



Pilot Trainee

Validation Report

Board of Pilot Commissioners
For the Bays of San Francisco, San Pablo, and
Suisun



Project Conducted by:
Selection Services Program
California Department of Human Resources
July 2017

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INTRODUCTION

This report documents the development and validation of the selection process used to select Pilot Trainees into the Pilot Trainee Training Program (Training Program), as used by the Board of Pilot Commissioners (BOPC) for the Bays of San Francisco, San Pablo, and Suisun.

The process was specifically designed to comply with both the letter and spirit of equal employment opportunity laws and court precedents as well as the methodology acknowledged in the Federal *Uniform Guidelines on Employee Selection Procedures* and the Standards for Educational & Psychological Testing (American Educational Research Association, American Psychological Association, and the National Council on Measurement in Education, 1999). Subsequent sections of this report detail the specific procedures followed in order to develop a content-valid selection instrument.

BACKGROUND AND PURPOSE

BOPC entered into a contractual agreement with the Selection Services Program (SSP) to develop a valid selection instrument for the Pilot Trainee position as used by BOPC. Examination development activities were based on and supported by the job analysis completed in November 2016. The intent of this report is to document the evidence of content validity for all selection procedures developed and used to select new Pilot Trainees into the Training Program.

Upon entering the Pilot Trainee program, the trainees begin hands-on training specifically tailored for the Pilot Trainee's background, skills, and needs. The initial pilot training program is one to three years. During this time, the Pilot Trainees perform their pilotage duties under careful supervision of veteran pilots on board working vessels in the various ports throughout the bays of San Francisco, San Pablo, and Suisun. Pilot Trainee performance on each trip is evaluated in writing as to the candidate's basic ship handling skills, knowledge of local waters, and ability to handle the requirements of the job. These evaluations are collected and reviewed by the Pilot Evaluation Committee before the pilot license is issued. Failure to meet any performance benchmark may result in a trainee being placed on probation.

METHOD

Prior to examination development, to ensure that the examination reflected the actual tasks performed by San Francisco Bar Pilot Trainees SSP conducted a job analysis to identify the essential tasks and corresponding knowledge, skills, abilities, and personal characteristics (KSAPCs) critical to the job and expected at entry into the Pilot Trainee position. Examination development activities were based on a review of these job analysis results and the identification of those KSAPCs most appropriate for assessment. Documentation demonstrating the relationship between the job tasks and KSAPCs to the exam content is available in the appendix section of this report.

(See APPENDIX D for the Examination Item/KSAPC Linkage)

The Board's Pilot Evaluation Committee identified licensed, working pilots to provide subject matter expertise in interviews and focus groups to support exam development activities. These licensed pilots were consulted to identify the major subject matter areas and to develop the examinations. The participating pilots had varying degrees of experience ranging from newly licensed to very experienced. All individuals involved with examination development activities signed an examination security agreement which specified that they would keep all examination materials secure, discuss the examination only during Board-sponsored meetings, and avoid involvement in any examination-oriented review program for prospective pilot candidates. Signers included Pilot Evaluation Committee (PEC) members, PSC staff, staff at the California Maritime Academy, and pilots who served as subject matter experts (SMEs) in all phases of written and simulation examination development scoring, and/or established the passing score for the written and simulator examinations.

Standardized procedures and protocols to administer both the written examination and simulator examination were developed to ensure that every candidate had the same examination experience.

Involved Project Processes and Activities:

- Conducted a job analysis study of the Bar Pilot Trainee to identify critical and expected upon entry knowledge, skills and abilities for testing purposes
- Developed detailed content specifications for the written examination
- Developed detailed content specifications for the simulator examination
- Developed multiple-choice questions based on the content specifications and job relatedness for new trainees
- Provided critical review of items by evaluating accuracy of the content and making editorial revisions
- Selected items for the published examination based on content specifications and SME feedback
- Evaluated scenarios and rating scales for the simulator examination for compliance with test and measurement principles
- Evaluated the standardized protocols that were developed to administer the simulator examination for compliance with test and measurement principles
- Facilitated the process for establishing criterion-referenced passing scores (modified Angoff) for the written and simulator examinations
- Determined the passing scores for the written and simulator examinations
- Developed the ranked list of candidates who passed both the written and simulator examinations

DEVELOPMENT OF EXAMINATION PLAN

KSAPC statement were reviewed to determine which assessment methodology would be the most effective method of measurement. It is not uncommon for a KSAPC to be measurable using a variety of methods. For example, a person's ability to review

information and take appropriate action may be measured using a written examination, a structured interview, or a job simulation activity, among other methods.

When considering the design of an appropriate selection procedure, it is strongly recommended that agencies consider using methods that might achieve their assessment goals while minimizing potential bias. Since most KSAPCs can be measured in a variety of ways, selecting the assessment technique that is the most effective for the broadest array of potential incumbents complies with the true spirit of anti-discrimination law.

SSP considers the variety of assessment procedures available when making the final recommendation to the agency in terms of the best approach for creating a valid and fair selection procedure. Issues considered included many pertinent variables such as administration resources, cost, efficiency, development resources, predictive validity of the various examination modalities, anticipated candidate size, vacancies to be filled, anticipated candidate characteristics, and job requirements to ensure that assessment modalities do not conflict with actual job requirements.

Upon consideration of all of the available information collected through this job analysis and examination development process, it was confirmed that the assessment procedures would consist of an Experience Evaluation, Written Examination and a Simulation Examination.

DEVELOPMENT OF EXAMINATION PROCESS SCORING MODEL

SSP project staff, in collaboration with the Bar Pilot Subject Matter Experts (SMEs), included as part of the examination development process a scoring model for the overall examination process for the Pilot Trainee position. The selection process consisted of three equally weighted components: experience, written examination and simulator examination. Through this process, it was determined that the scoring model would integrate all selection procedures in the following manner:

Experience: The process begins with an candidate application where they are tasked with demonstrating that they have sufficient experience to meet the requirements of 7 CCR, Division 2, Article 4, Subsection 213(e). The application is evaluated and those candidates who can establish proof of sufficient experience and other requirements are able to continue on in the examination process by sitting for the written examination. To sit for the written examination candidates must possess sufficient tug, deep draft, and/or piloting experience.

Written Examination: Candidates complete the Written Examination as the second assessment component. A pass point for this examination was established with Bar Pilot SMEs post examination administration. Candidates are required to pass the Written Examination in order to continue on in the examination process.

Simulation Examination: Candidates who pass the Written Examination proceed to the final assessment component, the Simulation Examination. In the

bridge simulator examination, a variety of real world complications and hazards are presented, and the candidates are evaluated on how well they handle unforeseen events. A separate pass point was established with Bar Pilot SMEs post examination administration.

All three components must be passed by the candidate. Final scores for the three components were totaled. Total scores were used to rank order candidates, thus allowing the commission to select individuals who scored the highest first into the Trainee Program, until the Board has exhausted the list of candidates.

DEVELOPMENT OF SELECTION PROCEDURES

Written Examination:

Nine (9) examination development meetings were conducted to draft, review, finalize, and approve all content for the Written Examination as well as the BOPC's item bank. Exam items were renewed and referenced to current sources. The examination development meetings convened on November 14-16, 2016, December 14-16, 2016, and January 23-25, 2017 were led by SSP project staff, with the participation of licensed Bar Pilots who served as SMEs. During these meetings, the SMEs reviewed the job analysis data and collaborated with SSP staff to determine the content areas to assess. SMEs and SSP staff then reviewed each established examination item to ensure the content corresponded with important and expected at entry KSAPCs and the difficulty level for all examination components were appropriate. The resulting final version of the examination was approved by the SMEs. Quality reviews of materials were performed prior to administration.

The written examination consists of 150 multiple-choice items, with each item being weighted equally at one point. Questions on the written examination were distributed with respect to the weights of four subject matter areas: (1) pre-transit planning, (2) master/pilot transition, (3) route piloting, and (4) docking, undocking, & anchorage. Weights of subject matter areas were derived from job analysis results.

(See APPENDIX B for Written Examination Content Specifications)

Simulation Examination:

Thirteen (13) examination development meetings were conducted to review, edit, finalize and approve all content for the Simulator Examination. The examination development meetings convened on the following dates in 2017: March 10, March 17, March 24, April 7, April 17, April 25, May 2, May 9, May 16, May 23-24, and May 30th. The development of the Simulation Examination involved several SMEs who worked to coordinate, program, test, and validate the examination procedure and content. These SMEs included: a computer programmer (also an experienced mariner), a Coordinator who was a retired pilot, multiple active pilots, and CalHR staff. The Simulation Examination evaluates the candidates on the following seven subject matter areas: (1) situational awareness, (2) appropriate response, (3) ability to respond correctly under pressure, (4) communication and bridge presence, (5) fundamental shiphandling, (6) bridge resource management, and (7) rules of the road. The number of measurement

opportunities were distributed according to the weights of subject matter areas.

The simulator's examination development process involved multiple repetitions of developing items, live testing with pilots, and revising content as necessary. Multiple revisions were necessary to ensure that nearly all of the possible actions that could be taken by candidates were identified and built into the system. The scoring system was designed around the metrics of +2 for highly effective, +1 for acceptable, 0 for ineffective, -1 for an allision (touching an object), and -2 for a collision. Evaluation forms were designed such that the candidates' evaluations were standardized. Numerous evaluation form revisions were necessary to achieve consensus regarding the wording, rating scales, and order of presentation of the measurement opportunities. Simulator raters were trained on the importance of ensuring the that the examination experience was consistent for each candidate. To support this, raters were briefed on the potential negative consequences associated with administration inconsistency (e.g., appeals, lawsuits, impact of unqualified candidates, negative press, candidate perceptions) and its impact on BOPC. To ensure there were an adequate number of items developed to appropriately assess the skill of the candidates, 45 measurement opportunities were developed.

(See APPENDIX C for Simulation Examination Content Specifications)

(See APPENDIX A for Examination Panel SME Information)

PASS POINT SETTING

The *Uniform Guidelines* require that the pass/fail cutoffs should be "...set so as to be reasonable and consistent with the normal expectations of acceptable proficiency in the workforce" (Section 5H). For licensing examinations, it is necessary to establish a passing score (cut score) based on the concept of minimal acceptable competence. The methodology most frequently applied and which was used for the written and simulator examination is the modified Angoff method.

Modified Angoff Method

SSP typically utilizes a form of pass point setting known as the Modified Angoff Method. Below are the steps for completing this process.

1. Select a representative sample SMEs who are truly experts in the content area and are diverse in terms of ethnicity, gender, geography, seniority (with a minimum of one year experience), and "functional areas" of the target position. Supervisors and trainers can also be included.
2. Facilitate a discussion with the SME panel to clarify and define the concept of a "minimally qualified applicant." The definition should be limited to an applicant who possesses the necessary, baseline levels of the KSAPC measured by the examination item to successfully perform the first day (before training) on the job.
3. Ask the SMEs to provide their ratings regarding probability of a minimally qualified applicant answering the examination item correctly.

4. Average the ratings across all SMEs for every item. Add these average ratings to establish the preliminary pass point.

The written and simulator assessments both require cut scores to be established. There are no predetermined standards to compare performance when determining if the standard set for passing is correct, or the number of points awarded for simulator activities is correct. Thus, SMEs were needed to establish appropriate pass points for both exam components. Participating SMEs provided their judgments based on: received training from CalHR staff, guidance from Bar Pilots with current and previous Bar Pilot exam development and administration experience, examinations' documentation, and using their own expertise as Bar Pilots. CalHR staff, and Bar Pilots involved with exam development and administration activities, instructed SMEs to use their evaluative skills and to maintain consistent scoring principles for each candidate. While consensus amongst SME raters appears to be a necessary component for expert judgments, SME agreement does not guarantee correctness. Differences in ratings between the SMEs are likely a result of having different perspectives due to different settings or work experiences (e.g., deep sea versus inland piloting). SMEs were asked to be highly discriminating when setting the passing scores or performing evaluations, and were reminded of the expectation to set pass points appropriate for the Bar Pilot Trainee level, rather than of an experienced, licensed Bar Pilot – the level of participating SMEs.

For the written examination component, there are 150 points possible. The modified Angoff method (as described above) was used to set the final pass point. Six pilots, serving as SMEs, evaluated the performance expected of minimally competent trainees. After the SMEs received training in the Modified Angoff process, they responded to the following question for each item: "What percentage of minimally competent candidates (pilot trainees) would answer the item correctly?" The data was aggregated across all items and all raters and divided by six, the number of SMEs. The results from the workshop established the passing score (cut score) at 106. The passing score was optimally established – the closest score above was 108 and the closest below was 103 which left clear gaps on both the pass and fail sides of the passing score.

For this simulator examination component, there are 90 points possible. The Angoff session for the simulator component included fourteen SMEs. Similar to the written examination, they received necessary training, and proceeded to provide their percentage of minimally acceptable candidates who would answer the item correctly. Data was again aggregated across all 45 items and divided by the number of participants. The final pass point was set to 42 points.

(See APPENDIX E for Pass Point Data)

PILOT TESTING

Written Examination: In order to maintain the security of the written examination, it was decided that the examination would not be piloted amongst SMEs. In lieu of a pilot test, the examination was evaluated by SMEs as part of a final review, and later reviewed again by CalHR staff to ensure examination quality. Such efforts, along with information learned from frequent discussions with SMEs helped ensure: the clarity of instructions and exam items, and that previously established time limits remained appropriate for administration.

Simulator Examination: Piloting of the simulator component occurred throughout the exam development process, as participating examination raters and other invited SMEs were asked to complete the assessment activities for the exam development focus group to view and evaluate. The benefits of this pilot testing included: ensuring that the programming software was operating appropriately, observing the variables and responses involved as candidates navigate throughout the examination and its items, ensuring the user-friendliness of tools (e.g., rating forms) developed for use by raters and exam proctors, ensuring the user-friendliness of candidate materials and instructions, establishing appropriate administration time limits, providing practice for raters to evaluate candidate and to determine how to rate newly identified observances, and other efforts to improve the overall quality of this component. Quality improvement modifications were consistently implemented as a result of these efforts.

RESULTS

Experience Points. The BOPC staff evaluated 32 candidate applications and determined that 29 individuals met or exceeded the minimum requirements to qualify for sitting for the written examination. Candidate scores ranged from 0 to 45 points for this component.

Written Examination. Candidates were provided 4 ½ hours to complete the 150 multiple-choice item examination. The administration occurred in the California Maritime Academy's cafeteria, with candidates being seated at large round tables, two candidates to a table. The arrangement helped ensure that candidates were not able to observe other candidate's responses. Additionally, two versions of the written examination were administered to further deter candidate cheating. Of the 29 qualified candidates, 25 qualified to sit for the written examination.

Of the twenty-five candidates who sat for the examination, twenty successfully passed, enabling them to continue forward to take the Simulator examination component. The lowest score was 59 and the highest was 139. The mean score was 113.48 and the median score was 119.

Simulation Examination. The SMEs involved with examination development activities received extensive training and guidance for evaluating and scoring the candidates. For training and practice purposes, the SME evaluators proceeded as if the person piloting the simulator was an actual pilot. Each evaluator first conducted their evaluation

independently before convening to discuss results with other raters. These experiences helped confirm rater consistency and that no aspects included in the design of the simulation had a negative impact on candidates' performance.

The processes applied for training the evaluators involved during actual administration were quite similar. The evaluators observed and rated pilots during numerous dry runs until the evaluators were consistent and confident in their evaluations. Evaluators were made aware of the consequences and impacts of their ratings by being reminded of two perspectives. The first necessity being that pilot trainees are expected to protect the public's health, safety and welfare. The second is the interest to ensure that the candidates' are assessed fairly and consistently in the examination program and selection process, where each candidate has the same opportunity to succeed throughout the selections process. The evaluators included representation from BOPC's Pilot Evaluation Committee, state licensed pilots from another jurisdiction, and industry representatives with command experience on deep draft vessels.

The California Maritime Academy hosted the simulation examination on a full bridge simulator over three days, June 14th, 15th, and 16th, 2017. On the 14th, the candidates who successfully passed the written examination: were fully briefed on the process, received materials designed to assist in preparing for the examination which they were allowed to take from the site, received a hands- on orientation to the bridge, and observed the vessel's track through the simulation exercise.

Upon candidates' scheduled examination time, the candidates were asked to arrive on time to return study materials and to make final preparations before entering the simulator. There were six evaluators who observed the candidates performance and participated in the discussion of the candidate's performance as based on the scoring sheets. Participation from all six evaluators helped in confirming that the performance of the candidates was accurately recorded. From those six, three pre-identified primary evaluator's ratings were recorded for each candidate to compute the candidate's ratings. To obtain a final score for each candidate the ratings were summed across the three evaluators and the 45 measurement opportunities. This means that the candidate's performance was measured 135 times. In assessment situations, multiple averaged ratings can result in more accurate measurement.

Similar to how the pass point was set for the written examination, a Modified Angoff workshop was conducted with fourteen SMEs. All evaluators were intimately familiar with the exam content and the evaluation process. The evaluators have trained pilots enabling them to have an in-depth appreciation of the skill set needed by pilot trainees. They were asked to evaluate the level of performance that a minimally competent candidate would exhibit on each of the 45 measurement opportunities. They were asked to judge the level of performance based on the examination rating system, +2, +1, 0, -1, and -2. The passing score was a scaled 42. Of the twenty candidates who took the simulator exam, ten obtained a passing score.

Scaling. The three components of the assessment process received equal weighting. With the total possible points varying for each exam component, it was necessary to

scale the experience points and the simulation exercise points to be comparable to the maximum score achievable on the written examination. Thus, the maximum experience points and the maximum simulator scores were scaled to equal 150. The maximum experience points was 90, which was scaled to equal 150, and the maximum score achievable on the simulation exercise was 90, which was also scaled to equal 150.

PROCESS FOR ESTABLISHING LISTING OF SUCCESSFUL CANDIDATES

The points awarded from each exam component were combined to establish the exam's total possible points. All three components must be passed by the candidate to pass the exam overall. Candidates, who possessed sufficient qualifying experience and successfully passed both the written and simulator components were placed on a list, ranked according to the total points earned. This allows the commission to select individuals who scored the highest first into the Trainee Program, until the Board has exhausted the list of candidates. The list was presented in a separate report to the BOPC.

APPENDIX A: Examination Panel Subject Matter Expert Participants

Written Examination Development Meetings

Date: November 14, 15, & 16, 2016

	Name	Classification	Contact
1	Erik Fawcett	Bar Pilot	[REDACTED]
2	John Carlier	Bar Pilot	[REDACTED]
3	Roger Kirk	Bar Pilot	[REDACTED]
4	Tony Coppo	Bar Pilot	[REDACTED]
5	William Lemke	Bar Pilot	[REDACTED]

Date: December 14, 2016

	Name	Classification	Contact
1	Arnold Kelso	Bar Pilot	[REDACTED]
2	Erik Fawcett	Bar Pilot	[REDACTED]
3	John Carlier	Bar Pilot	[REDACTED]
4	Peter Mclsaac	Bar Pilot	[REDACTED]
5	William Lemke	Bar Pilot	[REDACTED]

Date: December 15 & 16, 2016

	Name	Classification	Contact
1	Erik Fawcett	Bar Pilot	[REDACTED]
2	Peter Mclsaac	Bar Pilot	[REDACTED]
3	Roger Kirk	Bar Pilot	[REDACTED]
4	William Lemke	Bar Pilot	[REDACTED]

Date: January 23 & 24, 2017

	Name	Classification	Contact
1	Erik Fawcett	Bar Pilot	████████████████████
2	Mark Manes	Bar Pilot	████████████████████
3	Roger Kirk	Bar Pilot	██████████████████
4	Tony Coppo	Bar Pilot	████████████████████
5	William Lemke	Bar Pilot	████████████████████

Date: January 25, 2017

	Name	Classification	Contact
1	Erik Fawcett	Bar Pilot	████████████████████
2	Mark Manes	Bar Pilot	████████████████████
3	Tony Coppo	Bar Pilot	████████████████████
4	William Lemke	Bar Pilot	████████████████████

Written Examination Angoff Session SMEs

Date: June 12, 2017

	Name	Classification	Contact
1	Steve Teague	Bar Pilot	██████████████████
2	D. George Dowdle	Bar Pilot	██████████████████
3	Randy Pinetti	Bar Pilot	██████████████████
4	Sam D'Aloisio	Bar Pilot	██████████████████
5	Blake Coney	Bar Pilot	██████████████████
6	Drew Aune	Bar Pilot	██████████████████

Simulator Examination Development Meetings

Date: April 7, 17, 25 & May 2, 9, 16, 23, 30 2017

	Name	Classification	Contact
1	Steve Teague	Bar Pilot	[REDACTED]
2	Eric Robinson	Bar Pilot	[REDACTED]
3	D. George Dowdle	Bar Pilot	[REDACTED]
4	Bruce Alden	Bar Pilot	[REDACTED]
5	Mark Haggerty	Bar Pilot	[REDACTED]
6	Dan Boriolo	Bar Pilot	[REDACTED]
7	J.D. Gates	Test Proctor with California Maritime Academy (CMA)	[REDACTED]
8	Mike Noonan	Test Programmer, CMA	[REDACTED]

Simulator Angoff Session SMEs

Date: June 17, 2017

	Name	Classification	Contact
1	Einar Nyborg	Bar Pilot	[REDACTED]
2	Steve Teague	Bar Pilot	[REDACTED]
3	John Carlier	Bar Pilot	[REDACTED]
4	Bruce Alden	Bar Pilot	[REDACTED]
5	Eric Robinson	Bar Pilot	[REDACTED]
6	Dan Boriolo	Bar Pilot	[REDACTED]
7	Anne McIntyre	Pilot	[REDACTED]
8	J.D. Gates	Test Proctor	[REDACTED]
9	William McKinley	Ship Master	[REDACTED]
10	Bob Carr	Bar Pilot	[REDACTED]
11	D. George Dowdle	Bar Pilot	[REDACTED]
12	Charles Viebrock	Ship Master	[REDACTED]
13	Paul Amos	Pilot	[REDACTED]
14	Allen Garfinkle	Ship Master	[REDACTED]

APPENDIX B: Written Examination Content Specifications

Subject Matter Areas in Written Examination

SMEs worked as a group to evaluate and integrate task and KSAPC statements into four subject matter areas. Weights (percentages) to each area were based on the task ratings in the job analysis. Below is a table showing the four subject matter areas, area definitions, and weights.

Subject Matter Area	Definition	Weight
Pre-Transit Planning	Prepare for safe transit of vessel in a timely manner; determine feasibility of vessel movement	12%
Master-Pilot Transition	Exchange of information between master and pilot pertaining to transit; acclimate to vessel by analyzing equipment and vessel position	6%
Route Piloting	Take the conn; implement plans for safe transit of vessel from start to destination	44%
Docking, Undocking, & Anchorage	Initiate or terminate transit; approach or depart dock	38%

Written Examination Specifications

SSP utilized linkage data of job tasks and knowledge, skills, and abilities and personal characteristics (KSAPC) established by SMEs to organize KSAPC statements into Subject Matter Areas. The following tables represent the content specifications in the written examination. The specifications are organized in terms of Subject Matter Area and the KSAPCs that candidates must possess to perform job tasks. Each KSAPC, although linked to multiple job tasks, was listed only once to avoid redundancy.

CONTENT AREA	SUBAREA	ASSOCIATED KSAPC
I. Pre-Transit Planning (12%) – Prepare for safe transit of vessel in a timely manner; determine feasibility of vessel movement	A. Environment	<p>12 Knowledge of the effects of salinity on vessels’ draft to allow for safe underkeel clearance.</p> <p>13 Knowledge of available resources (e.g., Army Corps charts, Local Notice to Mariners) to obtain latest channel depths and characteristics to ensure safe passage of vessels.</p> <p>14 Knowledge of available resources to determine predicted tides and currents to ensure timely transit.</p> <p>15 Knowledge of the effect of environmental factors on tide and current predictions to efficiently carry out transit operations.</p> <p>17 Knowledge of the effect of various environmental conditions on vessels’ ability to ensure timely transit.</p>
	B. Geographic Conditions	<p>19 Knowledge of bridge clearances and configurations to avoid allision.</p> <p>20 Ability to identify and interpret information from charts to ensure safe transit.</p> <p>21 Knowledge of various types of port configurations and channels (e.g., turning basins, overhead structures) to ensure safe passage.</p>
	C. Vessel Capabilities	<p>24 Knowledge of the effect of vessel speed on squat, heel, and sinkage to determine safe and efficient transit.</p> <p>25 Knowledge of the effect of vessel’s draft and trim on its handling to safely navigate through various water conditions.</p> <p>26 Knowledge of tugboat characteristics and bollard pull to determine tug effectiveness.</p> <p>27 Knowledge of the effect of environmental conditions on handling techniques of different classes of vessels to ensure safe transit.</p> <p>28 Knowledge of the effect of interactions between vessels in close quarters to prevent damage.</p> <p>29 Knowledge of various types of vessel maneuvering characteristics for effective shiphandling.</p>
	D. Transit Planning	<p>32 Ability to identify potential conflicts (e.g., vessel traffic, debris, current change, tide levels) on transit routes to ensure safe passage.</p> <p>34 Ability to coordinate meeting location, availability, et cetera with assigned tugboats for effective use.</p> <p>35 Knowledge of underkeel clearance, and its effect on the vessel in various locations along route, to ensure safe passage.</p>

CONTENT AREA	SUBAREA	ASSOCIATED KSAPC
II. Master-Pilot Transition (6%) – Exchange of information between master and pilot pertaining to transit; acclimate to vessel by analyzing equipment and vessel position.	A. Leadership/Supervision and Management	9 Knowledge of crew responsibilities on various vessels to carry out timely transit operations. 8 Ability to coordinate and cooperate with Bridge Team to ensure effective transit operations. 10 Ability to coordinate passing arrangements with other vessels with regards to your own vessel limitations.
	B. (Bridge and Vessel) Equipment	36 Knowledge of factors (e.g., environment, traffic, geographic conditions) that affect reliability of estimated times of arrival when meeting other vessels. 37 Knowledge of various types of equipment (e.g., rudder, bitt [strength], thruster) necessary to ensure safe transit operations. 38 Knowledge of use and limitations of various shipboard navigational equipment and radar systems for vessel maneuvering and collision avoidance.
	C. Communication	39 Ability to communicate in standard nautical terminology with shore-based support systems, bridge-to-bridge, and working channels to comply with protocols and procedures. 40 Ability to communicate with Vessel Traffic Service to ensure safe navigation. 43 Ability to read written documents of varying complexity including departmental policy, manuals, and guides to comprehend and communicate information to others.
	D. Vessel Characteristics	45 Knowledge of different tugboat characteristics to determine their suitability for specific tasks. 47 Ability to interpret and interpolate draft mark readings to adjust shiphandling techniques accordingly. 49 Ability to determine information about vessel maneuvering limitations, special requirements, and unusual characteristics to ensure effective shiphandling.

CONTENT AREA	SUBAREA	ASSOCIATED KSAPC
III. Route Piloting (44%) – Take the conn, implement plans for safe transit of vessel from start to destination	A. Technical	1 Knowledge of applicable guidelines or standards (e.g., Regulated Navigation Areas, speed limits, Rules of the Road, escort regulations) as they relate to maritime operations safety. 2 Knowledge of shiphandling principles and methods to carry out safe and efficient transit operations. 3 Knowledge of vessel movement operational guidelines to ensure compliance and safe piloting. 4 Knowledge of the basic principles of physics (e.g., hydrodynamics) to assess the effect of external conditions on vessels and the vessels' effect on surroundings. 5 Ability to operate specialized global positioning and tracking technology (e.g., Electronic Chart Display, Automatic Radar Plotting Aid) to ensure safe transit. 6 Ability to read and interpret charts/soundings in order to determine conditions and navigate waterways safely. 7 Ability to perform mathematical calculations (e.g., basic algebra) to effectively navigate vessels safely in various geographic and environmental conditions.
	B. Shiphandling	50 Ability to adjust maneuvering techniques based on vessel's type and size to ensure efficient shiphandling. 52 Knowledge of hydrodynamic forces in narrow channels and shallow water to appropriately maneuver vessel in challenging conditions. 53 Knowledge of vessel's wake effect to reduce negative effects on surrounding environments. 56 Knowledge of the implications caused by vessels' speed relative to engine speed for effective shiphandling. 54 Ability to properly maneuver the vessel under changing channel configurations to ensure safe passage. 55 Ability to safely handle the vessel depending on changing vessel factors (e.g., underkeel clearance, heel) for effective maneuvering. 57 Knowledge of factors that affect pivot point to adjust shiphandling.
	C. Traffic Management	59 Knowledge of factors (e.g., weather, traffic, geographic conditions) constraining other vessels' transit to plan transit operations accordingly. 61 Knowledge of water depths and configurations in bays, channels, rivers, harbors, and anchorages, and their effects on navigation to manage transit planning accordingly. 62 Ability to properly apply Rules of the Road and/or Vessel Traffic Service regulations to ensure safe transit.
	D. Situational Awareness	75 Ability to strategize and prioritize information from multiple sources to carry out transit operations in a timely manner. 76 Ability to perform multiple tasks simultaneously when responding to unfolding events

		<p>to ensure a safe transit.</p> <p>77 Ability to adapt to sudden changing conditions (e.g., environmental, mechanical) in order to ensure vessel safety.</p> <p>78 Ability to observe actions and/or response of others to ensure compliance with orders.</p> <p>79 Ability to follow up with others (e.g., personnel, vessels) to ensure predetermined arrangements are carried out.</p> <p>80 Ability to choose and take the appropriate course of action to mitigate an unforeseen event or hazard.</p> <p>81 Ability to apply past experiences to present or future circumstances to ensure mistakes are not repeated.</p> <p>82 Ability to assess crew's effectiveness in responding to pilot's orders to ensure safe vessel transit.</p>
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CONTENT AREA	SUBAREA	ASSOCIATED KSAPC
IV. Docking, Undocking, & Anchorage (38%) – Initiate or terminate transit; approach or depart dock.	A. Anchorage	<p>63 Knowledge of factors that affect anchoring of a vessel to ensure its safety.</p> <p>65 Ability to assess potential hazards at local anchorages to ensure safety of vessel.</p> <p>66 Ability to carry out anchoring procedures while vessel is moving, mooring, or in emergency situations to ensure vessel safety.</p> <p>67 Knowledge of various navigation techniques to precisely anchor a vessel under various conditions.</p>
	B. Docking and Undocking	<p>68 Knowledge of acceptable protocol and etiquette for radio communication to ensure proper docking and undocking of vessel.</p> <p>69 Knowledge of the effect of existing traffic conditions on departure/arrival times to ensure safe transit.</p> <p>70 Knowledge of capabilities and limitations of different types of tugboats to safely dock and undock the vessel.</p> <p>73 Knowledge of various methods to determine distances, speed, and position of own vessel and of vessels in close proximity.</p> <p>74 Knowledge of environmental conditions (e.g., current, wind) for approach to berth in order to safely dock and undock vessel.</p>

APPENDIX C: Simulation Examination Content Specifications

Subject Matter Areas in Simulation Examination

SMEs worked as a group to determine which tasks were to be measured in simulation examination. Definitions for the seven subject matter areas in the simulation examination are as follows:

- 1) **Situational awareness:** Assesses the candidate's appreciation of the situation the vessel is in at the all times during the exercise including relative motion, traffic, aids to navigation, effect of wind, current and other forces on the vessel, and the candidate's ability to accurately filter and prioritize available information.
- 2) **Appropriate response:** Assesses the candidate's responses in routine transit, including timeliness and appropriateness of rudder commands, engine orders and other orders to the bridge team.
- 3) **Ability to respond correctly under pressure:** Separately assess the candidate's ability to respond under emergency or non-routine situations of increased stress.
- 4) **Communication and bridge presence:** Assesses the candidate's ability to use concise, clear, and pertinent communications using proper terminology on radios, with the bridge, and evaluation teams. In addition, assesses the candidate's professional composure, demeanor, and ability to communicate warranted self-confidence, which inspires confidence in the bridge team that the vessel's navigation is in good hands.
- 5) **Fundamental ship handling:** Assesses the candidate's knowledge of proper and timely use of engine and rudder commands and understanding the ship's response to those commands.
- 6) **Bridge resource management:** Assesses the candidate's proper use of all personnel and equipment resources available during the exercise.
- 7) **Rules of the road:** assesses the candidate's proper application of the navigational rules of the road to the situations presented. The Inland Rules will apply throughout this exercise.

Simulation Examination Specifications

Tasks selected for the simulation examination were derived from the job analysis which SMEs identified as critical tasks for successful job performance. The Simulator Examination Specification matrices on the following pages represent how SMEs categorized each job task per Subject Matter Area to allow for measurement opportunities in the Simulator Examination.

Simulator Measurement Opportunities

The table below shows the weight of each Subject Matter Areas and corresponding measurement opportunities in the Simulator Examination. Weighting was computed by taking the total number of tasks within a Subject Matter Area and divide by the sum of all tasks within the seven Subject Matter Areas.

Subject Matter Area	Tasks	Weight	Measurement Opportunities
Situational awareness	19	18%	8
Appropriate response	21	20%	9
Ability to respond correctly under pressure	22	21%	9
Communication and bridge presence	10	9%	4
Fundamental ship handling:	22	21%	10
Bridge resource management	7	7%	3
Rules of the road	5	5%	2
TOTAL	106	100%	45

I. Pre-Transit Planning

Tasks		Situational Awareness	Appropriate Responses	Respond Under Stress	Communication and Bridge Presence	Fundamental Ship Handling	Bridge Resource Management	Rules of the Road
1	Determine factors (e.g., weather, traffic, underkeel clearances, tugboat availability) affecting the desired route or alternative route to plan safe transit routes accordingly.	X	X	N/A	N/A	X	N/A	N/A
4	Calculate underkeel clearances by reviewing channel sounding charts and local area data for vessel safety.	N/A	N/A	N/A	X	N/A	X	N/A
5	Calculate overhead clearances based on height of tide at locations along route to ensure safe and uneventful transit.	X	X	N/A	X	X	N/A	N/A
10	Identify constraints on vessel maneuverability based on vessel factors (e.g., type, draft, air draft, vessel particulars) to plan efficient transit routes.	N/A	X	N/A	N/A	X	N/A	N/A
14	Develop a personal, standardized conference practice with Master to effectively execute Master-Pilot exchange.	N/A	N/A	N/A	X	N/A	X	N/A

II. Master-Pilot Transition

Tasks		Situation Awareness	Appropriate Responses	Respond Under Stress	Communication and Bridge Presence	Fundamental Ship Handling	Bridge Resource Management	Rules of the Road
15	Exchange information (e.g., pilot card, tug escort form) with Master to determine vessels' handling characteristics and readiness for emergency situations.	N/A	X	X	N/A	X	X	N/A
16	Communicate with Master regarding existing underkeel clearance, traffic, and environmental conditions to ensure departure/arrival times are feasible.	X	X	N/A	X	N/A	N/A	X
19	Establish radio communication with Vessel Traffic Service to report vessel location and destination, and to receive information about other vessel movements.	N/A	X	X	X	N/A	N/A	X

III. Route Piloting

Tasks		Situational Awareness	Appropriate Responses	Respond Under Stress	Communication and Bridge Presence	Fundamental Ship Handling	Bridge Resource Management	Rules of the Road
2	Evaluate environmental conditions to determine, and adjust accordingly, appropriate vessel operations (e.g., transit, maneuvering) in compliance with Vessel Traffic Service safety regulations.	X	X	X	N/A	X	N/A	N/A
3	Review timely navigational information to evaluate risks posed by unusual factors and/or special circumstances that may affect vessel movement.	N/A	X	N/A	X	X	N/A	N/A
6	Adjust to bridge environment and layout in order to carry out safe transit operations.	N/A	X	X	N/A	X	X	N/A
7	Monitor environmental and traffic conditions to appropriately update estimated arrival times.	X	X	X	N/A	X	N/A	N/A
12	Plan transit routes by evaluating traffic conditions to ensure vessel safety.	N/A	X	X	N/A	X	X	N/A
13	Determine current at locations (e.g., along planned route, at berth) to develop plans for maneuvering vessel.	X	X	N/A	N/A	X	N/A	N/A
17	Maintain communication with Bridge Resource Team to ensure free flow of information.	N/A	X	X	X	N/A	N/A	N/A
18	Communicate with Marine Exchange when checking in with escorted vessels to comply with California State regulations.	N/A	N/A	N/A	X	N/A	N/A	N/A
20	Communicate with other vessels in a timely manner to make passing arrangements and ensure the safety of vessels.	N/A	X	X	N/A	X	N/A	X
21	Communicate time of arrival with Lift Bridge Operator to arrange safe and timely transits.	X	X	X	N/A	X	N/A	N/A
25	Monitor Vessel Traffic Service and radio communications to determine traffic conditions and ensure vessel safety.	X	X	N/A	N/A	N/A	N/A	X
32	Determine the relative motion of other craft on the water to assess the risk of collision.	X	N/A	X	N/A	X	N/A	X
33	Utilize navigational equipment (e.g., radar, Electronic Chart Display) to determine information regarding vessels' transit (e.g., position, course, speed).	X	X	N/A	X	N/A	X	N/A
34	Assess potential risk caused by vessel transit to minimize harm to property, persons, and the environment.	X	X	X	N/A	X	X	N/A

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35	Determine vessels' clearance from objects in close proximity through all available means to avoid collisions/allisions.	X	N/A	N/A	N/A	N/A	X	N/A
40	Prioritize actions during transit to ensure essential operations are carried out in a timely manner.	X	X	X	N/A	N/A	N/A	N/A
41	Perform multiple tasks simultaneously when responding to unfolding events to ensure a safe transit.	X	X	X	N/A	N/A	N/A	N/A
43	Observe actions and/or response of others to ensure compliance with orders.	X	X	X	X	N/A	N/A	N/A
44	Follow up with others (e.g., personnel, vessels) to ensure predetermined arrangements are carried out.	X	X	N/A	X	N/A	N/A	N/A
46	Maintain awareness of current situation when interrupted by events to ensure vessel safety and necessary actions are completed.	X	X	X	N/A	X	N/A	N/A

IV. Docking, Undocking, & Anchorage

Tasks		Situational Awareness	Appropriate Responses	Respond Under Stress	Communication and Bridge Presence	Fundamental Ship Handling	Bridge Resource Management	Rules of the Road
8	Assess immediate navigation and traffic conditions to identify potential hazards to vessel.	X	X	X	N/A	X	N/A	N/A
9	Assess dock and berth characteristics to avoid potential obstructions.	N/A	X	N/A	N/A	X	N/A	N/A
11	Modify transit plan due to vessel responsiveness, traffic/berth conflicts, or environmental conditions for efficient transit operations.	X	X	X	N/A	X	N/A	N/A
22	Coordinate with Master and Bridge Resource Team to ensure timely availability of crew for anchoring, mooring or other evolutions.	N/A	X	X	X	N/A	X	N/A
23	Establish working radio communication frequencies to facilitate communication with other vessels and/or tugboats.	X	X	N/A	N/A	X	N/A	N/A
24	Communicate with Master regarding line handling and docking plan to ensure appropriate actions are being taken.	N/A	X	X	X	N/A	X	N/A
26	Determine the vessel's responsiveness to changes in course/speed and environmental conditions to ensure safe and effective maneuvering.	X	N/A	N/A	N/A	X	N/A	N/A
27	Observe vessel's response to helm and engine orders to ensure safe and timely maneuvering.	X	N/A	N/A	N/A	X	N/A	N/A
28	Take corrective actions (e.g., rerouting, speed adjustment) to ensure vessel arrives at predetermined points in an appropriate manner.	X	X	X	N/A	X	N/A	N/A
29	Position vessel for approach to berth to ensure vessel docks safely.	X	X	X	N/A	X	N/A	N/A
30	Maneuver vessel while ensuring safety of tugboats, vessel, and terminal facilities during transit and undocking/docking operations.	X	X	X	N/A	X	N/A	N/A
31	Control vessel at an appropriate speed when in transit and/or approach to berth or anchorage to ensure vessel safety.	X	X	X	N/A	X	N/A	N/A
36	Position vessel alongside berth to ensure safe cargo operations.	X	X	N/A	X	X	N/A	N/A
37	Monitor line handling that may affect ship personnel, equipment, or facility to ensure effective mooring and unmooring.	X	N/A	X	X	N/A	N/A	N/A

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38	Anchor vessel in appropriate locations to ensure safety and compliance with vessel traffic regulations.	X	X	X	N/A	X	N/A	X
39	Ensure final mooring arrangement is sufficient for prevailing conditions to ensure vessel is safely moored.	X	X	N/A	N/A	N/A	X	N/A
42	Adapt to sudden changing conditions (e.g., environmental, mechanical) in order to ensure vessel safety.	X	X	X	N/A	X	N/A	N/A
45	Choose and take the appropriate course of action to mitigate an unforeseen event or hazard.	X	X	X	N/A	X	N/A	N/A

APPENDIX D: Examination Item/KSAPC Linkage

Written Examination Item Linkage

Exam Item #	KSAPC #
1	1,5,6,13,20,32,35,36,38,63,61,65
2	2,4,6,17,25,27
3	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67
4	2,4,17,27,56,57
5	1,5,6,9,20,32,36,38,59,61,63,65,66
6	4,15,21,27,49,54,74,77
7	2,4,6,7,8,9,13,15,20,21,27,37,49,52,56,57,61,63,66,75,76,77,78,79,82
8	2,4,8,9,13,14,20,21,25,35,37,57,61,63,66,75,78
9	4,37
10	2,4,29,49,57
11	2,4,29,49,56,57,63,66,75,76
12	2,4,24,25,55,56,57,70
13	2,4,8,9,25,29,31,49,66,78,79,80
14	15,17,27,36,57,59,74,77
15	2,4,5,7,15,21,26,27,28,29,32,34,38,47,52,53,56,57,63,65,66,67,74,75,76,77,78,79,81,82
16	2,4,5,15,27,38,49,50,52,55,59,61,75,76,81
17	2,4,24,25,27,28,29,31
18	2,4,7,24,52,50
19	2,4,26,37,45,49,50,57,70
20	2,4,25,27,29,49,50,57,74
21	2,4,10,24,25,27,29,35,52,54,55,56,61
22	2,4
23	2,4,27,35,52,55,56,61
24	2,4,7,24,25,28,29,36,49,50,52,55,56,80,81
25	2,4,29,49,56,57,63,66,75,76
26	15,17,27,38,59,77
27	2,4,6,9,15,20,27,29,32,35,49,50,52,54,55,56,57,61,75,76,77,78,79,80,81,82
28	2,4,5,15,27,38,49,50,52,55,59,61,75,76,81
29	1,6,7,8,9,13,14,35,43,47,79,82
30	2,4,6,7,15,20,21,24,25,28,27,29,32,35,36,49,50,52,53,54,55,56,59,61,76,78,80,81,82
31	2,4,24,25,27,28,29,31
32	2,4,24,25,29,35,47,49,50,52,55,56,57,67,81
33	2,4,24,25,27,28,29,31
34	2,4,5,7,12,25,52
35	1,6,7,8,9,13,14,35,43,47,79,82
36	2,4,29,37,57,49,50
37	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67

Exam Item #	KSAPC #
38	2,4,6,8,9,13,14,21,37,49,52,57,61,63,66,76,77,78,79,80,82
39	2,4,7,17,26,37,38,47,56,57,74,76,77,79,80,81
40	2,4,29,37,49,52,56
41	2,4,24,25,27,28,29,31
42	2,4,25,27,29,49,50,57,74
43	38,49,75
44	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67
45	5,38,73
46	2,4,6,7,8,9,13,15,20,21,27,37,49,52,56,57,61,63,66,75,76,77,78,79,82
47	2,37
48	2,27,29,49,50,56
49	2,4,5,7,9,15,21,26,27,28,29,32,34,36,38,47,49,50,52,53,56,57,59,61,63,65,66,67,69,74,75,76,77,78,79,81,82
50	2,4,15,17,25,27,32,36,49,50,52,54,55,56,59,61
51	2,4,26,28,37,45,68,70,77,78,79
52	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67
53	2,4,25,27,29,49,50,57,74
54	2,4,26,28,37,45,68,70,77,78,79
55	7,49,73,74
56	2,4,7,24,25,28,29,36,49,50,52,55,56,80,81
57	2,4,29,37,49,56
58	4,6,12,17,24,25,52,55
59	2,4,24,25,27,50,57
60	2,4,26,28,37,45,68,70,77,78,79
61	2,4,8,9,15,21,27,29,35,49,50,55,56,57,61,66,74,78,82
62	2,4,6,7,15,20,21,24,25,27,28,29,32,35,36,49,50,52,53,54,55,56,59,61,76,78,80,81,82
63	2,4,7,37,56,57,74,79
64	1,2,3,6,9,75
65	2,4,37
66	1,6,7,20,47
67	2,4,8,9,15,21,27,29,35,49,50,55,56,57,61,66,74,78,82
68	2,4,7,15,27,32,36,59,74
69	2,4,29,49,56,57,63,66,75,76
70	2,4,24,25,29,49,50,52,54,55,61,77
71	2,4,10,24,25,27,29,35,52,54,55,56,61
72	2,4,14,15,26,27,29,37,45,49,50,57,70,74,78
73	2,4,10,24,25,27,28,29,34,35,36,37,49,50,52,54,55,56,61,76,77,78,79,80,81,82
74	2,4,24,26,29,37,45,49,50,57,70,75,78
75	6,7,12,13,14,15,20,21,24,25,26,35,43,52,55,61
76	2,3,4,26,70,73,74
77	2,4,29,49,73,74,77

Exam Item #	KSAPC #
78	2,27,29,49,50,56
79	2,4,17,21,24,25
80	2,4,27,35,52,55,56,61
81	2,4,6,8,9,13,14,21,37,49,52,57,61,63,66,67,76,77,78,79,80,82
82	1,2,3,6,9,75
83	2,4,26,28,37,45,57,68,70,77,78,79
84	2,4,10,24,25,27,29,35,52,54,55,56,61
85	4,24,25,29,55,61,77
86	2,4,10,24,25,27,28,29,34,35,36,37,49,50,52,54,55,56,61,76,77,78,79,80,81,82
87	2,4,5,15,17,19,25,27,29,36,38,47,52,49,50,54,55,59,73,74,77,80,81,82
88	2,4,25,27,29,49,50,57,74
89	2,4,6,7,13,14,15,20,21,24,25,27,28,29,32,35,36,49,50,52,53,54,55,56,59,61,76,78,80,81,82
90	2,4,26,28,37,45,68,70,77,78,79
91	2,4,26,45,50,57,68,70,73,74,79,80,82
92	1,7,9,79,83,84,87
93	2,4,7,12,24,25,35,49,50,55,56
94	4,24,25,29,55,61,77
95	2,4,10,24,25,27,29,35,52,54,55,56,61
96	2,4,12,13,15,17,24,25,35
97	2,4,24,26,28,45,56
98	2,4,12,13,15,17,24,25,35
99	2,4,7,10,14,15,17,20,21,24,27,28,32,52,54,56,61,74,77,81
100	2,4,6,7,12,14,17,20,21,24,25,27,28,29,32,35,36,49,52,53,54,56,61,80,81
101	2,4,7,24,25,28,29,36,49,50,52,55,56,80,81
102	2,4,10,24,25,27,28,29,34,35,36,37,49,50,52,54,55,56,61,76,77,78,79,80,81,82
103	4,25,45,55,57
104	2,4,29,37,57
105	2,4,7,24,25,27,36,49,50,52,55,56,57,61
106	4,25,45,55,57
107	6,13,14,20
108	2,4,25,28,32,35,52,53,54,56,80
109	2,5,6,7,63,67
110	6,13,20,21,32,35,63,65,67
111	2,4,6,21,52,54,55
112	2,27,29,49,50,56
113	4,37
114	2,4,7,15,27,32,36,59,74
115	2,4,5,15,17,19,25,27,29,36,38,47,49,50,52,54,55,59,73,74,77,80,81,82
116	2,4,17,27,56,57
117	4,12,24,25,52,56,77
118	2,4,26,37,45,49,50,57,70

Exam Item #	KSAPC #
119	2,4,7,14,15,17
120	6,13,20,21,32,61
121	2,4,5,7,9,15,21,26,27,28,29,32,34,36,38,47,49,50,52,53,56,57,59,61,63,65,66,67,69,74,75,76,77,78,79,81,82
122	2,4,10,24,25,27,29,35,52,54,55,56,61
123	38
124	2,4,25,27,29,49,50,57,74
125	6,7,13,14,20,43
126	2,4,12,24,25,49,50,52,55
127	2,4,24,25,55,56,57,70
128	15,17,24,27,32,35,36,61,74
129	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67
130	2,4,14
131	2,4,7,24,25,27,29,35,49,50,52,54,55,56,57,61,67
132	2,4,14,21,24,25,28,29,35,37,52,79,81
133	2,4,14,15,24,25,27,29,35,37,49,50,52,54,55,56,57,61,76,78,79,81,82
134	2,4,10,24,25,27,29,35,52,54,55,56,61
135	2,4,26,28,37,45,68,70,77,78,79
136	2,4,29,27,49,50,55
137	5,38,73
138	4,7,12,20,24,35,55
139	3,10,17,24,25,52,55
140	2,4,21,24,25,50,52
141	2,4,12,24,25,29,35
142	2,4,6,8,9,13,14,21,37,49,52,57,61,63,66,67,76,77,78,79,80,82
143	2,3,4,24,27,55
144	2,4,29,37,50,52,55
145	2,4,27,35,52,55,56,61
146	2,4,25,27,29,49,50,57,74
147	2,4,6,7,8,9,13,15,20,21,27,37,49,52,56,57,61,63,66,75,76,77,78,79,82
148	2,4,10,24,25,27,29,35,52,54,55,56,61
149	4,12,24,25,52,56,77
150	2,4,6,7,8,9,13,15,20,21,27,37,49,52,56,57,61,63,66,75,76,77,78,79,82

Simulator Examination Item Linkage

Exam Item #	Task #
1	3,4,5,14,16,17,18,19,22,24,33,36,37,43,44
2	4,6,12,14,15,22,24,33,34,35,39
3	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
4	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
5	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
6	3,4,5,14,16,17,18,19,22,24,33,36,37,43,44
7	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
8	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
9	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
10	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
11	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
12	4,6,12,14,15,22,24,33,34,35,39
13	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
14	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
15	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
16	3,4,5,14,16,17,18,19,22,24,33,36,37,43,44
17	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
18	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
19	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
20	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
21	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
22	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
23	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
24	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
25	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46

Exam Item #	Task #
26	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
27	16,19,20,25,32,38
28	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
29	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
30	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
31	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
32	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
33	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
34	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
35	4,6,12,14,15,22,24,33,34,35,39
36	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
37	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
38	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
39	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
40	1,2,5,7,8,11,13,16,21,23,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46
41	1,2,3,5,6,7,8,9,10,11,12,13,15,20,21,23,26,27,28,29,30,31,32,34,36,38,42,45,46
42	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46
43	3,4,5,14,16,17,18,19,22,24,33,36,37,43,44
44	1,2,3,5,6,7,8,9,10,11,12,13,15,16,17,19,20,21,22,23,24,25,28,29,30,31,33,34,36,38,39,40,41,42,43,44,45,46
45	2,6,7,8,11,12,15,17,19,20,21,22,24,28,29,30,31,32,34,37,38,40,41,42,43,45,46

APPENDIX E: Pass Point Data

Written Examination

EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE	EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE
1	0.78	1	43	0.93	1
2	0.69	1	44	0.80	1
3	0.78	1	45	0.78	1
4	0.67	1	46	0.53	1
5	0.88	1	47	0.77	1
6	0.49	1	48	0.81	1
7	0.55	1	49	0.63	1
8	0.53	1	50	0.50	1
9	0.74	1	51	0.68	1
10	0.66	1	52	0.60	1
11	0.68	1	53	0.73	1
12	0.64	1	54	0.51	1
13	0.54	1	55	0.84	1
14	0.68	1	56	0.78	1
15	0.53	1	57	0.83	1
16	0.82	1	58	0.53	1
17	0.77	1	59	0.78	1
18	0.82	1	60	0.68	1
19	0.51	1	61	0.80	1
20	0.73	1	62	0.63	1
21	0.67	1	63	0.56	1
22	0.63	1	64	0.90	1
23	0.59	1	65	0.84	1
24	0.58	1	66	0.92	1
25	0.71	1	67	0.57	1
26	0.70	1	68	0.87	1
27	0.90	1	69	0.89	1
28	0.71	1	70	0.59	1
29	0.52	1	71	0.88	1
30	0.50	1	72	0.83	1
31	0.82	1	73	0.52	1
32	0.60	1	74	0.62	1
33	0.73	1	75	0.80	1
34	0.69	1	76	0.61	1
35	0.67	1	77	0.83	1
36	0.43	1	78	0.89	1
37	0.82	1	79	0.57	1
38	0.51	1	80	0.84	1
39	0.67	1	81	0.50	1
40	0.74	1	82	0.85	1
41	0.72	1	83	0.83	1
42	0.75	1	84	0.83	1

Written Examination

EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE	EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE
85	0.75	1	123	0.81	1
86	0.52	1	124	0.84	1
87	0.73	1	125	0.78	1
88	0.76	1	126	0.53	1
89	0.50	1	127	0.75	1
90	0.73	1	128	0.64	1
91	0.88	1	129	0.73	1
92	0.88	1	130	0.83	1
93	0.85	1	131	0.77	1
94	0.78	1	132	0.60	1
95	0.69	1	133	0.77	1
96	0.59	1	134	0.75	1
97	0.71	1	135	0.50	1
98	0.74	1	136	0.83	1
99	0.83	1	137	0.83	1
100	0.53	1	138	0.81	1
101	0.64	1	139	0.87	1
102	0.78	1	140	0.83	1
103	0.50	1	141	0.48	1
104	0.83	1	142	0.83	1
105	0.62	1	143	0.83	1
106	0.52	1	144	0.81	1
107	0.86	1	145	0.74	1
108	0.80	1	146	0.84	1
109	0.83	1	147	0.58	1
110	0.53	1	148	0.70	1
111	0.82	1	149	0.67	1
112	0.84	1	150	0.55	1
113	0.62	1			
114	0.88	1			
115	0.85	1			
116	0.78	1			
117	0.82	1			
118	0.82	1			
119	0.69	1			
120	0.75	1		MAC Total	106.64
121	0.55	1		Total Poss.	150
122	0.68	1		Pass Score	106

Simulator Examination

EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE	EXAMINATION ITEM #	MAC SCORE AVERAGE	TOTAL POSSIBLE
1	0.21	2	31	0.59	2
2	1.14	2	32	1.89	2
3	0.71	2	33	1.61	2
4	0.95	2	34	0.59	2
5	1.21	2	35	0.73	2
6	1.38	2	36	0.75	2
7	0.98	2	37	1.04	2
8	0.86	2	38	1.02	2
9	1.18	2	39	0.84	2
10	1.09	2	40	1.00	2
11	0.88	2	41	0.96	2
12	1.16	2	42	1.11	2
13	0.25	2	43	1.14	2
14	1.29	2	44	0.89	2
15	0.95	2	45	1.05	2
16	0.75	2			
17	0.09	2			
18	0.36	2			
19	1.23	2			
20	1.45	2			
21	1.11	2			
22	1.89	2			
23	0.05	2			
24	0.38	2			
25	0.75	2			
26	1.30	2			
27	1.41	2			
28	0.21	2		MAC Total	42.63
29	1.18	2		Total Poss.	90
30	1.02	2		Pass Score	42