

Tower Crane Operator Job Analysis Report

Prepared for the
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Tower Crane Operator

Job Analysis Report

This Job Analysis was conducted in accordance with the 1999 revision of the *Standards for Educational and Psychological Testing* (American Educational Research Association, the National Council on Measurement in Education and the American Psychological Association). The *Standards* emphasize the concept of content validity and state that the evidence should include a description of the major job characteristics that the test is meant to sample, including the relative frequency, importance and criticality of the elements. The job analysis is used to ensure that the knowledge assessed in credentialing initiatives is in fact limited to those required for competent performance and serve a public protection function. Job analysis becomes the primary basis by which a credentialing agency establishes and defends the content validity of its credentialing requirements.

SME Training

The first meeting of the Job Analysis Task Force was held on February 21 - 23, 2003, in Birmingham, Alabama. The initial activity was a presentation by Anthony W. Mitchell, Ph.D. of International Assessment Institute. The presentation covered the important role job analysis plays in the examination development process, the concept of content validity and the methodology which would be followed in conducting the job analysis. The SME's discussed the scope of the job analysis that would be conducted and undertook training in the job analysis process.

Content Domains and Knowledge, Skill and Ability Statements

One of the initial challenges the Task Force had to deal with was the extent to which different skills are required of a tower crane operator depending on the specific types of tower cranes being operated. In other words, would the certification program need to include any specialty examinations for specific types of tower cranes. The group identified major types of tower cranes and their various configurations such as:

- § Fixed Tower Cranes
- § Top Slewing Tower Cranes
- § Bottom Slewing Tower Cranes
- § Self-Erecting
- § Hammerhead
- § Telescopic Tower Types
- § Inter-Outer Tower Types
- § Mono Tower Types
- § Saddle-Jib
- § Luffing Jib (Front Pivot)
- § Luffing Jib(Rear Pivot)
- § Fixed Luff Jib

After considerable discussion, the Task Force determined that all tower crane configurations could be dealt with as a single category with one exception, self-erecting cranes. The Task Force decided that "site" issues on self-erecting cranes could be handled through written examination questions that would be identified as specifically relating only to self-erecting cranes.

The Task Force members were asked to identify the major content domains within which the various tasks and KSA's could be grouped. Task Force members were asked to consider typical jobs and the sequence in which tasks were performed when conducting these jobs. The following content domains were established:

- § Site
- § Erection, Climbing and Dismantling
- § Operations
- § Technical Knowledge

SME's were then asked to identify and list both the individual tasks as well as the knowledge, skills and abilities (KSA's) required of a tower crane operator to perform those tasks. Each group compiled a list of tasks and KSA's and then reported back to the full Task Force. The full Task Force discussed, debated and deliberated on each KSA statement in an attempt to reach consensus.

The Task Force used the same process to determine the demographic information that would be gathered and to prepare the instructions to survey recipients.

Survey Instrument

The survey instrument was prepared by IAI based on the decisions made by the Task Force. The Task Force decided that because of the nature of the crane operation industry, the survey should be prepared using KSA statements rather than task statements. It was reviewed at the second meeting on June 17th -19th, 2003 in Dayton, New Jersey by the SME's to ensure that all of the recommended changes and modifications had been included.

A job analysis survey instrument is typically pilot tested to make sure that the instructions and the task, knowledge, skill or ability statements are clearly stated, and easily understood. However, given the similarity of the tower crane job analysis survey instrument to the original mobile crane survey instrument and given the extensive input from the SME's, it was determined that it was unnecessary to pilot the survey beyond that of the Task Force members.

The approved survey forms were then printed and prepared for distribution. A copy of the survey form is attached as Exhibit #1.

Survey Distribution

Task Force members discussed the size of the survey sample and how best to obtain a satisfactory response level, because of the difficulty in mailing directly to crane operators. It was agreed that the most effective approach would be to mail surveys to Task Force members who would then distribute the survey to tower crane operators. Three hundred (300) survey responses were sent out through the Task Force members. In addition, one hundred and fifty (150) surveys were mailed to CCO test sites. Test site coordinators were instructed to invite mobile crane operators who also work on tower cranes to complete the survey. The survey was also placed on the NCCCO website. A total of eighty-nine responses were received.

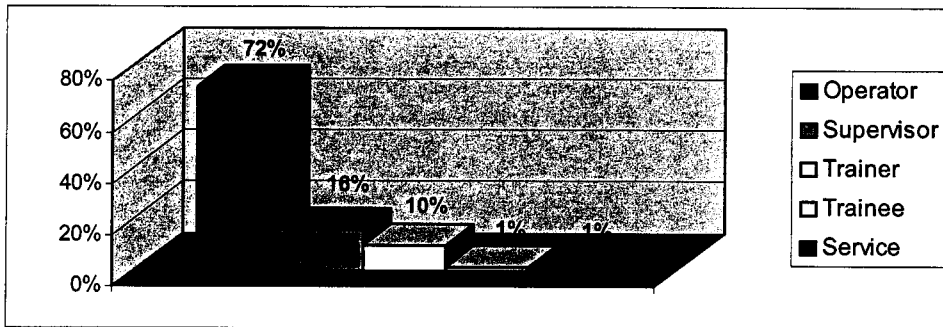
In October 2003, a preliminary statistical report was prepared by International Assessment Institute and presented to the Task Force. The number of respondents at that time was fifty-six (56). The Task Force used that information to move forward with the development process, recognizing that as additional survey responses were received, there might be some changes to the importance, frequency and criticality findings. Updates on the job analysis were presented to the Task Force at each subsequent meeting.

When the final survey results were disseminated, the Task Force also received a document comparing the earlier results with the final results. This allowed the Task Force to assess the significance of the changes and factor them into their deliberations. As of March 1, 2004, eighty-seven (87) surveys had been returned and are included in the final statistical analysis. Tabulation of the importance, frequency and criticality scores on each of the KSA statements was undertaken. The demographic information provided by the respondents was also tabulated and analyzed.

Survey Respondents - Demographic Information

A review of the demographic information derived from survey respondents demonstrates that a cross section of the tower crane industry is represented in the survey results.

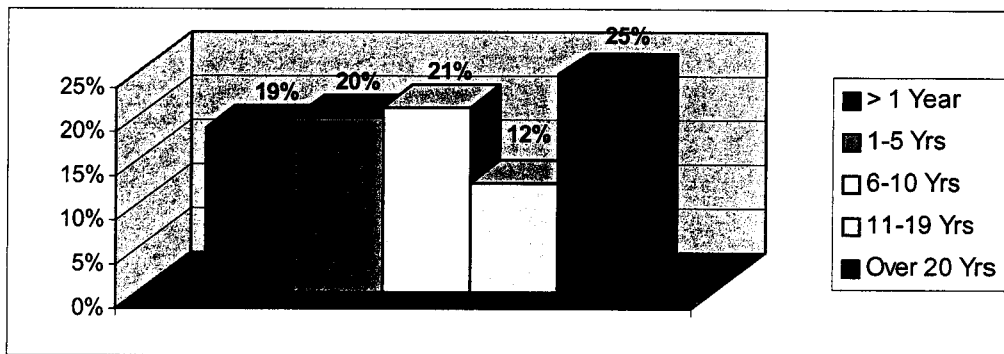
Job Description



Among the survey respondents 72% identified themselves as tower crane operators. Twenty-six percent (26%) were either trainers or supervisors.

Years of Experience

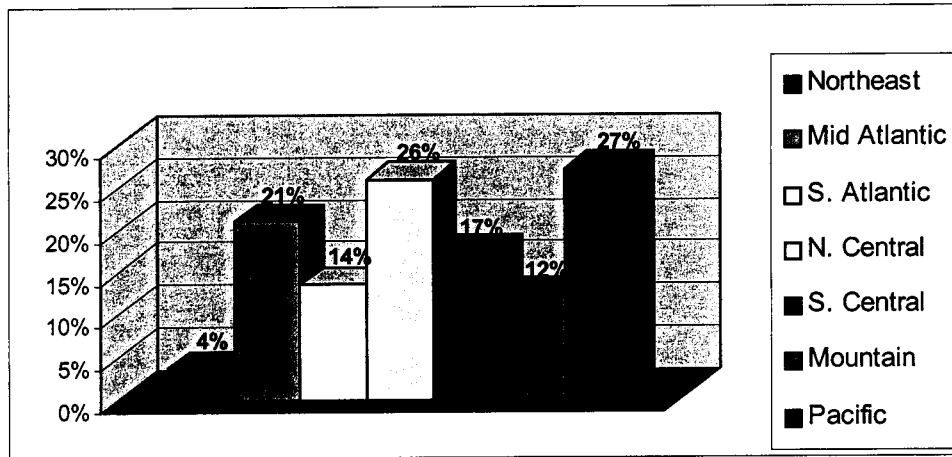
Survey respondents represented a wide range of experience as tower crane operators with 19%



having less than one year experience and 25% having more than 20 years experience.

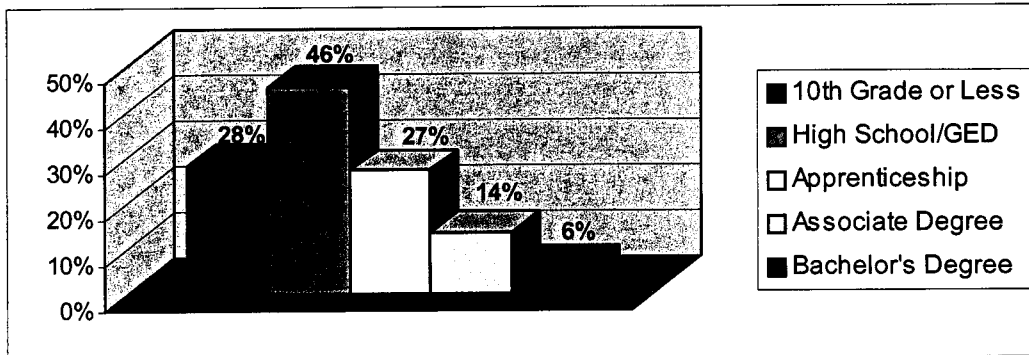
Geographic Locations

Survey respondents were asked to identify the geographical regions in which they operate cranes. All geographical regions were represented.



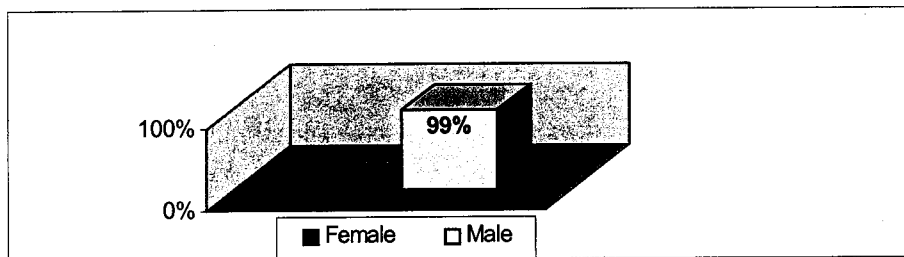
Education Level

The educational level of the Survey respondents was predominately High School/GED completion forty-six percent (46%). Twenty percent (20%) had completed an Associate or Bachelors degree.



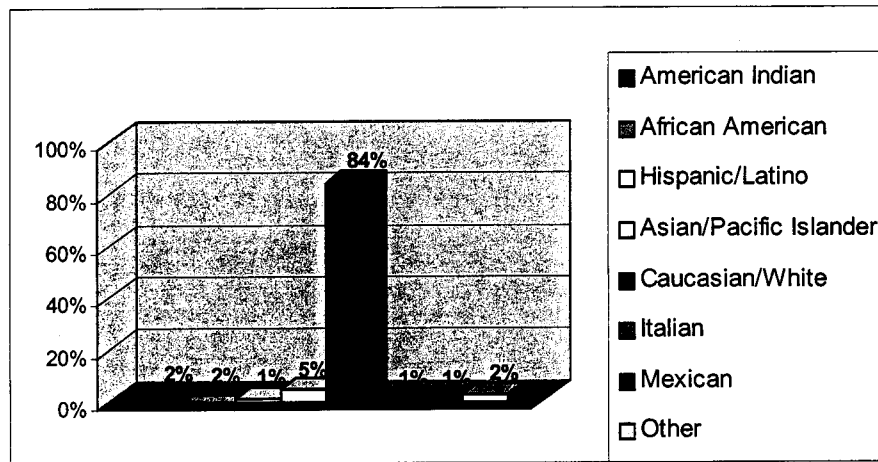
Gender

Gender representation was in line with expectations in the tower crane industry with 99% of respondents, males and 1% females.



Racial/Ethnic Background

In terms of racial or ethnic background, 84% of the respondents identified themselves as Caucasian/White. All minority groups were represented.



Job Analysis Survey Results

The knowledge, skill and ability (KSA) statements were presented in the survey in four (4) content domains:

- § (1) Site,
- § (2) Erection, Climbing, Dismantling
- § (3) Operations,
- § (4) Technical Knowledge.

Respondents were asked to identify the importance of each of the knowledge, skill or ability statements. In the survey instrument, Importance was described at four (4) levels:

1. Not Important - a lack of knowledge is unlikely to lead to accident or work disruption or a delaying of leaving work.
2. Somewhat Important - a lack of knowledge could lead to minor accident resulting in a work disruption or delay in completing the work.
3. Quite Important - a lack of knowledge could lead to a serious accident resulting in personal injuries or property damage.
4. Very Important - a lack of knowledge could lead to a serious accident resulting in a fatality or major property damage.

Respondents' were asked to circle 1, 2, 3, or 4 based upon their expert judgment regarding the importance of each of the knowledge, skill or ability task statements.

In the survey instrument, Frequency was also described at four (4) levels:

1. Almost Never - maybe once a year.
2. Sometimes - at least monthly.
3. Quite Frequently - at least weekly.
4. Very Frequently - just about every day.

Respondents' were asked to circle 1, 2, 3, or 4 based upon their expert judgment regarding the frequency with which each of the knowledge, skill or ability task statements is utilized in the job setting.

The following graphic shows the tower crane survey results in terms of each of the knowledge or skill statements and the number of respondents who selected 1, 2, 3, and 4. For calculation purposes, the 1, 2, 3, 4 was subsequently changed to 0, 1, 2, 3 so that tasks or KSA's that were judged to be "not important" or had a frequency of "almost never" had no value assigned to them.

	Importance				Frequency				Criticality
	Total Number for each level of Importance				Total Number for each level of Importance				
	0	1	2	3	0	1	2	3	
1. Site									
K1.1	2	10	11	64	9	21	27	30	
	0	10	22	192	0	21	54	90	
				224				165	
		Mean	2.57		Mean	1.90			7.05

The number of respondents selecting a given number was multiplied by that numeric value, i.e., 0,1,2, or 3 to derive a total number for importance. This number was then divided by the total number of respondents who completed that statement to derive the mean score for each knowledge, skill or ability statement. The same process took place in terms of the frequency statements. A criticality rating was then derived by taking two times the importance plus the frequency to arrive at a criticality rating. For Example:

$$\text{Importance} \times 2 + \text{Frequency} = \text{Criticality}$$

$$2.57 \times 2 + 1.90 = 7.05$$

Exhibit #2 contains the raw statistics for each KSA statement. Exhibit #3 shows the same importance, frequency and criticality scores along with the task or KSA statements used on the survey.

The range of criticality scores was from a low of 5.48 to a high of 8.34. The Task Force discussed eliminating these tasks or KSA statements that fell below a given criticality score, but decided that all of the task/KSA statements were important enough to be included in the content outline.

Development of the Content Outline and Examination Specifications

During the process of reviewing the KSA statements and their respective criticality scores, the Task Force spent considerable time revising the individual KSA statements. Some statements were eliminated, others were merged and a number were edited to clarify the meaning.

The result of this activity was the following content outline divided into the four content domains; Site, Erecting, Climbing and Dismantling, Operations/Load Chart and Technical Knowledge.

The SME's discussed the length of the examination. That is, how many questions needed to be asked to adequately sample the four content domains and the various knowledge areas covered in the four content domains. The SME's decided that a fifty (50) item examination would meet these needs. Using the information derived from the survey, the SME's determined the number of questions that should be written for each content area and for each KSA statement. The following chart shows this information.

Domain 1:	Site	10%	of the exam =	5	Questions
Domain 2:	Erecting, Climbing, Dismantling	25%	of the exam =	12	Questions
Domain 3:	Operations/5 Load Chart	50%	of the exam =	25	Questions
Domain 4:	Technical Knowledge	15%	of the exam =	8	Questions

The SME's discussed the issue of time allowed to take the test and settled on a one hour time limit. The Task Force approved the following content outline.

Tower Crane Written Exam Outline

The Tower Crane written examination certification program tests the following knowledge areas relating to the operation of tower cranes.

Domain 1: Site - *(Approximately 10% of Test)*

Domain 2: Erection, Climbing, and Dismantling - *(Approximately 25% of Test)*

Domain 3: Operations - *(Approximately 50% of Test)*

Domain 4: Technical Knowledge - *(Approximately 15% of Test)*

1. Site - *(Approximately 10% of Test)*

1. Know how to assess suitability of the supporting surface. *
2. Know how to determine if there is adequate room for outriggers and tail swing.*
3. Know how to locate and identify site hazards and restrictions such as electric powerlines, air-rights, or other hazardous systems and public access areas.
4. Be familiar with basic requirements for power sources, fusing, disconnects, lightning protection, and grounding.
5. Be familiar with the necessity to protect the crane's foundation.

*** 1 and 2 only refers to Self-Erecting Cranes**

2. Erection, Climbing, and Dismantling - *(Approximately 25% of Test)*

1. Know proper erection, climbing, and dismantling procedures specified by the manufacturer in the operator's manual.
2. Know general notes and warnings to be applied during climbing procedures.
3. Know the maximum allowable wind speeds during erection, climbing, dismantling, and operation.
4. Understand the proper procedures for bolting and/or pinning connections.
5. Understand the maximum freestanding height allowed.
6. Understand the proper counterweight configurations and/or central ballast requirements.
7. Understand the proper crane configuration.

8. Be familiar with standard minimum and maximum tie-in spacing and maximum tower height above tie-ins.
9. Be familiar with proper installation of internal climbing collars, support beams, wedges and climbing apparatus.
10. Be familiar with proper installation of top climbing units and tie-in collars, struts, and lower braces.
11. Know proper position of top climbing unit after climbing procedures in accordance with manufacturer's specifications.
12. Be familiar with proper travel rail installation and maintenance.

3. Operations - (Approximately 50% of Test)

1. Know how to inspect the crane for proper condition and complete required records.
2. Know how and when to communicate with management, crew, and signal person.
3. Know standard hand signals as specified in ASME B30.3.
4. Know how to shut down and secure the crane properly when leaving it unattended.
5. Know the manufacturer's recommendations for operating in various weather conditions.
6. Know how to verify the weight of the load and the rigging.
7. Understand basic load rigging procedures.
8. Know how to perform the basic maintenance.
9. Know the Crane Operator responsibilities contained in ASME B30.3.
10. Know how to use operator aids and limiting devices.
11. Know the proper procedures for operating safely under special conditions: i.e., traveling with suspended loads; approaching two-blocking; operating near electric power lines; lifting loads from beneath the surface of the water; handling loads out of the operator's vision ("in the blind"), and suspended personnel platforms.
12. Know the proper procedures for load control during the use of hand held tag lines.
13. Know emergency response procedures: i.e., fire control, electric power line contact, and control malfunction.

14. Understand federal, state, and local regulations and ASME B30.3 regulations pertaining to the operation of the crane.
15. Know how to review planned crane operations and requirements with site supervision.
16. Understand Tower crane load charts.

4. Technical Knowledge - (Approximately 15% of Test)

1. Understand the function, limitations, and characteristics of the crane.
2. Know the basic maintenance, inspection and replacement criteria for tower crane wire ropes.
3. Know basic tower crane nomenclature.
5. Understand basic machine power flow systems: i.e., mechanical, electrical, hydraulic, combination.
6. Understand boom, jib, counter jib, and counterweight configurations.
7. Know the "out of plumb" tolerance for the tower crane.
8. Basic understanding of metric units/US customary units.
9. Understand basic safety procedures. e.g. lock out, tag out, fall protection.