

MITRE

**Requirements for a  
Software Chief Engineer  
for a Weapons Systems Acquisition**

**Conference on  
the Acquisition of Software Intensive  
Systems**

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AI Florence  
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- Qualification Areas

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Proposals	Life Cycle
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## Introduction

- A large weapons systems project had a need for a Chief Software Engineer at the program office to oversee and manage the software development effort of several contractors.
- The project was incrementally being developed with current increment in the design phase while a request for proposal was being developed for the next increment.
- The applications have critical real-time embedded command, control, and communications software with many interfaces to other DoD systems.
- The agency asked this author to construct a list of the required experience and skills that this Chief Engineer should have and to support the selection.



## Introduction (concluded)

- This position is critical to the success of the weapons systems' mission.
- Software is key in this success; if software does not work, the mission fails.
- Software is an area that traditionally has not received the attention that it deserves.
- In order for software to meet mission requirements it needs to be of high quality and maintainable, developed within cost and schedule, and managed at the highest professional and technical levels.
- The Project Office Software Chief Engineer responsible for this has to have the appropriate education, experience and skills at the highest possible levels.
- The contents of this presentation can be used:
  - In other organizations looking to hire a Chief Software Engineer.
  - To increase skills of Software Engineers in the Project Office through training.

## Qualification Areas

- This position requires expertise in multiple areas of software development, including technical, acquisition, and management throughout the entire life cycle.
- It is recognized that it would be difficult to find the ideal candidate.
  - A selection methodology is included to guide the selection of the best possible candidate.
  - Gaps in the qualification areas can be augmented with other individuals in the program office.
- The following foils present these qualification areas and describes their appropriate attributes for this position.
- In all cases, the experience is relative to software-intensive systems, preferably embedded and real-time.

## Education (Qualification Area)

- A degree in a technical discipline (engineering, computer science) is critical. An advanced degree (MS or Ph.D.) is advantageous.
- Additional training in related fields is a benefit (such as acquisition, networks, radar, etc.).
- Training in specific domain-applicable technologies is also a benefit.
- Education should be viewed with and tempered with the experience related to the listed qualification areas.

# Years Experience

## (Qualification Area)

- Experience in large software intensive development efforts especially for:
  - real-time, embedded, critical weapons systems with many interfacing subsystems with multiple contractors.
- Experience in the listed qualification areas is also viewed as important.

# Management (Qualification Area)

- Experience in project management for a software intensive system, preferably across the full life cycle.
- Project management, program management, software management, and supervision should be considered.

## **Proposal Development / Evaluation (Qualification Area)**

- Experience in developing proposals from the contractor side.
- Experience in writing Requests for Proposal (RFP) and Statements-of Work (SOW).
- Experience in evaluating proposals and performing source selection.

# Planning (Qualification Area)

- Experience in planning life cycle activities, schedules, and resources for software intensive development efforts from both a development and acquisition point-of-view.
- Planning should include developing and evaluating plans for conducting the activities related to the listed qualification areas.

# Requirements (Qualification Area)

- Knowledge of the nature and role of requirements in software intensive systems.
- Experience in gathering user needs, translating them into technical and programmatic requirements, specifying, verifying, validating and allocating them to lower levels of abstraction.
- Experience in management of the requirements throughout their entire life cycle.

## Design (Qualification Area)

- Knowledge of software design techniques and tools.
- Experience in the design of software intensive systems from:
  - conceptual design,
  - to high level architecture,
  - to preliminary design,
  - to detailed design.
- Ability to review contractor proposed and developed design architectures.

# Implementation

## (Qualification Area)

- Knowledge of key programming languages (applicable to the domain in question).
- Experience in:
  - coding software solutions,
  - debugging,
  - integrating software modules.
- Ability to review contractors' implemented code.

# Test

## (Qualification Area)

- Knowledge of software testing techniques and tools.
- Experience in the formal and informal testing of software intensive systems, ranging from:
  - unit testing,
  - integration testing,
  - formal qualification testing (FQT),
  - system integration tests,
  - system acceptance tests,
  - certification tests.
- Experience in the development of test plans, test descriptions, and test reports, and the execution of the tests.

# Quality Assurance

## (Qualification Area)

- Knowledge of software quality assurance activities, tools, and techniques.
- Experience in establishing and conducting quality assurance activities for large software programs, with a focus on ensuring that the:
  - processes,
  - procedures,
  - standards

that are used on the project are followed as defined.

# Configuration Management (Qualification Area)

- Experience in establishing and conducting configuration management activities for large software programs.
- Experience in baselining requirements and managing changes to them.
- Experience in serving on configuration control boards.

# Risk Management

## (Qualification Area)

- Knowledge of risk management concepts.
- Experience in establishing and conducting risk management activities for software intensive programs, including:
  - the identification of project risks,
  - prioritizing them,
  - and the development and execution of mitigation plans and/or alternatives (contingencies).

## Metrics (Qualification Area)

- Knowledge of metrics definition and application.
- Experience in the:
  - definition of metrics,
  - collection of measurements on activities and products,
  - analysis of resulting metrics,
  - actions taken based on the analysis,
  - the reporting of the resulting findings.

## **Life Cycle (Qualification Area)**

- Knowledge of life cycle models for software development, including incremental, evolutionary, and spiral.
- Experience in defining and managing a software intensive system all the way through its life cycle, from operational concept through deployment and retirement.

# System Engineering

## (Qualification Area)

- Knowledge of systems engineering practices and processes for software intensive systems.
- Experience in defining and applying a software engineering process within a systems engineering process.

## Acquisition (Qualification Area)

- Experience in the acquisition of software intensive systems.
- Application of the listed qualification areas from an acquisition perspective.
- Sponsor specific acquisition process.
- The ability to influence others in the importance and proper application of these qualification areas, both at the contractor and program office level, are of extreme importance.

## **Standards (Qualification Area)**

- Knowledge of and experience in the selection and application of commercial and DoD standards to complex software-intensive systems.
- Knowledge of the role of standards in the design and development of large software-intensive systems.
- Knowledge of sponsor specific standards for architecture, development, management.

# Process Improvement (Qualification Area)

- Knowledge of the Software Engineering Institute's (SEI) Software and Software Acquisition CMMs.®
- Experience in measurement of process effectiveness.
- Experience in improvement of process and procedures that are followed during:
  - acquisition,
  - development,
  - operationof software intensive systems.

## Writing Skills (Qualification Area)

- The ability to write both technical and programmatic:
  - reports,
  - briefings,
  - documents,
  - plans,
  - white papers, etc.in a clear, understandable and concise fashion.

## **Communication Skills (Qualification Area)**

- The ability to communicate with management and technical individuals in a clear, understandable and concise fashion.
- The ability to act as a negotiator between the contractor and acquisition organization.

# Interviewing

- Prior to starting the interview the nature of the project and the position should be explained to the candidate.
- The organization and project should be explained in a fashion that entices the candidate to want to accept an offer.
- The importance of the position to the success of the mission should be emphasized.
- For each area the following questions should be asked as a minimum:
  - Would you please describe your experience related to (qualification area)
    - How much of this experience is on a contractor development effort?
    - How much of this experience is on an acquisition effort?
- Answers to these and other questions may influence what additional questions need to be asked for that area or other areas.

## Interviewing (concluded)

- If the candidate does not provide the needed information, additional questions can be asked in an attempt to elicit the information.
- Interview notes should include personal style; is the candidate:
  - arrogant or personable, poised or rattled?
  - these are subjective impressions that can still be important to the interpersonal aspects of his/her job.
- Additionally, one may ask the candidate to provide samples of work/papers written.
- All candidates should be ranked against each other in relation to each qualification area.
- At least two interviewers should interview each candidate to arrive at objective evaluations.
- The following foils present a methodology (an example) to guide in the selection of the best possible candidate.

# Candidate Evaluation - Example

Qualification Area	Weight	Candidate 1		Candidate 2		Candidate 3		Candidate 4	
		Rank	Score	Rank	Score	Rank	Score	Rank	Score
Education	6	5	30	6	36	2	12	8	48
Years Experience	7	6	42	9	63	7	49	6	42
Project Management	8	8	64	6	48	5	40	8	64
Proposals	7	4	28	6	42	5	35	7	49
Planning	8	3	24	6	48	7	56	4	32
Requirements	9	6	54	9	81	6	54	7	63
Design	5	6	30	8	40	5	25	9	45
Implementation	4	8	32	7	28	6	24	5	20
Test	7	6	42	8	56	5	35	4	28
Quality Assurance	6	7	42	6	36	8	48	6	36
Configuration Management	6	4	24	8	48	9	54	7	42
Risk Management	8	5	40	6	48	4	32	7	56
Metrics	6	6	36	7	42	7	42	9	54
Life Cycle	7	5	35	7	49	5	35	7	49
Systems Engineering	8	6	48	3	24	7	56	5	40
Acquisition	10	7	70	5	50	9	90	5	50
Standards	7	4	28	6	42	9	63	7	49
Process Improvement	9	6	54	5	45	7	63	8	72
Writing Skills	7	5	35	7	49	8	56	9	63
Communication Skills	8	6	48	6	48	7	56	7	56
<b>Total Score</b>			<b>806</b>		<b>923</b>		<b>925</b>		<b>958</b>

## Candidate Evaluation (continued)

- The weight of each qualification area indicates the importance of a particular qualification area in relation to all other qualification areas and depends on the needs of the organization.
  - Weights need to be agreed on by at least two individuals to be objective (could be management of the interviewers).
- The rank of each individual is determined by at least two interviewers to be objective.
- The score is the product of the weight and the rank.
- The total score is the sum of all scores.

## Candidate Evaluation (concluded)

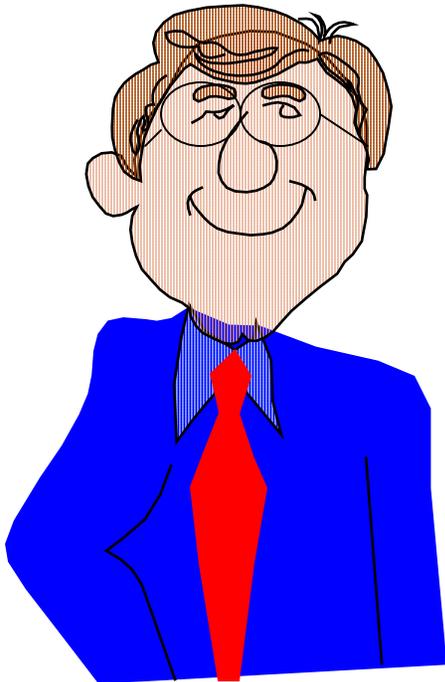
- The best candidate should not automatically receive a 10, experience and skills against the area should be the major consideration.
- The total score is the sum of all area scores which are the product of area weight and candidates rank for that area.
- The maximum total score is 1430.
- Any candidate receiving less than 50%, 715, should not be considered.
- If no candidates receive at least 50%, a new round of interviews should be conducted.
- When scores are close, a judgement call may be necessary.
- Interview notes on personal style and samples of work can be used to eliminate candidates or to select from among those with close high scores.

## Summary

- A large complex weapons systems acquisition effort should have an experienced software chief engineer to support the effort; the experience should span the spectrum of:
  - Program/Project Management
  - Software Engineering
  - System Engineering
  - Test Engineering
  - Quality Assurance
  - Configuration Management
  - Risk Analysis
  - Metric Analysis
  - Life Cycle Activities
  - Process Engineering
- This experience should cover both supplier development efforts and acquirer acquisition efforts.
- This criteria was successfully used to select a qualified Software Chief Engineer for the Acquisition Organization.

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