OMSE 510 Software Estimating
Discussion I: Principled Negotiation

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Preamble [A variant of this case study has been used on OMSE 511]

Your company, "JDI Inc." is a significant player in the software and systems integration business. JDI responded to the terms of reference provided by "Columbia" (below) and produced the winning bid that landed them the contract to build Columbia's Advanced Electronic Healthcare System (AEHS). An initial team was established by the company's senior management ("execs") in cooperation with the marketing department. The initial start-up team includes the Software Project Manager (a software engineer), and a handful of technical leads. The project start-up activities are outlined below including terms of reference for the project and key contract attributes.

Columbia and JDI realize that the accepted proposal represents a preliminary plan of action. It has been decided that the first task for the team is to re-estimate the schedule and resources and develop a solid plan of action for the project. The start-up team is directed to work with the project stakeholders to accomplish this task within 3 weeks. The next step is to determine the criticality of the contemplated requirements and feasibility of various technical alternatives that will shape the rest of the project. The stakeholders recognize that their project is positioned in the widest part (early stage) of the "Cone of Uncertainty" and hence the agreed budget, effort and schedule written into the contract need to be revisited.

Role-play the first step of achieving a flexible mutual commitment and updated project plan

This is a role-playing assignment designed to simulate the launch of a principled negotiation process between JDI and Columbia. The discussion aims to discover where the points of flexibility appear in both the problem and solution spaces. The purpose of this discussion is <u>not</u> to develop a new estimate for the project. Rather, the principle aim is to:

    (a) Define a short-list of prioritized project functions, features, and attributes (reqts) that will meet Columbia's needs

    (b) Define a list of feasible development and delivery (tech) options that JDI will implement to meet project needs

    (c) Agree to mutually acceptable prioritized requirements and technical options to reduce the "cone of uncertainty".

Comment: This problem-solving exercise represents the first significant step exposing the key points of flexibility, namely, Columbia's prioritized needs, and JDI's technical options. The next steps (which you are not being asked to explore) would be to reduce project uncertainties wherever possible, develop a new estimate, and make a mutual commitment to plan the project.

Discussion Teams and Threads

The class will be organized into discussion teams (A, B, C, etc.), each with a designated captain, and each divided into two sub-teams:

- **Non-Technical Sub-Team:** The customer and users driven by user and customer needs
- **Technical Sub-Team:** The SPM, requirements, architect, and development leads by technical solution options

Note that senior management and the head of marketing, though stakeholders, have not been included in this exercise.

Three discussion threads will be set up for each team by your instructor: one for each sub-team and a third "negotiation" thread to be used for the purpose of converging on a consensus:

1. During the first day or two of this week everyone needs to become thoroughly familiar with the principled negotiation process as well as Columbia's requirements and contract (below) [review Ch 23 and key points];

2. By Thursday midnight each sub-team should have agreed and discussed where they believe their flexibilities lay:
   a. The non-technical sub-team is to determine Columbia's project priorities
   b. The technical sub-team is to identify feasible development and delivery options

3. Over the subsequent three (3) days the sub-teams are to review each others' areas of flexibility, identify consistencies and inconsistencies between priorities and options, achieve consensus if possible, and but identify unresolved issues as "pending" problems. By Sunday evening (say by 8 pm) the sub-teams should complete this phase of their work.

4. The appointed team captain is to post a "consolidated" result from these inputs by Sunday midnight or Monday noon at the latest.

Context: A Recently Awarded Contract; Startup Team Established

The proposal was written in four weeks by a JDI marketing manager, a JDI engineer who understood telecommunications equipment, and a JDI senior software engineer. The proposal team did not have much experience in the application domain (healthcare IT), network security, or personal device technologies. However, the proposal team invested enough research into these areas that it was able to develop an initial "fuzzy estimate", submit a credible proposal, and win the bid. The negotiated contract was fixed at: $3.6M, 360 staff-months, and 18-month project schedule to completion. The total cost used to arrive at the bid price was a nominal figure of $10,000 per team member. The cost of equipment and other such project costs were priced separately to be charged to the customer at "cost plus".

The contract suggests using the waterfall software process. The contract and terms of reference specify that the final product must meet user needs, monthly progress meetings and reports are to be provided to ensure progress visibility, and the documentation should be sufficient to allow the customer to carry on maintaining the system after delivery. The requirements as specified in the terms of reference and attached to the contract are fairly broad. The contract calls for the customer to provide additional details about the requirements early in the project schedule.

It is recognized that the healthcare application domain is new to the company and neither the company nor the project team have any real experience with personal storage and handheld or mobile technologies. The project is not a mission-critical project in the military or aerospace sense, but it does appear to be moderately large and complex with some potentially demanding performance and security requirements. The reliability and availability of the system needs to satisfy a large number of healthcare users simultaneously accessing the system from various PCs and handheld devices, and must therefore be very responsive and available. Although the system requirements are fairly demanding, the company has taken on other such tough challenges in the past, has experienced developers, mature development tools, and an excellent track record – they are confident that the company can get the job done.

The SPM has met with the small startup team members who have a general idea of the required project activities and tasks. They have begun to review the project requirements and development tasks. The requirements manager confirms that the customer has committed time from several users to provide inputs on functional requirements and has met briefly with the customer and a user representative. The team is thinking of diverging from the agreed waterfall model and is considering a mixed model of prototyping, agile development and an incremental/staged development and release process. The team is not familiar with all the development technology and, if warranted, may change the main programming language, development environment, operating system, and database management system. They are also beginning to consider searching for candidate COTS (commercial-of-the-shelf) products to achieve some of the required functions and features.

A New Estimate is Needed

Upon being assigned, the SPM takes stock of the project with the help of the team leads (requirements, architect, and development leads). The SPM recognizes that a proper management plan needs to be put in place and that this means that a new estimate is required. Although the contract price is fixed, the requirements as stated are very broad and expressed at a very high level. It should therefore be possible to follow Steve McConnell's advice and launch a "principled negotiation" effort with the customer. Because the marketing department led the bidding effort and senior management signed off the contract, they will also need to be brought into the negotiations.

Advanced E-Healthcare System (AEHS), Columbia Healthcare Group

Terms of Reference

Project Purpose and Objectives

Purpose: Take the next significant step to develop a group-wide integrated healthcare IT infrastructure. The aim of this infrastructure is to enhance the quality of healthcare, increase the effectiveness of healthcare provisioning and claims processing, and decrease healthcare and claims processing costs. This initiative will build upon the Group's recently completed integrated Claims Processing System (CPS).

Project Objective: Develop an Advanced Electronic Healthcare System (AEHS) for current and planned healthcare provider operations of the Columbia Healthcare Group (CHG).

Specific Project Goals: The system is to support healthcare provisioning, authorized access and maintenance of patient records, orders, bills and other healthcare data, and integration among Columbia's healthcare provider services including Columbia's recently deployed Claims Processing System (CPS). The system is to exploit existing web and security technologies, reinforce HIPAA obligations, and conform to HL-7 interoperability standards. In addition, the planned system will exploit personal handheld devices to enable patients to capture, maintain and port their patient records among Columbia provider and claims processing services.

Context

Columbia Healthcare Group is an affiliated network of healthcare providers and health insurers in the US northwest covering the states of Oregon, Idaho, Utah and Washington. Columbia headquarters are located in Portland Oregon; Regional headquarters are located in the capital cities of each of these states. The Columbia network currently consists of approximately 20 hospitals, 75 clinician offices (300 primary care givers), 40 medical testing and imaging labs, 40 pharmacy locations, and 4 claims processing centers. Approximately 1,000,000 patients are provided healthcare insurance coverage through company and private plans.

Columbia started 20 years ago as a small collection of independent healthcare insurers in Oregon. In its infancy, Columbia members relied almost entirely on paper-based transactions to support patient records, lab and pharmacy orders, and insurance claims and billing. As the group began to expand its provider and geographic coverage, larger hospitals, clinics and clinician teams established information systems for electronic access to patient records and claims processing.

However, these systems are loosely coupled – mostly through paper-based schemes. Considerable paper burden remains which results in faulty, incomplete, and inconsistent patient records, erroneous and duplicate claims, increased operating overheads for healthcare providers and insurers, and delays in processing both lab and pharmacy orders. This in turn manifests in reduced quality of healthcare for patients, and in reduced effectiveness and efficiency of medical practitioners.

The planned new system is intended to bridge the inconsistencies and incompatibilities among currently deployed systems to field a much better, faster, cheaper integrated system that will yield a superior total solution to the one currently in place. The primary objective of the planned Advanced E-Healthcare System (AEHS) is to reduce the paper burden and integrate healthcare transactions and operations across all member healthcare providers and patients for their mutual benefit. The new system must maximize the use of integrating technologies such as the Internet (web), be compatible with emerging Health Level 7 (HL-7) interoperability standards, and comply with the provisions of the federal Health Insurance Portability and Accountability Act (HIPAA) [in particular, with respect to patient privacy and informed consent obligations].

User Needs and Functional Requirements

Detailed requirements satisfying user needs and customer priorities are to be developed and specified collaboratively by engaging Columbia user representatives with Contractor analysts in the early phases of the project via requirements solicitation and validation activities to be proposed and led by the Contractor. These activities are to be defined by the Contractor in collaboration with Columbia.

The required functional and non-functional capabilities for the planned system are documented in the paragraphs that follow. The Contractor is required to specify, design and deliver a system solution that meets these requirements.

Applications and Services

The system is to be appropriately designed to support the following categories of web-based services:

1. User Workstations (UW) for clinicians (a.k.a. healthcare practitioners), healthcare support staff, healthcare system administrators, and patients;
2. Healthcare Services (HS) providing local access and external transaction support within a clinical setting supporting workstation access, patient record keeping, diagnostic data and analysis, clinician orders (labs, pharma, etc.), and billing records;
3. Claims Services (CS) providing mechanisms for managing codes, collecting claims from Columbia healthcare providers and patients, and issuing claims processing transactions to Columbia's current (legacy) Claims Processing System which issues statements and payments.

4. System Administration (SA) services providing mechanisms for managing users and application services, in particular, to issue user credentials including permissions, issuing application software and clinical data updates, distributing network wide alerts, monitoring system-wide performance, and supporting backup and recovery.

Data and Database Requirements

The total scope of data and database requirements, including how the data will be distributed among the workstations and servers that will compose the system, is to be determined as the project unfolds. Keep data elements include:

1. Patient records including contact information and history of diagnoses, orders, procedures, etc.
2. Clinician profiles, services, policies, advisories, referrals, …
3. Healthcare knowledge base to support procedures, medical differential analysis support, medical resources, …
4. Billing records including insurance details, billing codes, treatments, statements, claims, reimbursements.

Functions and Features

The requirements are to include the following functions and features:

1. **Communications:** Support web transactions (http, ftp, smtp, pop3, etc.), text messaging, and instant messaging (e.g. MSN Messenger, AIM, Yahoo!, ...) among providers, patients and administrators;
2. **Access:** Support access to healthcare services and data from browser-enabled workstations including desktop and laptop PCs and handheld personal devices such as Personal Digital Assistants (PDA) or cell phones;
3. **Credentialing:** Create, issue, monitor and revoke electronic credentials of patients, providers and support personnel in support of controlled mediation and access;
4. **Mediation:** Mediate authorized access to patient records, orders, bills and other records by healthcare providers, patients and administrators in accordance with appropriate (to be agreed upon) security policies, identities, credentials (permissions, authorizations, …), revocations and expirations;
5. **Appointments:** Support web-based patient-clinician appointment-making and coordination including reminders and alerts;
6. **Registration:** Support patient registration for enrollment, reception, claims processing, etc. ;
7. **Forms:** Automate electronic processing of HIPAA and other forms to support informed consent, referrals, lab orders, prescriptions, etc;
8. **Patient Processing:** Support patient record keeping including clinical and patient record analysis and diagnosis, patient record updating, issuing of lab and pharmacy orders, and allocating billing codes;
9. **Claims Processing**: Create, validate, issue, and reconcile insurance bills and claims in coordination with Columbia's ("legacy") Claims Processing System (CPS);
10. **Personal Storage:** This requirement is for the purpose of automating enrollment, credentialing, capture and porting of a given patient's electronic health and billing records by means of a personal storage device such as a smart card, a USB flash drive, a PDA or a cell phone.

Clarification Note: It is anticipated that it may be possible to configure PDA and smart cell phone handhelds devices to support both requirement 2 (web access) and requirement 10 (personal storage device) above. However, it would only be possible to use smart card and USB flash drives as personal storage devices in support of requirement 10 above.

Technical Requirements

1. The Contractor is to adopt appropriate software engineering processes to plan, control, assure, specify, validate, and verify that the delivered system and work products will meet the agreed upon functional and non-functional requirements.
2. The delivered system, documentation and training must be of sufficient quality and rigor to enable transition and maintenance by Columbian's professional IT staff;

Design Constraints

With the collaboration and approval of Columbia, the Contractor is to develop a cost-effective solution that can be shown to satisfy the requirements, is "fit-for-use", and is completed within an agreed-upon budget and schedule for the project within the following additional design constraints:

1. The delivered system is to be sufficiently reliable, available, secure, scalable and maintainable to address the operational needs of the system's users;
2. All workstations are to support MS Windows (for PCs), or MS Pocket PC (for PDAs and cell phones);
3. Transactions between servers supporting Healthcare Services (HS), Claims Services (CS), Columbia's legacy Claims Processing System (CPS), and System Administration services must comply with Internet and HL-7 transaction protocols;

4. With respect to open source software for operating systems, web servers, database management systems, and administrative support systems, the Contractor must provide objective examples of successful deployment of same in equivalent operational settings.

Security Requirements

It is anticipated that Public Key Infrastructure (PKI), Secure Socket Layer (SSL/TLS) and password-based discretionary access controls will be used to support network security and server-based access mediation. The privacy and security requirements are to be developed in concert with Columbia during the requirements phase of the project.

Performance Requirements

The system shall respond (on average) to a user query or stimulus within x seconds of the submission of the query (for example, when the enter key is pressed) as follows:

> x = 5 secs for local database queries; x = 8 secs for Intranet queries among web servers

Reliability and Availability Requirements

The total system must be designed to be fault tolerant. The Contractor is to provide a system architecture that meets this goal. If a single server or central processor is used to back up and recover all other servers and workstations, then that server must be redundantly provisioned. Maximum downtime allowed for such a central processing is 8 minutes per year. Maximum downtime allowed for other servers is 1 hour per year. Downtime for workstations is not specified at this time but should be agreed to early in the project.

The system is to be designed to accommodate hardware and software upgrades with minimal service level interruptions. An appropriate figure of merit is to be agreed to early in the project.

Documentation and Deliverables

The following plans and technical documents are to be addressed as deliverables. Any other plans and technical documents required to complete the work are also to be delivered.

Plans
- Software Project Management Plan (SPMP)
- Software Requirements Plan (SRP)
- Software Development Plan (SDP)
- Software Test Plan (STP)
- Software Quality Assurance Plan (SQAP)
- Software Configuration Management Plan (SCMP)

Technical Documents and Software
- Software Requirements Specification (SRS)
- Software Architecture and Design Document (SADD)
- Software Test Description(s) (STD)
- Software Test Report(s) (STR)
- Software User Manual(s) (SUM)
- Source Code
- Master and Backup CDs with Run-time, install, and read-me instructions.

Contractor Responsibilities

The Contractor undertaking this project must clearly demonstrate that it has the capability and corporate maturity to achieve the following high priority objectives:

1. The Contractor is to work closely with Columbia to meet the objectives of the customer and user needs which together will drive the total project requirements within agreed resources, schedules and costs.

2. Columbia's general requirements described below are to be identified, refined and delivered to compose an operational system solution. This system solution shall enable healthcare providers, their operational support staff, and their patients to effectively and securely use designated functions and features of the system in the healthcare provider's environment, the home, or in a remote and possibly mobile location.

3. The planned system is to be sized to provide specified services 5 years from planned initial deployment and is to include a plan for growth and expansion to year 10 after initial deployment. Columbia will provide additional details beyond that provided herein during project conduct as required. Although Columbia also provides services to non-member patients, the e-healthcare system design and role-out will assume a "closed" system of member patients and providers. This will be a subject for further discussion between the Contractor and Columbia at a date to be determined.

4. The Contractor shall demonstrate that it is committed, capable and adequately resourced to institute best industry practices for the purpose of managing tasks and milestones, system scope, risks, system configurations, quality assurance, sub-contractors (if any) and vendors.

5. Although the Contractor is not required to be certified to be compliant with SEI CMM at Level 2 or higher, the Contractor should be prepared to demonstrate compliance at SEI CMM Level 2 on request.

6. The Contractor must demonstrate that it has the required core competencies to deliver the system and that it has the capacity and training resources to enhance and maintain the appropriate skills of all technical and management staff assigned to the project.

7. The Contractor must establish and maintain a project organization and staffing profile that is adequately structured to schedule, coordinate and oversee project task execution to meet project requirements, milestones and deliverables.

8. The documentation produced by the project must accurately specify the delivered system and support project planning, system operations after delivery, ongoing system maintenance, user and technical training, and both delivery and hand-over of the system to Columbia.

9. The delivered product documentation, must clearly present the functional and non-functional requirements of the system, including design constraints and performance requirements such as responsiveness, throughput, security, reliability, and availability requirements which are specified below. The product documentation must also provide top-level architectural design and detailed design specifications, together with source code, and regression test suites.

10. The Contractor is expected to address the make/buy/conversion/migration aspects of this project. The Contractor should distinguish between those components (hardware, software, and communications) that are COTS (commercial off-the-shelf), custom developed, reused, or modified. Components or services to be leased or rented should also be clearly identified, but not priced (although order of magnitude costs may be put forward).

11. In areas where customer-provided equipment or software can be identified, and/or conversion of such components may be required, the Contractor is to indicate constraints, assumptions, and requirements that impact on project schedule, requirements and costs.

12. A comprehensive process for achieving customer acceptance and sign-off is to be provided. This process must validate all system requirements - that they are consistent with Columbia's project objectives and operational needs. The Contractor must also demonstrate that all system requirements have been verified to be consistent with these validated requirements.

13. The acceptance process prior to delivery as well as acceptance prior to transition into operations must verify that the delivered system meets system requirements through test, demonstration, analysis and/or inspection in accordance with an agreed qualification process.

Contract Checklist

This checklist provides a summary only of the contract between the parties but should be sufficient for the purposes of the case study. If you need to make an assumption about the contract to address any given part of an assignment, make a reasonable one and clearly state what it is in your submission.

- The Customer's "Terms of Reference" are legally called up as part of the contract.
- The system to be constructed is to be integrated with an existing (legacy) system.
- The delivered system is to be web-enabled and support mediation and application domain services for access, storage, messaging, appointments and forms management.
- The contract is $3.6 million fixed price for labor budgeting 360 staff-months at $10,000 per month. The total period of performance is eighteen (18) months. The project started January 2nd and is to be completed by July 1st of the following year (this is a firm delivery date). Monthly progress reports are to be provided. Equal payments will be made quarterly provided progress, as evidenced by the progress reports and deliverables is being achieved.
- The system requirements are spelled out broadly in the "Terms of Reference" including both functional and non-functional requirements. The contract stipulates that the delivered software must be "fit-for-use".
- The project is expected to be developed following a waterfall software process. Monthly progress reports are to be produced and progress meetings are to be scheduled monthly.
- A number of customer-provided support and contractor-provided deliverables are specified in the contract.
- The overriding objective of the contracted project is to develop software systems and application services designed to satisfy the general requirements to be elicited in further detail during the project.
- The Contractor is to test and install all equipment and software and provide training.
- The Customer is to supply test time on their processor situated in Portland, about thirty miles from the Contractor's offices in Beaverton. Access to this computer installation requires personnel clearances processed by the Customer.
- The contract contains a Statement of Work (SOW) that implies the project will be staffed by the Contractor with one (1) software project manager; one (1) requirements manager; two (2) software development managers; fourteen (14) programmers; four (4) requirements analysts; two (2) specialty engineers (communications and software estimating); two (2) support services staff.
- The Customer has agreed to supply an additional four (4) of its best available programmers to assist on the project under the direction of the Contractor.