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Requirements for a Chief Software Engineer in a DoD Acquisition Agency

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The MITRE Corporation

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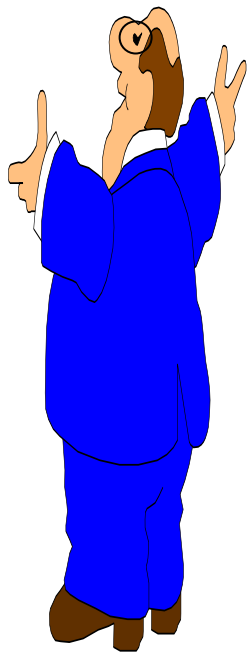
- Air Weapons Integration Seminar, Institute for Defense and Government Advancement (IDGA); Silver Spring, MD; 2006
- System and Software Technology Conference (SSTC), Poster session; Salt Lake City; 2005
- Acquisition of Software-Intensive Systems Conference; Washington DC; 2004

Agenda

- Introduction
- Qualification Areas

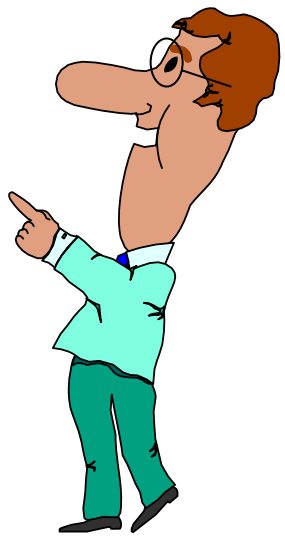
Education	Configuration Management
Years Experience	Risk Management
Project Management	Metrics
Proposals	Life Cycle
Planning	Systems Engineering
Requirements	Acquisition
Design	Standards
Implementation	Process Improvement
Test	Writing Skills
Quality Assurance	Communication Skills

- 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.

Where are We?

- Introduction
- Qualification Areas

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Years Experience	Risk Management
Project Management	Metrics
Proposals	Life Cycle Paradigms
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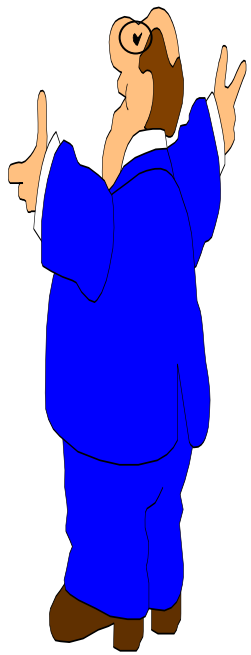

Qualification Areas

- 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 weapon systems.

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, budgets, 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 conducting impact assessments of proposes changes
- 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,
  - development and execution of mitigation plans and alternatives (contingencies).

Metrics
(Qualification Area)

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

Life Cycle Paradigms
(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 specification, deployment and retirement.
- Experience in defining and executing entry and exit criterion for life cycle reviews and milestones

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 of specific acquisition processes.
- 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 specification, 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) Capability Maturity Model Integration CMMI®.
- Experience in measurement of process effectiveness.
- Experience in improvement of process and procedures that are followed during:
  - acquisition,
  - development,
  - operation

  of software intensive systems.

® CMM is a registered trademark of the SEI

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.

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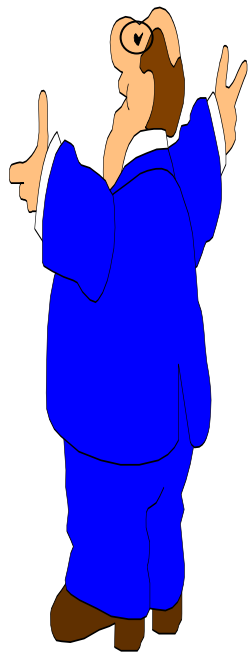

Interviewing

- 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.

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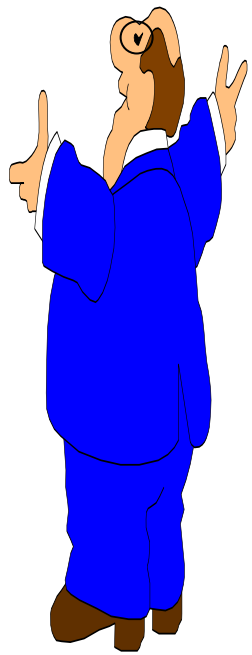

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Example - Candidate Evaluation

		Candidate 1		Candidate 2		Candidate 3		Candidate 4	
Qualification Area	Weight	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
Total Score			806		923		925		958

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).
- Each individual is ranked against each other on all qualification areas.
- 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.

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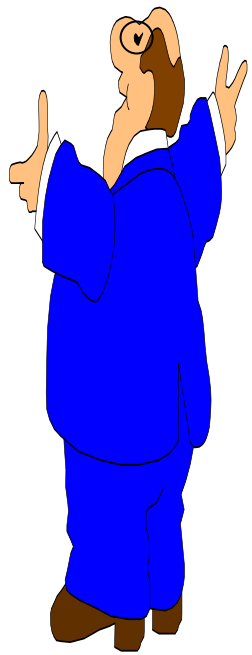
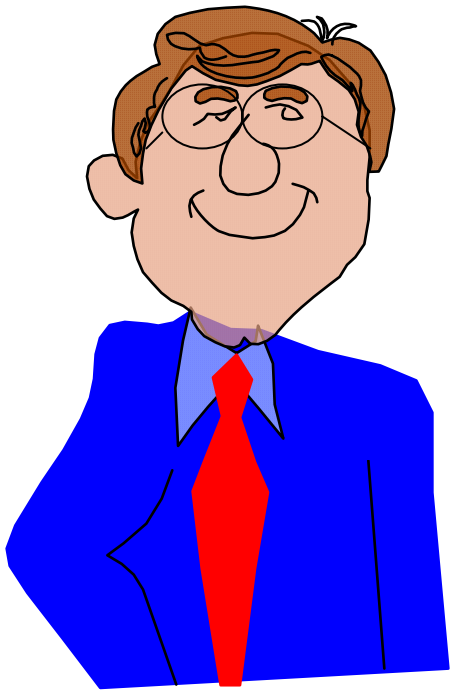


Summary

- 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.
- The criterion was successfully used to select a Chief Software Engineer.

Contact Information



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