

THE DEVELOPMENT OF A QUALIFICATION BOARD TO DOCUMENT ENGINEERING CADET PERFORMANCE AS PART OF A TRAINING PERIOD AT SEA

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Abstract. This paper describes the assessment review conducted by the Engineering faculty at Maine Maritime Academy (MMA) and the resulting decision to implement a process of a Qualification Board for junior engineering cadets. The pre-existing assessment methodology will be detailed and the process of developing and implementing the Qualification Board Process prior to and during the 2018 MMA Training Cruise will be described.

The use of a Board of Senior Officers to conduct a final review of a mariner's readiness for additional responsibilities has been a part of many Navy's officer qualification processes for hundreds of years. This paper will detail some of that history, as well as the methods used for cadet assessment by MMA through the 2017 Training Cruise conducted by the school. That process involved multiple methods of assessment and concluded with a final assessment day that included examinations, demonstrations, and completion of cruise and Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) checklists (check-offs). As part of MMA's continuous improvement process and surveys of both cadets and instructors, there was a general dissatisfaction concerning both the operation of this process and its efficacy in actually reflecting the cadet's knowledge and performance.

As a result, the overall assessment plan has been modified and, as part of this change, a final Qualification Board will be added for each junior engineering cadet. The details of this process will be discussed in the paper, but the Qualification Board will provide for a more structured and interactive final assessment, with clear methodologies and standards for successful completion. Additionally, the Qualification Boards replace the "Flashlight Examinations" which took place in the engine room and had limited effectiveness due to the test environment. This assessment will allow the cadet to demonstrate knowledge of the subject materials and skills, while also allowing evaluation, by multiple senior officers, of the cadet's maturity and performance during a stressful situation. The Qualification Board is expected, when combined with the other aspects of the

assessment program to be detailed in the paper, to provide a more complete and accurate assessment of each cadet’s readiness for his/her career.

Ninety-Six (96) Qualification Boards were conducted on the 2018 Summer Sea Term. The process evolved as the series of examinations occurred, using feedback from both faculty and cadets. Overall, the process fulfilled the goal to improve the overall assessment of junior engineering cadets. Specifics of the process and results will be detailed in the paper and conference presentation. This added assessment technique appears to have merit and likely would improve the assessment of practical skills and knowledge at any maritime university.

1 INTRODUCTION

There are a number of ways of assessing student performance, including examinations, observation of specific activities, and individually observed demonstration of specific skills or knowledge. When evaluating the performance of engineering cadets during the at-sea portion of their training to become professional mariners, there often have been questions regarding the efficacy of these assessments to measure their readiness for the merchant marine. This paper will highlight the assessment methods used to determine an engine cadet’s performance during the MMA Annual Training Cruise and the development and implementation of the new step of using Qualification Boards to improve that process. It is expected that other maritime universities have experienced similar issues and may find the Qualification Board development process and the actual board process itself valid for consideration as part of, and to improve, their student assessment programs.

2 EXISTING PERFORMANCE ASSESSMENT METHODOLOGY

Junior engineering cadets completing the course CE-303 – “Junior Cruise (Engineering)” during the 2017 summer sea session were assigned a course grade based on the following assessments:

- | | |
|-------------------------------------|-----------|
| 1. Quizzes | 15 Points |
| 2. Final Exam | 15 Points |
| 3. Plant Analysis Project | 15 Points |
| 4. Maintenance Performance | 6 Points |
| 5. Regimental Performance | 7 Points |
| 6. Watchstanding Performance + Test | 7 Points |
| 7. Flashlight Exam | 20 Points |
| 8. Systems Drawing | 10 Points |

During this course, junior engineering cadets were separated into four administrative companies. The companies then rotated through multiple iterations of four assignments: Watch, Ship Maintenance, Training, or Utility. For a watch assignment, the cadets stood two, four-hour watches in the engine room per day, supporting engine room operations. On a maintenance day, the cadets were assigned to one of the ship’s crew for an eight hour period supporting ship upkeep and repairs. During training, the cadets participated in up to eight hours of classroom

lectures, as well as demonstrations and practice of engineering activities, such as obtaining main engine firing pressures or disassembly and cleaning of an oil purifier. On utility, junior cadets worked with and supervised first-year cadets in general ship cleaning and upkeep activities for an eight hour shift.

During the training periods, the cadets were taught by MMA faculty and experienced engineers from industry. Topics covered included an in-depth review of training ship systems, as well as applicable industry topics such as high voltage power systems and the use of standard operating systems. Assessments were built into this training and included a daily written quiz on the prior training day's material.

Cadet assessment ended with a final training day just before the end of the cruise. This day included three major assessment tools:

1. A "Flashlight Exam." During this evaluation, cadets were randomly assigned to one of several areas of responsibility in the training ship engine room. They met there with an assigned faculty member and had to locate specified components, describe the operation of plant equipment, and answer questions regarding ship operations. This examination was typically conducted over a 20 to 25 minute period for each cadet and five parallel evaluations were conducted at a time in different areas of the engine room. The noisy environment limited cadet-faculty interaction and often caused confusion and lack of clarity during communications.
2. A System Drawing. Each cadet was required to create a one line diagram of a specified ship system drawn from a list of six systems.
3. A Final Examination. An examination over the topics covered during the cadet's training days. The test typically consisted of 3-5 multiple choice questions over each subject area included in the Training curriculum for the at-sea period.

The total weighting of these assessments factored as 45% of the cadet's overall cruise grade.

While this program of final assessment had been in place for several years, both the students and faculty had begun to realize that this program could be improved. During the 2017 at-sea training period, 31 junior engineering cadets drafted and submitted a letter to the training staff indicating dissatisfaction with the current program evaluation process. Among other points, they stated that "We do not feel that the existing training program does a great job of accurately assessing our knowledge of this vessel." This feedback was one of the final pieces of input to support the action to conduct a major revision to the assessment methods for the at-sea session and CE-303.

3 ISSUES WITH EXISTING ASSESSMENT METHODOLOGY

The existing training and assessment program had evolved over several years and certain aspects of the program had been normalized in ways that resulted in a reduced effectiveness in student learning and assessment of that learning. In some cases, course material had devolved to "teaching to the test" and in other instances, students would focus on the testable material almost to the exclusion of general knowledge and understanding of ship systems and good operational

practices. In fact, one of the chief complaints in the student letter mentioned above was that “The part that we feel needs to be changed is the memorizing of plant schematics.” This was contrary to the actual teaching practices, and how the ship systems were introduced, which clearly stated that overall understanding of the system was expected, that the cadets were expected to trace each assigned system, and that a system sketch was only one part of the evaluation. From the student’s perspective, this had devolved to a requirement to memorize a system sketch which had become available via their predecessors. Significant cadet time was spent memorizing the drawings, in some cases with minimal understanding of the actual system in the engine room. Additionally, the “Flashlight Examinations” which took place in the engine room had limited effectiveness due to the test environment. This often caused confusion and limited the ability of faculty to provide effective feedback and corrections during the examination.

4 ASSESSMENT METHODOLOGY CHANGES CONSIDERED

The Engineering Faculty, as part of the school’s continuous improvement program, meet at the conclusion of each at-sea period to conduct an after action review of that year’s session. In 2017, the result of that review concluded that changes should be made to the assessment program. Key items considered included:

1. How to increase student engagement, especially to foster “buy in” to the at-sea session as an overall learning experience.
2. How to better capture student activities during the at-sea session to increase the faculty’s understanding of what students were actually doing when they were not in Training.
3. How to best assess the competence of these Cadets who were within one year of reporting to a ship as a Junior Officer.

In order to address the observed weaknesses in the existing program, the faculty considered several changes to the assessment process:

1. Developing a way to capture student actions and understanding and including an evaluation of these data in the overall assessment process.
2. Providing assessment methods where the process evolved from a “snapshot” of the student’s capabilities at a point in time and included the ability to correct and guide the students during the assessment process.

Complicating this evaluation was a change to the overall at-sea training program which resulted in junior engineering cadets participating in a 35-day 2018 cruise rather than the prior year’s 45-day period.

5 PLANNED ASSESSMENT METHODOLOGY CHANGES

After some consideration and discussion, the Engineering Faculty, determined that, as a first step, two major assessment changes would be implemented:

1. Junior engineering cadets will be required to maintain a Cruise Journal. This physical record of their at-sea training will be used for both periodic and final assessment as described below.

2. A Qualification Board will be put in place to replace the “Flashlight Exam” and the system sketch. The rationale for this change and the proposed process are described below.

An additional key factor to successfully implement these changes is the support of the training ship’s crew, especially the watch standers in the engine room.

6 THE CADET ENGINEERING JOURNAL

To provide a standard basis for evaluating student actions, a daily cruise journal was implemented. Students were required to purchase a blank (6” X 9”) journal book from the MMA bookstore and were provided with guidance on journal entries, as well as examples of a typical day’s entries for each of the different assigned activity days. The guidance details included:

1. “Start each day’s record on a new right-hand page, with the day of the week, date and your company’s assignment(s) for the day (Utility, Training, Watch, or Maintenance.
2. As you record activities, you can continue onto the backside of each page and/or additional pages as necessary, but start each new day on the next blank right-hand page.
3. Throughout the day and/or watch, record major activities. The entries should be written in past tense, documenting the time each event started to fully document the day’s Cruise actions.”

The journal write-ups will be a key part of the assessment for Watch and Maintenance Grades, as well as forming the basis for discussion during the Cruise Qualification Boards. The completed journal will be turned in to the Senior Engineering Training Officer by 1630 the day before each company’s last day, and will be used as part of the Cruise Qualification Board. A properly completed journal must be turned in to meet course requirements.

7 THE QUALIFICATION BOARD

The use of a board of senior officers to conduct a final review of a mariner’s readiness for additional responsibilities has been a part of many Navy’s officer qualification processes for hundreds of years. For example, beginning in the 17th century, Great Britain’s Royal Navy required all Lieutenants to pass a Navigation examination conducted by a board of senior officers. Additionally, as a more current example, during a typical United States Navy deployment period, the USS Crommelin conducted qualification boards for the Engineering Officer of the Watch, Command Duty Officer, and Surface Warfare Officer positions.

This evaluation was often the final assessment before an officer was allowed to independently stand watch and assume the full responsibilities of his/her position. The process has been found to be an effective assessment, in that it provides for a more interactive evaluation of the candidate’s understanding and preparedness for the role and allows the reviewing officers to teach and guide, as well as determine the final readiness for the position for whichever qualification was being assessed.

In adapting the process for engineering cadets, MMA faculty integrated the formal board with the use of the cruise journal to attempt to better capture the students’ status relative to course and

program requirements, as well as their preparedness for the role of professional mariner. The general guidelines for the Board were established as follows:

1. The board will be composed of three engineering training officers or members of the ship's crew.
2. The duration of the board will be limited to 20 minutes.
3. Cadets will be assessed over these items:
 - A. A ship system - Its Purpose/Functions, Key Operating Parameters, Operation of Key Equipment, and will include a system one-line diagram sketch (Major Flow Path only) drawn on the Classroom Board.
 - B. Any of the Cruise or Standards for Training Certification and Watchkeeping (STCW) Check-offs
 - C. Proper Watchstanding and Operations Practices
 - D. Topics of Interest from the cadet's Cruise Journal.
 - E. The Cruise Power Plant Project, oriented to key topics rather than on detailed calculations.
 - F. Other topics as determined by the Examining Officers.

The three examining officers will direct questions to the cadet following these basic guidelines, but may expand or re-visit any topic depending on the cadet's previous answers. Officers will record their evaluation of the cadet's performance on a provided grading sheet and issue a letter grade for the board based on the following metric:

1. The board will use the following metric in assigning Board Results as a letter grade (+/- Grades are allowed):
 - A. Cadet was outstanding. System description and sketch demonstrated clear understanding of the machinery and operation of the system. Cadet clearly demonstrated the Cruise/STCW Check-off skills or knowledge assessed by the Board. Cadet spoke clearly, provided timely answers, made eye contact and was confident in her/his responses to the Board's questions.
 - B. Cadet was very good. System description and sketch demonstrated good understanding of the machinery and operation of the system. Cadet demonstrated, with minimal prompting from the Board members, the Cruise/STCW Check-off skills or knowledge assessed by the Board. In general, the cadet spoke clearly, made eye contact and was confident in her/his responses to the Board's questions.
 - C. Cadet responses were adequate. System description and sketch demonstrated basic understanding of the machinery and operation of the system. Cadet demonstrated, with some prompting or guidance from the Board, the Cruise/STCW Check-off skills or knowledge assessed by the Board. For most of the board's duration, the cadet spoke clearly, made eye contact and was confident in her/his responses to the Board's questions.

F. Cadet did not meet standards. System description and sketch did not demonstrate basic understanding of the machinery and operation of the system. Cadet could not demonstrate the Cruise/STCW Check-off skills or knowledge assessed by the Board. The cadet did not speak clearly, avoided eye contact, and was not confident in her/his responses to the Board's questions, even with significant prompting and clarifying questions or comments from the Board.

Should the student performance warrant a lower grade, board officers may assign a numeric grade below 65%.

2. The three officer grades will be averaged and a final board grade will be assigned for each cadet. The use of three separate perspectives should decrease the variability between the assessments and will result in a grade that more accurately captures actual student performance.
3. This assessment will allow the cadet to demonstrate knowledge of the subject materials and skills, while also allowing evaluation, by multiple senior officers, of the cadet's maturity and performance during a stressful situation.

Prior to starting this process, all Training Officers will receive an overview of the process and review expectations and guidelines for their conduct during the board and how results will be compiled and recorded. Additionally, a mock qualification board will be conducted for each company of cadets so that they can understand the format of the evaluation and ask questions about the process before their actual session. Each student will be assigned a specific time and place for their board session and it is expected that, with two boards proceeding in parallel, each company's boards will be completed in less than three hours. The four mornings of qualification boards, one for each cadet company, will take place as close to the completion of the at-sea period as possible.

8 REVISED COURSE ASSESSMENT

With the implementation of the cruise journal and qualification board, the grade for the 2018 session of CE-303 will be determined using the following assessments:

Evaluation:

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|------------------------------|----------------------|
| 1. Quizzes | 10 Points |
| 2. Final Exam | 10 Points |
| 3. Plant Analysis Project | 15 Points |
| 4. Maintenance Performance | 15 Points |
| 5. Regimental Performance | 10 Points |
| 6. Watchstanding Performance | 15 Points |
| 7. Qualification Board | 20 Points |
| 8. Cruise Journal | 5 Points & Pass/Fail |

The expected result of these changes is a better understanding of each student's readiness for his/her career and a grade for the course that more accurately reflects that actual condition.

9 RESULTS OF THE MODIFICATION TO THE ASSESSMENT PROCESS

Ninety-Six (96) Qualification Boards were conducted on the 2018 Summer Sea Term. Prior to the Final Assessment Day, a “Mock Board” was conducted with a volunteer cadet and cadets were able to observe the process and ask questions regarding the scope and methods. Several of these “Mock Boards” were recorded as video and these videos were made available to the cadets on the ship’s server. The process evolved as the series of examinations occurred, using feedback from both faculty and cadets. Specifically, it was determined that, unlike a traditional Qualification Board, where the cadet would be evaluated as meeting or not meeting the Board requirements, in order to assign a numerical grade, each question asked would be assigned a grade. The question grades were then averaged to determine a grade for the Qualification Board. The average grade for the Qualification Boards was a C+ and the grade distribution exhibited the expected range, with several outstanding performances and a smaller number of students not performing well. Additionally, the use of Cruise Journals provided significant insights into cadet activities, especially their actions outside of scheduled Training days. It is expected that, with this data, additional changes may be made to the overall sea session to improve the cadet experience. Overall, the process met faculty expectations and fulfilled the goal to improve the assessment of junior engineering cadets. Additional specifics of the process and results will be detailed in the conference presentation.

10 CONCLUSION

This paper has described the issues with student assessment on prior MMA at-sea sessions, the review conducted to develop and implement improvements to the process, and provided the specific details, expectations and results of the changes implemented on the 2018 Training Cruise. The new assessment methods, including the use of a final Qualification Board, appear to have allowed for a more accurate and complete assessment of student capabilities and outcomes. The processes described was implemented during the 2018 at-sea session and additional results will be described during the presentation of this paper in October 2018. This added assessment technique appears to have merit and likely would improve the assessment of practical skills and knowledge at any maritime university.

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