Model-Based Proposal Development

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ABSTRACT

The competition for new business is increasing. There are fewer new starts being pursued by the government. Consequently, bidders need to find ways to increase their probability of win and reduce the cost of proposal preparation. This paper addresses the application of a model-based systems engineering CASE tool, CORE®, to the proposal preparation process. The development and application of the proposal schema is discussed. The user benefits by decreasing the cost of writing the proposal and being better prepared when the contract is awarded.

BACKGROUND

One of the key goals of each corporate executive is to increase profits by aggressively pursuing new business. With the decline of the Cold War and the increased competition from merger-enhanced mega-corporations, it is very difficult to increase a company's win percentage. In addition, "aggressive pursuit of new business" implies increasing demand for bid and proposal (B&P) funds. The material in this paper was motivated by client needs for ways to reduce the cost of proposal preparation and increase the probability of win. The author applied CORE®, an object-oriented computer-aided systems engineering tool to the process. The following steps were taken:

- The proposal process was defined
- A schema was developed to support the proposal process
- A sample problem was constructed to validate the schema
- Automated documentation was designed.

THE PROPOSAL PROCESS

There are many different versions of "the proposal process." We are not going to presume to have the definitive process. The techniques described in this paper are applicable to any company's proposal process. Figure 1 illustrates a sample flow for a representative technical proposal process.

The formal process begins with receipt of the final Request for Proposal (RFP). Although the bidder has been analyzing and planning before this, a final bid-no bid decision cannot be made until the final RFP is issued. The RFP must be read in search of surprises and an assessment must be made of how well the company's competencies match the required skills. Eventually, a probability of win is developed and a bid/no-bid decision is made. Once a decision is made to bid, one needs to plan the proposal. This includes extracting and understanding the requirements, developing win themes, and developing a proposal schedule. In addition, the team needs to identify the issues and risks associated with the proposal. A mitigation plan is usually developed and tracked throughout the proposal. During the high-level design phase, the following activities are usually performed:

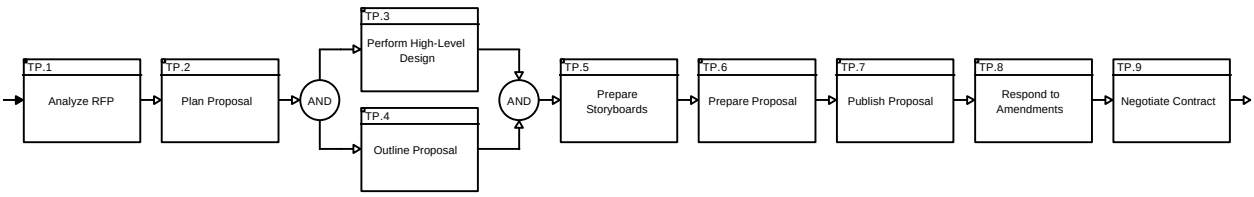

Figure 1. Technical Proposal Process.

- Develop one or more functional designs
- Model the behavior for each design
- Trace originating requirements to behavior
- Simulate the behavior to verify the designs
- Trade off the designs to select the best
- Develop one or more physical designs based on the selected functional design
- Allocate the behavior to the physical designs
- Select the best physical design based on cost, complexity, manufacturability and supportability as well as any other key parameters.
- Develop a verification and validation plan, to include a test dependency matrix.

The proposal is outlined using the storyboard approach. It is a technique that began in the entertainment industry. Directors would layout a whole movie as a series of small cartoons. Microsoft PowerPoint® does a similar thing in the "slide sorter" view. For proposals, the storyboards are usually 11"x17" sheets which represent subsections of the proposal and are usually tacked on the wall of a "war room". In our application, all storyboards will be kept within the database, our electronic war room, but can be printed at any time. Each storyboard identifies the following:

- Section title and number
- The theme(s) or message(s) to be conveyed
- The author
- The number of page in the final proposal allocated to the topic
- An outline of the section, with the key points to be made
- Diagrams, tables and figures to be used

Note that the storyboard provides no way to ensure that all specific topics are addressed. Once the storyboards are complete, they are reviewed by a management team, sometimes referred to by some color, such as the "pink team". Their objective is to assess how well each storyboard answers the requirements and conveys the corporate win themes. When the storyboard issues are resolved, full text is developed based on the storyboard outline. Figures, tables and diagrams are finalized. A proposal compliance matrix is usually developed to cross-reference customer requirements to the location in the proposal addressing each item. This helps the evaluators and also ensures that you do not forget to address something. The matrix is usually done manually in a spreadsheet program and is extremely sensitive to changes to the proposal. The creation of this matrix would be greatly facilitated by an object-oriented database. An automated report could generate a complete and correct matrix in a minute.

The publishing portion of a proposal schedule can be the most frustrating and take up far more time than it should. Desktop publishing has improved the publishing time. However, automatic document generation using an object-oriented database offers the promise of very significant time reductions. Printing the proposal is merely a matter of sequentially printing the *description* field in every numbered proposal section, inserting any referenced graphics or text.

A phase rarely considered to be part of the proposal process is the evaluation and negotiation period. More and more often today, the customer will issue amendments to the RFP after the proposal is submitted. The customer will make changes in requirements and request a revised proposal to be submitted. Then the customer will come back and ask for a "best and final offer" (BAFO). Bidders usually arrive at a BAFO price by making some assumptions or imposing some additional terms and conditions on their offer. These changes to the foundations of the design are not usually reflected in the technical database and can be a major issue if the contract is won. By updating the design and database during the evaluation and negotiation period, the proposal team is able to assess the true impact of those assumptions that led to a lower price.

A SCHEMA FOR PROPOSAL PREPARATION

Webster defines a *schema* as "a diagrammatic presentation". In the language of object-oriented databases, a schema defines the elements, attributes and relationships which form the basis for the database storage mechanisms. An element is a class of object, such as an *originating requirement* or a *function*. An attribute is any modifier or descriptor associated with the element, such as the *cost* of a component or the *description* field in a storyboard.

Figure 2 illustrates the schema developed for proposal preparation. The words in italics represent the *relationship* between the two elements at either end of the arrow and in the direction of the arrow. For example, a document (an RFP in our case) *documents* the originating requirements. The circular arrow on the originating requirements indicates that they are hierarchical. That is, there can be several levels of originating requirements before they are reduced to a single testable statement at the leaf level.

The originating requirements are key to developing the storyboards for the proposal. Those storyboards, also hierarchical, *outline* the proposal, its volumes and the individual sections. The proposal themes, developed early on, *inspire* the storyboards. External graphics and text can also be used to *augment* the storyboard. And

when it is time for a review of the storyboards, the "pink team" members can link their comments directly to the storyboard to which they pertain using the *reviews* relationship.

In parallel with the proposal development, the team must also develop a technical concept for the system being proposed. Figure 3 illustrates the schema path for the design of the system. The functional design is expressed with the function element. To ensure that all requirements are addressed, each originating requirement *traces to* a function. In a similar fashion, each function must be *allocated to* a component, the physical design element. With this linkage, it is possible to trace all design decisions back to specific requirements. If they do not trace back to a requirement, it is possible that they are "gold plating". Tracing from the originating requirements, it is possible to identify any requirements that were overlooked and do not trace to a function and/or component.

APPLYING THE SCHEMA TO A PROBLEM

Figure 4 Illustrates a hierarchy of originating requirements that were all traced from the requirements document to the leaf level. In one case, for OR.1.1, a risk was identified. In another, OR.2, an issue was identified. Issues often indicate some ambiguity in the originating requirement which prevents proper interpretation. The resolution of this issue becomes the requirement which governs your design. The ambiguous originating statement cannot be used.

Table 1 illustrates an example of how one might track the status of storyboards. This table was generated with a predefined script. It shows the storyboards that have been scored by the reviewers, the score given and the reviewer's comments.

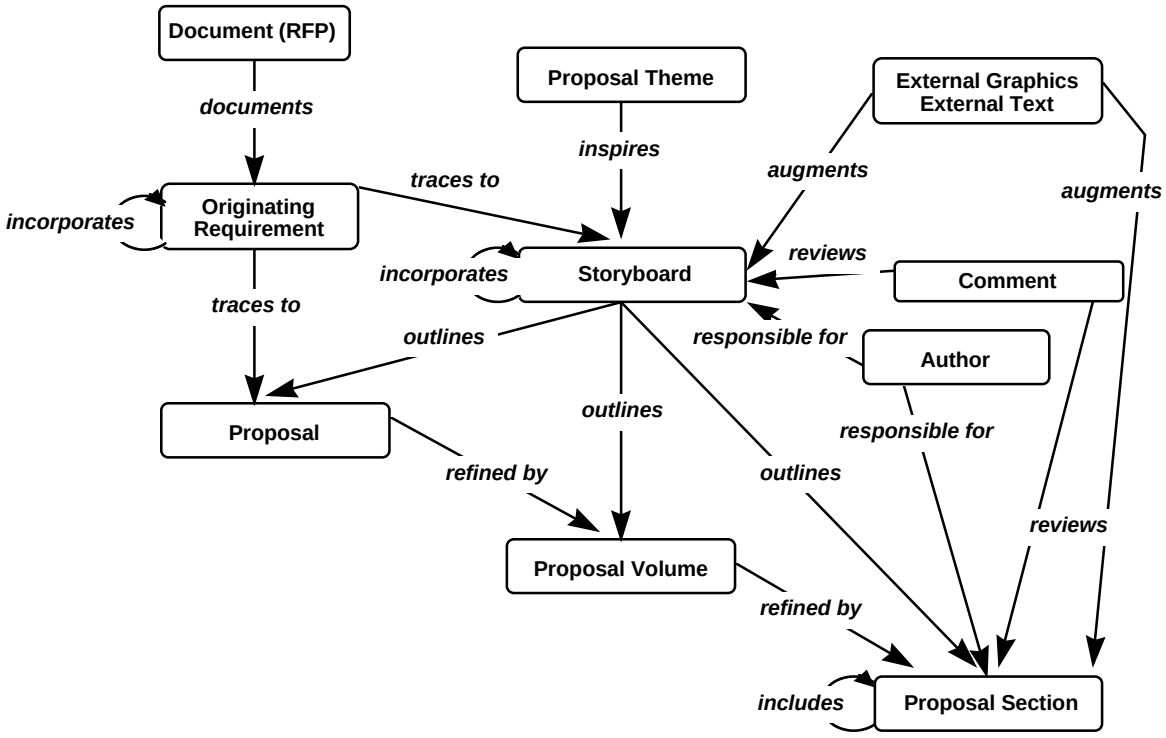

Figure 2. The Proposal Preparation Schema.

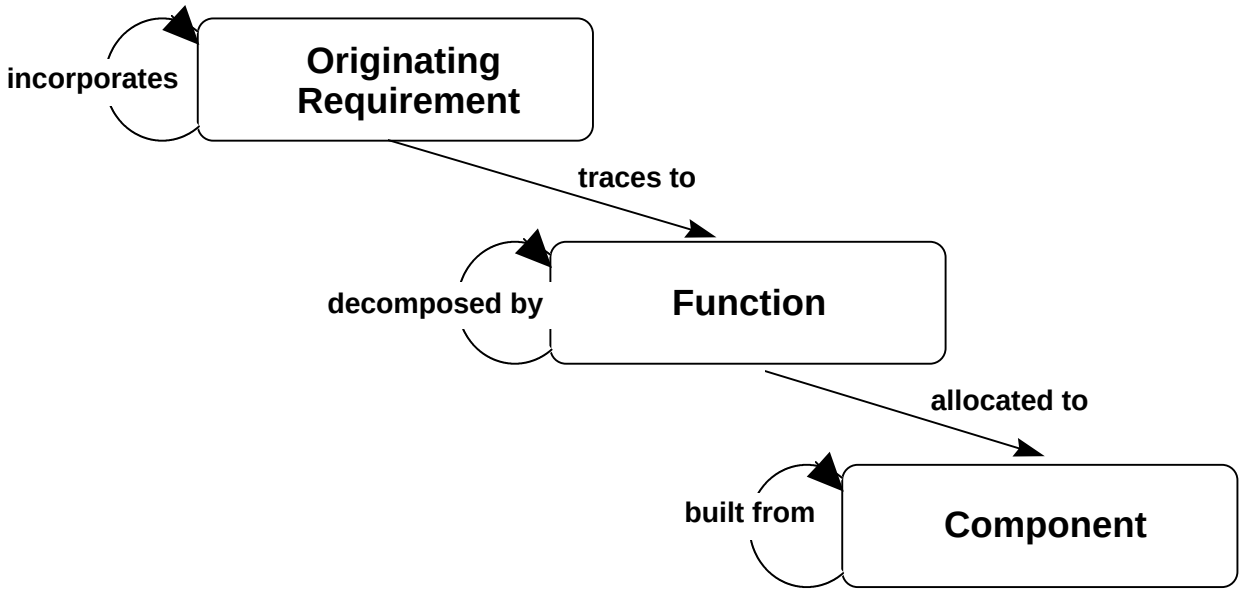

Figure 3. The Design Path.

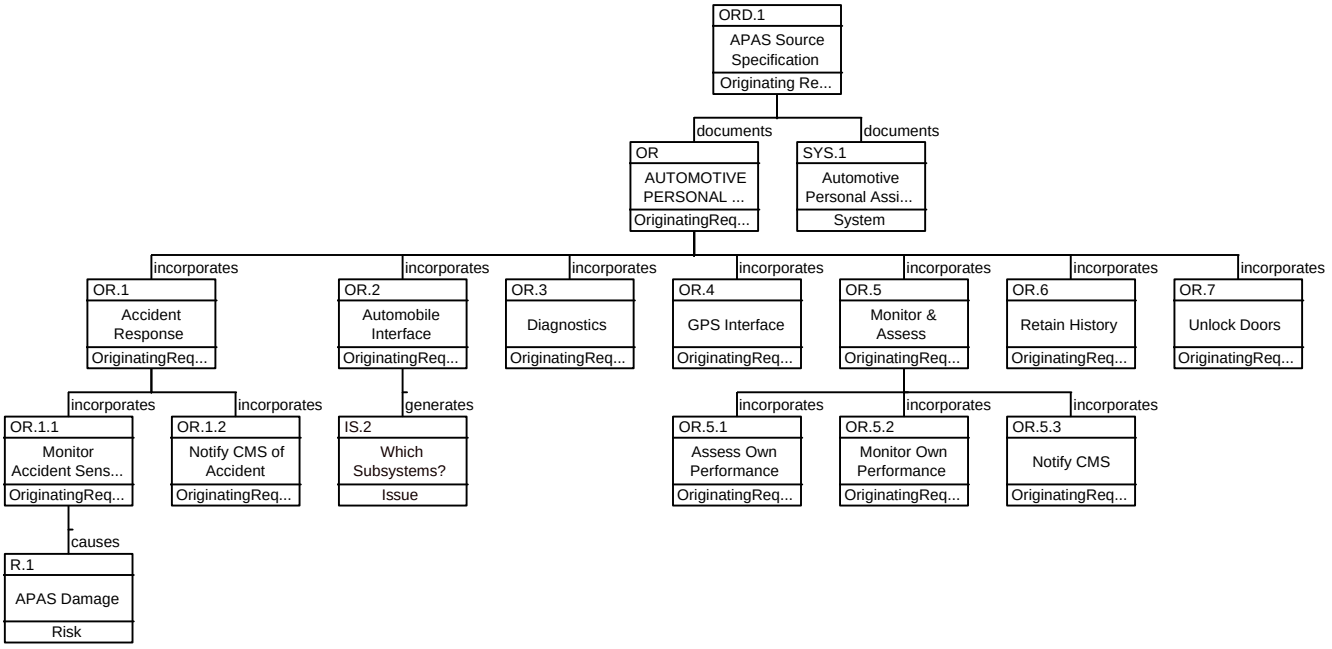

Figure 4. Originating Requirements Hierarchy.

Name	Description	Reviewer	Storyboard Score	reviews
Failed to Answer Requirement	The author of this storyboard did not address the customer requirement for retention of position history data for 24 hours. How was the memory sized?	Jack Doe	Unsatisfactory	SB.2.1.2.2 Position History Management

Table 1. Example of Storyboard Tracking.

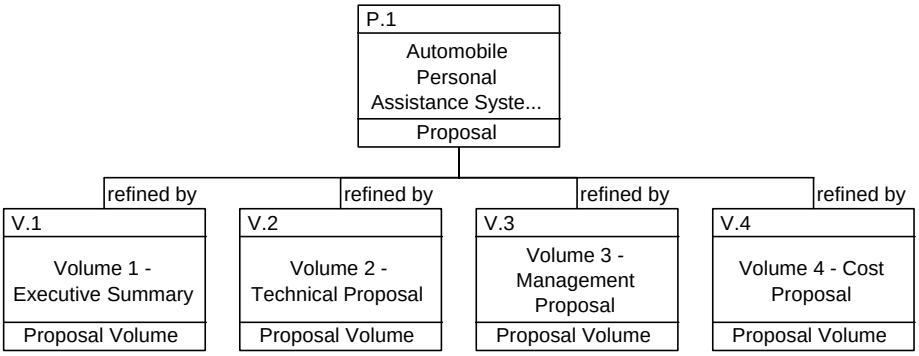

Figure 5. Proposal Hierarchy.

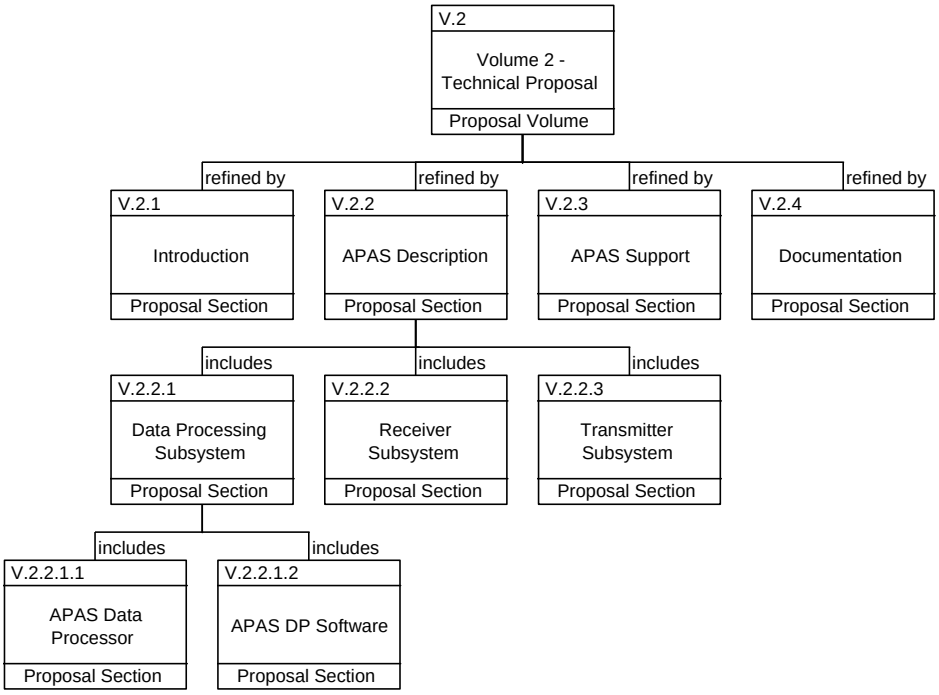

Figure 6. Technical Proposal Volume.

Figure 5 illustrates that the proposal contains four volumes:

- Executive Summary
- Technical Proposal
- Management Proposal
- Cost Proposal

Many RFPs dictate the format. If they don't, you can do top-down outlining with this feature.

Figure 6 illustrates an expansion of Volume 2 to show the first three levels of sections in the Technical Proposal. When trying to insert new information, it is sometimes helpful to have a diagram of the proposal.

Figure 7 illustrates how one might inquire "where can I find the storyboards that support Theme 1?". In this case the theme is being addressed on three separate storyboards. This provides verification that all the marketing win themes are being covered adequately.

Figure 8 illustrates the relationship of a storyboard to the other elements of the database. In this case, the storyboard outlines the material for Section 2.1.2.2 of Volume 2, the Technical Proposal. It was reviewed by the Storyboard Comment titled "Failed to Answer Requirement". The storyboard is expected to respond to three requirements (OR.1.2, OR.5.1, and OR.6). The storyboard element has the following fields (or attributes) in it:

- Name
- Number
- The content of the storyboard
- Number of pages Allocated to this topic in the proposal
- Status of the storyboard
- Reference to proposal instructions
- Reference to evaluation criteria

The *Storyboard* is assigned to a specific author using the *responsible for* relationship. With the addition of the relationships with other elements, this provides all that is needed to outline a proposal.

The *Comment* permits documenting the review of the storyboard. It contains the following attributes:

- Name
- Number
- Comment
- Reviewer
- Storyboard Score (Unsatisfactory to Excellent)

The CORE schema also contains a Verification and Validation facility. This permits detailed test planning and tracking. For proposal purposes, it is useful to identify a Verification Requirement (VR) for each originating requirement. This VR contains the following attributes:

- Name
- Number
- Description
- Test Method (i.e., Inspection, Similarity, Analysis, Demonstration, or Test)
- Verification Level (i.e., System, Subsystem, Element, Component)

With this information and the Originating Requirement, it is possible to construct the Test Dependency Matrix that we commonly find required by our customer in the back of the System Specification. A line from the matrix might look like Table 2 below. Additional verification can be accomplished by executing the system behavior diagrams and verifying their logical correctness.

DOCUMENTATION

The schema presented above establishes a hierarchy of objects which can be assembled logically into an entire proposal. The graphics and text are kept in the database. The graphics are generated on the fly as the document is being printed. The result is a document that is always up to date and consistent. This handles the last minutes changes to proposals that result in a figure not matching the text; or the Technical Proposal not matching the Executive Summary. The document preparation is wholly dependent on the data in the database being correct. The final item to be included in the proposal should be the Proposal Compliance Matrix, as illustrated in Table 3. This matrix assists the proposal evaluators in finding where each requirement is discussed. If they don't find your response, they will assume that you did not answer the requirement.

CONCLUSIONS

Object-oriented techniques offer a significant advantage in the development of proposals.

- The data is consistent and correct.
- The behavior models can be executed in a simulator to verify them.
- Tracking status of storyboards and proposal sections is easier.
- Many reusable elements will evolve.
- It will eliminate missed requirements.
- The customer will appreciate the manner in which the data is presented.

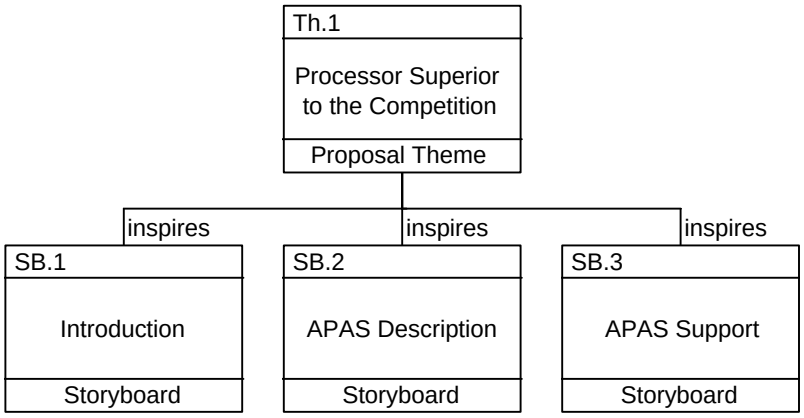

Figure 7. Proposal Theme Inspires Storyboards.

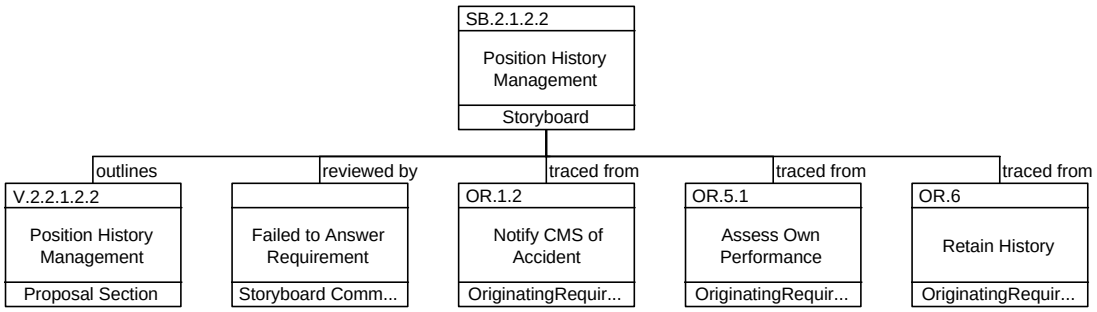

Figure 8. Storyboard Trace.

Number	Name	Technique	Verification Level
V.1	Accident Sensor Test	Test	System

Table 2. Example of Test Dependency Matrix.

Requirement Number	Requirement Title	Proposal Volume - Section Where Response is Found	Proposal Page Number
OR.5.1	Assess Own Performance	2 - 2.1.2.2	2- 34

Table 3. Example of Proposal Compliance Matrix.

BIOGRAPHY

Gerard H. Fisher is a Member of the Technical Staff at the Vitech Corporation, in Vienna, Va. He provides consulting services on the application of CORE® to support systems engineering, decision analysis, product development and program management. Prior to joining Vitech, Mr. Fisher was the corporate Director for Enterprise Process Improvement, for CACI. For 25 years, Mr. Fisher was a Senior Systems Engineer at IBM Federal Systems (and Loral after the acquisition) in Manassas, Virginia. He was involved in systems engineering on the Advanced Ballistic Missile Defense System and several high-performance signal processors for federal customers. He was responsible for quality and process. He chairs the INCOSE System Reengineering Working Group and is Technical Chair for the INCOSE WMA Chapter. He received his B.S. in Physics from St. Bonaventure University and M.S. in Systems Engineering from Virginia Tech.