

IC³ Validation Brief

2002-2003

DOCUMENT PURPOSE

This Validation Summary document has been created to inform those reviewing or evaluating the Internet & Computing Core Certification (IC³) program of the processes and procedures used to develop and validate the IC³ examinations.

True certification-level exams undergo an in-depth and strenuous development process. In summary form, this document outlines the steps taken by the exam developers to ensure the IC³ program meets the highest industry standards of quality and validity for test and certification program development. This document is not intended to be an exhaustive report of the research, analysis, and developmental steps taken to create the IC³ certification program. The full validation report, prepared by The Donath Group, is available to qualified parties under a non-disclosure agreement.

INTRODUCTION

Internet & Computing Core Certification Overview

The Internet & Computing Core Certification (IC³) is a standards-based certification program for basic computing and Internet literacy. IC³ provides specific guidelines for the knowledge and skills required to be a functional user of computer hardware, software, networks and the Internet. By establishing this vendor-independent standard, IC³ provides a reliable, universal measure of basic computing and Internet skills.

IC³ consists of three different competency exams. Passing all three IC³ exams qualify an individual to receive IC³ certification.

- *Computing Fundamentals*: this exam measures examinee knowledge of computer hardware, software, and basic operating system skills.
- *Key Applications*: this exam evaluates examinee proficiency in two computer applications (a word processor and spreadsheet) and the common features of different applications.
- *Living Online*: this exam measures basic skills in using networks, electronic mail, the Internet, and Web browsing software as well as an understanding of how computers and the Internet affect society.

Each exam uses various test-question methods. Whenever possible, testing the ability to use specific product functions (such as file and system management functions of Windows) is done with performance-based test items where candidates are asked to perform specific software tasks in a realistic simulation of the software environment. Performance-based testing has proven to have a high degree of statistical reliability and user satisfaction. Testing of other knowledge types (such as knowledge of hardware and software) is done with traditional linear type questions, like multiple choice, multiple response and matching test items.

The appropriate mix of linear and performance-based testing questions to measure the knowledge, skills and abilities of candidates for IC³ ensures a high degree of validity, reliability and impartiality for all participants in the program.

IC³ Program Partners

The IC³ program was developed through the partnership of Certiport, Inc., the leading provider of global, performance-based certification programs and services, and SkillCheck, Inc., a leading provider of assessment and testing products to the education and training, human resources, and staffing services industries.

The exam development process was guided by The Donath Group, a leading psychometric and evaluative research consulting organization with over fifty years of highly specialized experience in test construction, measurement, and statistical analysis.

IMPORTANCE OF VALIDATION

Certification Validation Overview

Exams developed as industry recognized certifications must meet high demands of rigor in the test development, validation and analysis processes. By publishing certification exams that have followed the most credible development standards and methodologies, test developers can ensure that certificate holders possess the clearly defined knowledge and/or skill sets corresponding to that specific certification. In short, certifications purporting to be industry standards must also be standards driven—they must adhere to the testing industry’s highest set of guidelines of acceptable professional test development processes represented by such guidelines as *The Standards for Educational and Psychological Testing* and the *Uniform Guidelines on Employee Selection Procedures*.

Exam Validity

Exam test validity is the most important consideration in evaluating tests for a particular purpose—especially when exams are used for industry certifications. The concept of validity refers to the meaningfulness, usefulness and appropriateness of inferences made from test scores. Test validation, therefore, is the process of gathering evidence to support the inferences made by test scores.

Validity cannot be adequately summarized by a single set of evidence, such as a reliability coefficient. This is particularly important today as the term “certification” is usually used to make an inference about probable job behavior performance based on the resulting test score. Because of this, it is critically important that validity for a particular test score be supported through an accumulation of empirical, theoretical, statistical, and conceptual evidence.

Types of Validity

The following discusses the main types of validation evidence for interpreting test scores.

Content-oriented validation

Content validity refers to the extent to which test scores measure the content they are intended to measure. Content-related validity evidence can be gathered by examining the degree of congruence between test items and the content domains purportedly measured by the test items. This typically requires convening a panel of subject matter experts and asking them to rate the item-objective congruence according to some established criteria.

Construct-related validation

Construct validity refers to the extent to which the test scores measure the construct it is intended to measure. It focuses on the relationship between the specific research operations used and the abstract labeling of them either in cause or effect constructs. Construct validity can be investigated using factor analysis or a multitrait-multimethod matrix procedure. A construct is usually a theoretical, unobservable dimension of a measurement procedure. Test question responses are used to assess whether there is a statistical underlying factor represented by the responses.

Criterion-related validation

Criterion-related validity evidence refers to how well test scores correlate or predict other measures of importance, such as some level of job performance, experience, knowledge or skills. Criterion-related validity can be determined by contrasting groups of known masters and nonmasters in the content area and perform a comparison of the test score distributions and reliabilities. This has the benefit of being entirely empirical when the two groups are identified.

Standard Validation Methodology

The following are brief descriptions of well-established exam development methodologies used to fulfill the main types of validity and publish high quality certification exams. These activities formed the basis for the validation of the IC³ program.

- Job Task Analysis - Identify the knowledge, skills and abilities required of a certified employee or individual.
- Blueprint Development - Define the scope and content of the skills to be measured by the exam.
- Survey Analysis - Gather supporting evidence from a blueprint survey of subject matter experts.
- Pilot Tryout & Analysis – Pilot all test items through a complete tryout with a representative sample of certification candidates. The tryout demonstrates empirically how each item behaves under standardized testing conditions.
- Pilot Test Analysis - Evaluate key indices such as the item difficulty value, the discrimination, and the correlation with external criteria and background groups.
- Final Exam Construction - Construct the final exam using the best performing items fitting the exam blueprint.
- Standard Setting – Establish cut scores based on an analysis of candidate data and exam score by using a regression analysis.

The following section describes the many steps IC³ went through to ensure the highest levels of validation.

IC³ VALIDATION

IC³ Validation Overview

From its conception, the mission of the IC³ program was to develop state-of-the-art exams that meet or exceed industry validation standards. To this end, The Donath Group guided the IC³ program development and ensured the IC³ program's compliance with the highest test development methods and procedures, including those outlined by the following standards organizations:

- *The Standards for Educational and Psychological Testing* (American Educational Research Association, the American Psychological Association and National Council on Measurement and Education)
- *The Uniform Guidelines on Employee Selection Procedures* (The Equal Opportunity Commission, Civil Service Commission, Department of Labor and Department of Justice)
- *Certification: A NOCA Handbook* (National Organization for Competency Assurance)

IC³ Exam Validity

In commitment to its mission, the IC³ program took steps to accumulate ample empirical, theoretical, statistical, and conceptual evidence to support its claims of achieving the highest levels of exam validity.

The IC³ exams were developed, created, and validated over a two year period—utilizing the expertise of three leading testing, validation, and evaluation corporations—and drawing on the knowledge of over 270 subject matter experts in 19 countries—and, pilot tested in over 40 different locations worldwide, with over 1,500 exams delivered. The IC³ exams are completely vendor-independent, and have garnered endorsements and recognition from recognized industry and government organizations like CompTIA (Computing Technology Industry Association) and NSSB (National Skills Standard Board).

The result of the IC³ program's validation efforts is a true certification program that accurately and reliably can be used to make solid inferences about an individual's knowledge, skills, and applicable job performance based on the resulting exams' scores. The IC³ program is perfect for academic institutions, workforce development programs, and organizations needing a reliable means of ensuring individual computing literacy in an increasingly digital world.

Types of Validity—Fulfilled by IC³

The IC³ exams fulfilled all necessary processes to ensure coverage of the main types of validation evidence for interpreting test scores.

Content-oriented validation

Content validity refers to the extent to which test scores measure the content they are intended to measure. The IC³ examinations were developed from research in the field of computer and Internet literacy, and then empirically established the most important areas to measure skills and knowledge for this behavioral domain.

Additionally, subject matter experts (SMEs) carefully reviewed the IC³ test objectives and test items for item-objective congruence. The blueprint survey review of the content defined the

appropriate content of the examination and the test item reviewers verified that the test items measure and represent the content of each of the test objectives covered in the examination.

Content-oriented validation evidence is provided in points 1, 2, 3, 4 and 5 under sub-section “IC³ Validation Methodology.”

Construct-related validation

Construct-related validity refers to the extent to which the test scores measure the construct it is intended to measure. The construct being measured by the IC³ exams is basic knowledge and skills in computing as it exists today for most entry-level jobs using computers. This construct is supported by current research literature, qualitative evaluations by SMEs, and a factor analysis that determined there is an underlying statistical construct for the IC³ test data.

Construct-related validation evidence is provided in points 1, 2, 3, 4, 5 and 6 under sub-section “IC³ Validation Methodology.”

Criterion-related validation

Criterion-related validity evidence refers to how well test scores correlate or predict other measures of importance, such as some level of job performance, experience, knowledge or skills. Criterion-related validity was established by comparing and analyzing survey responses by certification candidates to their IC³ exam score distributions. IC³ exam scores were found to highly correlate to a candidate’s computing and other appropriate experience levels.

Additionally, when analyzing pass and fail decisions compared to candidate experience, the decisions are very consistent with their levels of experience. Each IC³ exam had strong relationships with these predictor variables.

Criterion-related validation evidence is provided in points 6, 7 and 8 under sub-section “IC³ Validation Methodology.”

IC³ Validation Methodology

The sections below summarize the steps taken in the development of the IC³ exams. This process follows, and in some cases exceeds, standards for test validation developed in such documents as *APA Standards* and the *Uniform Guidelines on Employee Selection Procedures*.

1. Industry and Academic Research
 - Research was completed identifying the knowledge, skills and abilities required for IC³ certified individuals
 - A thorough literature review was performed of industry training and educational programs that relate to computer literacy and the latest training and educational methodologies (including Digital Literacy, Information Literacy, Fluency in Information Technology, Media Literacy and Digital Divide)
 - A study was completed of existing national and international programs and curriculums that clearly define needed competencies in hardware, software and operating systems, applications, networking, electronic mail, and use of the Internet
 - An analysis was conducted of training programs from courseware, CBT, training vendors and book publishers which cover material related to this subject matter

- Focus group discussions with SMEs input were conducted
 - Sample Result: A review of over twenty classroom training programs, CBT and eLearning products, educational texts, commercial books, and testing products revealed a set of 120 features of a word processor and a spreadsheet that 80-100% of all programs consider to be core functionality required by all users of these applications.
 - Sample Result: A study of the latest methodologies for computer education (including Digital Literacy, Internet Literacy and Fluency in Information Technology) revealed that most current thinking in these areas stress not just technical skill, but the ability to understand and interpret information gathered from online sources.

2. Job Task Analysis

- A job task analysis (JTA) was carefully documented and analyzed through surveys and discussion groups of SMEs
- The JTA study defined the important job behaviors for an IC³ certified individual
- The JTA identified the knowledge, skills, and abilities required to be computer and Internet literate by the IC³ standard
- The JTA analysis served as the primary source of evidence supporting the content validity of the exams making up the IC³ certification
 - Sample Result: The JTA determined that "Literacy" in computer applications requires an understanding of at least two applications at a basic level and also an understanding of the common functions (such as common file-management, editing, formatting and printing functions) of all applications.

3. Blueprint Development

- From an analysis of the Industry and Academic Research and the JTA, a draft specification of the domains and objectives for the three IC³ exams was developed
- The resulting document from the Industry and Academic Research and the JTA is known as the exam blueprint
- Blueprint development was guided by The Donath Group
- Initial blueprint content was selected by SMEs participating in focus groups
- Separate blueprints were developed for each of the three IC³ exams
 - Sample Result: The original draft of the IC³ exam blueprints consisted of 14 Domains and 42 Objectives. The final version of the IC³ exams resulted in 10 Domains and 30 Objectives.

4. Survey Analysis

- The IC³ certification blueprints were refined and validated by surveying over 270 SMEs, in 19 countries, who reviewed, rated, and commented on each objective in the three IC³ blueprints
- The participating SMEs were selected from a pool of more than 1,800 industry professionals
- An analysis of the survey results provided guidelines for the weighting of different domains for each IC³ exam that was used to create tests that met content validation requirements based on SME input

- **Sample Result:** Based on survey results of the exam blueprint for the IC³ Computing Fundamentals exam, the following weighting of domains was used to develop a pilot exam that would meet content validation requirements:

Table 1: Computing Fundamentals—Domain and Objective Weighting

Domain 1: Computer Hardware	43%
1.1 Identify different types of computers, how computers work (process information) and how individual computers fit into larger systems	12%
1.2 Identify the function of computer hardware components and common problems associated with individual components	12%
1.3 Identify issues relating to computer performance and how it is affected by different components of the computer	10%
1.4 Identify the factors that go into a decision on how to purchase a computer or select a computer for work or school	10%
Domain 2: Computer Software	22%
2.1 Identify how software works and how software and hardware work together to perform computing tasks	10%
2.2 Identify different types of software, the tasks for which each type of software is most suited, and the popular programs in each software category	12%
Domain 3: Using an Operating System	35%
3.1 Be able to identify what an operating system is and how it works	10%
3.2 Be able to manipulate and control the Windows desktop, files and disks	13%
3.3 Be able to change system settings and install software	12%
Total	100%

5. Item and Pilot Test Development

- SMEs wrote high-quality test items that fulfilled the overall IC³ blueprint goals and were representative of the test objectives outlined in each exam blueprint
- The Donath Group conducted psychometric reviews (verifying that items conformed to proven guidelines and standards) and editorial reviews (verifying the grammar, usage, readability, clarity and consistency of usage) of each proposed test item
- SMEs participated in a technical review of the proposed test items for technical accuracy, relevance, and importance
- Based on the results of The Donath Group and the SMEs' analysis of each proposed test item, pilot IC³ exams were automated and created
- Each IC³ pilot exam included 60 test items, with selection determined by content validation requirements based on final blueprint survey analysis

- Sample Result: The Donath Group’s psychometric and editorial analysis of over 250 test items created to meet objectives in the IC³ blueprint determined 180 items (60 for each pilot exam) best met industry test item standards. These items (a mix of performance-based and linear test items) were further reviewed for clarity and adherence to industry item-writing and formatting standards. Final items were automated and used to construct the three exams used for the IC³ pilot.

6. Pilot Tryout & Analysis

- All IC³ accepted test items were pilot tested in a standardized computer format with over 500 potential certification candidates
 - Pilot tests were conducted at over 40 different testing sites under the exact same conditions in which actual certification testing would take place
 - After taking each pilot exam, each candidate completed a survey of their self-assessed technical skill proficiency and demographic background information
 - Candidate survey results formed the basis for test and item analysis performed by The Donath Group
 - All items were analyzed for item difficulty, item discrimination, and analysis of distracters
 - Items demonstrating statistically aberrant behavior were flagged for possible removal in the final exam, or for further detailed review
 - SMEs conducted additional reviews of questionable items, and assisted in the selection of the final set of items
 - Scores from each pilot exam were reviewed for potential bias in gender, race, age, or any other variable that defines a protected group
 - A mastery composite score for the pilot tryout was calculated and correlated with the pilot test scores
 - A regression analysis of the predictor variables and composite score was used to assess the relationship between the pilot exam and the survey
- Sample Result: No pattern of statistical differences was determined to exist that would indicate that the IC³ exams are functioning differently for any protected groups.

7. Final Exam Construction

- Based on the results and analysis of the IC³ exams pilot tryout, test items were selected for the final IC³ exams’ item pools
- After detailed analysis test items demonstrating statistically deviant behavior, or potential biases toward gender, race, age, or any other protected group, were discarded
- A comparison of the remaining test items to the determined IC³ exam content (final blueprint) was conducted to ensure percentage representation remained consistent with content validation requirements
- The remaining accepted items were included in a set of 44-45 question tests to be used as the final IC³ exams
- A mastery composite score for the final exam was calculated and correlated with the pilot test scores
- A regression analysis of the predictor variables and composite score was used to assess the relationship between the pilot exam and the survey
- Each test candidate taking part in the original beta test had their test results rescored based on the final selection of items in the three IC³ exams

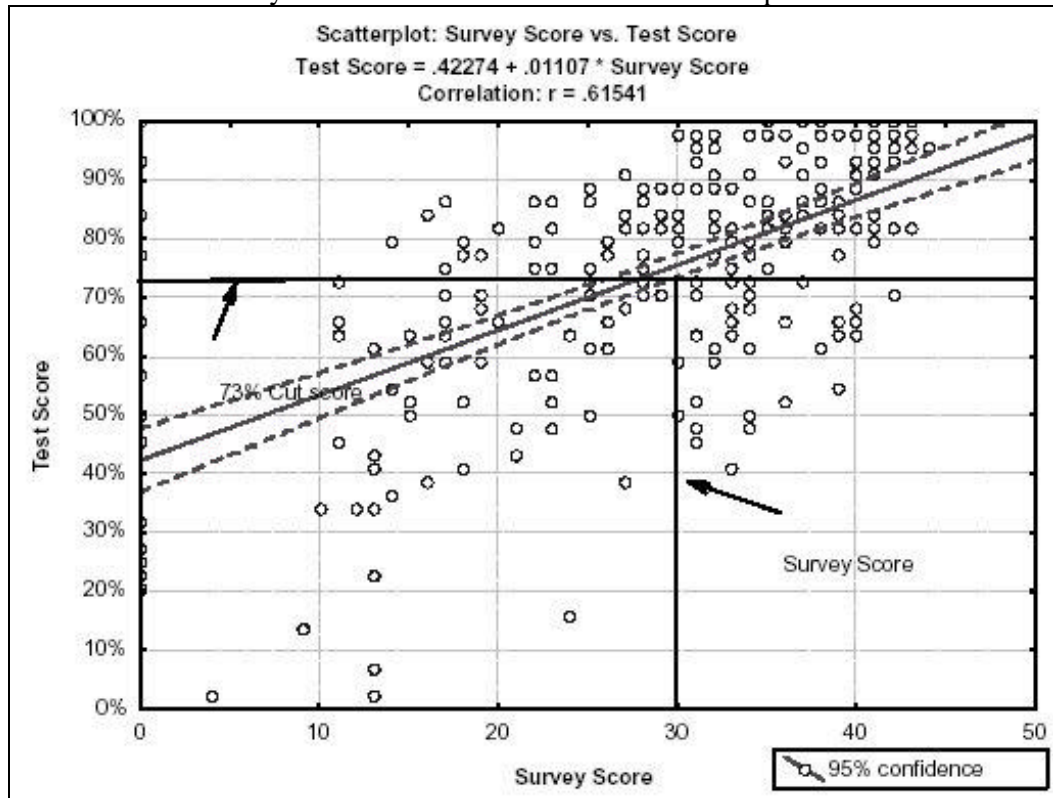
- Sample Result: From the original set of 60 questions for each pilot exam, final IC³ exams were created that included 44-45 high-performing, high-quality items that met content validity requirements based on the original content study.

8. Standard Setting

- IC³ final exam cut score determination completed by considering level of mastery, standard deviation, test score means, and decision error
- All test performance results, as well as candidates' self-reported assessment of their skill level, were analyzed together—this analysis provided the mechanism to guide the standard setting, or cut score
- IC³ certification exams were published for delivery on November 8, 2001

- Sample Result: An analysis of test scores vs. survey results on experience level determined cut score for each exam, as illustrated in the following chart:

Chart 1: Survey Score vs. Test Score—Correlation to Experience Level



CONCLUSION

The Internet & Computing Core Certification (IC³) program was created to offer a unique, validated, global certification program that provides specific standards for the knowledge, skills, and abilities required to be a broad-based, productive user of computer hardware, software, networks, and the Internet. Through in-depth research and analysis into the world of digital literacy, it was determined that three exams were needed to cover the range of subjects necessary for an individual to be IC³ certified.

- *Computing Fundamentals*: a measure of an examinee's knowledge of computer hardware, software, and basic operating system skills.
- *Key Applications*: a measure of an examinee's proficiency in two computer applications (a word processor and spreadsheet) and the common features of different applications.
- *Living Online*: a measure of the basic skills in using networks, electronic mail, the Internet, and Web browsing software as well as how computers and the Internet affect society.

IC³ certification exams were created to meet the highest, standards-based development processes accepted industry-wide. This process was guided by The Donath Group, an industry-recognized leader in exam construction, measurement, and statistical analysis. The IC³ program took steps to accumulate ample empirical, theoretical, statistical, and conceptual evidence to support its claims of achieving the highest levels of exam validity. The quality and validity of the IC³ exams is recognized by other industry organizations like the NSSB and CompTIA.

The final result of the IC³ program's validation efforts is a true certification program that accurately and reliably measures an individual's knowledge, skills, and abilities to effectively live and work in our increasingly digital world.