hosting

Public hosting via cloud ensures that multiple clients can share the same hardware, services and network devices through an internet connection. The provider is responsible for the data architecture, configuration, security and other resources. The customer pays for EHR as a service.

Conclusion

Allscripts is committed to developing enterprise software with a focus on quality, and that quality is the result of established processes, rigorous metrics and a commitment to continuous improvement. With an eye on current technology trends, process reviews, customer feedback, continuous inspection and adaptation, Allscripts modernizes and creates high-quality solutions. When organizations are in the planning stages of developing enterprise software, especially in the healthcare industry, establishing their own set of stringent guidelines is critical to creating a high-quality solution that meets, and exceeds, customer expectations.

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