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Technical Contribution

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Topic: Contribution to Biometric Performance Testing and Reporting Part 3, Scenario Testing (currently in Draft 2.0)

CONTRIBUTOR NOTES

- The following material is meant to replace much of the current Scenario Test Reporting content (6.N), which may be moved to other sections, moved to an informative annex, or deleted.
- Italicized text indicates areas where major decisions need to be made on how to render certain data.
- I have introduced a distinction between system-level results and subject-level results that may or may not be viable.
- This contribution focuses more strongly on what must be reported than on how it must be reported. Once we have consensus on what should be mandatory and optional to report, then the “how” can be better developed. For example, the breadth of information addressed here suggests that Scenario Test reports should be preceded by an executive summary with a small subset of the results.
- Certain requirements may be sufficiently generic that they are a better fit in Part 1.
- All comments and suggestions for improvement are appreciated

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6. Scenario Test Reporting

In addition to the normative and informative Reporting elements addressed in Part 1 of the Standard, the following normative and informative Reporting elements apply to Scenario Testing.

6.1 Systems and environment

The test report shall document system and environment-related elements of the Scenario under evaluation, including at a minimum the following:

6.1.1 Biometric system specifications

For each biometric system tested, the test report shall document the following elements:

- Acquisition devices: manufacturer, model, version, and firmware as applicable. If the acquisition device tested as part of the biometric system is a peripheral or device with a 3rd party modular sensor, such as a fingerprint sensor, then the sensor manufacturer, model, version, and firmware as applicable shall be documented in the test report.
- Biometric algorithms: provider, version, revision as applicable.
- Biometric applications: provider, version, build as applicable.
- Use of off-the-shelf acquisition and processing components vs. components customized or optimized for test effort.
- Biometric data acquisition, processing, and storage architecture, specifying (1) components tested to comprise the system, (2) data flow between components, and (3) location of sample processing functions, template generation processes, template matching processes, and template storage.

6.1.2 Platform specifications

As applicable for each biometric system tested, the test report shall document the following elements of the platform on or through which the biometric systems were evaluated:

- Operating system and database
- Hardware specifications including CPU speed, RAM, and hard drive capacity
- Network type and throughput
 - e.g. 10/100 LAN

6.1.3 System implementation

For each biometric system tested, the test report shall document system implementation information corresponding to each of the following:

- Method of biometric and platform system acquisition
 - e.g. use of previously fielded systems such as those from within a test organization; procurement of systems from vendors; use of vendor-loaned systems
- Vendor involvement in system implementation
 - e.g. hardware and software installed and configured offsite by vendor, then shipped to Test Organization; hardware and software installed and configured onsite by vendor; e.g. hardware and software installed and configured by Test Organization

6.1.4 Physical layout of test environment

The test report shall document the physical layout of the test environment, providing at a minimum information as follows:

- Dimensional area dedicated to scenario test execution
- Presence of natural and artificial lighting
- Positioning of biometric acquisition devices
 - e.g. all devices positioned on desks of equal height; devices mounted at identical fixed height; devices mounted as per vendor instructions

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- Use of chairs or other apparatus on the part of test subjects
- Relative location of each system in the test environment, rendered through a system schematic

6.1.5 Operational environment

The test report shall document operational conditions in the Test environment corresponding to each of the following:

- Temperature
- Lighting, including type, direction, intensity
- Humidity
- Variations in any operational environment element over time or from system to system
- Methods by which and frequency with which operational environment data was measured and logged

6.1.6 Match and enrollment outputs

For each biometric system tested, the test report shall document whether the biometric systems evaluated utilized 1:1 functionality and/or 1:N functionality.

For each 1:1 system tested, the test report shall document each of the following:

- Type of match outputs reported
 - e.g. raw match scores; BioAPI match scores; match/no match decisions
- For systems reporting match scores, range of potential match scores
- For systems reporting match scores, vendor-reported thresholds used for purposes of match score processing
 - e.g. low, medium, and high security
- mapping of match thresholds to match scores to execute match decisions
- Method(s) through which match outputs were provided by the biometric system
 - e.g. logged by application; visually indicated through GUI/LCD

For each 1:N system tested, the test report shall document the following:

- Type of match outputs reported
 - e.g. candidate lists; single-record best match; match scores
- For systems reporting match scores, range of potential match scores (if known)
- Method(s) through which match outputs were provided by the biometric system
 - e.g. logged by application; visually indicated through GUI/LCD
- Use of open set and/or closed set identification during imposter trials

For all systems, the test report shall document the following:

- Type of enrollment quality scores reported, if applicable
 - e.g. numerical raw enrollment quality scores; generic ranges such as low, medium high
- For systems reporting numerical or range-based enrollment quality scores, range of potential enrollment quality scores (if known)
- Method(s) through which enrollment quality outputs were provided by the biometric system
 - e.g. logged by application; visually indicated through GUI/LCD

6.1.7 Scenario Narrative

The test report shall incorporate a narrative that describes the scenario test as well as the fundamental elements that comprise the concept of operations under evaluation. The narrative shall, at a minimum, address the following:

- Scenario evaluated

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- e.g. identification – surveillance, screening, duplicate detection
- e.g. verification – logical access, physical access
- Test results generated
 - e.g. enrollment, false accept, false reject, false match, false non-match
- Number of systems tested
- Number of technologies tested
- Rationale for system selection
- Attended vs. unattended operation
- Overt vs. covert biometric data acquisition
- Use of acclimated vs. non-acclimated subjects

Note: it is assumed that requirements for documenting test subject population composition will be addressed in Part 1.

6.2 Test processes

The test report shall document process-related elements of the Scenario under evaluation, including at a minimum the following:

6.2.1 Test subject management

The test report shall document information related to test subject management, including at a minimum the following:

- Method of determining order in which test subjects interact with systems
- Sequence of subject interaction with systems
 - e.g. enrollment in all systems, followed by imposter matching in all systems, through to process *N* in all systems
 - e.g. enrollment and matching in system A, followed by enrollment and matching in system B, through to enrollment and matching in system *N*.
- Typical and maximum number of test subjects and test operators within Test Environment during test process
- Method of selecting gallery record against which imposter attempts are executed
- Amount and type of personal data collected
 - e.g. name, race, gender, occupation

6.2.2 Performance data collection and management

The test report shall document the following information:

- Methods of recording data for each performance element:
 - e.g. manual; automated through custom-built logs; automated through vendor-designed logs
- Processes for auditing and validating performance data collection
- Use of online and offline sample processing, template generation, and template matching functions

6.2.3 Use of Identifiers

For each biometric system tested, the test report shall document information as related to identifiers and identity claims.

For each 1:1 system tested, the test report shall document each of the following:

- Mechanisms by which test subjects claimed identities for the purposes of 1:1 matching
 - e.g. username, PIN, token
- Manner in which this mechanism was used to claim an identity
 - e.g. test subject-provided; test operator-provided
- Impact of identity claim processes on test subject interaction with systems

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- e.g. if test subject-system interaction was timed, did timing of interaction commence with identity claim; did erroneous identity claims impact results
- Variances in identity claim processes for genuine and imposter trials

For each 1:N system tested, the test report shall document the following:

- Type and range of unique identifiers used for test subjects
 - e.g. usernames, ID numbers
- Manner in which this mechanism was used to claim an identity
 - e.g. test subject-provided; test operator-provided
- Impact of identity claim processes on test subject interaction with systems
 - e.g. if test subject-system interaction was timed, did timing of interaction commence with identity claim; did erroneous identity claims impacted any test execution or results

6.2.4 Enrollment processes

For each biometric system tested, the test report shall document the following:

Basic methods and policies

- Methods by which test subjects provide enrollment data
 - e.g. live interaction with device
- Type of biometric data stored during enrollment
 - e.g. samples and/or templates
- Number of distinct biometric samples enrolled (e.g. 2 fingerprints, 2 irises)
 - Note: test report should also indicate whether multiple sample acquisition was due to system requirements or at the discretion of the test designer
- If multiple samples collected, policies for usage and processing
- Specification of which biometric sample(s) are enrolled
 - e.g. right iris, fixed voice pattern, variable voice pattern
- Policy for use of fallback samples if primary samples cannot be enrolled
 - e.g. reversion to alternative fingerprint or signature pattern
- Policy for use of test subjects unable to enroll in execution of false match testing
- Use of reference model-based methods by which test subject enrollment data informs basis of match results
- Execution of 1:N searches upon enrollment to identify similar records
 - Note: systems that execute such 1:N matching may prevent the enrollment of the 2nd sample
- Number of times each test subject enrolls
 - i.e. can test subjects enroll more than once for any reason

Definition of enrollment events

- Definition of enrollment presentation
- Definition of enrollment attempt
- Definition of enrollment sequence
- Definition of enrollment trial
- Minimum number of presentations necessary to constitute an enrollment attempt
- Minimum number of attempts necessary to constitute an enrollment sequence
- Minimum number of sequences necessary to constitute an enrollment trial
- Maximum number of presentations permitted to constitute a match attempt
- Maximum number of attempts permitted to constitute an enrollment sequence
- Maximum number of sequences permitted to constitute an enrollment trial
- Criteria by which successful enrollment is declared
- Criteria by which failure to enroll is declared
- Time-out policies for systems unable to acquire data, including system-based and test operator-based

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Guidance and instruction

- Attended/unattended nature of enrollment
- Information provided by test operator to test subjects prior to enrollment regarding Test effort and biometric system operations
- Range of feedback provided by biometric system to user during enrollment process
- Sequence and content of instructions pertaining to interactions with each system provided by test operator to test subjects prior to enrollment
 - e.g. are test subjects instructed in interaction with each system prior to interaction with any system, or are test subjects instructed in interaction with each system immediately prior to interaction
- Range of guidance, if any, test operator was permitted to provide to test subjects during enrollment process
- Use of vendor-provided scripts, instructions, guidance tools, or other mechanisms to inform test subjects as to the optimal method(s) of interacting with the system during enrollment
- Processes implemented in case of egregiously improper interaction with device, such as speaking into wrong end of telephone
 - e.g. disregard presentation, count as presentation
- Constraints on test subject appearance and apparel
 - e.g. removal of glasses, hats, contacts
- Composition of gallery database, including source(s) of gallery data
 - e.g. enrollment data collected in same environment as testing, from same subjects; enrollment data collected from external databases

6.2.5 Matching processes

For each biometric system tested, the test report shall document the following:

Basic methods and policies

- Imposter matching methodology
 - e.g. real-time test subject matching against a single gallery record, with new data acquired for each trial against a new gallery record; recording of scenario-based sample data for automated matching vs. N gallery records
- Genuine test subject matching methodology
 - e.g. real-time test subject matching against self-same gallery record; recording of scenario-based sample data for automated matching vs. N self-same gallery records
- Number of imposter trials executed by each test subject (probe)
- Number of imposter trials executed against each test subject (gallery)
- Methods by which test subjects provide matching data
 - e.g. live interaction with device
- For genuine and imposter trials, policy for matching against fallback enrollments if primary samples are unavailable
- For genuine and imposter trials, policy for matching against fallback enrollments if unable to match against primary enrollment
- For genuine and imposter trials, policy for executing additional presentations, attempts, and sequences subsequent to successful match
 - e.g. in an imposter trial, after a successful match, does the test subject continue to repeat placements against the same enrolled imposter data to gather more data
- For each genuine match event, time elapsed since initial enrollment

Guidance and instruction

- Attended/unattended nature of matching
- Range of guidance, if any, test operator was permitted to provide to test subjects during matching process

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- Sequence and content of instructions pertaining to interactions with each system provided by test operator to test subjects prior to matching
 - e.g. are test subjects instructed in interaction with each system prior to interaction with any system, or are test subjects instructed in interaction with each system immediately prior to interaction
- Use of vendor-provided scripts, instructions, guidance tools, or other mechanisms to inform test subjects as to the optimal method(s) of interacting with the system during enrollment
- Processes implemented in case of egregiously improper interaction with device, such as speaking into wrong end of telephone
 - e.g. disregard presentation, count as presentation

Definition of match events

- Definition of match presentation
- Definition of match attempt
- Definition of match sequence
- Definition of match trial
- Minimum number of presentations necessary to constitute a match attempt
- Minimum number of attempts necessary to constitute a match sequence
- Minimum number of sequences necessary to constitute a match trial
- Maximum number of presentations permitted to constitute a match attempt
- Maximum number of attempts permitted to constitute a match sequence
- Maximum number of sequences permitted to constitute a match trial
- For genuine trials, criteria by which successful match is declared
- For genuine trials, criteria by which false non-match is declared
- For imposter trials, criteria by which correct non-match is declared
- For imposter trials, criteria by which false match is declared
- Presence of time-out logic

6.3 System-Level results

System-level results provide information regarding each biometric systems' ability to enroll test subjects as well as to match or identify test subjects in their role as genuine users and/or imposters. For each biometric system tested, the test report shall document the following:

6.3.1 System-Level enrollment results

For each biometric system tested, the test report shall document the following:

- Number of subjects attempting to enroll
- Total number and percentage of test subjects unable to enroll
- Number and percentage of test subjects able to enroll at each incremental presentation interval
 - e.g. if a minimum of 2 placements are required to successfully enroll, and a maximum of 9 placements are permitted to successfully enroll, test report shall document number and percentage of test subjects able to enroll within 2 placements, 3 placements, continuing to report up to 9 placements.
- Number and percentage of test subjects able to enroll at each incremental attempt interval
 - e.g. if a minimum of 1 attempt is required to successfully enroll, and a maximum of 3 attempts are permitted to successfully enroll, test report shall document number and percentage of test subjects able to enroll within 1 placement, 2 placements, and 3 placements.
- Number and percentage of test subjects able to enroll at each incremental sequence interval
 - e.g. if a minimum of 1 sequence is required to successfully enroll, and a maximum of 2 sequences are permitted to successfully enroll, test report shall document number and percentage of test subjects able to enroll within 1 sequence and 2 sequences.

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- Number and percentage of test subjects unable to enroll due to lack of biometric characteristic
- Number and percentage of test subjects unable to enroll due to system's inability to acquire minimum number of samples necessary to constitute an enrollment
 - Note: System-driven time-outs and operator-drive time-outs shall be reported separately
- Number and percentage of test subjects unable to enroll due to low-quality enrollment scores subsequent to acquisition
- Number and percentage of test subjects able to partially enroll in systems requiring two distinct samples
- Number and percentage of enrollees able to enroll via fallback biometric, if applicable
- Instances of duplicate detection in 1:N enrollment search, if applicable
- For attended tests in which test operator was permitted to provide to provide guidance to test subjects during enrollment process, number of test subjects for whom such guidance was provided.
- Time required to enroll / duration after which FTE was declared, measured from initiation of test subject interaction with acquisition device.
- Time required to enroll / duration after which FTE was declared
- Number of incidences of egregiously improper interaction with devices and resolution of such instances
- *Range and frequency of enrollment quality scores reported for successful enrollees, if reported*
- *Range and frequency of enrollment quality scores reported for unsuccessful enrollees, if reported*
- *Range and frequency of enrollment quality scores reported for all enrollees, if reported*

6.3.2 System-level 1:1 match results

For each 1:1 biometric system tested, the test report shall document the following:

Genuine trials

- Number of genuine trials executed
- Total number and percentage of test subjects falsely rejected
- Number and percentage of test subjects able to match at each incremental presentation interval
 - e.g. if a minimum of 1 placement is required to successfully match, and a maximum of 9 placements are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 placements, 2 placements, continuing to report up to 9 placements.
- Number and percentage of test subjects able to match at each incremental attempt interval
 - e.g. if a minimum of 1 attempt is permitted to successfully match, and a maximum of 3 attempts are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 placement, 2 placements, and 3 attempts.
- Number and percentage of test subjects able to match at each incremental sequence interval
 - e.g. if a minimum of 1 sequence is required to successfully match, and a maximum of 2 sequences are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 sequence and 2 sequences.
- Number and percentage of test subjects unable to match due to system's inability to acquire a sample
- Number and percentage of test subjects unable to match due to match scores below minimum matching threshold
- Number and percentage of test subjects unable to match against primary enrollment subsequently able to match against fallback enrollment
- Number and percentage of test subjects unable to match against primary enrollment subsequently unable to match against fallback enrollment

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- For attended tests in which test operator was permitted to provide to provide guidance to test subjects during matching process, number of test subjects for whom such guidance was provided
- Number of incidences of egregiously improper interaction with devices and resolution of such instances
- *Range and frequency of average time lapsed between test subjects' enrollment and matching events.*
- For systems in which minimum and maximum template aging between test subjects enrollment and match data varies by more than 25%, test report shall document the number and percentage of test subjects associated with each of series of equivalent template aging ranges such that no one range accounts for more than 20% of the total enrolled test subject population. The test report shall document the average match score for each of these equivalent template aging ranges.
- Time required to match / duration after which non-match was declared, measured from initiation of test subject interaction with acquisition device
- Range and frequency of match scores reported for successful matches, if reported
- Range and frequency of match scores reported for unsuccessful matches , if reported
- Range and frequency of match scores reported for all enrollees, if reported

Imposter trials

- Number of imposter trials executed
- Number and percentage of test subjects able to match at each incremental presentation interval (FAR)
 - e.g. if a minimum of 1 placement is required to successfully match, and a maximum of 9 placements are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 placements, 2 placements, continuing to report up to 9 placements.
- Number and percentage of test subjects able to match at each incremental attempt interval
 - e.g. if a minimum of 1 attempt is permitted to successfully match, and a maximum of 3 attempts are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 placement, 2 placements, and 3 attempts.
- Number and percentage of test subjects able to match at each incremental sequence interval
 - e.g. if a minimum of 1 sequence is required to successfully match, and a maximum of 2 sequences are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 sequence and 2 sequences.
- Total number and percentage of test subjects unable to match
- Number and percentage of test subjects unable to match due to system's inability to acquire a sample
- Number and percentage of test subjects unable to match due to match scores below minimum matching threshold
- For attended tests in which test operator was permitted to provide to provide guidance to test subjects during matching process, number of test subjects for whom such guidance was provided.
- Number of incidences of egregiously improper interaction with devices and resolution of such instances
- Time required to match / duration after which non-match was declared, measured from initiation of test subject interaction with acquisition device
- *Range and frequency of match scores reported for successful matches, if reported*
- *Range and frequency of enrollment quality scores reported for unsuccessful matches , if reported*

Summary Results

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- Receiver Operating Characteristic Curves based on range and frequency of FAR/FRR/match scores

6.3.3 System-level 1:N match results

For each 1:N biometric system tested, the test report shall document the following:

- Number of trials executed with test subject in gallery (i.e. closed-set trials)
- Number of trials executed with test subject not in gallery (i.e. open-set trials)
- Number and percentage of test subjects identified at each of N positions (n=database size) at each incremental presentation interval
 - e.g. if a minimum of 1 placement is required to successfully match, and a maximum of 9 placements are permitted to be identified, test report shall document number and percentage of test subjects identified at each of N ranks within 1 placements, 2 placements, continuing to report up to 9 placements.
- Range and frequency of match scores
- Based on the match scores associated with the comparisons above, the test report shall provide the following information at matching thresholds sufficient to represent more than multiple security levels.
 - Number and percentage of “test subject in gallery” trials scored above threshold (a correct match)
 - Number and percentage of “test subject in gallery” trials scored above threshold as a different test subject (an incorrect match)
 - Number and percentage of “test subject in gallery” trials not scored above threshold (an incorrect non-match)
 - Number and percentage of “test subject not in gallery” trials scored above threshold (an incorrect match)
 - Number and percentage of “test subject not in gallery” trials not scored above threshold (a correct non-match)
- Number and percentage of test subjects able to match at each incremental sequence interval
 - e.g. if a minimum of 1 sequence is required to successfully match, and a maximum of 2 sequences are permitted to successfully match, test report shall document number and percentage of test subjects able to match within 1 sequence and 2 sequences.
- Number and percentage of test subjects for whom system was unable to acquire a sample
- Number and percentage of test subjects not identified against primary enrollment subsequently able to match against fallback enrollment
- Number and percentage of test subjects not identified against primary enrollment subsequently unable to match against fallback enrollment
- For attended tests in which test operator was permitted to provide to provide guidance to test subjects during matching process, number of test subjects for whom such guidance was provided.
- Number of incidences of egregiously improper interaction with devices and resolution of such instances
- Time lapsed between test subjects' enrollment and matching events
- Time required to match / duration after which non-match was declared, measured from initiation of test subject interaction with acquisition device
- For systems in which minimum and maximum template aging between test subjects enrollment and match data varies by more than 25%, test report shall document the number and percentage of test subjects associated with each of series of equivalent template aging ranges such that no one range accounts for more than 20% of the total enrolled test subject population. The test report shall document the average match score for each of these equivalent template aging ranges.
- *Range and frequency of match scores reported for successful matches, if reported*
- *Range and frequency of enrollment quality scores reported for unsuccessful matches , if reported*

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6.4 Subject-level results

Subject-level results provide information regarding each test subjects' ability to enroll, genuine-user system interactions, and imposter system interactions. For each test subject, the test report shall document the following:

6.4.1 Subject-Level enrollment

For each test subject, the following data shall be documented:

- Number of enrollment trials
- Number and percentage of systems in which the test subject was able to enroll
- Number of placements, attempts, and sequences required to enroll in each system
- Enrollment quality scores for each system, plotted against range of other test subjects' scores for each system
- For systems in which test subjects were unable to enroll through a primary biometric, the test subject's ability to enroll via a fallback biometric
- For systems in which test subject was unable to enroll, number and percentage of systems in which failure to enroll was attributable to failure to acquire
- For systems in which test subject was unable to enroll, number and percentage of systems in which failure to enroll was attributable to insufficient enrollment quality scores
- Number and percentage of systems with which the test subject was found to have egregiously improper interaction

6.4.2 Subject-Level 1:1 match results

For each test subject, the following data shall be documented:

For each probe subject

- Number of false match and true match trials executed, by system
- FRR and correct match rate for genuine transactions, by system
- The FAR and correct non-match rate for imposter transactions, by system
- Number and percentage of systems in which test subject was able to match correctly
- Number of placements, attempts, and sequences required to match in each system
- Match scores for each system, plotted against range of other test subjects' scores for each system
- For systems in which test subject was unable to match through a primary biometric, test subject's ability to match via a fallback biometric
- For systems in which test subject was unable to match, the number and percentage of systems in which failure to match was attributable to failure to acquire
- For systems in which test subjects were unable to match, the number and percentage of systems in which failure to match was attributable to insufficient scores
- Number and percentage of systems with which the test subject was found to have egregiously improper interaction

For each gallery subject

- Number of false match and true match trials executed against, by system
- Number and percentage of successful and unsuccessful imposter attempts against, by system
- Number and percentage of successful and unsuccessful genuine attempts against, by system
- Number of placements, attempts, and sequences required to match against, by system
- Range and frequency of match scores for each test subject against the gallery subject

6.4.3 Subject-level 1:N match results

- Number of open and closed set trials executed, by system

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- Number and percentage of systems in which test subject was identified at each of N positions (n=database size) at each incremental presentation interval
 - Number and percentage of systems in which “test subject in gallery” trials scored above threshold (a correct match)
 - Number and percentage of systems in which “test subject in gallery” trials scored above threshold as a different test subject (an incorrect match)
 - Number and percentage of systems in which “test subject in gallery” trials not scored above threshold (an incorrect non-match)
 - Number and percentage of systems in which “test subject not in gallery” trials scored above threshold (an incorrect match)
 - Number and percentage of systems in which “test subject not in gallery” trials not scored above threshold (a correct non-match)