Guide for

Smart Technologies for Shipyards

February 2023

GUIDE FOR

SMART TECHNOLOGIES FOR SHIPYARDS
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American Bureau of Shipping
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the State of New York 1862

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Foreword

The transition towards digitalization is moving fast in the shipbuilding industry. The whole industry seeks to capitalize on technological transformation to improve design, fabrication and operational processes as well as improve the health, safety, and quality processes in shipyards.

This Guide introduces the process to recognize shipyards utilizing and incorporating Smart Technologies into their operational processes. A shipyard Smart Technology Certification Framework is established providing guidelines for shipyards to demonstrate the integration of qualified Smart Technology into their operational processes.

Upon compliance with the applicable requirements in this Guide, shipyards will be eligible for the class recognition of **Shipyard Smart Technology** in the ABS Type Approval database.

Compliance with the requirements in this Guide does not negate specific requirements related to ship construction and Survey contained in other applicable Rules, Guides, or regulations.

This Guide becomes effective on the first day of the month of publication. Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of these Guidance Notes is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.

GUIDE FOR

SMART TECHNOLOGIES FOR SHIPYARDS

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SECTION 1
General

1 Introduction

This guide:

i) Describes the approach for recognition of shipyard that incorporates Smart Technologies into their operational process(es).

ii) Introduces a systematic process to verify and validate the Smart Technologies which have been adopted into the yard process(es).

iii) Documents the process for utilizing the technologies to meet Class requirements, when applicable.

2 Scope

This Guide is applicable to Smart Technologies adopted and incorporated in the operating process(es) within shipyard. In the context of this Guide, Smart Technologies are technologies which utilize digital, and data driven innovation in three key areas: hyperconnectivity, advanced automation, and/or data-driven intelligence, to support decision-making capabilities and improve operations and work processes.

3 Smart Technologies for Shipyards

3.1 Shipyard

A shipyard, herein called a yard, is a facility where building, repair, and physical works on marine vessels or offshore units are carried out. Shipyards can be associated with initial construction, repairs, modifications, and maintenance activities.

3.2 Implementation of Smart Technologies in Shipyards

A shipyard described in this Guide refers to a yard utilizing Smart Technologies in their operating activities, production activities and work processes. Examples of implementation of Smart Technologies in shipyards are:

- Location intelligence (used for tracking location of personnel within the shipyard environment)
- Artificial Intelligence and data analytics (e.g., robotics or AI-driven applications in production processes, using real-time production and inventory data to optimize inventory management, using image recognation algorithms for welding quality inspection, and using real-time equipment sensor data to drive predictive and cognitive maintenance analytics)
- Worker on-the-job health monitoring (e.g., using real-time sensor data to monitor the workforce safety and health by the safety departement)
- Augmented Reality – to connect assests and facilities, making sense of data and digitize business operations (e.g., to assist maintenance personnel in maintanence and repair of equipment or assets)

4 A Shipyard Smart Technology Certification Framework

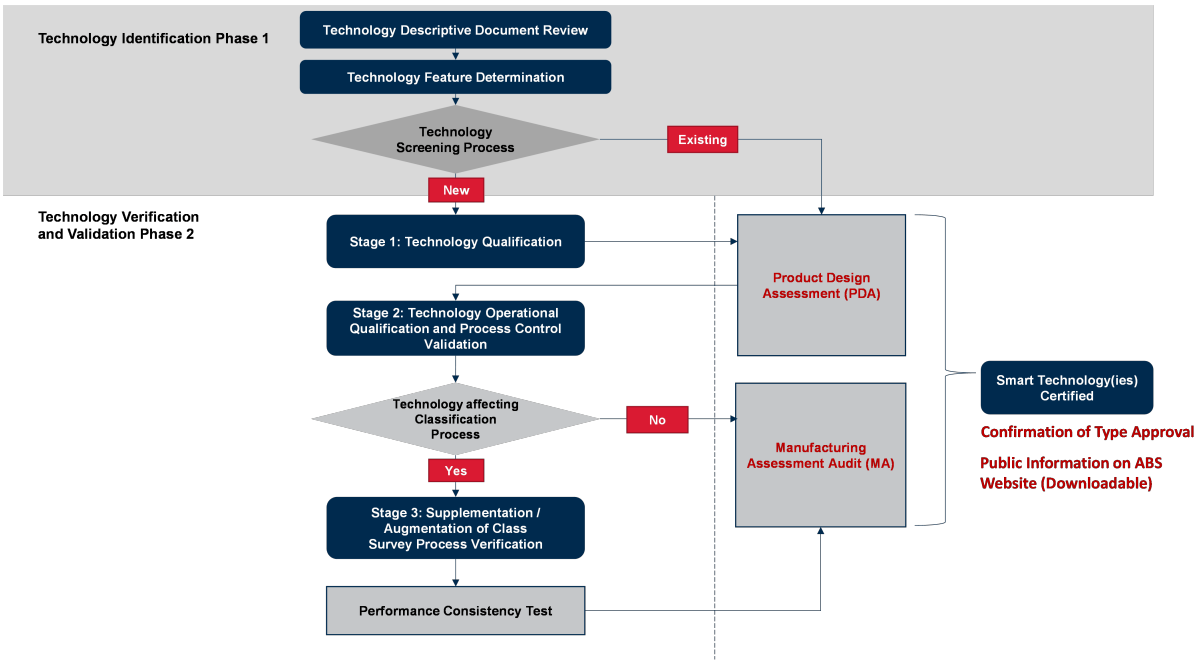
The Shipyard Smart Technology Certification Framework consists of the following phases:

i) Technology Identification Phase

ii) Technology Verification and Validation Phase

Figure 1 below provides an overview of the Shipyard Smart Technology Certification Framework.

FIGURE 1
Shipyard Smart Technology Certification Framework



4.1 Technology Identification Phase

The objective of this phase is to:

- Review and identify the Smart Technology, and
- Determine the features of the Smart Technology.

This phase contains two steps:

i) *Technology Descriptive Document Review*: A technology descriptive document is to be prepared and submitted to ABS for review. This document is to include a high-level description of the technology implementation, hardware and software incorporated in the technology for use, and functional and technical specifications. It is to be maintained and updated as the process progresses to Phase 2 of the Technology Verification and Validation.

ii) *Technology Feature Determination* – In this step, the features of the Smart Technology are determined by ABS based on the information provided by shipyards.

For the purpose of this Guide, the Smart Technologies can be classified as possessing one or more of the following three features.

- Hyper-Connectivity
- Advanced Automation

- Data-driven Intelligence

See Subsection 2/3 for details on this categorization.

Once the technology features have been identified, a Technology Screening Process is performed to determine if the technology is new or existing. See Subsection 2/4 for details on this screening process.

4.2 Technology Verification and Validation Phase

The objective of this phase is to verify the Smart Technology and validate its implementation into the shipyard's processes. This phase is aligned with ABS Type Approval Program (Refer to 1-1-4/7.7 of ABS *Rules for Conditions of Classification (Part 1)*.

The "Confirmation of Type Approval" in this Guide (see Figure 1) represents that the Smart Technologies, including the development of software, related hardware, and quality assurance and control system incorporated in the Smart Technology have been reviewed for compliance with one or more ABS Rules or Guides, statutory, industrial or manufacturer's standards, or other criteria acceptable to ABS.

This phase consists of three (3) stages as follows:

- Stage 1 – Technology Qualification (equivalent to Design Assessment, issuance of PDA for either existing or new technology)
- Stage 2 – Technology Operational Qualification and Process Control Validation (equivalent to design validation and quality management assessment, issuance of Manufacturing Assessment (MA) and Type Approval Certification for the technology used for non-Class related activities)
- Stage 3 – Supplementation / Augmentation of Class Survey Process Verification (equivalent to Class Survey, issuance of Manufacturing Assessment (MA) and issuance of Type Approval Certification for the technology used as a part of Class Survey)

For Smart Technologies to be used for non-Class related activities, upon successfully completion of Stages 1 and 2, the Smart Technology implemented by the shipyard is eligible for a Confirmation of Type Approval – Tier 3 (Upon completion of PDA and MA). This certificate is available from the ABS website, www.typeapproval.org, when a valid Product Design Assessment Certificate (PDA) - Tier 2 and a valid Manufacturing Assessment Certificate (MA) – Tier 3 remains current. The Type Approval herein is to certify that the implementation of the Smart Technology complies with a recognized standard at least to ISO9000 series or equivalent. Equivalency will be determined by ABS on a case-by-case basis.

For Smart Technologies to be used as part of the Classification process, such as to supplement, augment, or to complement tasks that are related to or affecting the Classification process in ship construction, repair, or commissioning activities, an additional step (in Stage 3 – Supplementation/Augmentation of Class Survey Process) is required. The issuance of a Manufacturing Assessment Certificate (MA) – Tier 3 is contingent upon the Rule-required surveys and tests which are to be conducted by the attending ABS Surveyor. A performance Consistency Test is required. This stage involves two processes. The purpose is to make sure that the qualified process using Smart Technology can produce results that are the same or better than the traditional process/approach.

Stage 1: Technology Qualification – This stage applies to existing and new technologies which focus on the design evaluation. Smart Technologies utilizing existing and proven technologies may skip the Technology Qualification and move directly do engineering evaluation (e.g., review the requirements for system integration, installation, commissioning, operation, maintainability, and decommissioning) and issuance of PDA.

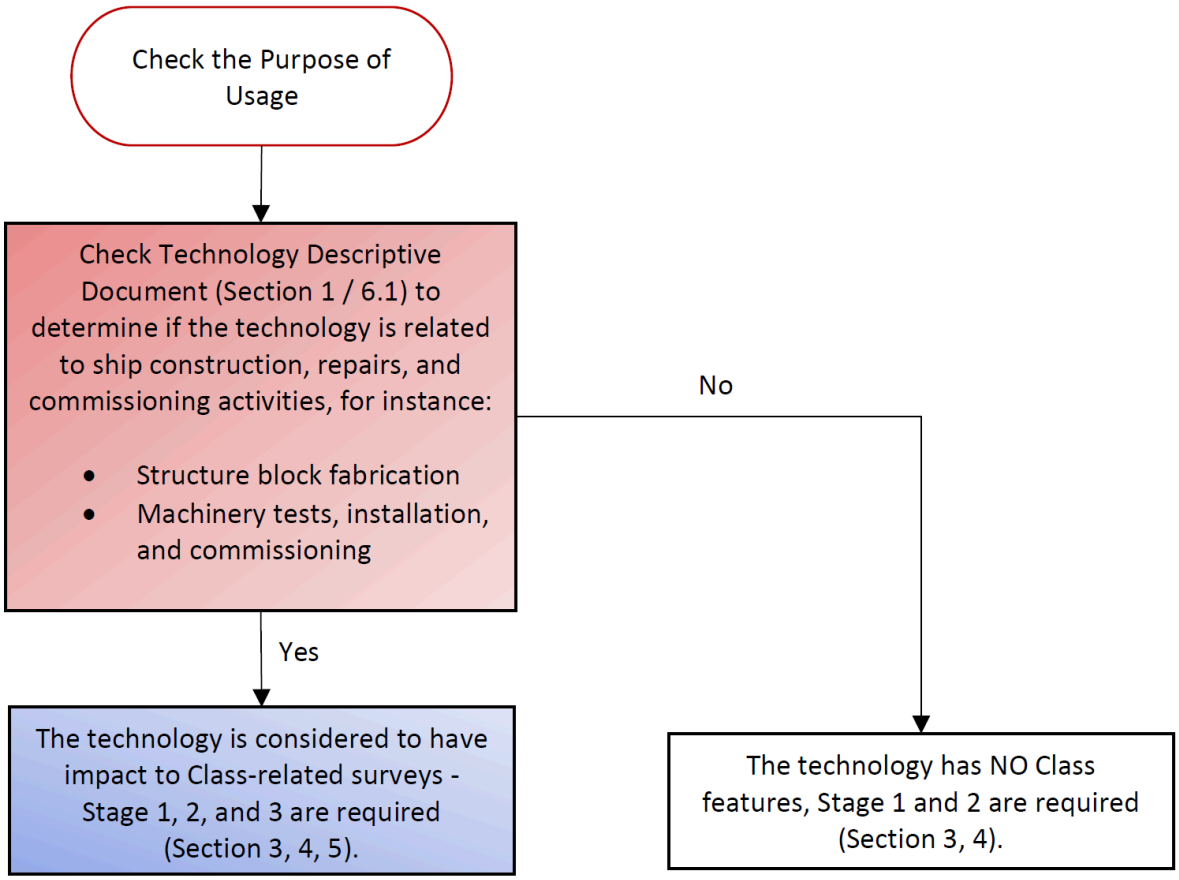
The objective of the Technology Qualification stage is to evaluate and qualify the maturity level of the new technology through an iterative process including design concept verification and prototype validation based on engineering reviews (i.e., engineering evaluations and risk assessments). The Smart Technology is to be validated through demonstration as being able to perform in accordance with the defined

performance requirements as outlined in the document of System Requirements prior to final engineering review and issuance of PDA.

Stage 2: Technology Operational Qualification and Process Control Validation – This stage is firstly to validate the technology has been integrated into the final system and has been operating successfully in the actual operating environment for a satisfactory amount of time, and secondly to verify the shipyard quality control for the technology in practice (i.e., the yard can control the processes and technologies qualified) and validate the training requirements and qualification of the people who execute the process using the technology (i.e., organizational capability) after issuance of PDA. This stage focuses on both technology operational incorporation validation and yard Quality Assurance and Quality Control (QA/QC) processes. An onsite survey (refer to 6/2.2.1) is required to validate all functional and performance requirements of the integrated system in the actual operational environment through an in-service field test. In addition, the shipyard is to demonstrate methods to control the qualified technology as a part of the yard processes. An onsite audit (refer to 6/2.2.2) is to be conducted to validate the yard has an ongoing quality control process of the qualified technology that complies with a recognized quality standard at least equivalent to the ISO 9000 series. Upon completion the Manufacturing Assessment (MA) and Type Approval Certification will be issued.

Stage 3: Supplementation/Augmentation of Class Survey Process – This stage applies only where the Smart Technology is used to supplement, augment, or complement tasks related to or affecting the Classification process in ship construction, repair, or commissioning activities. Figure 2 provides a guideline on which technology is considered to have an impact to Class-related survey or inspection activities. A Performance Consistency Test is to be performed to validate if the Smart Technology is to meet the current Rule and/or process requirements. The purpose of this test is to confirm the technology has comparable results with the conventional methods to support the Rule compliance process. Refer to 6/2.3 for further details. Upon completion of audit and survey required is Stage 2 and the Performance Consistency Test of Stage 3 the Manufacturing Assessment (MA) and Type Approval Certification will be issued.

FIGURE 2
Technology involved with "Classification Processes"



5 Certificates

5.1 Product Design Assessment (PDA) Tier 2

At the end of Stage 1, for either new or existing technologies, when the design (e.g., Smart Technology implementation processes) shows compliance with the applicable requirements of the Rules or an alternative criteria/standard acceptable to ABS, a Product Design Assessment (PDA) certificate can be issued by ABS to the shipyard, who has legal or patent rights to produce the material, component, product, or system relate to applying Smart Technologies.

If the shipyard decides to implement the same Smart Technology or process by a sister shipyard, that sister yard may receive a Duplicated Product Design Assessment (PDA-DUP), refer to 1-1-A3/5.1.5 of ABS *Rules for Conditions of Classification (Part 1)*.

The details of the process for Product Design Assessment (PDA) refer to 1-1-A3/5.1 of ABS *Rules for Conditions of Classification (Part 1)*.

5.2 Manufacturing Assessment (MA) Tier 3

The application of the Manufacturing Assessment (MA) can only occur in conjunction with Product Design Assessment (PDA, or PDA-DUP). At the end of Stage 2, upon the shipyard that is successfully validated through onsite Survey and Audit in accordance with 6/2.2, the yard can be found to:

- Have undergone a satisfactory product (e.g., Smart Technology implementation processes) design evaluation,

- Comply with a quality assurance standard, and
- Have a quality control that meets the applicable provisions of the Rules, or the applicable product standard, or the manufacturer's specifications

At the end of Stage 3, for the Smart Technology which is to be used as part of the Classification process (apart from an effective quality assurance system and quality manual in operation), a Performance Consistency Test is required during initial and renewal audits to confirm that the implementation of the Smart Technologies meets ABS Rules, Guides, or statutory requirements. The shipyards will be issued a Manufacturing Assessment (MA) certificate by the attending Surveyors. The yard will be eligible for listing on the ABS website under the Type Approved Product index together with the PDA Certificate data, as appropriate. The details of the process for Manufacturing Assessment (MA) refer to 1-1-A3/5.3 of ABS *Rules for Conditions of Classification (Part 1)*.

6 Submittal Requirements

TABLE 1
Submittal Requirements

Submittal Requirements	***Technology Identification Phase***	***Technology Verification and Validation Phase***		
	Technology Feature Determination	***Stage 1: Technology Qualification***	***Stage 2: Technology Operational Qualification and Process Control Validation***	***Stage 3: Supplementation / Augmentation of Class Survey Process***
Technology Descriptive Document	x			
New Technology Screening Table	x			
System Requirements	x			
Inspection Test Plan (as applicable)		x		
In-Service Inspection Plan (ISIP)			x	
Audit Program			x	
Organizational Plan			x	
Performance Consistency Test program				x
Management of Change Program				x
Data Management Plan			x	

6.1 Technology Descriptive Document

The Technology Descriptive Document is to include:

i) Description of goals to be achieved by the Smart Technology implementation. (e.g., purpose of the usage and impact to health/safety/quality/environment/efficiency)

ii) Description of the scope and conditions of implementation to highlight if the technology is to affect the Classification process related to requirement for ship construction, repair, or commissioning activities (refer to 1/4.2, Figure 2)

iii) Description of the level of constituent systems for the proposed technology, providing a list of component/equipment, subsystem and/or System to be implemented (e.g., hardware and software incorporated in the technology for use)

iv) Description of the overall monitoring, analytics, reporting, and decision-making process covered through the Smart Technology implementation

v) Description of the overall quality control procedure(s) and quality acceptance criteria

vi) Self-assessment of Smart features for the technology (i.e., to identify what are the Smart feature of the technology, a selection from "Hyper-Connectivity", "Advanced Automation" or "Data-driven Intelligence" (refer to Subsection 2/3 for a description of Smart features)

vii) Description of the overall operational scenarios, maintenance, and inspection strategies

6.2 New Technology Screening Table

A new Technology Screening table (see Subsection 2/4 for details) is to be submitted to ABS for review. This table will help identify whether a Smart Technology utilizes new technology or existing technology in its design and implementation.

6.3 System Requirements

The design and installation documents of the systems to deliver the Smart Technology are to include:

i) Functional requirements to define what the Smart system is required to perform.

ii) Performance requirements to define how well each functional requirement is to be accomplished. The performance metrics include identification of critical performance parameters and the performance criteria, such as performance error rates.

iii) System Interface Requirements to define all internal and external physical and functional interfaces with the yard infrastructure, if any (e.g., mechanical, electrical, etc.)

iv) Human System Interface Requirements to define usability requirements which identify user needs and expectations (e.g., appropriate allocation of functions between users and the technology as well as the measurable effectiveness, efficiency, and satisfaction criteria in specific contexts of use with or without humans in the loop. See also ii) above)

v) Approach to technology development to define the process used to develop the technology. For example, training and testing a machine learning model, including the data sets employed in same.

6.4 Inspection Test Plan

An inspection test plan (ITP) is to be developed and submitted to ABS for review if an onsite Prototype Survey is required during the prototype validation process at Stage 1. The following items are to be defined in the plan:

i) The inspection and testing tasks.

ii) Testing or inspection methods (e.g., remote inspection for protype validation as applicable).

iii) The inspection check points.

iv) The timing and frequency of these inspections. The plan will also set up intervals of auditing to make sure that the necessary inspections have been performed and are sufficiently documented.

v) The level of acceptance for each inspection task (e.g., specifications/approved drawings/relevant Rules, Guides, Industry Standards, as applicable)

6.5 In-Service Inspection Plan (ISIP)

An In-Service Inspection Plan (ISIP) is to be developed for planning survey activities, which relate to system integration testing and operational testing. The plan details test techniques, test limits, and expected test data. Quality assurance requirements should be developed and submitted to ABS for review before the onsite survey. All test procedures and test results are to be summarized in a report and submitted to ABS for review. This plan may contain:

i) Onsite survey procedures to address in-service survey, inspection, monitoring, sampling, and testing (as applicable) during operations

ii) In-service survey check items corresponding to the testing criteria established in 1/6.3

iii) The yard survey or inspection scope, minimum number of trial cases, minimum trial period, frequency, and maintenance schedules are to be verified

The detailed plan is to be submitted for ABS review during the plan review process. Changes to the ISIP are to be submitted to ABS for approval.

6.6 Audit Program

An audit program is to be developed for planning audit activities, which relate to quality assurance and quality control system assessment for implementing Smart Technology in operation. This program is to be submitted to ABS for review which may contain:

i) Onsite audit procedures to address witnessing, monitoring, sampling, and testing (as applicable) during operations

ii) On-going data assurance check on data acquisition, data storage, data processing, reports and actions check and security check in line with criteria established in 1/6.3

iii) Critical systems, components or tasks requiring completion as identified in the technology risk assessment per Subsection 3/3 (as applicable)

iv) Resolution of feedback, improvements, and failures from actual implementation from 6.8 below.

The detailed program is to be submitted for ABS review during the plan review process. Changes to the audit program are to be submitted to ABS for approval.

6.7 Organizational Plan

The information listed below is to be submitted to demonstrate the shipyard's organizational plan for implementing the Smart Technology:

i) Organization Chart showing roles, duties, and skills necessary to manage and implement the technology implementation in the yard process.

ii) Quality assurance and quality control procedure governing the technology implementation in the yard processes (i.e., at least the certified ISO 9001 certificate or recognized equivalent).

iii) Documented confirming training of personnel is in accordance with requirements set forth by recognized standards or governing quality processes, whenever possible.

iv) Where recognized standards do not exist to confirm training and qualification of personnel, the yard is to define the standards for the training and qualification of its personnel relevant to the tasks or roles they are authorized to perform in the documents covered by item ii, above.

6.8 Performance Consistency Test Program

A Performance Consistency Test program is to be developed for survey planning to confirm the Smart Technology has consistent results compared to the conventional methods. This program is to be submitted to ABS and is to contain the following:

i) Identification of the applicable ABS or statutory related requirements.

ii) Details of the test method including test period and test limits for Smart Technology and conventional methods.

iii) Identify test procedures including the checkpoint (e.g., which the Surveyors need to witness) to compare the performance of the Smart Technology with the conventional methods.

iv) Define acceptance criteria for evaluating the test results. In principle, the results obtained by the Smart Technology should be equivalent to those of the conventional methods. Any limitation or condition specific to the test results are to be clearly stated.

v) The method of data review and the criteria to evaluate the data (e.g., live-streaming data, photos, videos) quality. Proper equipment should be arranged by the yard and the vendor to enable the attending Surveyor to review the data.

vi) The Surveyor may require additional testing by using traditional methods to verify the consistency of the Smart Technology.

6.9 Management of Change Program

An effective Management of Change program is to be implemented and is to be reviewed by ABS to ensure product control through version iteration and product evolution.

The program is to include the policies and procedures used to evaluate the potential impacts of a proposed change (temporary or permanent) to prevent unacceptable risks to system operational characteristics, performance, or safety.

Changes include equipment and personnel change, hardware modification and replacement, software patching and version upgrading, data analytics model revision, data source or data structure change, and changes to staffing levels or operator qualification requirements.

Whenever a change is to be made, the potential consequences of that change are to be assessed before implementation. Risk Assessments are to be re-executed if the change may alter the scope and objectives of the original risk assessment. Related documents are to be reevaluated and where necessary submitted to ABS for review.

The ABS *Guidance Notes on Management of Change for the Marine and Offshore Industries* provides detailed information on the development of a Management of Change program.

6.10 Data Management Plan

The following information is to be presented and supported by the proper documentation if data analytics is involved in the Smart Technology incorporation process:

i) A brief description of hybrid or data-driven application associated with the Smart Technology.

ii) Identification of data sources and acquisition.

iii) Data quality check/assessment plan as applicable.

iv) Data storage, data backup and data recovery capacity and usage monitoring and alarming.

v) Established cyber security and data integrity control for data governance, storage, and backup (e.g., the documents of ABS CyberSafety™ series, such as to describe the access limitations, use of passwords, or the restriction of communications between some areas of the system)

7 Reference Documents

- ABS *Rules for Conditions of Classification (Part 1)*
- ABS *Guidance Notes on Qualifying New Technology*
- ABS *Guidance Notes on Management of Change for the Marine and Offshore Industries*
- ABS *Guide for Smart Functions for Marine Vessels and Offshore Units*

- ABS *Guide for Marine Health, Safety, Quality, Environmental and Energy Management*
- ABS. *(2019). Advisory on Data Quality for Marine and Offshore Application - Time Series Data.*
- ABS *Guidance Notes on The Application of Cybersecurity Principles to Marine and Offshore Operations - ABS CyberSafety™ Volume 1 (2016)*
- ABS *Guide for Cybersecurity Implementation for the Marine and Offshore Industries - ABS CyberSafety® Volume 2 (2021)*
- *ISO/TR 11065:1992 Industrial automation glossary*
- *ISO 8000-61:2016. (2016). Data quality - Part 61: Data quality management: Process reference model.*
- *ISO 8000-8:2015. (Nov, 2015). Data quality - Part 8: Information and data quality: Concepts and measuring.*
- *ISO 9001:2015. Quality management systems – Requirements.*
- *ISO 14001:2015. Enviormental management systems – Requirements with guidance for use.*
- *ISO 5000:2018. Energy Management Systems – Requirements with guidance for use.*
- *ISO 45001:2018. Occupational health and safety management systems – Requirements with guidance for use.*
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- Burke, R.; Mussomeli, A.; Laaper, S.; Hartigan, M.; Sniderman, B. The Smart Factory, Responsive, adaptive, connected manufacturing, August 2017
- Connelly, James Orion, and Paula Miller. A Conceptual Framework for SMART Applications in Higher Education: Emerging Research and Opportunities. Hershey, PA: IGI Global, 2020. (https://doi.org/10.4018/978-1-7998-1542-6)
- "The Fourth Industrial Revolution: what it means, how to respond", World Economic Forum, 14 Jan 2016, https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

8 Definitions

Digital Data. Visual data (e.g., still images, live-stream video, and recorded video), gauging data, and data from other emerging technologies.

Data Quality Assurance. The process of data profiling to discover inconsistencies and other anomalies in the data, as well as performing data cleansing activities (e.g. removing outliers, missing data interpolation) to improve the data quality. These activities can be undertaken as part of data warehousing or as part of the database administration of an existing piece of application software.

Inspection Test Plan. A document specifying the processes of the quality management system (including the product realization processes) and the resources to be applied to a specific product, project or contract can be referred to as a quality plan.

In-Service Inspection Plan. A document specifying the processes refer to inspection that takes place under the following conditions:

i) After equipment is placed in-service.

ii) Usually made during scheduled shutdowns.

An ISIP is to address in-service survey, inspection, monitoring, sampling, and testing (as applicable) during operations.

New Technology. Any new technique (including component, equipment, subsystem, or system), process or procedure that does not have prior in-service experience, and/or any Classification Rules, Statutory Regulations or industry standards that are directly applicable. New technology falls into one of the following three categories:

i) Existing technique/process/procedures in new shipyard implementations (e.g., lack of defined performance standards for use in shipyards)

ii) New technique/process/procedures in existing shipyard implementations

iii) New technique/process/procedures in new shipyard implementations

Onsite Survey. Performed to validate all functional and performance requirements of the integrated system in the actual operational environment through in-service field test. In addition, the shipyard is to demonstrate methods to control and manage the qualified technology as a part of the yard process(es).

Onsite Audit. Performed to confirm the yard has an ongoing quality control of the qualified technology through implementation (i.e., to ensure the shipyard has quality control procedures and trained personnel over the real-time equipment monitoring, on-going data assurance, documentation process, and decision-making for anomaly alarming and disposition).

Performance Consistency Test. Conducted to validate if the implementation of Smart Technology is to meet the current Rule and/or process requirements. The purpose of this test is to confirm the Smart Technology / system can produce results that are the same or better than the conventional method to support the Rule compliance process.

Quality Assurance and Quality Control. Typical quality plans and related processes for controlling quality during production.

Quality Management System. A set of policies, processes, and procedures required for planning and execution (production/development/service) in the core business area of an organization.

Qualification. The process of confirming, by examination and provision of evidence, that equipment meets specified requirements for the intended use. See API RP 17N.

Smart Technologies. Technologies which leverage the digital and data driven possibilities brought on by innovation, namely hyperconnectivity, advanced automation, and data-driven intelligence to support decision-making capabilities, and improve operations and work processes.

Type Approval. A voluntary ABS Program for product certification that is used to demonstrate a product manufacturer's conformance to the Rules or other recognized standards. The Product Design Assessment (PDA) and Manufacturing Assessment (MA) together result in a Type Approval or a "Type Approved" product.

Verification. The process of evaluating a system to determine whether the product of a given development stage satisfies the approved requirements and can be performed at different stages in the product life cycle by testing, analysis, demonstration, or inspection.

Validation. The process of evaluating a production unit (or full-scale prototype) to determine whether it meets the expectations of the customer and other stakeholders as shown through performance testing, analysis, inspection, or demonstration.

Prototype Validation Process. This is the verification of the original Smart Technology and its implementation Process(es) (new Smart Technology, e.g., location intelligence, artificial intelligence,

worker health monitoring or augmented reality). If a Surveyor's witness is required, this may not be waived under any section of the Rules, unless it is done by a recognized third party.

Product Design Assessment (PDA). Technical evaluation of a product (i.e., Smart Technology implementation processes) for potential use in the yards' process (es). The process involves ABS Engineers verifying product compliance with the shipyards or vendors' specifications, applicable ABS Rules and national or international standards.

Manufacturing Assessment (MA). An inspection of the process (i.e., Smart Technology implementation processes) through onsite Survey and Audit, an assessment of the quality assurance and control system that must be satisfactorily completed for the Smart Technology to be labelled "Type Approved" under the ABS Type Approval Program.

Recognized Third Party. A member of the International Association of Classification Societies, a Flag Administration, a Nationally Certified testing Laboratories and others who may be presented to ABS for special consideration.

SECTION 2

Technology Identification Phase

1 Introduction

This section focuses on the determination of the Smart Technology feature(s) and confirmation that the Smart Technology being employed consists of existing or new technology based on the submitted Technology Descriptive Documents.

2 Technology Descriptive Document and System Requirements Review

The technology descriptive document and system requirements as defined in Subsection 1/6 determines the submittal requirements for the Smart Technology. The main purpose of this step is to evaluate if the technology proposed by shipyard can be defined as Smart (1/3.2) based on the submitted documents.

3 Technology Features Determination

For this Guide, Smart Technologies can be classified as falling under three (3) broad categories:

- Hyper-Connectivity
- Advanced Automation
- Data-Driven Intelligence

3.1 Smart Technology Features

The description of the features are as follows.

3.1.1 Hyper-Connectivity

Hyper-connectivity is a key enabler for the implementation of Smart Technologies. It encompasses human-to-machine and machine-to-machine communication in networked organizations. Characteristics of Smart Technologies with hyper-connectivity features include:

i) Provides communications among human, devices, and information systems (e.g., Internet of Things). This connectivity may be integrated through an organization-wide network

ii) Provides real-time data transfer/information sharing on operational processes

iii) Complies with suitable and relevant industrial standards, data communication protocols for connectivity

iv) Includes cyber physical security network architectures with Smart Technology if necessary

3.1.2 Advanced Automation

Advanced Automation in this Guide means the production/operation activities are performed by the automation equipment or computers to substitute all or part of previously part of human tasks or replace entire human work. The response to maintenance or failure of yard equipment is either managed by a human or performed autonomously. Characteristics of Smart Technologies with advanced automation features include:

i) They can be implemented through automatic monitoring, control, and execution through mechanical or electric devices under predefined conditions to substitute part of human tasks using automated equipment. For example, the production activities are performed by mechanized devices (blasting, cutting, grinding processing, coating/painting procedure, welding of sub- assembly, etc.), but the start and end of work and management activities for abnormal conditions are performed by humans.

ii) For certain technologies, the production and management activities are operated by machines and computers without human intervention. The production activities and maintenance to production stoppage such as failures are performed autonomously through embedded prognostic health management.

3.1.3 Data-driven Intelligence

Data-driven Intelligence in this Guide means information generation through analysis/inference by engineering algorithms, human level computer intelligence or even superior to humans. Characteristics of Smart Technologies with data-driven intelligence features include:

i) The collected data is controlled centrally (e.g., cloud computing or wireless infrastructure).

ii) Provides data processing and conducts data analytics via machine learning or artificial intelligence.

iii) Definition of input and output and preparation of input data are performed by humans, and the input data are processed/analyzed/inferred by engineering algorithms implemented in a computer to generate information used for decision-making.

iv) For certain technologies, the artificial intelligence algorithms at the same level of human thinking or even superior to human can perform decision-making support of all kinds.

3.2 Technology Feature Selection

From the review of the Technology Descriptive Document, the features of the Smart Technology will be identified. The possible combinations of technology features are listed below. As an enabler, Smart Technologies solely exhibiting hyper-connectivity features are not eligible to be listed.

i) Advanced Automation (standalone application)

ii) Data-driven Intelligence (standalone application)

iii) Advanced Automation + Data-Driven Intelligence

iv) Hyper-Connectivity + Advanced Automation

v) Hyper-Connectivity + Data-driven Intelligence

vi) Hyper-Connectivity + Advanced Automation + Data-driven Intelligence

In addition to Technology Descriptive Documents as listed in Table 1, the self-Smart feature assessment/ identification and other supporting documents are to be used for technology feature determination.

Upon completion of the document review, the type of technology feature will be identified and listed in the Product Design Assessment Certificate (PDA) or Type Approval Certificate. For example, "**Hyper-**

Connectivity + **Advanced Automation** + **Data-driven Intelligence**" may be assigned to AI/AR-based wearable devices for workforce training, operations, and maintenance.

4 Technology Screening Process

Once the technology has been described, the next step is a technology screening process to determine if the Smart Technology can be considered as a new or an existing technology. Prior to Phase 2 of the Technology Verification and Validation Phase, the shipyard is to perform the screening process independently. A new technology screening table as shown in Table 2 is to be submitted to ABS for review.

TABLE 2
New Technology Screening Table

Item	*Description*	*Smart Feature Category (See Note 1)*	*Similar Application*	*Relevant Rules, Guides, or Industry Standards for This or Similar Application*	*New Technology (Yes/No)*	*New Technology Category (See Note 2)*
x	Describe the Smart Technology (To list any recognized certificate(s) as applicable)	Select the associated Smart feature(s)	Does a similar application exist?	Shipyards need to list the relevant rules/Guides/ Industry Standards related to this technology	Is the technology new or existing?	Select the category of new technology

Notes:

1 Smart Feature (As defined in 2/3.2):

- ***i)*** Advanced Automation (standalone application)
- ***ii)*** Data-driven Intelligence (standalone application)
- ***iii)*** Advanced Automation + Data-Driven Intelligence
- ***iv)*** Hyper-Connectivity + Advanced Automation
- ***v)*** Hyper-Connectivity + Data-driven Intelligence
- ***vi)*** Hyper-Connectivity + Advanced Automation + Data-driven Intelligence

2 New Technology Category (As defined in Subsection 1/8):

- ***i)*** Existing technique/process/procedures in new shipyards implementations (e.g., lack of defined performance standards for use in shipyards)
- ***ii)*** New technique/process/procedures in existing shipyards implementations
- ***iii)*** New technique/process/procedures in new shipyards implementations

Smart Technologies categorized as new technologies are to undergo Stage 1 - Technology Qualification. See Section 3.

Smart Technologies categorized as existing technologies are to proceed directly to validate the design and issuance of PDA, and then proceed to Stage 2 – Technology Operational Qualification and Process Control Validation. See Section 4.

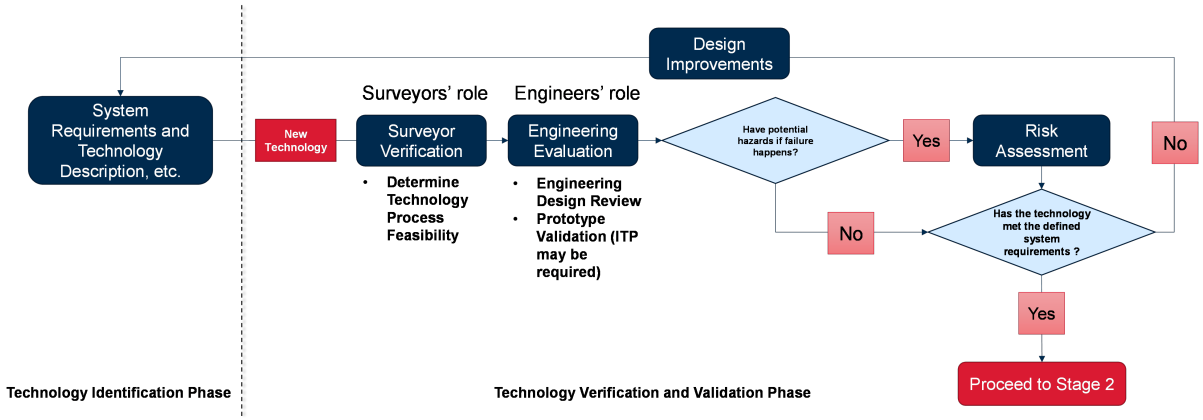
SECTION 3

Technology Verification and Validation Phase - Stage 1: Technology Qualification

1 Introduction

In this phase, the feasibility of the Smart technology process needs to be determined prior to the Product design Assessment(PDA), Smart Technology categorized as New Technology in the Technology Screening Process will be qualified in accordance with the defined functional and performance requirements. The Smart Technology qualification process in this Guide follows the New Technology Qualification Plan (NTQP) as provided in the ABS *Guidance Notes on Qualifying New Technologies*. Figure 3 shows the Stage 1 new technology qualification plan. Submittal requirements are described in Subsection 1/6.

FIGURE 3
Stage 1 – New Technology Qualification Plan



2 Engineering Evaluation

In this step, an Engineering Evaluation is carried out on the Smart Technology. Engineering evaluations are used to verify that the new technology can perform acceptably with respect to intent and overall safety according to the functional and performance requirements. Various tests are performed to gather data to feed the engineering analyses or to verify key assumptions made in the analysis work and to confirm that the application performs as intended. The types of activities for engineering evaluation may include:

- *Review Engineering Design Requirements:* The functional and performance requirements submitted at Phase 1 (Technology Identification Phase) are reviewed
- *Technical Analyses and Simulations:* Engineering design analyses and simulations are used to verify the technology at the earlier qualification stages.

- *Validation Testing:* Functional, model testing or phototype testing are used to confirm the new technology satisfies all the specified functional and performance requirements.
- *Interface Analyses:* Analyses of the interactions between the new technology and surrounding systems, including humans and the environment.
- *Verification of Operability:* The operational testing data is required to verify the new technology satisfy the operational requirements.
- *Verification of Inspectability and Maintainability:* The new technology must be reviewed to confirm that it can be monitored, inspected, and maintained in a manner consistent with existing practices.
- *Quality Assurance and Quality Control (QA/QC) Program:* An effective quality control procedure and quality acceptance criteria must be established and maintained.

For engineering evaluation for each maturity level, including Feasibility Stage, Concept Verification Stage and Prototype Validation Stage, the details of activities can refer to the subsection of "Engineering Evaluation" Section 3 to 5 of the ABS *Guidance Notes on Qualifying New Technologies*.

2.1 Engineering Design Review

Up to the Prototype Validation, the engineering design is to confirm that the overall system, down to the lowest component level, has satisfied all system requirements. The performance requirements a technology must meet should be finalized and measurable. In addition, the requirements for system integration, installation, commissioning, operation, maintainability, and decommissioning should be established.

2.2 Prototype Validation

Prototype validation is intended to prove that the interactions between the systems/subsystems/components under relevant environmental operating conditions can perform reliably as intended. Surveyor attendance during the prototype validation process may be required. Refer to 6/2.1 for survey inspection requirements.

3 Risk Assessment

Risk assessment is used to identify potential hazards associated with the use of the technology and its failure to perform to specified performance requirements, as applicable. The level of risk is to be mitigated through risk control measures as the part of the technology qualification process. A risk assessment plan and report is to be submitted to ABS for review. For details of activities for risk assessment, refer to 2/9.1 of the ABS *Guidance Notes on Qualifying New Technologies*. For Smart Technologies with no potential risk in their use, the requirement of a risk assessment may be waived upon consultation and agreement with ABS.

4 Technology Qualification Completion

Upon completion of this technology qualification (engineering evaluation and prototype validation), a Product Design Assessment (PDA) Tier 2 will be issued to the shipyard, who is the Intellectual property (IP) holder to devise a system for the Smart Technology implementation in yard processes. See 1-1-A3/5.1 of the ABS *Rules for Conditions of Classification (Part 1)*.

For the technologies identified as existing technologies, a normal PDA assessment process will be followed, refer to 1/5.1.

Upon completion of this technology qualification, the technology will proceed to Stage 2 – Technology Operational Qualification and Process Control Validation. See Section 4.

SECTION 4

Technology Verification and Validation Phase - Stage 2: Technology Operational Qualification and Process Control Validation

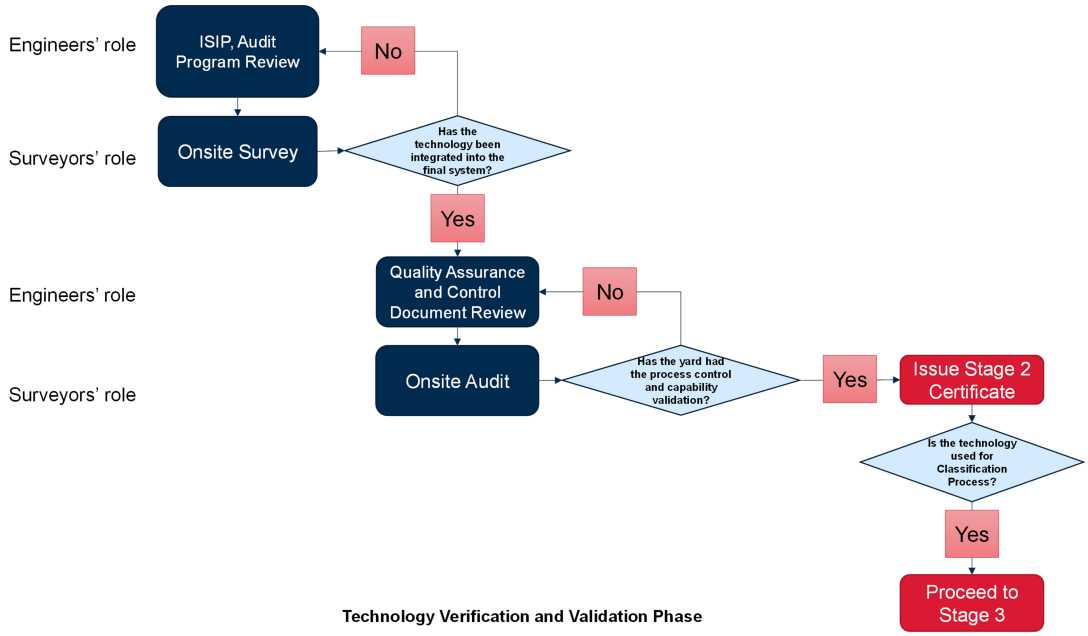
1 Introduction

There are two main focuses in this stage. First, the technology operational qualification aims to confirm the technology has been integrated into the final system and operated successfully in the actual operational environment. Secondly, the technology process control and capability validation process aim to confirm that the shipyard has continuing and ongoing process control and oversight over the use of that Smart Technology in the yard process and that the shipyard has incorporated the training and qualification requirements to implement the technology in the yard.

The shipyard is to document the work process denoting how they use the technology, such as standard operating procedures (SOP) and the quality control system (e.g., QA/QC program). Onsite survey and audit are to be conducted to validate the implementation of the Smart Technology in the yard.

Figure 4 shows the technology operational qualification and process control validation plan. This validation process starts upon the completion of engineering evaluation and issuance of the PDA, refer to section 6.2.2. An initial operational test and evaluation is to be performed to assess the technology operational effectiveness and suitability in the actual operating condition. Refer to 1/6.5, an In-Service Inspection Plan (ISIP), including in-service survey plan, test procedures and results, which are to be summarized in a report and submitted to ABS for review. Once the technology is integrated into the final system, the quality assurance and control process review and an onsite audit are performed by ABS to verify that the yard has in place an effective quality assurance and control system. Submittal requirements can be found in Subsection 1/6. For detailed survey and audit requirements in Stage 2, refer to 6/2.2.

FIGURE 4
Stage 2 - Technology Operational Qualification and Process Control Validation Plan



2 System Integration Testing

The technical qualified technology is to be integrated (by installation) with the final intended operating system. All functional and performance requirements of the integrated system are to be validated through testing before (or during) commission. Survey during the system integrating testing may be required as agreed upon in the In-Service Inspection Plan (ISIP).

- System interface and integration requirements are to be submitted to ABS for review.
- The operational performance parameters are to be defined, and in-service operation procedures are to be developed.
- Interface analysis is to be conducted to verify that the incorporation of the Smart Technology does not adversely affect the integrity of the surrounding systems and components (e.g., mechanical, electrical, data, human, etc.). All necessary functional and physical interfaces are to be reviewed.
- An ISIP to address in-service survey, test techniques, test limits, test data review, and quality assurance requirements is to be developed by the yard and submitted to ABS for review before the integration testing.
- All test procedures and results are to be documented in a report and submitted to ABS for review.

3 Onsite Survey

The ABS Surveyor will witness the system integration testing plan as specified in the In-Service Inspection Plan (ISIP) per 1/6.5 to verify that proper testing processes are followed, and they meet the quality assurance requirements based on the witness points as agreed between the yard operation team and ABS. For detailed survey requirements, refer to 6/2.2.1.

4 Quality Assurance and Control Process Review

The following aspects are to be documented and maintained for plan review and onsite audit:

- Local work processes

- Quality control procedures
- Maintenance, inspection, testing, and calibration processes
- Ongoing data assurance and control
- Organizational chart showing roles, duties with specific attention to processes requiring a human in the decision-making loop
- Training of personnel is documented in accordance with requirements set forth by recognized standards, whenever possible
- Related quality system certifications - Health, Safety, Quality & Environmental Management systems

5 Onsite Audit

A qualified ABS Surveyor will be required to witness the trials in the actual operating environment and quality control procedures in practice. The following scope is to be conducted at the audit site to validate through a representative trial case or through an agreed trial period (e.g., real-time equipment monitoring may need a trial period, but some digital class related applications may need a trial case – for instance, Augmented Reality to assist maintenance personnel in maintain and repairing equipment):

- Audit programs (refer to 1/6.6) to address onsite audit, monitoring, sampling, and testing (as applicable) during operations are to be submitted for ABS review before in-service operation.
- Demonstration of an effective quality control procedure and quality acceptance criteria to validate that the yard can control the technology implementation.
- Demonstration that the key users ensuring the implementation of the technology have been trained and qualified.
- Demonstration of the qualified technology features, covering self-monitoring, analysis, reporting (anomaly/diagnostics/prognostic) and human-in-the-loop decision making.
- Demonstration of data quality assurance and control, as applicable.
- Validation of Quality Management System Certification (s), a recognized standard at least ISO 9001 or equivalent certified by a recognized certification body. Equivalency will be determined on a case-by-case basis. Any others are to be documented (e.g., ISO 14001:2015, ISO 50001:2018, ISO 45001:2018) and validated, as applicable.

6 Technology Operational Qualification and Process Control Validation Completion

Once the operational experience of the Smart Technology has been proven to be successful through the onsite survey for a satisfactory amount of time, and the quality assurance and control processes have been validated by ABS Surveyor through the onsite audit, a Manufacturing Assessment (MA) Certificate will be issued to the yard. Technologies having non-Class related features are eligible for listing on the ABS website under the Type Approval (Tier 3) together with the PDA Certification data, as appropriate. See 1-1-A3/5.3 of the ABS *Rules for Conditions of Classification (Part 1)*.

SECTION 5

Technology Verification and Validation Phase - Stage 3: Supplementation/ Augmentation of Classification Survey Processes

1 Introduction

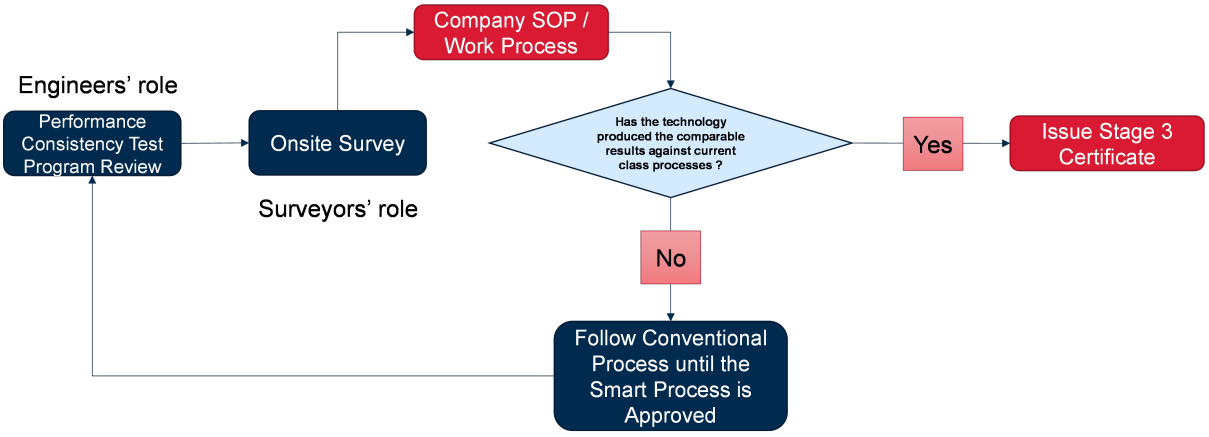
Upon completion of Stage 1 or Stage 2 of the Technology Verification and Validation Phase detailed in Section 3 and Section 4, Smart Technologies intended for use in processes affecting Classification Survey requirements are to comply with the requirements in this section.

Compliance with the requirements in this Guide does not negate specific requirements related to ship construction, repair or commissioning or the Survey processes governing those activities contained in applicable Rules, Guides, or regulations. Rather, they are to demonstrate how such technologies can be incorporated into the processes with Survey support and acceptance of same.

Where the technology is intended to supplement or enhance an existing process or change it in some manner, the Smart Technology is to undergo a Class Rule Requirements/Process Performance Consistency Test. The shipyard is to run the proposed modified process using the Smart Technology qualified in Stage 1 or Stage 2 in parallel with the previously implemented process for a trial period to establish a minimum equivalency of the new process.

The main aim of this trial is to demonstrate that the proposed modified process using the Smart Technology produces consistent or improved results or outcomes as compared to the previously used process which it is supplementing or augmenting. ABS and the shipyard will mutually determine the trial period. Stage 3 will be considered completed upon successful conduct of trials and incorporation of the process using the Smart Technology into the shipyard's work process.

FIGURE 5
Performance Consistency Test



2 Onsite Survey

A Performance Consistency Test as shown in Figure 5 is to be carried out for Smart Technologies intended to supplement or augment processes in the yard which affect Classification Survey processes or procedures. Submittal requirements can be found in Subsection 1/6. For Survey Requirements in Stage 3, refer to 6/2.3. This survey may be combined with survey in Subsection 5/2.

3 Consistency Demonstration

The following aspects of the consistency test program and results are to be documented and submitted to ABS for review:

- The yard is to prepare and submit the Class Rule/process performance consistency test program to ABS for review before starting the in-service trial.
- The yard is to submit the inspection, monitoring, sampling, and testing performance/results to prove that the Smart Technology can produce the same or better results against the traditional Classification processes.
- The yard is to show the repeatability of the process utilizing the Smart Technology versus the repeatability of the old process through the trial period with the two processes running concurrently (e.g., Nondestructive Testing)
- A process is established for Management of Change (MoC) and re-deployment checkpoints for the entire consistency test period to verify proper testing processes are followed, results are recorded, and that they meet the quality assurance requirements are to be carried out and witnessed by an ABS Surveyor per section 6/3 of this Guide.

Upon satisfactory completion of the onsite verification and validation at Stage 3, as the Smart Technology is to be used as part of the Classification processes, a Manufacturing Assessment (MA) Certificate will be issued to the yard. See 1-1-A3/5.3 of the ABS *Rules for Conditions of Classification (Part 1)*.

SECTION 6

Survey and Audit Process

1 Introduction

The Smart Technologies can be used in conjunction with non-class related yard internal activities or in conjunction with class-related surveys. This Section provides guidance on the survey and audit process and requirements in accordance with the three stages as showed in the Technology Verification and Validation Phase of Shipyard Smart Technology Certification Framework (Refer to Subsection 1/4 Figure 1).

2 Initial Survey and Audit

2.1 Stage 1 – Technology Qualification

ABS Surveyor will carry out an onsite survey to verify the technology process prior to the Product Design Assessment (PDA) issuance. In addition, new technologies will require a prototype validation survey to the satisfaction of the attending surveyor. The ABS Surveyor will witness the entire process to verify that the proper procedure is followed, and it meets the quality assurance requirements. The yard is to provide the below items to ABS for review:

i) A kick-off meeting for initial survey is to be held between all parties, including the yard, the vendor, and the ABS surveyor to verify that the arrangements envisioned in the survey process are in place. Responsibilities of all personnel are to be verified.

ii) The yard is to submit an Inspection Test Plan (ITP) to ABS for review per 1/6.4. The ITP is to define the scope of the equipment and machinery test, witness points and hold points as agreed between the yard and ABS before the commencement of the survey.

iii) The attending Surveyor is to review identified risks and associated mitigation plans, as applicable. All parties are to acknowledge the risks associated with the implementation of the Smart Technology and agree to the mitigation plan associated with those risks during an initial kick-off meeting

2.2 Stage 2 – Technology Operational Qualification and Process Control Validation

2.2.1 Onsite Survey

The implementation of the Smart Technology is to be carried out by qualified personnel. An In-Service Inspection Plan per 1/6.5 which is to address in-service witnessing, monitoring, sampling, and testing (as applicable) during operations is to be submitted to ABS for review. An onsite survey covering the below items identified in the PDA are to be carried out by the attending Surveyor.

i) Validate the technology has been integrated into the final system and demonstrate the successful performance of the function in its intended operational environment for the minimum testing period (the minimum number of trial cases or the minimum trial period is to follow the ISIP outlined in 1/6.5).

ii) The system integration testing is to be witnessed by the ABS Surveyor verifying that the proper testing processes are followed per the quality assurance assessments based on the witness points as agreed between the yard /and ABS.

iii) Input sensors are to be examined.

iv) Means of communication between onboard operator station(s) and onshore remote control/inspection station as applicable.

v) The plans and any modifications to them are to be submitted to the surveyors in sufficient time to allow review before the relevant survey activity commences.

2.2.2 Onsite Audit

An audit program per 1/6.6, which is to address in-service witnessing, monitoring, sampling, and testing (as applicable) during operations is to be submitted to ABS for review. An onsite audit covering the below items are to be carried out by the ABS Surveyor per the PDA:

i) The yard is to possess a Standard Operation Procedure (SOP) denoting how the Smart Technology is incorporated into the existing yard processes

ii) A yard's management quality assessment is required. The Surveyor evaluates the yard's quality assurance and quality control system to assess and verify their capability to meet the specified level of quality control.

iii) The yard is to submit to ABS an effective quality assurance and quality control program, including a recognized standard at least to the certified ISO 9001 certificate, or recognized equivalent, and a quality plan setting out the applicable controls that are planned to be performed on the material, component, product, or system for compliance with the Rules, Guides or other standards.

iv) The Surveyor is to confirm that the yard follows quality process.

v) The Surveyor is to assess and verify the training requirements and qualification of the people who execute the process using the Smart Technology (i.e., organizational capability)

Upon satisfactory completion of the management quality assessment, the ABS attending Surveyor may issue a Manufacturing Assessment (MA) Certificate to confirm that the yard has ongoing processes to control and provide oversight over the use of the Smart Technology in the yard processes and that the yard has the training and qualification requirements to execute the technology.

2.3 Stage 3 – Supplementation/Augmentation of Class Survey Process Verification

The attending Surveyor is to witness the tests as listed in the Performance Consistency Test Program in 1/6.8. For the Smart Technologies affecting class-related surveys, the survey requirements are to follow this section instead of 6/2.2.1. This may be combined with the survey requirements in section 6/2.2.2.

Confirmation that Management of Change per section 1/6.9 is effectively implemented.

Acceptance of the survey results is to be at the satisfaction of the attending Surveyor. The Surveyor may require additional inspections using other alternatives or traditional survey methods depending on the conditions found and results of the Smart Technology. The local ABS survey office is to be contacted for details on survey planning, scheduling, and execution.

Upon satisfactory completion of the management quality assessment, the ABS attending Surveyor will issue a Manufacturing Assessment (MA) Certificate to confirm that the yard has ongoing processes to control and provide oversight over the use of the Smart Technology in the yard processes and that the yard has the training and qualification requirements to execute the technology.

The flag Administration of the vessel may have additional requirements or restrictions for using Smart Technologies during statutory surveys that should be considered during the survey planning, if any survey item falls under statutory, Flag Administration's acceptance is to be requested at the time of survey planning for each project.

3 Renewal Audit for Maintenance of Certification

i) In addition to 1-1-A3/5.1 and 5.3 of the ABS *Rules for Conditions of Classification (Part 1)*, for the shipyard to maintain the existing Type Approval Certification for Smart Technology endorsement, an annual audit by an ABS Surveyor will be required. The scope of the annual audit is also to include: Verification that the technology description and system requirement documents are up to date and in accordance with the recognized Smart Technology Descriptive Document. These documents are to be made available to the attending Surveyor. This verification is performed to confirm that the subject technology and associated processes are in satisfactory condition for continued service. Records of modifications and updates to the technology description and system requirement documents are to be submitted to ABS for review.

ii) Verification that the attained QA/QC certifications are available, any modification or changes made to the QA/QC system are documented and made available to the attending Surveyor.

iii) Confirmation that Management of Change per section 1/6.9 is effectively implemented.

iv) Confirmation that any changes to organizational structures and program control are documented.

v) Validation that the Smart Technology has been qualified in accordance with the documented performance requirements and criteria documented in the System Requirements (refer to 1/6.3). Where the stated capability has not been achieved, the results of the audits and reviews are to be shared with all personnel having responsibility in the subject area involved and relevant management. Continuous improvement of the Smart Technology in yard implementation is required. Documented corrective and preventive actions of the implementation of the audit program and audit results are to be maintained.

vi) Verification that the Smart Technology-relevant hardware and software are functioning, any updates from Version control and management-of-change (refer to 1/6.9) of new technology, including software are documented.

vii) Review the maintenance records of the Smart Technology to verify that the pre-operations and periodic audit/survey are up to date.

viii) Review a type of performance summary which is prepared by the yard to summarize the implementation process of the Smart Technology over the annual period to confirm that no negative impact, issues, incidents occurred. If incidents or hazardous situations have occurred, the yard is to report on the details, Root Cause Analysis (RCA), corrective and preventive actions taken (CAPA) to support that the annual and renewal audit would recommend continued approval.

For the shipyard to maintain their approval, any changes to the implementation of the Smart Technology are to be identified and re-assessed based on both audit scope and engineering review. The necessary survey and audit activities as per Subesection 6/2 are to be conducted where applicable. The annual audit must be able to produce records of continued compliance of the management quality assurance and control, as well as the products (e.g., hardware and software) with the specified standard.

4 Validity

The certificates (PDA and MA) indicated in 1/5.1, and 1/5.2 will be issued initially for a period of 5 years, The PDA certificate is renewable for another 5 year period (from the expiry date of the previous certificate) subject to the latest edition of the Rules and Standards when requested. The MA certificate remains valid subject to annual audit and annual endorsement for Shipyard Smart Technology (refer to Subsection 6/3). For details of issuance of Type Approval related certificates, refer to 1-1-A3/5.7 of the ABS *Rules for Conditions of Classification (Part 1)*.