Best Practice

**Quality Assurance of Product Development
in the Lottery Industry: Acceptance Testing**

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NASPL

THE *Open* GROUP

Best Practice

Quality Assurance of Product Development in the Lottery Industry:
Acceptance Testing

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Preface

North American Association of State and Provincial Lotteries (NASPL)

NASPL has approved the creation of a standards initiative, which is dedicated to the adoption or creation of Technical Standards, Best Practices, and Certification Programs that will further the lottery objectives of integrity, security, interoperability, and profitability.

The NASPL Standards Initiative (NSI) was approved and funded by NASPL and the vendor community as a collaborative development effort with participation from the lotteries, gaming vendor, and retail associations. Project management and facilitation services for standards development and certification are provided by The Open Group.

The NSI Vision is to provide an interoperable lottery environment that is based on a set of open Technical Standards, approved Best Practices, and Certification Programs that, when implemented, will improve the quality and integrity of the lottery environment, and will provide increased efficiencies, resulting in reduced costs and increased profit margins for lotteries, vendors, and lottery retailers.

The NSI mission is to establish a resilient organizational structure, set of processes, and procedures that will engage all constituents (lotteries, vendors, and retail representatives) in an environment of open discussion and cooperative development.

The Open Group

The Open Group is a vendor-neutral and technology-neutral consortium, whose vision of Boundaryless Information Flow will enable access to integrated information within and between enterprises based on open standards and global interoperability. The Open Group works with customers, suppliers, consortia, and other standards bodies. Its role is to capture, understand, and address current and emerging requirements, establish policies, and share best practices; to facilitate interoperability, develop consensus, and evolve and integrate specifications and Open Source technologies; to offer a comprehensive set of services to enhance the operational efficiency of consortia; and to operate the industry's premier certification service, including UNIX certification.

Further information on The Open Group is available at www.opengroup.org.

The Open Group publishes a wide range of technical documentation, the main part of which is focused on development of Technical and Product Standards, Best Practices, and Guides. Full details and a catalog are available at www.opengroup.org/pubs.

This Document

This document is the Best Practice for Quality Assurance of Product Development in the Lottery Industry, specifically addressing Acceptance Testing. It has been developed and approved by NASPL in association with The Open Group.

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Acknowledgements

1 Introduction

A Best Practice provides a clear description of a set of processes, procedures, and guidelines, that when practically applied to an operation brings a business advantage. A Best Practice has a record of success in providing significant advantage in cost, schedule, quality, integrity, performance, safety, environment, or other measurable factors that impact an organization. Various organizations identify and publicize Best Practices so that others, particularly internal business units, external business partners, or otherwise affiliated external organizations, can benefit from implementing the Best Practice and improving the operation of their business.

Best Practices can be applied to particular subject areas (such as new technologies or management theories), product sectors (such as software and hardware development), and vertical markets (such as the lottery industry). Best Practices are used frequently in the fields of healthcare, government administration, education, project management, hardware and software product development, and elsewhere. A commitment to using the Best Practice in any field is a commitment to using a prescribed method to ensure success.

A NASPL Best Practice is a Best Practice that applies to the lottery industry, has been approved by the NASPL Standards Initiative (NSI), and which serves as a recommendation for adoption by the lottery industry. A NASPL Best Practice is a practice that when implemented is intended to improve the quality and integrity of the lottery environment, and to provide increased efficiencies, resulting in reduced costs and increased profit margins for lotteries, vendors, and lottery retailers.

A NASPL Best Practice is described in terms of its:

- Purpose

- Components

- Constituents and their roles

- Prescriptive requirements

- Methods and techniques

- Tools

- Relationship to other Best Practices

The development of a NASPL Best Practice involves the following stages:

1. The NSI, through the Best Practices Working Group, selects a candidate practice using specific assessment and acceptance criteria (as defined by the NASPL Steering Committee).

2. The Best Practices Working Group develops a Best Practice document.

3.	Optionally, the Best Practice document is subject to an informal review process by NASPL members and the NSI participants.

4.	The Best Practice document is subject to a formal review process by the NSI Steering Committee and the Best Practice Review Board.

5.	A set of conformance criteria and a conformance policy for the Best Practice are defined.

The approved NASPL Best Practice describes the practice in enough detail to enable it to be readily deployed by other organizations, assuming the availability of the necessary resources.

This chapter describes this NASPL Best Practice in terms of its purpose and its scope, and gives a definition of the terminology used throughout this document.

## 1.1	Purpose

This Best Practice is one of three addressing Quality Assurance of Product Development in the Lottery Industry:

1.	Requirements Definition (Doc. No. BP0401)

2.	Development Process (Doc. No. BP0402)

3.	Acceptance Testing (this document)

The purpose of this set of Best Practices is to provide a documented set of quality assurance processes and procedures that will allow lotteries and vendors to follow an approved and repeatable method for the purpose of meeting the goals and objectives of the lottery through hardware and software deployment.

## 1.2	Scope

This Best Practice – together with the associated Requirements Definition and Development Process Best Practices – provides a set of processes and procedures that address the quality assurance requirements throughout the hardware and/or software production cycle from requirements specification through design, implementation, and testing, to acceptance and deployment. The scope of this Best Practice, although general enough for many software and hardware production environments, has several quality assurance aspects that are specific to the lottery industry. This Best Practice is not intended to cover procurement of off-the-shelf applications or ready solutions.

This set of quality assurance Best Practices is related in some ways to the Request For Proposal (RFP) process, particularly with respect to Requirements Definition. The RFP process itself is the subject of another NASPL Best Practice, and is outside the scope of this document.

1.3   Terminology

This section provides a set of terms and their definitions, which should be used when describing and interpreting the Best Practice requirements of the quality assurance processes and procedures specified in this document.

Must   Indicates an absolute, mandatory requirement of the Best Practice that has to be implemented in order to conform to the Best Practice.

Should   Indicates a recommendation that ordinarily must be implemented. To conform to the Best Practice, an acceptable justification must be presented if the requirement is not satisfied.

May   Indicates an optional requirement to be implemented at the discretion of the practitioner, and which has no impact on conformance to the Best Practice.

Must not   Indicates an absolute preclusion of the Best Practice, and if implemented would represent a non-conformity with the Best Practice.

Should not   Indicates a practice explicitly recommended not to be implemented. To conform to the Best Practice, an acceptable justification must be presented if the requirement is implemented.

2   Best Practice Environment

This section describes the typical business environment, the business drivers, and the objectives driving this NASPL Best Practice as context.

2.1   Business Environment Summary

2.1.1   Business Scenario – General Description

This section describes the stakeholders in a typical lottery operation. The roles played by the constituents are not necessarily the same for every lottery. The constituents may take on different roles during the execution of business processes based upon local practice, how the lottery is organized, the budget allocated to the lottery organization, or any number of other factors. Therefore, in one jurisdiction a constituent may take a role that is taken by another constituent in another jurisdiction; for example, developing software or hardware for a lottery may be done by a vendor or by a lottery organization. These roles may actually change over time.

The key organizations and entities in the typical lottery business environment – particularly those relevant to the processes discussed in this Best Practice – are illustrated in the following figure.
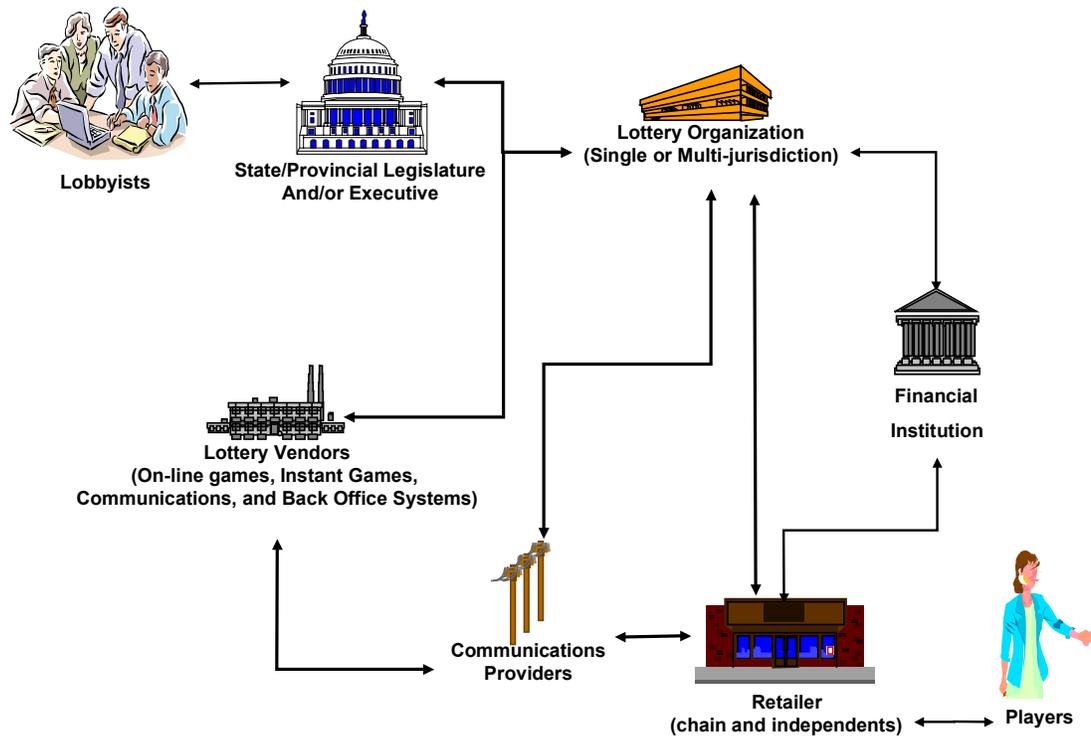
Figure 1: The Lottery Business Environment

Not all organizations will have all of these components and relationships. However, the figure illustrates a number of points typical of lottery enterprises, each of which has particular implications for the benefits of standards for the lottery industry. Points to note regarding some of these constituents and their relationships to this Best Practice:

- Lottery vendors provide solutions for many lotteries; therefore, a reduction in the need for per-lottery customizations and variable quality assurance requirements improves the efficiency of the lottery vendor.

- Lotteries may buy different systems or components from different vendors over time, so developing a set of quality assurance Best Practices that are understood and followed by all vendors and lotteries will result in less time required in defining the practices and procedures to be followed during the product development lifecycle.

- Many lotteries participate in multi-jurisdiction games, bringing additional (and shared) governance processes and operational requirements. If requirements for quality assurance are defined as standard Best Practice among all lotteries, there would be less time and effort spent in meeting the cross-jurisdictional requirements, once a lottery decides to participate in a multi-jurisdiction game.

- The lottery retailers serve the players, and must do so in a timely fashion as most of the retailers are convenience (or sometimes grocery) stores where even occasional long waits resulting from poor quality gaming software or hardware systems can have significant impact on revenue.

The following list of constituents and the roles they play in the larger lottery environment is provided here to give a big picture view. The constituents involved in this Best Practice and the roles they play are a subset of those in the larger lottery environment and are identified in more detail in subsequent sections.

Constituent	Role Played
State Executive or Legislature	Authorize lottery operation under state/provincial laws.
	Direct use of lottery revenues (and by implication, lottery operating budgets).
	Monitor and audit lottery operations, sometimes impacting lottery development.
	May appoint lottery director.
Board of Directors / Lottery Commissioners	Oversee lottery organization and their policies and procedures.
	Hire lottery executives.
	Approve major lottery contracts.
Lottery Organizations	Conduct overall operation of the lottery.
	May operate lottery IT infrastructure.
	May develop games.
	Oversee lottery integrity and security, including validation of winners.
	Optimize profitability from games (current and future), selecting new games, stopping old games, developing new games, and managing the selection and implementation of game infrastructure through Requests For Proposals (RFP).
	Manage retailers; including accounting, and game material inventory; e.g., instant game books.
	Manage vendors, including possible outsourcing of lottery operations.
	Develop marketing campaign.
	Manage large prize payouts individually or in conjunction with multi-state organizations.
Retailers/Agents	Sell lottery tickets and games at retail location.
	Market lottery products.
	Validate and redeem tickets.
	Manage and account to lottery for sales including ticket "books", report sales to lottery commission, redemption of unsold game books.
	Manage accounting of lottery contribution to store profit and loss.
	Optimize contribution of lottery sales (within lottery regulations) to store.
Financial Institutions (e.g., banks)	Provide "sweep accounts" to facilitate transfers of funds from on-line and instant ticket purchase between the retailer/agent and the lottery.
	May provide interface between state treasury and lottery.
Players	Play on-line and instant games, self-validate tickets (in some jurisdictions), redeem tickets, and receive winnings.

Constituent	Role Played
Lottery System Vendors	Provide lottery systems, components, games, and/or products.
	May provide the networking component (possibly customized) of a lottery system.
	Operate lottery IT systems (under subcontract from lottery organization) in many jurisdictions.
	Provide maintenance, field, and technical service in some jurisdictions.
	Respond to Requests For Information (RFI), Requests For Proposals (RFP), and Requests For Software Changes (RFS).
Telecommunications Providers	Provide the networking component (possibly customized) of a lottery system.
Lobbyists	Impact lottery responsibilities and limitations (through legislature) within a jurisdiction.

2.1.2   Operational Scenario

To provide an understanding of where and when the quality assurance Best Practices will be applied, this section depicts a typical product development lifecycle as it applies to the lottery industry: from specifying requirements to Acceptance Testing. This operational scenario highlights the major processes and illustrates the associated need for quality assurance Best Practices. It also identifies the constituents who will be carrying out the quality assurance Best Practices.

The software or hardware development cycle and the quality assurance processes associated with it begin with articulating requirements for new or upgraded software or hardware, which is done primarily by the appropriate lottery personnel within their own environment. Once the requirements are documented, they are handed off to the vendor. After the requirements are agreed, the vendor begins their development cycle incorporating quality assurance processes that cover design, implementation, testing, and release procedures. When the product is "released" to the lottery, the lottery, with the vendor supporting the process, performs Acceptance Testing to determine whether the product meets the acceptance criteria typically defined initially during Requirements Definition.

The constituents involved in this Best Practice are as follows, with the lotteries and vendors having a major role in most of the processes, and the retailers having a minor role in some jurisdictions:

- Lotteries

- Vendors

- Retailers/Agents

The operational environment for this Best Practice is:

- **Dynamic** – Lotteries continually upgrade existing games and institute new games so that their business can evolve and grow. High availability with optimum performance and quality software and hardware are essential in the lottery business so that downtime during upgrades, deployment of new games, and ongoing operations must be minimal.

- **Diverse** – Since there is no enforcement of a common method among lotteries, every jurisdiction's operation executes slightly differently and according to its own method of choice and interpretation. However, there should be an effort to provide commonality between states where possible.

- **Local and culturally-specific** – Geographical differences mean that jurisdictions vary, manifesting in diverse needs. This represents diversity in participants and method, including cultural differences.

It is imperative that the quality assurance Best Practices support this business environment.

2.1.2.1 Operational Functions and Processes

The key functions and processes that require Best Practice support are further identified in the table below. The specific needs within each business function or process requiring Best Practice support are also described.

Function/Process Name	Best Practice Needs
Requirements Definition	The requirements for the system or system components must be defined, documented, agreed, and approved by both the supplier and customer of the system. Best Practices need to validate that this process happens, that the correct information is specified, and that the right processes are used in reaching agreement between vendors and the lottery.
Development Process	Use of a development process that covers design, implementation, testing, problem tracking and resolution, change control management, and release and installation. The process needs to include adequate documentation and approval phases.
Acceptance Testing	Utilize a defined Acceptance Testing process and plan that is typically agreed during Requirements Definition and is carried out in a controlled environment during Acceptance Test Execution.

2.1.2.2 Operational Topology

The topology of the environment to which this Best Practice applies (below) typically represents distributed and separate locations with variable overlap, and sometimes complete overlap, between some of these entities:

- Lottery Organization

- Retailer Site

- System Vendor

- ICS Vendor

2.1.2.3 Operational Location Information

The following matrix shows the *primary* locations where each of the functions or processes related to this Best Practice is executed, though all identified locations may not be involved in every situation. In cases where different parts of a function or process involve different locations, the component parts of the function or process are identified. This demonstrates the need for integration of different requirements when creating and adopting this Best Practice.

Functions/ Processes	Locations			
	Lottery Organization	Retail Site	System Vendor	ICS Vendor
Requirements Definition	X	X	X	
Development Process				
– Software and Hardware Design			X	X
– Software and Hardware Implementation			X	X
– Vendor Internal Testing			X	X
– Acceptance Test Readiness Review	X		X	
– Change Control System			X	
– Problem Reporting	X	X	X	X
– Problem Resolution			X	X
– Release Process	X		X	
Acceptance Testing	X		X	X

2.2 Business Rationale

This section describes the business drivers, objectives, and benefits of implementing this NASPL Best Practice.

2.2.1 Business Drivers

The major business drivers for implementing a Best Practice for Quality Assurance of Product Development in the Lottery Industry are the potential for reduced risk and increased integrity for the lotteries, reduction in development costs, decreased potential for lost revenue, and decrease in rate of project failure. These business drivers are summarized below:

- **Liability**

  The potential for liability issues exists if faulty software or hardware is installed. The types of conceivable issues depend on the type of software or hardware being installed, but issues could include large dollar liabilities in the case of incorrect tickets being generated or paid. Even with the protection of rules and regulations, which attempt to limit the liability issue, legal issues will still arise and may ultimately be successful. Preventing problems by following Best Practices for quality assurance before deployment will help prevent the costs after the fact.

- **Lost revenue**

  This business driver is associated with the costs to the business in terms of lost sales or productivity when the system or supporting networks are down or performance is poor, in the retail environment or at the lottery central office.

- **High costs associated with fixing problems in the field**

  Development time and costs are decreased if problems are discovered and resolved during testing in the development or acceptance cycle rather than after installation and deployment in the field.

- **Public relations and loss of integrity**

  Public relations problems can result from the installation of defective software or hardware systems in the lottery or retailer environment. Any problem a lottery incurs that becomes public has the potential for negative consequences and negative publicity, which can ultimately turn into concern on the part of the public about the integrity of the lottery.

- **Loss of initiative**

  When a new program initiative fails, the impact often extends beyond that of the current initiative. For example, if the software implementation of a game change goes badly, a lottery may be reluctant to run other games of a similar type or to introduce other new types of games. This can result in a lottery having a lower risk tolerance for introducing other innovative programs in the future.

2.2.2   Objectives and Benefits

This section outlines some of the business objectives for introducing the quality assurance Best Practices and some of the benefits that could be attained once these Best Practices have been adopted.

The major objective for implementing a Best Practice for Quality Assurance of Product Development in the Lottery Industry is to increase the integrity of the lottery business by producing higher-quality systems, which could result in the following benefits:

- **Reduced risk associated with liability** by providing assurances that the systems have been through approved quality assurance Best Practices, particularly during the Development Process and Acceptance Testing.

- **Reduction in lost revenue** as a result of better performance and higher availability.

- **Reduced costs** associated with development, testing, and maintenance.

- **Increased integrity,** resulting in greater public confidence and player satisfaction that could lead to increased sales.

3   Best Practice Overview

This chapter provides an overview of the Acceptance Testing Best Practice.

To assure quality in lottery systems, it is considered best practice to follow a consistent set of processes and procedures in three distinct phases of the product development lifecycle of a lottery system as follows:

- Requirements Definition

- Development Process

- Acceptance Testing

This Best Practice addresses Acceptance Testing.

Acceptance Testing is the process by which the lottery verifies that the product delivered by the vendor meets all of the agreed requirements, and thus is acceptable for deployment in the lottery environment. This Best Practice covers Acceptance Testing from test planning, through test execution and acceptance of the product.

The applicability of this Best Practice extends to all areas of software and/or hardware production for the lottery industry, including:

- Production of a new lottery system

- Creation of new software and/or hardware components for use in an existing lottery environment

- Updates or extensions to existing lottery system components

3.1   Relationship with Other Best Practices

This Best Practice is one of three that address Quality Assurance of Product Development in the Lottery Industry, as follows:

- Requirements Definition (Doc. No. BP0401)

- Development Process (Doc. No. BP0402)

- Acceptance Testing (this document)

This set of quality assurance Best Practices is related in some ways to the Request For Proposal (RFP) Best Practice, particularly with respect to Requirements Definition. The RFP Best Practice is centered around publication of the RFP, submission and evaluation of the response, and vendor selection, whereas the quality assurance Best Practices are focused on Best Practices

that should be implemented after the vendor has been selected by the lottery to provide the product(s) or upgrade(s).

4 Best Practice Description

4.1 Overview

This chapter defines the Best Practice for Acceptance Testing that is performed by or on behalf of the lottery.

Acceptance Testing is the process by which the lottery verifies that the delivered lottery system or system components meet all of the contractual requirements, meet the lottery's standards for quality, and are thus acceptable for deployment into the lottery environment.

Best Practice in Acceptance Testing involves the use of a defined testing process that spans test planning, test specification, test execution, and test reporting. Good Acceptance Testing will clearly identify the roles and responsibilities of the lottery and the vendor, be based on standard Acceptance Testing procedures, and use an agreed approval process with defined acceptance criteria.

Acceptance Testing will be most effective when planning is begun during Requirements Definition in the product development lifecycle to ensure that factors affecting testing are considered up-front. The appropriate level of acceptance test effort needs to be determined as part of the overall project plan, as too much testing needlessly increases cost and too little increases project risk. The Acceptance Test Plan produced by the lottery or its authorized representatives will address time estimates, scheduling issues, resource planning, test team training, and skill sets, as these all affect how Acceptance Testing is executed.

Involvement of the relevant Quality Assurance personnel during Requirements Definition helps to ensure that requirements and system specifications consider what will be required for Acceptance Testing, and ensure that the impact of the new product on the existing lottery environment is factored into the system design process.

Vital also to the success of the project planning process is defining what constitutes successful completion of a given phase of the project. The criteria for determining when the product is ready to transition from the Development Process to customer Acceptance Testing, as well as for determining when Acceptance Testing is complete, need to be identified and agreed during the project planning stage. Key to this is lottery quality assurance personnel working with the development group to set standards for acceptance at each phase.

Developing handover criteria and customer acceptance criteria prior to Acceptance Testing ensures that all parties understand and agree upon the definition of success prior to reaching each key phase. This step also prevents the acceptance testers from becoming an extension of the vendor's Development Process testing by testing products that are not ready for Acceptance Testing or are unstable and still being actively developed.

4.2   Constituents and Roles

The primary constituent is the lottery. The lottery is responsible for planning and executing Acceptance Testing, and ultimately accepting the delivered system or system component.

Key constituents within the lottery organization include:

Constituent	Role
Quality Assurance (QA) Organization	The group within the lottery that is responsible for carrying out Acceptance Testing. This group may perform all aspects of Acceptance Testing itself, from planning to execution, or may outsource some or all of the process to another party, such as the vendor, or a third party. This group within the lottery ideally consists of key personnel from various sections or departments within the lottery that are impacted the most by the change.
Quality Management	Responsible for overseeing Acceptance Testing, and providing the lottery's sign-off to formally accept the lottery system or system components.
Test Designers	Responsible for determining what testing is required based on the lottery system or component to be tested, creating the tests to be executed, and authoring the Acceptance Test Plan.
Testers	Responsible for executing the acceptance tests in accordance with the Acceptance Test Plan.
Test Observer	Responsible for witnessing the acceptance test execution and ensuring that the procedures defined in the Acceptance Test Plan were followed.
Auditor	Responsible for ensuring that proper Acceptance Testing was executed. Auditors are independent of and not a part of the Quality Assurance Organization.

The vendor plays a secondary role in Acceptance Testing. The main role of the vendor organization is to support the lottery in Acceptance Testing, as identified and agreed in the Acceptance Test Plan. In some cases, the vendor may also be involved in development of the Acceptance Test Plan by providing inputs to the plan; for example, on the necessary environment for executing Acceptance Testing.

4.3   Components

4.3.1   Acceptance Test Plan

The Acceptance Test Plan documents what is necessary for the lottery to perform Acceptance Testing, including who is involved in various parts of the process, what testing will be performed and how, how the outcomes of testing will be reported and to whom, what will be done in the event that problems are found during Acceptance Testing, and how the lottery will determine when Acceptance Testing is complete. A good Acceptance Test Plan will enable the lottery to prepare in advance for Acceptance Testing, identify problems before they occur, and allow for proactive adjustments.

The Acceptance Test Plan constitutes an agreement between the vendor and the lottery on what defines an acceptable product. As such, it needs to be aligned with existing contracts between

the vendor and lottery for service or product delivery. The Acceptance Test Plan thus requires the approval of both parties. It is also important that the acceptance criteria specified in the plan are strictly adhered to and that both parties are in agreement on this plan's relationship to any existing contractual agreements.

The following section identifies general requirements for an Acceptance Test Plan. These requirements are applicable to Acceptance Testing of any type of lottery system or system component. The subsequent section contains requirements specific to Acceptance Testing of a gaming system. In the future, additional sections may be added to address other types of lottery systems, such as back-office systems, internal control systems, or administrative systems.

4.3.1.1   *Best Practice Requirements*

Acceptance Testing must be documented in an Acceptance Test Plan.

The Acceptance Test Plan must be authored by the lottery or authorized lottery representatives and must be reviewed with the vendor. The vendor should especially review the Acceptance Test Plan with respect to any dependencies on the vendor.

Once the Acceptance Test Plan has been reviewed, it may be modified if the changes are mutually agreed by the lottery and vendor.

All planned testing to be performed for acceptance must be specified in the Acceptance Test Plan.

The Acceptance Test Plan must cover each of the following areas, and if the lottery believes that an area is not applicable for the product being tested, the Acceptance Test Plan must state that explicitly along with supporting rationale:

- Risk assessment that analyzes the impact of the new product on the lottery and which must consider:

    — Lottery systems as a whole

    — System components

    — Business processes

    — Features not to be tested

- Procedures for installation and integration of the system components into the acceptance test environment

- Training requirements

- Financial and activity balancing processes and requirements

- Testing schedule and approach

    — The schedule must include milestones for the development and approval of the test scripts.

- Types of testing to be performed during acceptance test execution. Appendix C defines the various test strategies that may be employed during Acceptance Testing:

— The test designers should consider all of the test strategies and must determine the specific set of testing to be performed for acceptance based on the particular system or system component to be tested.

— If the lottery chooses to rely on the vendor's internal testing rather than perform the testing itself, then during acceptance test execution, the lottery's testers must validate that the testing was performed and must validate that satisfactory results were achieved.

- Requirements and procedures for test reporting:

— The requirements must indicate that the test report must include both actual and expected results and must highlight any deviations from expected results.

- Criteria that must be met in order to start or stop Acceptance Testing. These criteria must include:

— Entry criteria to be met in order for the lottery to commence Acceptance Testing. The entry criteria must include a criterion indicating that the Acceptance Test Readiness Review has been completed and the lottery representative has authorized commencement of Acceptance Testing based on this review.

— Suspension and resumption criteria – these criteria must define the conditions under which some or all of the testing identified in the Acceptance Test Plan must be halted, and the conditions that must be met in order to resume testing activity after a suspension.

— Acceptance criteria that must be met in order for the lottery to accept the lottery system or system components.

- Hardware requirements; i.e., number of terminals, communications network requirement, connectivity to various systems, etc.

- Requirements and working conditions needed at the test site, which may include:

— Test system set-up

— The number of testing terminals

- Procedures for updating the Acceptance Test Plan

4.3.1.2   Best Practice Requirements for Gaming Systems

In addition to meeting the Best Practice Requirements for the Acceptance Test Plan, any Acceptance Test Plan that includes testing of a gaming system should also meet these requirements for the Acceptance Test Plan for Gaming Systems. In some cases, the requirements here are an expansion of the general requirements.

The installation and integration procedures should describe any pre-requisites for installation:

- In some cases, specific actions need to be taken prior to installation of gaming system components to enable specific testing to be performed. For example, wagers, validations, or reports may need to be created prior to the installation of gaming system components.

- In other cases, installation may need to occur as part of a specific test, and this should be defined in the preconditions for the test.

The selected test strategies should include testing designed to mimic everyday production, in order to determine how well the product interacts with other games and applications during normal business use. In addition, the test strategies should include testing of non-typical conditions, which may include:

- User-requested reports

- Testing of periodic activities that do not occur everyday, such as end-of-month processing

The following should apply when writing the detailed test documentation for each type of testing to be performed:

- The description of what capabilities are being tested should include explicit information on how the gaming system will interact with one or more of the following:

  — Other games

  — Applications

  — End-user GUIs

- The test preconditions should explicitly describe the required condition of the system prior to the start of testing. If installation of a gaming system component is to be performed as part of the test rather than prior to it, the test preconditions should describe the actions required prior to installation, which should include:

  — Establishing a known condition of the system

  — A description of at what point installation occurs

  For example, to test validation of a multi-draw ticket part-way through the draws, the preconditions may include:

  — Creation of the multi-draw ticket

  — Performing at least one draw, prior to installing the new gaming system component

  — Ensuring that the system reflects the draw history prior to executing the test instructions

- The specific test instructions should provide testing to cover enough business days to completely test the drawings, validations, purging, and billing cycles for the accounting periods.

4.3.2 Test Script Creation

The types of testing to be performed during Acceptance Test Execution are identified in the Acceptance Test Plan. Detailed test documentation will need to be developed for each type of testing specified in the Acceptance Test Plan. This documentation includes complete, well-defined test scripts with documented expected results.

4.3.2.1   *Best Practice Requirements*

Each test script must include:

- A description of what capabilities are being tested

- Test preconditions – the set-up and configuration required to facilitate a known state of the system prior to executing an individual test or group of tests

- Specific test instructions

- Expected test results

Each test script should include:

- Test post-conditions – the operations that should be performed to restore the system to a neutral state after the running of an individual test or group of tests. This is also known as test clean-up.

4.3.3   Acceptance Test Execution

The purpose of Acceptance Testing is to confirm that the lottery system meets its business requirements and to provide confidence that the system works correctly and is usable before it is formally "handed over" to the lottery user (either the end user or the operations user). Acceptance Testing validates that the product functions as designed, while maintaining the security, data integrity, and other essential system standards that the lottery has set forth.

4.3.3.1   *Best Practice Requirements*

Acceptance Testing must be executed in accordance with the process defined in the Acceptance Test Plan. All types of testing defined in the plan must be completed and test reporting must be completed in accordance with the procedures defined in the plan.

Problems identified as a result of the new product must be reported to the vendor using the agreed problem reporting mechanism.

At the completion of Acceptance Testing, the lottery Quality Management must sign-off on the testing to formally accept the system components as meeting the contracted requirements.

If Acceptance Testing indicates that the vendor's product does not meet the acceptance criteria, then the vendor and lottery must work together to determine a suitable course of action, which must result in one of the following:

- Revised deliverables

- Revised acceptance criteria

- Other defined actions

5   Methods, Techniques, and Additional Considerations

This section describes methods and techniques that support Acceptance Testing.

5.1   Methods for Creating an Acceptance Test Plan

There are several steps that are helpful when creating an Acceptance Test Plan. They are:

- Analyze the product to be tested, including performing a risk analysis

- Determine testing strategy

- Identify entry, suspension, resumption, and acceptance criteria

Techniques for performing each of these steps are provided in the following sections.

5.1.1   Analyze the Product to be Tested, Including Performing a Risk Analysis

When to Analyze

The process of analysis starts at the beginning of the project, during Requirements Definition. The business requirements, system design, user interface, and all other aspects of the system requirements and documentation are developed with Acceptance Testing in mind. It is critical to project success that this analysis occurs at the beginning of the project, as risk analysis may significantly impact design, build, testing, and cost.

The initial steps of the testing analysis process can occur simultaneously, as they begin from a common point; i.e. the design documents upon which the product was constructed.

What to Analyze

Acceptance Testing, in general, is designed to ensure that the product, as implemented, meets the requirements set out and agreed during Requirements Definition. It also ensures that the risks associated with the product have been properly identified, so that the testing process can help mitigate the impact of the risks. The testing strategy may also stem from this process of analysis. This analysis is based upon the business requirements, system design (covering the software and hardware, architecture, system inputs and outputs), user interface, and any other documents that describe the features, data, and functions that compose the lottery system.

As with any test procedure, the success of Acceptance Testing will be dependent upon the test bed or environment. The more closely the test bed can mirror the live environment, the more confidence can be had in the validity of the test results. As the complexity of production environments increases, with integrated network solutions, multiple processors, decentralized processing, and distributed processing environments, the more care, concern, and resources will

be necessary to duplicate and maintain the complexity of the testing environment as an effective mirroring of the production environment.

The analysis process necessary to create an Acceptance Test Plan will vary based upon the nature of the product being tested. Significant issues to consider are the user requirements, the criticality of the product to the business, the integration points between the new product's software, hardware, and data with existing systems and databases, communications mechanisms, data input and output requirements, and the relevant security requirements.

Ways to Analyze

Test designers may be able to complete this analysis process from documents alone; however, in terms of efficiency; it is best to include the test designers during Requirements Definition in the process of gathering user requirements and approving them in the Requirements Specifications. If the test designers and testers are involved in the total process, they will understand the user's requirements from the user's perspective. The result is that during Acceptance Testing, less will be left to interpretation, which is a common source of error and misunderstanding in this process.

Risk Assessment

A critical aspect of acceptance test planning is the quality assurance assessment of the risk to existing systems, system components, computer operations, and business processes that will be affected by the new product. Test designers design a process that recognizes these and other aspects of the new system, and takes into consideration how the new system will touch all existing system components and business processes. Care is taken to recognize that the existing system(s) might have very little in common with the new product except that they process similar data. However, from a testing perspective, any change or any new aspect need to be tested thoroughly in conjunction with all existing systems or components that have common touch points with the new product. The above mentioned risk assessment is critical in this regard; without such an analysis, it has to be assumed that any new product is to be tested with all existing system components, in order to ensure that there are no touch points that would affect the features and functions upon which the current components produce their results. It is vital to look at all forms of input, output, and data stored within any files or databases. When creating test scenarios, test designers consider all devices (methods or means) of inputting data or transactions, where and how related data is stored, where and how data is processed, where and how related systems store, process, or affect any of part of the transaction. The test scenarios test how data is viewed, accessed, changed, and deleted (purged). Data integrity is paramount. Test scenarios are designed to ensure that wherever the data from a transaction or process resides, that it accurately reflects the business transacted, and that all forms or views of that data balance with one another. The use of the product within the context of a business process is tested against each of the above features. This includes testing how the product fits within the environment in which it is intended to operate, and how it will affect the business processes that are performed. Ideally, test scenarios are designed to allow parallel processing to take place, wherever possible, to ensure both fit and functionality to support the processes (current or future) that the product is intended to impact.

The Acceptance Test Plan contains sufficient detail on the identified risks and plans for how these risks will be mitigated to provide full comprehension by all team members, managers,

users, and management involved in Acceptance Testing. It is often helpful to produce a "risk matrix" that identifies the risks that will be tested for, the testing that will be performed to help mitigate the risk, and the acceptance criteria that indicate successful testing for the identified risk.

5.1.2   Determine Testing Strategy

There are many aspects to testing a lottery system. During their analysis and test design, the test designers determine which methods of testing are required for the particular system or system component to be tested. The various test methods typically employed in Acceptance Testing for lottery systems are defined in Appendix C.

A recommended test strategy for system testing follows. This test strategy has been used successfully in Acceptance Testing of lottery systems and may be a useful starting point for designing a system testing strategy. A good system testing strategy includes the following types of testing:

- Deliverables Compliance – Validation that all deliverables in the contract have been delivered. Deliverables compliance typically is conducted via an audit of the deliverables against the RFP or other contractual documents.

- Functional Testing – Validation that the system accepts the input that it should, and creates the output that it should.

- Usability Testing – Validation that the system is intuitive and straightforward to use by the target user community, which consists of retailers, lottery staff using management terminals, and system operations staff (typically supplied by the vendor). Usability testing is largely based on observations during functional and failover testing.

- Quantitative Performance Testing – Validation that any quantitative specifications stipulated in the RFP and/or claimed in the vendor proposal or subsequent documents can be met by the system.

- Failover Testing – In systems with a fault-tolerant capability, validation that the fault-tolerant features work correctly.

- Process Testing –Validation that the system vendor, as operator, has complemented the system technology with procedures and training that will promote reliable and consistent operations support. Process testing typically is conducted by inspection of supporting documents such as manuals and policies, and observation of vendor staff behavior during functional and failover testing.

When selecting the test methods, test designers perform an analysis of what testing needs to occur in order to minimize the risks identified in the risk analysis such that Acceptance Testing will ensure the organization has the highest probability of success when installing and operating the new system or system component.

The various components within the overall lottery system are tightly integrated. Testing how a new system component will work in the integrated environment and how it interacts with other systems is an important part of the test strategy. This will often require execution of other systems during testing of one system component. For example, testing a back-office system will

require exercising a gaming system to ensure the back-office system is correctly capturing data from the gaming system. When documenting the testing strategy in the Acceptance Test Plan, it is good practice to cover the following areas:

- Itemized statement of each test method chosen and how it will be applied

- List of issues or challenges inherent in the chosen testing strategy and the particular test methods

- Indication of any parts of the product that will not be well tested, along with rationale for the decision

It is important when developing the test strategy to consider the risk analysis and to take into account prioritization, time, and resources allocated for testing to assure that the components, interfaces, and systems that are most at risk for defects are being tested proportionately to that perceived risk.

Once the test strategy is identified, the specific test scenarios to be tested and test scripts to be executed are defined. First, the test scenarios/cases are documented against software requirements, and then the test scripts are developed from the test scenarios/cases.

5.1.3   Identify Entry, Suspension, Resumption, and Acceptance Criteria

Entry Criteria

Entry criteria address the requirements for commencing Acceptance Testing, and may also include requirements for starting particular portions of the testing activity. Things to consider when defining entry criteria include requirements for:

- Documentation

  Criteria cover the completeness of the documents, ensure they have been reviewed and approved according to approved practices, and ensure they are up-to-date and have been maintained throughout the project. Criteria should also address all relevant documents such as requirements and functional specifications, user manuals, and training materials.

- Tester preparedness

  Criteria cover any prerequisites for testing that impact the testers, including the level of training that may be required.

- System readiness

  Criteria cover requirements for the stability of the system components to be tested, installation, and any capabilities that need to be in place prior to the start of Acceptance Testing.

- Vendor readiness

  Criteria cover the completeness of the system and completion of the vendor's quality assurance process.

Suspension and Resumption Criteria

It is good practice to clearly articulate during the planning stage what will happen if problems are encountered during Acceptance Testing, and the type or severity of problem that will invoke a suspension in testing if encountered.

Likewise, it is good practice to define the conditions to be met in order to resume Acceptance Testing. The criteria will include an indicator of assurance that the conditions or problems that caused the suspension have been rectified.

Acceptance Criteria

Acceptance criteria are defined at the start of the project, during Requirements Definition. This ensures that all parties know what constitutes an acceptable system or system component prior to any design and development work being done. Acceptance criteria may be described in terms of specific metrics with minimum and maximum values.

5.2 Recommended Approach for Acceptance Test Execution

A recommended approach for lottery personnel executing Acceptance Testing follows. It is important that vendor support be provided if necessary during Acceptance Testing, particularly the operations and systems engineering staff to help with test configuration and system set-up.

1. Review the Acceptance Test Plan.

2. Schedule execution of tests, taking into consideration all of the test pre-conditions identified in the test scripts and impact on production systems. The test execution schedule needs to support and be aligned with what is defined in the Acceptance Test Plan. Also, the order in which tests are executed needs to be carefully designed to ensure efficiency with respect to test set-up and clean-up activities.

3. Execute all acceptance tests, check all results, and document the outcomes of testing using the defined test reporting mechanism. The test reporting may include results reporting, test logs, and test summaries.

4. Analyze the test report to determine whether any defects were identified during Acceptance Testing.

5. Reconcile any deviations from expected results.

6. If there are adverse test outcomes, it is important for the lottery to negotiate with the vendor to determine the impact on the continuance of Acceptance Testing and whether system modifications are needed. This negotiation should consider:

    a. The release in which the defect will be corrected

    b. Any schedule delays to the planned Acceptance Testing

    c. The re-testing required

    d. Whether deferral of changes until a future release is appropriate

7. Utilize a test observer to observe the acceptance test execution and then ensure that the appropriate completed test report is countersigned by the test observer.

8. On completion of Acceptance Testing, provide the Quality Management with the completed test reports.

6 Tools to Support Acceptance Testing

At this time we do not list specific tools, but rather describe the type of tools that support this Best Practice. Actual tools may be listed as the Best Practice matures.

The use of a third-party or in-house software tool to develop test scenarios and in turn the acceptance test script from approved software requirements can be of great assistance to lottery Acceptance Testing, particularly during major conversions or software implementations. For a complete and accurate test, it is essential that test scenarios for all software requirements are documented and tracked. By creating the test script within a tool, balancing reports reflecting financial activity can be easily produced and compared against gaming system reports for quick and accurate reconciliation. Once defined, test scenarios and test scripts can be used throughout the lifecycle of the software application.

7   Conformance Overview

Defining conformance and creating a certification policy and program for this Best Practice is the next step in establishing an effective Best Practice. Without the associated conformance criteria and certification processes, there is no assurance that a practitioner has implemented practices according to the approved Best Practice.

Certification provides formal recognition of conformance to an industry Best Practice or Technical Standard specification, which allows:

- Suppliers and practitioners to make and substantiate clear claims of conformance to a Technical Standard or Best Practice

- Buyers to specify and successfully procure from vendors who conform to the Best Practice or provide products that conform to the Technical Standard

Following the approval of this Best Practice, the NSI will work with The Open Group to establish conformance criteria and define an associated Certification Program for this Best Practice. The conformance assessment to be used will be determined at that time. Conformity assessment is the act of determining the compliance of an implementation to a specification, or the adherence of a business operation to a best practice or process definition. There are many techniques for assessing such compliance, including the use of a standardized test method, quality assessment by industry experts, and vendors' claims of conformance made within a defined legal framework. The techniques to be used will be chosen during the process of defining the Certification Program.

Following implementation of the Certification Program, practitioners wishing to have their practices certified as compliant to the Best Practice will be to able to apply for certification of their practices, where a conformance assessment will be performed.

APPENDIXES

A   Requirements Checklist

	Requirement	Level	Practitioner	Reference
Acceptance Testing: Acceptance Test Plan				
1	Acceptance Testing must be documented in an Acceptance Test Plan.	Must	Lottery	4.3.1.1
2	The Acceptance Test Plan must be authored by the lottery or authorized lottery representatives.	Must	Lottery	4.3.1.1
3	The Acceptance Test Plan must be reviewed with the vendor.	Must	Vendor	4.3.1.1
4	The vendor should especially review the Acceptance Test Plan with respect to any dependencies on the vendor.	Should	Vendor	4.3.1.1
5	Once the Acceptance Test Plan has been reviewed, it may be modified if the changes are mutually agreed by the lottery and vendor.	May	Lottery	4.3.1.1
6	All planned testing to be performed for acceptance must be specified in the Acceptance Test Plan.	Must	Lottery	4.3.1.1
7	The Acceptance Test Plan must cover each of the following areas, and if the lottery believes that an area is not applicable for the product being tested, the Acceptance Test Plan must state that explicitly along with supporting rationale: • Risk assessment that analyzes the impact of the new product on the lottery and which must consider: 　– Lottery systems as a whole 　– System components 　– Business processes 　– Features not to be tested • Procedures for installation and integration of the system components into the acceptance test environment • Training requirements • Financial and activity balancing processes and requirements • Testing schedule and approach 　– The schedule must include milestones for the	Must	Lottery	4.3.1.1

Requirement	Level	Practitioner	Reference
development and approval of the test scripts.			

• Types of testing to be performed during acceptance test execution. Appendix C defines the various test strategies that may be employed during Acceptance Testing:
   – The test designers should consider all of the test strategies and must determine the specific set of testing to be performed for acceptance based on the particular system or system component to be tested.
   – If the lottery chooses to rely on the vendor's internal testing rather than perform the testing itself, then during acceptance test execution, the lottery's testers must validate that the testing was performed and must validate that satisfactory results were achieved.
   –
• Requirements and procedures for test reporting. The requirements must state that: "The test report must include both actual and expected results and must highlight any deviations from expected results".
• Criteria that must be met in order to start or stop Acceptance Testing. These criteria must include:
   – Entry criteria to be met in order for the lottery to commence Acceptance Testing. The entry criteria must include a criterion indicating the Acceptance Test Readiness Review has been completed and the lottery representative has authorized commencement of Acceptance Testing based on this review.
   – Suspension and resumption criteria – these criteria must define the conditions under which some or all of the testing identified in the Acceptance Test Plan must be halted, and the conditions that must be met in order to resume testing activity after a suspension.
   – Acceptance criteria that must be met in order for the lottery to accept the lottery system or system components.
• Hardware requirements; i.e., number of terminals, communications network requirement, connectivity to various systems, etc.
• Requirements and working conditions needed at the test site, which may include:
   – Test system set-up
   – The number of testing terminals
• Procedures for updating the Acceptance Test Plan			

Acceptance Testing: Acceptance Test Plan for Gaming Systems			

	Requirement	Level	Practitioner	Reference
8	In addition to meeting the Best Practice Requirements for the Acceptance Test Plan, any Acceptance Test Plan that includes testing of a gaming system should also meet these requirements for the Acceptance Test Plan for Gaming Systems. In some cases, the requirements here are an expansion of the general requirements.	Should	Lottery	4.3.1.2
9	The installation and integration procedures should describe any pre-requisites for installation: • In some cases, specific actions need to be taken prior to installation of gaming system components to enable specific testing to be performed. For example, wagers, validations, or reports may need to be created prior to the installation of gaming system components. • In other cases, installation may need to occur as part of a specific test, and this should be defined in the preconditions for the test.	Should	Lottery	4.3.1.2
10	The selected test strategies should include testing designed to mimic everyday production, in order to determine how well the product interacts with other games and applications during normal business use.	Should	Lottery	4.3.1.2
11	In addition, the test strategies should include testing of non-typical conditions.	Should	Lottery	4.3.1.2
12	Non-typical conditions may include: • User-requested reports • Testing of periodic activities that do not occur everyday such as end-of-month processing	May	Lottery	4.3.1.2
13	The following should apply when writing the detailed test documentation for each type of testing to be performed: • The description of what capabilities are being tested should include explicit information on how the gaming system will interact with one or more of the following: – Other games – Applications – End-user GUIs • The test preconditions should explicitly describe the required condition of the system prior to the start of testing. If installation of a gaming system component is to be performed as part of the test rather than prior to it, the test preconditions should describe the actions required prior to installation, which should include: – Establishing a known condition of the system – A description of at what point installation occurs For example, to test validation of a multi-draw ticket part-way through the draws, the preconditions may include:	Should	Lottery	4.3.1.2

	Requirement	Level	Practitioner	Reference

	– Creation of the multi-draw ticket
	   – Performing at least one draw, prior to installing the new gaming system component
	   – Ensuring that the system reflects the draw history prior to executing the test instructions
	
	• The specific test instructions should provide testing to cover enough business days to completely test the drawings, validations, purging, and billing cycles for the accounting periods.			

Acceptance Testing: Test Script Creation				
14	Each test script must include: • A description of what capabilities are being tested • Test preconditions – the set-up and configuration required to facilitate a known state of the system prior to executing an individual test or group of tests • Specific test instructions • Expected test results	Must	Lottery	4.3.2.1
15	Each test script should include: • Test post-conditions – the operations that should be performed to restore the system to a neutral state after the running of an individual test or group of tests. This is also known as test clean-up.	Should	Lottery	4.3.2.1
Acceptance Testing: Acceptance Test Execution				
16	Acceptance Testing must be executed in accordance with the process defined in the Acceptance Test Plan.	Must	Lottery	4.3.3.1
17	All types of testing defined in the plan must be completed and test reporting must be completed in accordance with the procedures defined in the plan.	Must	Lottery	4.3.3.1
18	Problems identified as a result of the new product must be reported to the vendor using the agreed problem reporting mechanism.	Must	Lottery	4.3.3.1
19	At the completion of Acceptance Testing, the lottery Quality Management must sign-off on the testing to formally accept the system components as meeting the contracted requirements.	Must	Lottery	4.3.3.1
20	If Acceptance Testing indicates that the vendor's product does not meet the acceptance criteria, then the vendor and lottery must work together to determine a suitable course of action, which must result in one of the following: • Revised deliverables • Revised acceptance criteria • Other defined actions	Must	Lottery	4.3.3.1

B Documentation Checklist

This Appendix summarizes the various documentation responsibilities of each party.

Under Responsibility, the following terms are used with these associated meanings:

Sole   For documents in which the specified party has sole responsibility for producing the document in accordance with the requirements of this Best Practice.

Primary   For documents that are to be authored by both parties, this identifies the party with the lead authoring role, and who has overall responsibility for producing the document in accordance with the requirements of this Best Practice.

Secondary   For documents that are to be authored by both parties, this identifies the party that will work with the lead author to produce the document. The Secondary role has the responsibility to provide inputs, author portions of the document, and collaborate with the lead author to ensure successful completion of the document.

Lottery Requirements

Item to be documented	Responsibility	Comments
Acceptance Test Plan	Sole	May receive inputs from the vendor, but still has sole responsibility for producing the plan.
Test Scripts	Sole	
Test report from acceptance test execution	Sole	

Vendor Requirements

The vendor does not have any direct responsibilities for documentation under the Acceptance Testing Best Practice.

C System Testing

This appendix defines the various types of testing that may be deployed during the testing of lottery systems. System testing is usually performed during a vendor's internal test process and during the lottery's Acceptance Testing.

The test methods defined below are applicable for use in testing a complete lottery system. The descriptions provide information on what the test method is, the purpose of that particular type of testing, and techniques for how the testing is performed.

C.1 Anomaly Testing

Anomaly testing is used to determine how the system reacts to anticipated user errors such as invalid input. This testing will help validate that error messages are useful and accurate.

C.2 Business Cycle Testing

Business cycle testing is used to verify the operation of the system over time. This testing emulates the activities performed on the system over all applicable business cycles, including daily, weekly, and monthly cycles, and any events that are date-sensitive.

This testing is performed by identifying a time period, such as an invoice period, and executing all transactions and activities that would occur during that period.

C.3 Configuration Testing

Configuration testing verifies the operation of the system on multiple platform configurations. This type of testing is intended to uncover compatibility issues between different software and hardware configurations. In most production environments, the particular hardware specifications for the client workstations, network connections, and database servers vary. Client workstations may have different software loaded; for example, applications or drivers, and at any one time, many different combinations may be active using different resources.

C.4 Conversion Testing

Conversion testing is used to verify that data is handled consistently when converting from one system to another (i.e., converting to a new gaming system.). This is accomplished by running data through both systems in parallel and validating that the systems show the same results.

C.5   Failover and Recovery Testing

Failover and recovery testing verify that the system can successfully failover and recover from a variety of hardware, software, or network malfunctions with undue loss of data or data integrity.

Failover testing ensures that, for those systems that need to be kept running, when a failover condition occurs, the alternate or backup systems properly "take over" for the failed system without loss of data or transactions.

Recovery testing is an antagonistic test process in which the system is exposed to extreme conditions, or simulated conditions, to cause a failure, such as device input/output (I/O) failures or invalid database pointers and keys. Recovery processes are invoked and the system is monitored and inspected to verify proper system and data recovery has been achieved. Recovery testing needs to cover both the automated aspects of system recovery as well as the manual procedures required.

C.6   Functional Testing

Functional testing is testing of a system against its base requirements. This type of testing is based upon black box techniques in which the tester knows the inputs and expected outcomes of the system, but not how the program arrives at those outputs.

The purpose of functional testing is to verify that the system performs in accordance with the specified business and technical requirements. The goal of functional testing is to verify system functions such as proper data acceptance, processing, and retrieval, and the appropriate implementation of the business rules.

Functional testing verifies the system or component and its internal processes by interacting with the system via the user interface and analyzing the output or results. Functional testing is used to verify that the system performs correctly when subjected to a variety of circumstances and repetition of the transactions.

One of the specific aspects of functional testing important to the testing of lottery systems is included below.

Audit Trail Testing

Audit trail testing is testing of the audit trail function to ensure that a source transaction can be traced to a control total, that the transaction supporting a control total can be identified, and that the processing of a single transaction or the entire system can be reconstructed using audit trail information.

C.7   Installation Testing

There are two types of installation testing.

The first is typically used by vendors when preparing a system for release to a customer. The purpose of this testing is to ensure that the system can be installed under different conditions

such as a new installation, an upgrade, and a complete or custom installation under normal and abnormal conditions. Abnormal conditions include insufficient disk space, lack of privilege to create directories, and so on.

The second type of installation testing, which may be performed during either the Development Process or Acceptance Testing, verifies that, once installed, the system operates correctly. This usually means running a number of the tests that were developed for functional testing.

C.8 Interoperability Testing

Interoperability testing is a formalized testing process where people, procedures, and systems/equipment are brought together in an operational environment to test the system interfaces and determine the reliability, usability, timeliness, and accuracy of the exchanged information.

In the lottery environment, interoperability testing is primarily testing that a lottery system interacts with other systems, such as a credit card authorization system, an ICS, or another back-office system. Testing is performed at the system boundaries to make sure that the two systems interface correctly.

C.9 Operations Testing

Operations testing is the testing of a complete system's operational characteristics and processes including start-up, operation, and recovery.

Operations testing verifies that the system can be operated and supported by the operations staff in an efficient and consistent manner. Testing is usually performed following documented operational procedures and checklists. Operations testing is performed on the production system, or a system that mimics the production system.

C.10 Performance Testing

Performance testing is designed to establish the performance of a system against predefined metrics or other alternative systems. Performance testing will test aspects of a system's performance such as response times, transaction rates, availability, capacity, and scalability. Typical performance testing measures include throughput, response time, storage capacity, and concurrent use. There are multiple types of performance-related tests; each is described below.

Performance Profiling

Performance profiling is a performance test in which response times, transaction rates, and other time-sensitive requirements are measured and evaluated. The goal of performance profiling is to verify that performance requirements have been achieved. Performance profiling is implemented and executed to profile and tune a system's performance behaviors as a function of conditions such as workload or hardware configurations.

Load Testing

Load testing is a performance test which subjects the system to varying workloads to measure and evaluate the performance behaviors and ability of the system to continue to function properly under these different workloads. The goal of load testing is to determine and ensure that the system functions properly beyond the expected maximum workload. Additionally, load testing evaluates the performance characteristics such as response times, transaction rates, and other time-sensitive issues.

Stress Testing

Stress testing is a type of performance test implemented and executed to find errors due to low resources or competition for resources. Low memory or disk space may reveal defects in the system which are not apparent under normal conditions. Other defects might result from competition for shared resources like database locks or network bandwidth. Stress testing can also be used to identify the peak workload the system can handle.

Stress testing is very important given the potential for extreme spikes in system use during high jackpot periods and other events that place unexpected loads on the system. Stress testing should occur at various times throughout the internal test cycles and, if required, during the acceptance test cycle. Stress testing should emulate various scenarios and operating conditions to ensure the system will degrade gracefully. In addition to exercising normal usage patterns (i.e., wagers, validations, cancellations), stress testing should also exercise any system mechanisms to provide point-of-sale updates as these can place extreme load on the communication mechanism.

C.11　Regression Testing

Regression testing is the selective re-testing of a system or component that has been modified to verify that the modifications have not caused unintended effects and that the system or component still complies with its specified requirements.

In the context of a particular system component, regression testing is used to ensure that modifications to the system component to fix defects or add functionality have not introduced problems in unmodified and previously working functions of the component.

In the context of a lottery system, regression testing is used to ensure that the system component being installed does not affect any portion of the lottery system already installed or any system components that interface with the new component.

Regression testing is typically performed using previous error-free tests to provide the assurance that the defects reported to be fixed are indeed fixed and the system or component has not introduced unintended effects in the unaltered parts of the system. It is considered best practice to automate regression testing wherever possible.

C.12　Security and Access Control Testing

Security and access control testing is performed to ensure that established security rules, procedures, or regulations are properly handled by the system.

Security and access control testing focus on two key areas of security:

- Application-level security, including access to the data or business functions

- System-level security, including logging into or remote access to the system

Application-level security ensures that, based upon the desired security, actors are restricted to specific functions or use cases, or are limited in the data that is available to them. For example, everyone may be permitted to enter data and create new accounts, but only managers can delete them. If there is security at the data level, testing ensures that "user one" can see all customer information, including financial data; however, "user two" only sees the demographic data for the same client.

System-level security ensures that only those users granted access to the system are capable of accessing the applications and only through the appropriate gateways.

Virus protection and intrusion detection ensure that systems are not susceptible to unwanted access and control. The system should be tested to ensure that intrusions and viruses are not facilitated; for example, by leaving open ports.

C.13   Usability Testing

The ultimate success of the system will depend heavily on the ability of people to use it. Testing the ease-of-use of the system by people is an important aspect of testing. As usability is difficult to evaluate prior to the test phases, it is important that the people aspect of the system is evaluated in as realistic an environment as possible. One aspect of usability testing is manual testing of typical usage scenarios to ensure that the people interacting with the automated system can perform their functions correctly.

Testing for "user- friendliness" is clearly subjective and will depend on the targeted end user or customer. User interviews, surveys, video recordings of user sessions, and other techniques may be used. Quality assurance testers are usually not appropriate usability testers. Quality assurance typically measures the degree to which the system can be understood, learned, used, and liked by the user when the system is used under specified conditions. Quality assurance tests the ease-of-navigation, layout and design, performance, error feedback, and consistency of the system to determine the system 's overall usability.

If a User Guide accompanies the system, it is reviewed to verify that all instructions are correct and that all figures and images displayed in the User Guide match the screens displayed in the system. As many users rely on the User Guide that accompanies a system, it is critical to ensure that it is correct.

C.14   Volume Testing

Volume testing subjects the system to large amounts of data to determine whether limits are reached that cause the software to fail. Volume testing also identifies the continuous maximum load or volume the system can handle for a given period.

For example, if the system is processing a set of database records to generate a report, a volume test would use a large test database and check that the software behaved normally and produced the correct report.

Glossary

The following terms and acronyms are used in this document.

Lottery Industry-Specific Terminology

Term or Acronym	Definition
Administrative Systems	Systems designed to support the lottery's business operations, such as accounting, retailer management, claims processing, and information management.
Back Office Systems	Data processing systems used to support the central business operation of the lottery, as distinct from gaming systems or systems employed by the retailer at the point of sale.
Gaming System	The set of software and hardware components required to deploy a particular game or set of games, which includes game terminals, network, and game host computers at the lottery central office.
ICS Vendor	The entity producing the Internal Control System, which may be a third-party vendor or the Lottery Development Organization.
Internal Control System (ICS)	The audit system and its associated processes, which perform auditing of the Gaming System component to ensure the integrity, security, and accuracy of gaming transactions.
Lottery Development Organization	The group within the lottery that is responsible for the development and/or integration of software and hardware components that comprise the lottery systems. They are responsible for running the IT systems and to a certain extent they act as an in-house technical development team. This service is often outsourced to third-party vendors.
Lottery Environment	The full set of software and hardware components that comprise a lottery, including gaming systems, the ICS system, administrative and back office systems, website, instant tickets, telecommunications network infrastructure, as well as the human participants who operate the hardware and software components including the Lottery Organization, vendors, retailers, and players.
Lottery Organization (Lottery)	The lottery organization comprises all those responsible for the overall operation of the lottery, which includes the director and other management personnel, and operational and technical personnel including the lottery development office. Together, they are responsible for overseeing lottery integrity, optimizing profitability from games (current and future), system procurement, managing retailers and vendors, and for marketing and payouts.

Term or Acronym	Definition
Lottery System (System)	The software and hardware associated with a particular function within the lottery, such as a gaming system.
Product	Product refers to the software and/or hardware that the lottery has contracted the vendor to produce.
System Components	The software and hardware components associated with a lottery system.
System Vendor	The entity producing the system components, which may be a third-party vendor or the Lottery Development Organization.

General Software and Hardware Industry Terminology

Term or Acronym	Definition
Acceptance Testing	Testing performed by the lottery to determine the acceptability of the delivered lottery system or system components for deployment into the lottery environment.
Code Module	A code module consists of lines of high-level computer language which, when compiled, are designed to carry out a specific function or sub-function of the system. A code module will include self-contained documentation for maintainability in the form of explanatory comment text placed within the lines of code themselves and at the beginning of the module.
Code Walkthrough	A technical review, normally by peers, in which a programmer's code is reviewed by other programming professionals with the intent to identify bugs at an early point and prior to system integration.
Formal Method	The use of a mathematical model or fourth generation language for software design such that a proof of correctness of the resultant code to the requirement from which it was generated is inherent, thus dispensing with the need for internal testing to assure quality.
Integration Testing	Testing in which software components, hardware components, or both, are combined and tested to evaluate the interactions between them. Integration testing focuses on testing the interfaces between the components.
Interoperability	The exchange of data between separate heterogeneous systems.
Portability	The ability of software application code to be run on heterogeneous platforms without change to the code.
Requirements Specification	The Requirements Specification documents a description of the expected features, constraints, interfaces, and other attributes of the system components to be produced, and forms the basis for the agreement between the lottery and the system vendor on what the

Term or Acronym	Definition
	system is designed to do.
Sign-off	The act of formal agreement that a given phase in the product development lifecycle is complete.
System Design Specification	The System Design Specification, when used, is the document in which the system design description is documented. The system design description provides a high-level description of the overall lottery system, the software and/or hardware component(s) that comprise it, and how the components interact.
System Testing	Testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements.
Test Case	A Test Case is a documented single test instance that includes a set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific single requirement. It is desirable for test cases to be uniquely identifiable and traceable. Multiple test cases may exist for a single requirement.
Test Scenario	A set of test cases used to validate the behavior of a product through testing of the business process flows.
Test Script	A detailed set of instructions for the set-up, execution, and evaluation of results of one or more test cases. A test script may be executed by an automated test tool or manually.
Test Summary Report	A written report produced at the end of a period of testing (such as vendor internal testing, or the lottery's Acceptance Testing) that provides a summary of the types of testing performed and a summary of the results of that testing.
Unit Testing	The testing of individual hardware or software units or groups of related units.

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