BS 5760-24:2014

BSI Standards Publication

Reliability of systems, equipment and components –

Part 24: Guide to the integration of risk techniques in the inspection and testing of complex systems

bsi.

...making excellence a habit.™

Publishing and copyright information

Published by BSI Standards Limited 2014

ISBN 978 0 580 74264 4

ICS 03.120.01; 21.020; 29.020

The following BSI references relate to the work on this document:
Committee reference DS/1
Draft for comment 13/30240790 DC

Publication history

First published March 2014

Amendments issued since publication

Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2014. It was prepared by Technical Committee DS/1, *Dependability*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

The following parts of BS 5760 have been published or are in preparation:

- Part 0: *Guide to reliability and maintainability*;
- Part 2: *Guide to the assessment of reliability*;
- Part 8: *Guide to assessment of reliability of systems containing software*;
- Part 10: *Guide to reliability testing*;
- Part 12: *Guide to the presentation of reliability, maintainability and availability predictions*;
- Part 13: *Guide to reliability test conditions for consumer equipment*;
- Part 18: *Guide to the demonstration of dependability requirements – The dependability case*;
- Part 24: *Guide to the integration of risk techniques in the inspection and testing of complex systems*.

Information about this document

This part of BS 5760 provides a methodology for applying risk-based techniques to optimizing the inspection and testing of complex systems.

Use of this document

As a guide, this part of BS 5760 takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

There is no universal definition of a complex system, but from a dependability standpoint its most important feature is that it is composed of interconnected parts that as a whole exhibit properties that are not easily discernible from the explicit properties of the individual parts. This includes most systems containing software.

Common features of a complex system include:

a) difficulty in determining the boundaries of the system;

b) complex systems within the system that make up the complex system; and

c) reuse of system elements from other complex systems.

As projects and acquisitions become increasingly complex, companies and governments are challenged to find effective ways to manage them. As programmes become more network-centric and complex, businesses are forced to find ways to manage complexity while governments are challenged to provide effective governance to ensure flexibility and resiliency.

The systems of the 1970s were largely stand-alone, analogue and mechanically controlled. In contrast the new systems address problems with more accurate, reliable, interoperable and maintainable systems. Current systems are often software intensive and network enabled with on-board complex sub-systems. The arising complexities are often the result of interactions among the systems and sub-systems and therefore cannot be tested and evaluated in isolation.

The live testing of complex systems is becoming increasingly expensive, particularly as many impacts and interactions result in the addition of new equipment or of complementary or adversary systems and performance. Testing regimes which seek to test every function of a system are also becoming increasingly time-consuming due to the complexity and nature of the systems. These challenges can be mitigated, however, by the careful incorporation of risk techniques in the development, assessment and testing of complex systems, which are covered in this standard.

This page deliberately left blank

1 Scope

This British Standard gives guidance on defining complex system requirements and focuses on the important aspects that are needed to establish an efficient testing regime.

It also gives guidance on the inspection and testing of complex systems, including the integration of risk management techniques.

This British Standard applies to managers involved in the early development of a complex system, such as project managers, requirement managers, test managers and financial controllers.

NOTE This British Standard only makes reference to aspects such as risk management, project management and requirements management where such explanations aid this guide. Full details on these subjects are not the intent of this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4778-3.2 (IEC 60050-191), *Quality vocabulary – Availability, reliability and maintainability terms – Part 3.2: Glossary of international terms*

3 Terms and definitions

For the purposes of this part of BS 5760, the terms and definitions given in BS 4778-3.2 and the following apply.

3.1 business analyst
person who analyses the needs of a company for the future development of systems by defining its requirements

NOTE A business analyst is often referred to as a requirement analyst.

3.2 complex system
any type of system that is composed of interconnected parts

3.3 complex system requirement
desired technical or business outcome of a complex system, as defined internally within a company or externally by a customer

NOTE This is also referred to within the standard as a requirement.

3.4 customer
party requiring the complex system for implementation and use

3.5 designer
party responsible for the design of a complex system

3.6 developer
party responsible for developing the complex system

3.7 end-user
person from the target user group of the complex system

NOTE An end-user might be required for testing of the complex system while in development.

3.8 item
subject being considered

NOTE 1 The item might be an individual part, component, device, functional unit, equipment or system, and consist of hardware, software, people or any combination thereof.

NOTE 2 The item is often comprised of elements that may each be individually considered.

NOTE 3 See BS 5760-0, ***2.8****.*

3.9 item testing
test or series of tests carried out on a single part, component or element of a complex system

NOTE This might be carried out at any stage in the complex system development process.

3.10 producer
party responsible for developing the complex system

3.11 revolutionary development
system where very little (or none) of the design existed previously

NOTE Identifying revolutionary development areas can assist in establishing the risk likelihood.

3.12 supplier
party responsible for supplying the complex system to a customer

3.13 test
inspection and testing of a complex system

NOTE Due to the limitations of test scenarios (such as size, availability, cost, security, safety and environmental concerns), it can be difficult to perform testing in a real life environment and a simulated environment might need to be used.

3.14 tester
individual responsible for inspecting and testing items or the whole complex system

4 Developing a complex system

4.1 Establishing the requirements

Assessing and understanding the importance of the requirements for a complex system can help the customer and producer to define the framework of the project, outline the development process and to determine the resources that should be allocated to it. The customer and producer should use this framework to determine how and at which points the capabilities and limitations of the complex system are tested, and their conclusions should be recorded in a project plan.

NOTE The requirements are bespoke or tailor made if the customer is external to the company responsible for meeting the requirements. For an internal customer, such as the marketing department, the requirements are tailored with consideration to the marketing demands and the resources and time required to meet these demands.

Complex system requirements should be formulated, assessed, documented and confirmed to be verifiable by the relevant parties, such as the designer, tester, business analyst and customer. Vague statements such as "a high number of transactions" or "highly secure passwords" should be avoided so that the designer and tester have a clear definition of the complex system requirements.

The designer, tester, business analyst and customer should be involved in clarifying and refining the complex system requirements. This is an appropriate time to analyse the potential consequences if a particular requirement is not met. Scenarios for unexpected events (beneficial, benign or negative) such as hazards, triggers, probability of occurrence and range of consequence should also be covered in the complex system requirements through a risk assessment (see Clause **5**).

4.2 Categorization

During the assessment and refining period, complex system requirements should be grouped into categories depending on their function (such as performance, usability, disaster recovery and consistency of end-user experience) and whether, for example, they have an impact on the infrastructure in which the complex system is embedded. In some cases this might necessitate a requirement to be divided so that it can be specifically allocated to each relevant function.

NOTE To categorize the complex system requirements into functions and sub-functions, a failure mode and effects analysis can be used, see BS EN 60812 for further information.

The system and the associated systems are linked to establish items that can be designed and developed as separate entities. This might result in a requirement being modified as the item might only fulfil one part of an overall function.

4.3 Item interface

In addition to developing the complex system requirements, the interfaces between items should be determined. These interfaces cover those which are internal to the system (across items) and those which are external to the complex system (across the complex system and other associated systems/end-users to satisfy the complex system requirements). The risk assessment should also cover the commonality across interfaces and the possibilities of consolidation.

4.4 System deployment

The deployment of a complex system into an operational environment should be undertaken as a series of releases, each release progressively accommodating more and more functions and associated complex system requirements.

For each release, a series of tests should be specified and undertaken in stages in order to confirm correct working of the complex system.

4.5 Test stages

This stage should include the following types of test:

a) item test, to confirm the correct performance of discrete items;

   NOTE 1 Sometimes referred to as a unit test.

b) integration of items test for correct passing of information between items;

c) built environment test for correct configuration of the testing platform;

d) complex system test reflecting the requirements and total system function as appropriate to test stage (i.e. some test elements might be simulated if certain items are in development);

e) associated complex system test (e.g. performance test for the efficiency of the complex system);

f) operational readiness test prior to deployment of the complex system and any associated systems;

g) commissioning test to determine the serviceable condition of the complex system; and

h) deployment test for when placed into a real-life environment.

Where different tests can be combined, they should be undertaken.

NOTE 2 For example, item testing and integration testing might be combined by conducting the tests in an environment containing all of the items.

NOTE 3 This combined approach can be useful when dealing with progressive releases; however, it is advisable to assess any risks associated with combining the relevant tests (such as the difficulty of identifying the origin of a fault) and the timescales involved before they are undertaken.

5 Risk assessment

A risk assessment should be carried out during the complex system requirement development stage (**4.1**).

Identification, analysis and evaluation of risks should be applied to each test stage (**4.5**) to identify and outline potential consequences to:

a) the customer, through loss of business, total complex systems failure or temporary complex systems failure; and

b) the designer/developer/supplier, through minimizing development costs, testing early to identify risks and faults that can be more expensive to rectify later.

NOTE 1 In contrast, testing undertaken late in the development stage where time constraints are at their most stretched could result in a pressure to complete, and if not done correctly, could lead to loss of reputation and future orders.

The consequences of the identified risks should be grouped into categories such as high impact, medium impact and low impact, as defined, agreed and documented by the relevant parties such as the supplier and the customer. Ideally, there should be a reasonable spread of complex system requirements falling within these categories.

NOTE 2 It might be useful to include non-essential but desirable complex system requirements separately. In this way their cost implications and time constraints can be recognized.

5.1 Risk calculation

The likelihood that the complex system requirements are not being met should be calculated. This calculation should be based upon the following factors:

a) the experience of the designer/developer;

b) the complexity of item/complex system function;

c) the size or quantity of items within the complex system (e.g. estimated number of lines of code or items);

d) the complexity of any associated system/infrastructure elements;

e) the technology status (whether new or proven over several years);

f) the commonality of the item/complex system function (i.e. a function used many times, such as security access); and

g) the number of test failures (this can only occur after initial testing has been undertaken).

5.2 Identifying and prioritizing risks

A simple matrix should be used to derive the priority to be applied to each risk. Suggested priority numbers are given in Table 1.

Table 1 **Prioritization scoring of likelihood and consequences of risks**

	Low impact	Medium impact	High impact
Highly likely	4	2	1
Likely	5	3	1
Unlikely	5	4	2

NOTE Numbers are for demonstration purposes only.

One third of the risks are typically given a priority value of 1 or 2. Sometimes an item has sub-functions that meet only part of a complex requirement (priority 1 or 2). In these cases, ways in which the total function of an item or the complex system are assessed should be tested at an early test stage, even where this entails using dummy interfaces to be replaced later in the development.

NOTE A revision of the overall programme might be necessary. For example, ensuring that software data is transferred as discrete packets, as opposed to directly accessing the data tables, can greatly simplify the testing process and quickly locate problem areas and bottlenecks. This approach might have an effect on the overall performance but does enable parts of the system (such as legacy systems) to be modernized at a later date.

6 Testing

6.1 Principles

The testing of complex systems is a time-consuming and expensive activity. It has to be recognized that testing every single aspect and possible scenario is often unrealistic. Testing substantiates that the requirements (**4.1**) have been achieved. Once the test has been established, the requirements serve no purpose except as a retrospective assessment in the event of a failure that was not detected by the test. The customer should play a major role in establishing which requirements are important, and where in the testing stages test evidence is required.

6.2 Types of testing

Testing is undertaken at various stages in the life cycle of a system (see **4.5**) and the purpose of the tests can vary. Testing can be a basis for confirming:

a) the requirements of a system;

b) the specific functional operation; and

c) the smooth operation of all items and components.

While the majority of tests are conducted during the design and development stage of a system, testing may also be conducted during a live demonstration of the system delivery (see Clause **11**).

6.3 Destructive and non-destructive tests

Tests can be destructive as well as non-destructive. For destructive tests, such as structural strength, the test should be conducted once and if the same materials and manufacturing processes are repeated there is no need to repeat the test. For non-destructive testing, a small subset of the tests should be repeated at future stages to provide a level of confidence (for example, testing at environmental extremes is not normally repeated except for testing at normal ambient conditions).

NOTE In some cases non-destructive tests are not undertaken at later stages as the design is sufficiently robust. For example, noise filtering capacitors are not normally tested after the assembly of a repairable item if it can be shown that the probability of several capacitors failing is low.

6.4 Testing functional operability

These tests are a subset of the tests given in **6.3** and should be undertaken at delivery, prior to operation and occasionally during operation. These tests confirm that the complete chain of items and interfaces for a particular function are operating correctly. They should be designed to be reasonably simple and therefore relatively quick to undertake. This is an important feature if test times are to be kept short.

6.5 Testing item and component operability

Confirming item operability is a major part of testing during operation. With the design established, the operability of its components (and replaceable items) should be tested to confirm that all system requirements are met.

These tests are usually conducted after a functional test (**6.4**) identifies a fault within an item or component that needs to be replaced. If there is no time limit, tests to confirm the operability of all items and components should be undertaken.

6.6 Testability

The ability to test a system and the problems associated with false alarms and 'no fault found' are given in BS EN 60706-5.

7 Testing strategies

7.1 Business requirements

Management of a business requirement involves quantification of the requirement, identification of the function that needs to perform successfully in order for it to conform, and selection of the method to use to measure acceptance. This method might entail theoretical analysis (such as stress analysis), modelling, use of past evidence (a unit performing in another complex system) and testing. Where possible, a combination of these measures should be used to determine business requirement conformity. However, proving function conformity to a complex system requirement should be separated from proving conformity of a complex system upon delivery.

NOTE If a unit, for example, can be shown to meet the essential functions during its initial testing, then it is acceptable to test only the integration elements such as power input and command input for conformity to the complex system requirement when incorporated into a complex system for delivery.

7.2 Design and delivery conformity

It might be necessary to test the full complex system for design conformity, but this might not be necessary for delivery conformity. Therefore, both design conformity and delivery conformity should be taken into account in the test strategy and testing should be tailored accordingly.

NOTE 1 For example, a complex system that has operated successfully at sub-zero temperatures in the design stage does not need to be tested at the operation stage in this environment.

For revolutionary development areas, the testing at the extremes of the design envelope, such as power and environment, should be incorporated. The design envelope should be greater than the operating envelope, for example:

a) if the power of an item is increased by 5% above the maximum, are there controls in place to manage this increase and minimize the impact to prevent damage to other items in the system and to ensure a fail-safe design?

b) if an interactive website is required to operate satisfactorily with 1 000 users, how is it going to cope with 1 200 users? Is it going to put 200 users in a queue or slow the system down so that all users become dissatisfied?

NOTE 2 Testing at these extremes can accelerate failures that would have a low probability of occurrence under normal operating conditions. However, some of these failures might be a direct result of operating at these extreme levels.

The strategies for testing items that are mechanical, electrical, software and have a human interface are given in **7.3** to **7.6**.

7.3 Testing mechanical complex systems

The final inspection and testing of mechanical items within complex systems should concentrate, firstly, on the priority 1 or 2 functions given in **5.2**. Sometimes a fault-free analysis can be used to identify which mechanical check relates to a specific function and the severity of the problem if the item fails to conform to the check. This can reduce the number of final inspections.

NOTE 1 For example, a face mask might have a high priority for end-user comfort and a low priority for accuracy.

NOTE 2 See BS EN 61025 for more information on testing mechanical systems.

Alternatively, for large or expensive items, the development of mechanical interfaces can be costly and changes to the design could save money.

NOTE 3 For example, the mechanical interface for a fuselage can be greatly simplified if tolerances for each interconnection are increased by the introduction of flexible couplings. Where mechanical interfaces have tight tolerances, matched pairs should be used.

NOTE 4 An example of a matched pair is a bar that fits inside a tube with tight tolerances.

7.4 Testing electrical complex systems

The testability of an electrical complex system is given in BS EN 60706-5, as well as false alarms and fault recognition times. Priority 1 or 2 functions (**5.2**, Table 1) should be fully testable with minimum false alarms. However, in some cases this might not be practicable and alternatives should be explored.

NOTE 1 For example, measuring the susceptibility of a complex system to electromagnetic field pulses might have to be based upon the design analysis and the reliability of components such as the use of multiple capacitors so that the chance of multiple faults would be extremely rare.

Additionally, the function operating just outside its complex system requirement parameters should be taken into account in the design. The design robustness might have to be checked, but operating at these extremes can provide major benefits.

NOTE 2 For example, at what humidity and temperature would the insulation fail on a particular product and give rise to electric shock? The complex system might survive with water being poured over it, but if the surface tension were reduced, would it still survive? If a spike came down the power input at the same time, would it still survive? Testing a complex system or complex sub-system in these extremes can help to eliminate failure occurrences, which would take many hours of testing.

For large complex systems, there is a tendency to electrically test everything practicable within a unit or system so that a component failure can be identified and related to a board or unit for replacement. This takes time and a faster approach is to confirm function operation and to only identify the component when there is a change in the characteristics of the function.

NOTE 3 This assumes that components are tested at board level and the design has been proven.

After integrating units that have been fully tested, only the integrating elements should be taken into account. For example, a guided missile could be tested by moving a model in the distance and confirming that the guidance fins move correctly. This confirms the interconnections for many functions. The test strategy for electrical tests associated with priority 1 or 2 functions should be to:

a) test outside the design envelope to substantiate the design and improve reliability; and

b) adopt a simpler complex system testing approach that minimizes unit or complex system testing times.

7.5 Testing software complex systems

Having established the priority 1 or 2 functions, these should be subjected to more thorough testing. There is a tendency to declare the number of tests established, in the belief that the bigger the number, the better the testing. However, the number of tests should not be the driving criteria.

The environment and infrastructure needed to test a function at a particular release should be taken into account in the strategy for testing software. The amount of data tables required and even the simple task of assigning sign-on capability for end-users and testers can greatly facilitate the testing.

7.6 Testing human interfaces

Two separate aspects should be taken into account when formulating the strategy for testing human interfaces. The humans involved in the operation of the complex system should be the same humans involved in the maintenance of the complex system. When a maintenance activity (such as servicing or replacement of failed items) is initiated, its consequences on the complex system requirements should be taken into account and a process should be implemented to avoid negative impacts.

Before commencing a maintenance activity, if the inadvertent operation of certain items within the system have been identified as potentially hazardous and could cause further damage to the system or maintainer, they should not be operated. Tests should be undertaken to demonstrate that this is the case, and should take into account essential aspects as well as possible impacts.

When maintenance is complete, the tests undertaken should confirm that the maintenance activity has been successfully accomplished before removing any inhibitions to the system. The whole complex system should then be tested before being returned to operational use.

8 Testing combined complex systems

The testing of combined complex systems should make use of all the strategies given in **7.1** to **7.6**. Although there are slightly differing strategies mentioned within each of these, there are analogies that can be applied across all complex system types.

9 Test documentation

Written documentation should be established to cover the following:

a) a test strategy covering the overall testing process;

b) a test plan(s) for each stage/release, incorporating the associated test cases;

c) a test procedure(s) (including any software scripts) related to the test cases; and

d) any test results.

Additionally, a risk assessment workshop should be carried out and documented (**10.2**).

10 Implementation guidance

10.1 Demonstration

During the early stages of complex system implementation, the operation of as many critical functions as possible should be demonstrated at the earliest opportunity, even if this only involves partial demonstration of an incomplete function.

The aim should be to involve an end-user who is familiar with the item functional requirements (**4.1**) as well as having an understanding of the overall requirements as a tester, and therefore able to develop and improve usability of the complex system. The demonstration is intended to identify any misinterpretation, ambiguity, error or omission within the complex system requirements as early as possible. Any errors should be recorded within a defect reporting system as they can result in changes to the complex system requirements, which can have an impact on the testing.

NOTE Demonstrations have been found to be particularly beneficial when requirements are missing, ambiguous or are still being refined while development and testing have already commenced.

Subsequent steps should be identified in a risk assessment workshop involving the detailed testing of functions, as well as the testing of integrated items.

10.2 Risk assessment workshop

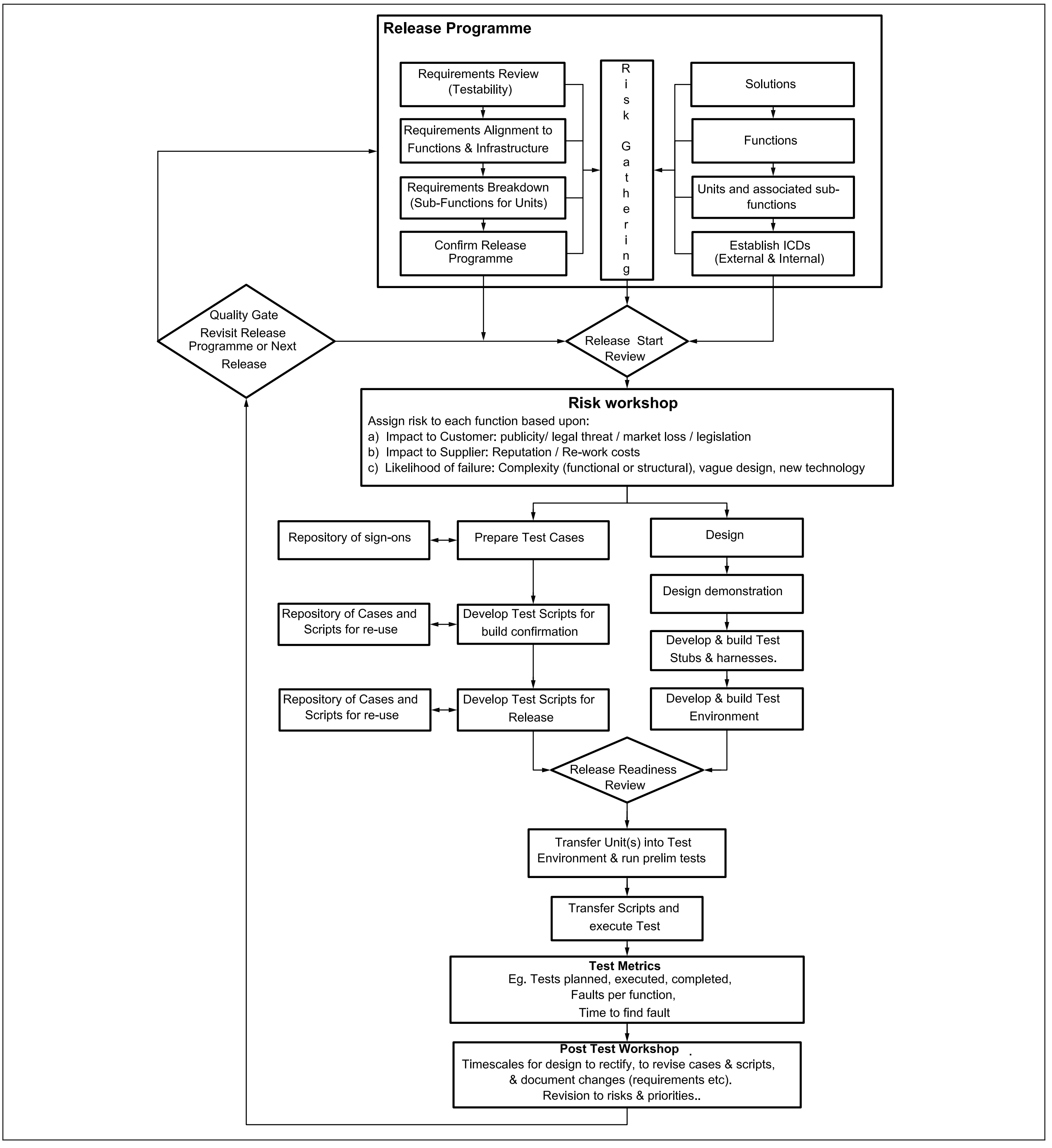
A risk assessment workshop should be undertaken to utilize the information gathered for the identification, analysis and evaluation of the critical functions, and to establish the tests that are to be applied against each release stage. The workshop should be integrated into the project plan (**4.1**) and address all functions but place greater emphasis on the functions having priority 1 or 2 (**5.2**).

The risk assessment workshop should be divided into clear stages. The functions that relate to each of the complex system requirements and the items to perform these specific functions should be identified from the onset. The interfaces across units (**4.3**) and associated systems or their environments should also be identified.

The stage at which the function of an item can be tested (or partially tested) and the associated environment that is required to perform these tests should be identified. The interface should be tested for satisfactory performance, and the development of a test interface can progress alongside function development in order to be aligned and made compatible. Complex functions, in particular, should be covered in the risk assessment workshop as they are likely to take longer to test and should be automated as early as possible in the process.

A brief schematic showing an example of a risk assessment workshop for a software product is shown in Figure 1.

Figure 1 **Software product risk assessment workshop**



At the end of the risk assessment workshop, a review document should be produced to indicate the results and to address the following questions:

a) do any of the functions require their risk priority (**5.2**) to be revised?

b) are there any gaps in the tests being conducted and do they need to be revised or increased?

c) where a function has failed a test, what is the estimated time required to rectify the problem?

d) which faults should be rectified before the next release?

e) is the release to be repeated?

f) is the next release to be undertaken out as planned, and if not, how much additional time is likely to be required to meet the schedule?

11 System delivery

11.1 Verification and validation

Verification and validation of a complex system can be costly. In order to achieve value for money, the most important functions should be prioritized in order to provide the best return. All functions should be verified and validated, but not necessarily to the same extent as the critical functions. A progressive approach to verifying and validating the system should be implemented taking into account the findings gathered during the risk assessment workshop (**10.2**). Data should be gathered throughout the verification and validation process, for instance:

- the version numbers associated with the item(s) involved, the test interfaces, the test software and hardware, and the associated environment/infrastructure;
- the number of tests planned and executed for each function;
- the faults detected for each function and whether the fault is related to the function itself or an error in the interfaces or the environment/infrastructure;
- the severity of the fault;
- the time taken to test and the time taken to track fault causes;
- the version changes and related number of faults over calendar time; and
- the lessons learned, to be incorporated in future releases.

A high number of faults detected might not indicate a problem. These faults should be weighed against the number of tests undertaken and also whether they increase or decrease in number as the test stages progress. As further layers of complexity are added, problems of a different nature might occur, but eventually the trend should clearly indicate a lessening of faults in quantity as well as severity.

11.2 Feedback

Feedback should be gathered from all release stages. This feedback should be used to indicate whether the project should progress to the subsequent release stage, or be repeated. It should also be used to confirm whether particular problems have been satisfactorily resolved or can be held for resolution at the next release.

In advance of final acceptance of the complex system, there should be a final demonstration of it in its test environment to satisfy the end-user or customer that the complex system fulfils its requirements.

11.3 Transferring the system

Transferring the complex system into a live environment can result in problems occurring that had not previously been detected. Where the transfer can be progressive, this should be noted in the complex system project plan. If a progressive transfer is not possible, then rapid transfer and rapid removal should be used so that time is available to identify problems associated with the live environment. Where necessary, the test environment should be adapted to replicate the live environment. A final acceptance demonstration should take place in the live environment.

11.4 Maintenance and upgrade

Complex systems might need to be maintained or upgraded from time to time and the impact of these should be addressed in the risk assessment workshop (**10.2**). Where a complex system has been maintained or upgraded, the complex system requirements should include specific maintenance activities and each of these should be treated in the same manner as a function and their impact and likelihood assessed.

NOTE For large complex systems there might be maintenance on parts of the system that are not apparent to all end-users. A partially or inadequately completed maintenance job could have a major impact on the complex system. If these are clearly identified at the outset of the project, measures can be taken to prevent risks with highly detrimental consequences from occurring.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 60706-5, *Maintainability of equipment – Part 5: Testability and diagnostic testing*

BS EN 60812, *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*

BS EN 61025, *Fault tree analysis (FTA)*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

...making excellence a habit.™