Requirements for a Software Chief Engineer for a Weapons Systems Acquisition Conference on the Acquisition of Software Intensive Systems

27 January 2004

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Agenda

• Introduction
• Qualification Areas

<table>
<thead>
<tr>
<th>Education</th>
<th>Configuration Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Experience</td>
<td>Risk Management</td>
</tr>
<tr>
<td>Project Management</td>
<td>Metrics</td>
</tr>
<tr>
<td>Proposals</td>
<td>Life Cycle</td>
</tr>
<tr>
<td>Planning</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>Requirements</td>
<td>Acquisition</td>
</tr>
<tr>
<td>Design</td>
<td>Standards</td>
</tr>
<tr>
<td>Implementation</td>
<td>Process Improvement</td>
</tr>
<tr>
<td>Test</td>
<td>Writing Skills</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>Communication Skills</td>
</tr>
</tbody>
</table>

• Interviewing
• Candidate Evaluation
• Summary
• Contact Information
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,
  – operation

of 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

<table>
<thead>
<tr>
<th>Qualification Area</th>
<th>Weight</th>
<th>Candidate 1</th>
<th>Candidate 2</th>
<th>Candidate 3</th>
<th>Candidate 4</th>
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<td>2 12</td>
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<tr>
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<tr>
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<tr>
<td>Process Improvement</td>
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<td>Writing Skills</td>
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<tr>
<td>Communication Skills</td>
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<tr>
<td><strong>Total Score</strong></td>
<td><strong>806</strong></td>
<td><strong>923</strong></td>
<td><strong>925</strong></td>
<td><strong>958</strong></td>
<td></td>
</tr>
</tbody>
</table>
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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