Designing and Pricing to Win with the SEER Tools

By

Evin J. Stump
Senior Consultant
Galorath Incorporated

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Introduction

This paper assumes that the reader is at least minimally familiar with one or more of the SEER family of parametric estimating tools, products of Galorath Incorporated. Accordingly, little is said about the mechanics of using the SEER tools to produce estimates. Instead, the focus is on the information available from the SEER tools, and how this information can be used effectively to support a design / price to win strategy.

In today's defense market, buyers have less money to spend, yet face a diverse, rapidly evolving set of threats. Contractors are stressed by the shrinking market, and have consolidated to maintain skills and viability. Concurrent with the declining scope of procurements is an accelerating demand by buyers to get more for their money. Competition among sellers has becomes fiercer, and the penalties of losing out in a bidding situation have become more severe.

In this environment, proposal teams come under enormous pressure. They must work harder and smarter. Sometimes, they are literally "in over their heads," in the sense that their experiences and capabilities, and especially their design traditions and work habits, have not fully equipped them to deal with a tight, fiercely competitive market.

The phrase "design traditions and work habits" is used advisedly. Even after several years of defense industry consolidations, the traditions and work habits of an earlier, more abundant era still prevail in many project teams.

In these teams, designers focus on what they are used to building, as opposed to what the customer is willing to accept. They stress performance and consider cost only as an afterthought. They do a minimal number of trade studies and leave many useful options unexplored. Worst of all, they start with expensive concepts and try to trim them down to fit constraints, as opposed to starting with minimal concepts, and enhancing them as little as possible.

It is these teams that will lose out in the race against sophisticated bidders who are ultra competitive. These bidders have developed design to win / bid to win strategies, and have trained their project teams to execute them. They take a minimal approach to product design, and insist that the result be affordable to the customer. They work closely and continuously with the customer to be sure they are attuned to what the customer's decision-makers want.

This paper describes a workable design / price to win strategy. It is based in part on the SEER estimating tools. The biggest advantage of using SEER tools in the proposal environment is that the trade space can be much larger for a given proposal budget, thereby making it much more likely that the best, most competitive design / cost solution will emerge. This in turn increases the probability of a win by the project team. But there are other advantages as well, as will be seen. Among these is the virtual elimination of the possibility of a very large estimating error, the kind that typically kills a project.

Proposal teams not accustomed to working in the kind of competition aware environment described in this paper may find it a bit overwhelming at first. It may be all too easy for them to lapse back into their habitual modes of operation. For that reason, we recommend that teams executing this strategy for the first time use an experienced outside coach to help them stay focused. Galorath Incorporated will be pleased to supply or recommend coaching support, tailored to your team's needs.

Elements of a Design / Price to Win Strategy

The premise underlying this paper is that the winner of a bidding competition in today's defense industry environment will be the bidder who convinces the customer that he can best satisfy the customer's wants at a price the customer can afford.[1] The paper breaks this premise down into three elements, and devises a strategy based on them. The three elements underlying the strategy are:

1. **Know what the customer wants**
2. **Know what the customer can afford to pay**
3. **Bulletproof your proposal.**

In the remainder of this section, we will explore each of these three elements in the context of a competitive D / PTW strategy. But before doing that, we make a needed clarification. In some circles, the phrase "price to win" has become synonymous with a price intentionally reduced so much that it is almost bound to be below that of any competitor. It is usually a price that is not rationally connected to the bidder's design approach. To rationalize it, proposal management may refer to it as a "challenge" price, meaning "we're not sure how we can do it, but we're going to say we can, anyway." Often, the hope behind a so-called challenge price is that, once the customer is locked in, change orders will be the route to profitability. This style of price to win has sometimes been successful for bidders in the past, in the sense that it got them the work. For the customer, it was more often unsuccessful, in the sense that costs usually ballooned far beyond original expectations.

Today, this style of price to win can be very risky for three reasons. One is that customers have become increasingly astute at detecting artificially low estimates, which represent attempts to "buy in." A second is that customers are increasingly wary of buy-ins because they tend to make the project outcome problematic. A third reason is that the profitable change orders may not materialize. High value change order traffic may signal to the customer that the project is in trouble, which could result in cancellation.

This paper is not about the style of price to win described above. It is about *design* / price to win. In this approach, price is rationally connected to design, and the "challenge" is to find that design that minimally satisfies the customer's wants.

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[1] This paper stresses what the customer "wants," as opposed to what the customer "needs." If you as a bidder perceive that what your customer *wants* is not what he truly *needs*, then you should try to educate him as to the difference. If you can't do that, then what your customer wants becomes of paramount importance. This issue is further discussed in the section on "Educate your customer away from mistakes."

1. Know what the customer wants

Understand customer wants in depth. Knowledge of what the customer wants is not complete unless the bidder is able to establish a hierarchy of customer needs. As a (bare) minimum, this means creating a rank ordered list of product or service features. Much to be preferred is a list that assigns numerical weights to each product / service on a ratio scale, say 0 to 10, ten being of most value to the customer. The numerical weighting, even if not precise, serves the useful purpose of helping project team members allocate their efforts more appropriately.

The proposal leader should be the focal point in creating this list. By the nature of their work, systems engineers and certain others will likely contribute insights. But for a truly "in depth" understanding of what the customer wants, each member of the project team who has any substantial duties should be briefed on and fully understand these wants, and should have a current copy of a list of at least the top ten or twenty. This helps to eliminate the common narrow, parochial focus where each team member tries to optimize his or her own contribution, as opposed to optimizing the team's contribution.

Help shape the requirements. One reason buyers reach out to contractors is to get the benefit of their knowledge and experience. This knowledge and experience can be a positive force not just for meeting the customer's wants, but also for shaping and clarifying them. But for that to happen, the contractor must be involved in the procurement process long before release of the formal, final request for proposal (RFQ). The final RFQ is a summarization of considerable intellectual effort. But the rationale behind it often is not clear from the document itself. It is important to understand how the document got to be what it is.

For very large acquisitions, early involvement in shaping the requirements may need to begin a year or more in advance of the likely proposal due date. For many major projects, about six months is appropriate, and for smaller projects, a few weeks may suffice. If the customer is beginning to think seriously about the project, you as a bidder should be thinking seriously about it, too, as soon as (and to the extent that) you have reason to believe the project is real.

A bidder who has participated actively in shaping the project requirements will likely understand them much better than a bidder who has not. Moreover, bidder participation is likely to result in a set of requirements that are more reflective of reality. This means that the work will be less risky, and the bids can safely be lower and more competitive.

Stay close to the key decision-makers. Being involved early is necessary, but not sufficient. Just as important is being close to the customer's key decision-makers. High rank in the customer's organization is one indicator that an individual is a key decision maker, but high rank may merely mean that a person exercises veto power, or ratifies decisions made by others. Or, it may merely indicate that the individual exercises policy level control and is not particularly involved in decisions that drive cost, schedule, and risk.

Much decision making power may reside with relatively low ranked people because of their special skills and experience. Millions of dollars in costs may turn on decisions made by these persons. Understanding what these people want may be just as important to the success of a bid as knowing what the program manager has in mind.

Conduct trade studies. A trade study is an activity aimed at determining the relative costs and benefits of various ways of meeting the customer's requirements. Historically in the defense industry, trade studies have tended to focus more on relative benefit (i.e., performance) and less on relative cost.

But recent customer initiatives, most notably "Design-To-Cost" (DTC) and "Cost As Independent Variable" (CAIV), have pushed designs in the direction of meeting predetermined cost constraints. The CAIV initiative has at times allowed some liberties to be taken with the performance requirements if sufficient offsetting cost savings could be realized. Because of this, it has become important to balance customer wants and costs as part of conducting trade studies. That subject is further discussed under the heading "Know what the customer can afford to spend."

DTC and CAIV have tended to increase the number of trade studies conducted in proposals and in the early stages of projects. Contributing to that trend has been an increased tendency among customers to preface major procurements with some sort of "risk reduction" phase, in which contractors are paid to conduct trade studies. Whatever the customer role in promoting trade studies, the bidder who conducts them vigorously in the proposal phase will likely be at an advantage over the bidder whose trade studies are few and desultory.

The traditional way to conduct trade studies is to identify two or more competing design alternatives, then do enough studies to make valid comparisons as to performance and cost. The alternative that "wins" generally is the one that "scores" highest in some weighting scheme constructed by the project team.

This paper suggests a somewhat different approach to the primary trade studies. In this approach, the primary trade studies are directed at finding the lowest cost way of meeting

a specific set of primary customer wants. Costs are allowed to rise above this minimum only if secondary customer wants clearly demand it. An aspect of this kind of "minimum seeking" trade study is that the project team attempts always to maintain a reasonable balance between the importance of wants and their relative costs. These subjects are further explored in the next section.

There also is a place in D / PTW for the more traditional type of trade study. It is in finding the most "manufacturable" design.[2] That aspect is further discussed in the section titled "Create efficient designs."

2. Know what the customer can afford to spend

The business intelligence aspect of affordability. Sometimes a customer will freely and openly provide information about available funding for a project. At other times, he will not, for a variety of reasons. When the information is withheld, it is often possible to make reasonably accurate inferences about available funding from high level budgets and historical patterns of contract awards.

Other than mentioning these possibilities, the business intelligence aspect of estimating available funding is beyond the scope of this paper. Interestingly, most proposal teams manage to come up with this information.

Affordability is a range, not a number. It may be that the available funds are known exactly as a single number. Probably more often, they should be expressed as a range, because of uncertainties. Uncertainties arise for many reasons. Among them are:

- Political influences in the budgeting process
- Other projects with higher priorities that may siphon off funds in the future
- Other customer expenses, such as the program office, or support from other agencies, that will use up some of the funds
- Unknown amounts of management reserve set aside by the customer's program office, that may be diverted to other uses.

Assuming that a range of affordability is determined or estimated, it can be used to help position the winning bid. Minimal design alternatives that give the customer just what he wants and little or no more, are more likely to be near the low end of the affordability range than are "gold plated," high performance designs. This means they have a higher

[2] In software only projects, the equivalent of the most manufacturable design is the most efficient development process.

chance of resulting in a winning bid. They also have a higher chance of surviving the program cuts that now, more often than ever, come after contract award.

Balance customer wants and costs. A subtle and particularly troublesome problem, especially in high technology projects, is lack of balance between the customer's perceived value of (i.e., importance of, desire for) design features and the cost of these features. This problem is quite common. It can result in a risky, volatile project that has a high probability of failure.

To illustrate, suppose that the customer has issued a request for proposal for development and production of a laptop computer. You, as a prospective bidder, have managed to elicit the following information from the customer:

Features	Relative Value %	Goal
Weight	20	5.9 pounds
Processor speed	9	800 mhz
Storage	9	300 mb RAM
Display	5	25"
Battery life	5	6 hours
Price	20	<$1,500
Warranty	5	3 years
Options	13	Kits #1,#2
Availability	14	2001Q3

As a prospective bidder, you are concerned that the customer 1) may be asking for more than he can afford, and 2) may be unwittingly adding expensive requirements that are out of proportion to their true value to him.

Using the above table of features, you estimate relative costs for each feature as a percentage of total average product cost. Most of the estimates will be simple and straightforward, but some will require careful thought. An example of the latter is the weight requirement. Weight is neither hardware nor software. It is actually a constraint on a physical property of the hardware. How can it have a cost?

That question can be answered in the following way: If the weight requirement can be met without violating any of the other requirements, then it has no cost. But if cost must be incurred to reduce the weight of one or more of the components of the laptop in order to meet the weight requirement, then that incremental cost should be assigned to weight.[3]

[3] Challenge to readers: What is a reasonable way to deal with the "relative cost" of the price constraint in this example?

To further illustrate, suppose you add to the above table your estimates of relative cost, with the following results:

Features	Relative Value %	Relative Cost %	Goal
Weight	20	35	5.9 pounds
Processor speed	9	7	800 mhz
Storage	9	6	300 mb RAM
Display	5	5	25”
Battery life	5	5	6 hours
Price	20	18	<$1,500
Warranty	5	5	3 years
Options	13	11	Kits #1,#2
Availability	14	8	2001Q3

Of all the requirements in this example, only weight has a relative cost that is significantly higher than the relative value. Since the relative cost considerably exceeds the relative value, it may be worthwhile to re-examine the weight requirement to see if it should be relaxed. If the answer is that it should not be, then perhaps weight is really more important than was previously thought, and that should be acknowledged.

Comparisons between relative cost and relative value should be based on minimal designs. Minimal designs are discussed in a subsequent section of this paper titled “Follow principles of affordable design.”

Educate your customer away from mistakes. A sometimes overlooked aspect of determining customer wants is that customers, like everybody else, can make mistakes. A common mistake is to think you want a certain artifact or technology, when your real needs can be satisfied in simpler, less expensive or less risky ways. Another common mistake is to want a lot more than you can afford.

If these types of mistakes are not remedied, a very unstable competitive situation may result. It is even possible that the contractor most likely to fail will be the one who is awarded the contract. That is unfortunate for the other bidders, but most of all for the customer.

If you uncover customer mistakes, it is usually in your best interests to proactively educate the customer away from them, that is, to show and convince him of a better way to go. Of course, this must be done in a professional manner, with respect and courtesy. If the customer is not willing to be convinced, you must assume that he knows what he needs at least as well as you do, and your focus must be on what he wants.

The benefits of educating the customer away from mistakes may include:

- A bias in favor of your proposal because you helped him avoid future problems

- Lower project risks, with corresponding improved probability of project success.

Make the team aware of affordability. It has already been noted that knowledge of what the customer wants should be widely diffused among team members. The same can be said of knowledge of what the customer can afford. This knowledge will reduce the possibility that team members will lock in an overly expensive decision that will be hard to undo.

Wide distribution and frequent reviews of this information will tend to make every team member stop and analyze cost before making any important decisions. Affordability goals should be established not just for the project as a whole, but also for its major parts. Establishing goals for the third level of the work breakdown structure is usually reasonable and appropriate.

3. Bulletproof your proposal

Follow principles of affordable design. The notion of minimal design is a key principle of D / PTW. The basic idea is to give the customer just what he wants and little or nothing more. As previously discussed, maximum knowledge about what the customer wants comes not just from reading the RFQ, but also from staying close to the customer's decision-makers, and helping them shape the project requirements.

Perhaps the most powerful tool for achieving a minimal design is functional analysis, a mainstay of value engineering. A functional statement about a product or service typically is a verb followed by a noun. A simple and instructive example is a lady's purse. Suppose we agree that a reasonable principal functional statement for a lady's purse is "hold small junk." We next ask, what is the cheapest known way to fulfill this function?

Further suppose, after some investigation (i.e., a trade study), the answer turns out to be "paper sack" at $0.01 each. Does this mean that you give your wife a paper sack for her birthday when she asked for a purse? If you do, it is probably because you did not understand all of her requirements.

In addition to the principal requirement "hold small junk," there usually will be other secondary requirements. One might be "repel water." Suppose this can be met with a $0.10 plastic bag. You consider giving a plastic bag to your wife, but your instincts warn you that you need to further explore her requirements.

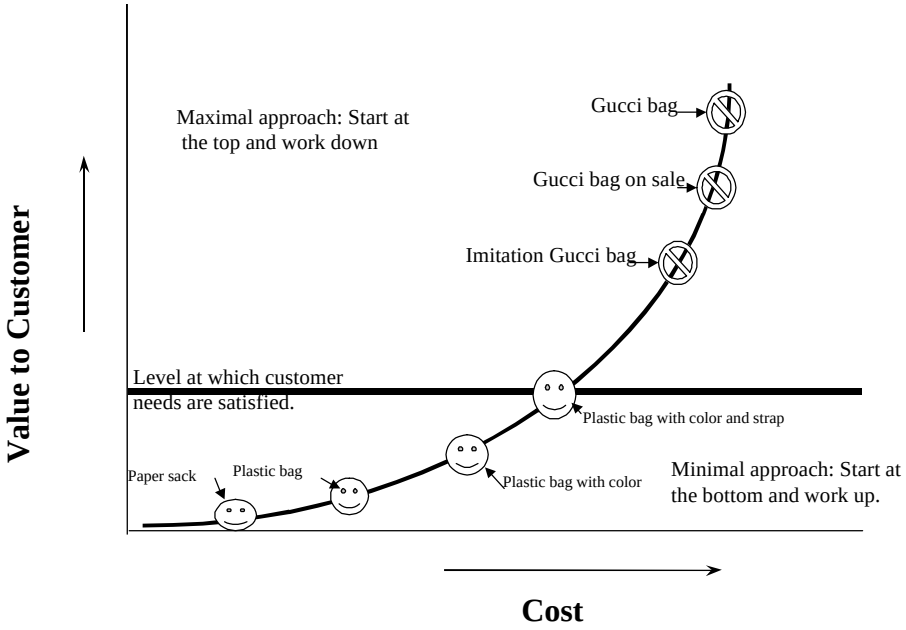
You find that another requirement is "have color." This, it turns out, makes the plastic bag cost $0.15. Upon further exploration of the requirements, you find that another one is

"have strap." You determine through trade studies that you can meet this requirement and all of the others, for $0.25.

Having met all of you wife's requirements, you buy the colored plastic bag with a strap for $0.25 and present it to her for her birthday. She is happy because your family is on a very tight budget, and she is saving money for a summer vacation. She will be unhappy only if you have failed to understand a true requirement. To avoid missing one, it is clearly important that you begin an early dialog with her, and help her shape the requirements.

The foregoing is a simple example of the minimal design process. It involves creating valid primary and secondary functional descriptions of the product, using feedback from the customer. It involves cost analysis and research (i.e., trade studies) to determine the cheapest way to reliably and credibly fulfill the function. It works up from the cheapest possible way, adding costs incrementally only when necessary to fill a requirement. It tends to result in the overall cheapest way to meet the customer's requirements.

A bid that is based on the minimal design approach will most likely "blow away" a bid based on the more usual approach followed in many firms. That might be called the maximal approach.



Let's continue with the purse example. In the maximal approach, your wife has said she needs to have a way to carry all of her small junk. You decide that your wife should have a Gucci purse. You determine that a really nice one has a regular price of $85. Knowing that this unaffordable, you look for purses on sale. That gets the price down by 20%. Then, you look for a more basic Gucci purse that does not have all of the features of the first one you liked. You get the price down another 10%. After continued struggle with the problem, the cheapest Gucci purse you can find is $50, and you're not even sure it's a genuine Gucci.

Your cost is still far higher than the cost based on a minimal design approach. You wind up being unable to give your wife a purse because you can't afford it.[4]

The figure above makes clear the differences between the minimal and maximal design approaches.

Create efficient designs. The starting point for an efficient design is to use the minimal design approach, as discussed above. But that is not always enough. Here is an example of why. Suppose you have determined that your customer's wants will be satisfied with a minimal design laptop computer that you estimate will cost $550 to build. You will win out against any competitor who offers essentially the same functionality for $650. But it may be that some other competitor offers that functionality for $490. Then he will win out over you.

The difference, it turns out, is that the competitor who can do it for $490 has created a design that can be built with less labor. His design is more efficient than yours in the sense that it is more in tune with efficient manufacturing processes. This competitor has considered "design for manufacturabilty" (DFM) and you have not.

Design for manufacturability is a process by which designs are crafted so that they can be manufactured at minimum cost. Such designs minimize what must be done by hand or with expensive materials. Snap into place replaces screw down with many fasteners. Testing is automated. Parts counts are minimized.

Many expensive and risky projects today are concerned only with the development of software. Design for manufacturability is not a consideration, because there is no hardware to manufacture. The closest equivalent to DFM in the software world is probably function point analysis. Function points are features of the software that meet

[4] Some readers may ask, "But what if my wife really wants a Gucci purse?" The answer is, if it's affordable, get her one. If it's not affordable, you have the somewhat thankless (but necessary) task of educating her as to what is affordable and what is not.

specific customer wants.[5] They are strong drivers of both effort and schedule in software development. Through function point counting, you can show your customer how his wants relate to costs. And you can conduct trades studies that lead to minimal designs.

A current trend in software development that must not be overlooked by astute proposal teams is the re-use of existing code and commercial off the shelf software (COTS) to avoid software development costs. These options are not cost free, and in a few instances may be more expensive than developing code from scratch. But used judiciously, they can cut development costs and schedule considerably.

Test costs as your customer will. The customer must perceive the bidder's price as being realistic. If it is not so perceived, the customer may arbitrarily add risk money to it before forming his judgments on affordability and relative value. Feeling compelled to add a large amount of risk money to a bidder's price will reduce the customer's confidence in the bidder.

While it is important for the bidder to have a credible price, it is even more important that the customer perceives it as credible. If it known that the customer tends to use certain techniques to test a price, then the bidder should pre-test his price using those same techniques.

War game for improved competitiveness. In most worthwhile bidding situations there are one or two, sometimes more, strong competitors who potentially have a good chance of winning. The identities of at least the one or two strongest competitors can usually be determined from bidder lists, press releases, or other sources.

Once the credible competitors are known, their design approaches can often be inferred from their known strengths and experience. If they are known to be strongly competitive, as demonstrated by winning a high percentage of the work they bid, all ethically available sources of information relating to their intentions should be pursued.

If the proposal team has sufficient resources, it should consider "war gaming" what the lead competitors might do, and testing strategies for countering it. War gaming exercises tend to make a proposal more competitive because they uncover strengths and weaknesses that might otherwise be overlooked. War gaming is actually a form of trade study; it is done at the "strategic" (i.e., project bidding) level, as opposed to the "tactical" (i.e., design) level.

[5] Formal, reliable rules for counting function points have been developed and are maintained by the International Function Point Users Group.

Honestly appraise risks. If your customer is sharing the project risks with you, and especially if he is assuming most or all of them, he has a right to your fair and honest assessment of them as a part of your proposal.[6] Your assessment should address not only the residual risks that are still to be dealt with, but also the risks you are confident have already been mitigated.

Discussion of risks already successfully dealt with is important because otherwise the customer may think they still exist. It is important for him to know that you have already "fixed" them. Not knowing that may cause him to feel he must add risk money to your price.

The risks you have already avoided include those that are known to be inherent in the probable design approaches of your competitors, if they differ from your approach. It is fair to gently remind your customer of these. Residual risks should be addressed frankly and realistically. If your analysis shows signs of hubris or false optimism, you customer may well detect that and penalize you for it.

Mostly we think of risks in terms of things that can go wrong. But as every businessman knows, a successful business is the result of risks that went right. These we call opportunities. If your design approach includes significant opportunities, these should be pointed out in your proposal. This can have the beneficial effect of psychologically offsetting the "bad" risks you disclose to your customer.

There is a long-standing argument as to whether there is value in quantifying risks. The alternative is to simply list them in what you believe to be rank order of importance.[7] Experience has shown that risks can be badly managed whether they are quantified or not, and they can be well managed whether they are quantified or not. The really important thing is to have a good understanding of:

- Their relative likelihood, either in a rank order sense or in a quantitative sense

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[6] Proposal managers are understandably nervous about being honest with the customer about risks. They feel this puts them at a disadvantage vis-à-vis competitors, who may not be so honest. In truth, this can happen. What can also happen, if the stage is properly set for it (as part of staying close to the customer), is that the customer will appreciate an honest appraisal of the risks. Also, competitor dishonesty about risks can often be offset by discussing you competitor's risks in your own proposal.

[7] You should of course quantify if your customer requests it. You should also quantify if your project team has been trained to think that way and you have a reasonable, valid process for doing it. An advantage to quantification is that it tends to provide justification for expenditure of risk mitigation money. A disadvantage is that it requires at least one project team member who has the tools and special statistical knowledge to do it.

- Their possible impacts on the project, in terms of potential failures to fulfill customer wants, or to potential overruns of cost or schedule (it is best to at least roughly quantify these if you can)
- What it would take to mitigate them, wholly or in part (it may not be realistically possible to mitigate some of them).

With these understandings, you can write a realistic risk management plan. On any major proposal, such a plan should be a part of the management plan in your proposal, whether or not your customer asks for it. It provides assurance to the customer that you are "on top" of the situation, and his chances of a failed project are minimal.

The nature of project risk is such that plans to mitigate it are themselves risky. They may fail. But if they fail because the plan has not been diligently executed, both you and your customer will suffer consequences. Included in your consequences will be damage to your reputation as a project team. It will help your proposal if you can include evidence of your likely diligence in executing your risk management plan. One piece of evidence might be that you have done so previously in other projects. If that is unavailable, an appropriately worded policy memorandum is helpful.

How SEER Tools Can Help Execute the D / PTW Strategy

Summary of the D / PTW Strategy. To fully understand how the SEER tools can help the D / PTW strategy, it is necessary to have that strategy clearly in mind. It has been discussed in some detail in the previous sections; the following is a concise summary of it:

- **Know what your customer wants**
  - ◊ Get close to your customer early enough to help shape the requirements
  - ◊ Know who the key decision makers are and stay close to them
  - ◊ Create a weighted list of customer wants, and update it as necessary; be sure everyone on the project team has a copy
  - ◊ Conduct and document as many trade studies as you can think of to assure that you are giving your customer the best alternative, in the context of minimal design
- **Know what your customer can afford to pay**
  - ◊ Consider that affordability is probably a risk range, not just a number
  - ◊ Be sure that the principal wants of the customer and the corresponding costs are not grossly out of balance (if they are, the tendency will be toward an unstable bidding process and a volatile, risky project)
  - ◊ If your customer is making or tending toward any mistakes, politely educate him
  - ◊ Be sure that everyone on the project team is aware of the affordability constraints; everyone on the project team should have a copy of them, allocated to at least the third level of the work breakdown structure
- **Bulletproof your proposal**
  - ◊ Follow principles of minimal design
  - ◊ Design all hardware for ease of manufacture; develop all software using your most efficient processes, including function point counting
  - ◊ Test your cost estimates using the same methods your customer will use
  - ◊ War game your proposal to increase the probability that you will defeat the competition
  - ◊ Tell your customer what risks you have already mitigated, and how you did it; also tell him what risks you think remain, and how you expect to deal with them in the future. Don't forget to mention your competitors' risks, especially if they exceed your own.

Functionality of the SEER tools. Galorath Incorporated offers four tools for managing projects. Their functionality is briefly described here. They are:

- **SEER-SEM**™, for managing software development projects, and subsequent software maintenance.

- **SEER-H**™, for managing hardware development and production projects, and subsequent operations and support.
- **SEER-DFM**™, For production process trades studies for hardware manufacturing.
- **SEER-IC**™, for development and production of integrated circuits.

All four models are "parametric" models. That is, all estimates produced by the models are based on product, team, and environmental parameters, as opposed to bottom up estimates made by project team members based on their individual judgments.

One advantage of parametric models is that estimates that would take a proposal team days, or even weeks, to make bottom up can be done by a single analyst in a matter of hours. Of course, the analyst must have knowledge of certain parameter values. Much of this knowledge may come from interviewing proposal team members.

The parameters in SEER models are arranged in a special hierarchy that simplifies the work of obtaining estimates early in the project. This special hierarchy makes possible rapid trades studies. Here is how it works:

- About five or so "general" parameters called "knowledge bases" are set first by the user. These parameters have been carefully selected by Galorath Incorporated so that their appropriate settings are almost always known (or can be decided) very early in a proposal. The settings for knowledge bases typically include such information as what the product will be used for, what will be the use environment, what primary specification governs the development, and how the product will be acquired.
- One (or a few) primary "sizing" parameters must be set. For example, for software one possible primary sizing parameter is function point count. Another is estimated lines of code to be produced. For mechanical hardware in SEER-H™, the primary sizing parameter is estimated product weight. For electronic hardware, it is printed circuit board count.
- Setting the knowledge bases causes SEER models to automatically set default values for a list of secondary parameters. The default settings are functions of the knowledge base settings. The secondary parameters characteristically concern such matters as competence of the project team, manufacturing capability, and project working environment.
- Equipped with the knowledge base settings, the corresponding secondary parameter default settings, and the primary size setting, the SEER tool automatically produces "industry norm" cost and other estimates, including risks.
- Inspection of the default (i.e., knowledge base) parameter settings by the proposal team may lead the team to believe that those settings are inappropriate for their particular situation. They then adjust these settings to more appropriate values to further refine the estimates.

Various uses of the SEER models in execution of a D / PTW strategy are illustrated in the subsequent sections of this paper.

Helping shape the requirements. By staying close to the customer, and helping shape the requirements, a bidder can assure that his particular expertise does not get overlooked as a potential solution to the customer's problem. But perhaps just as importantly, the bidder can help assure that the requirements, as ultimately stated in the RFP, do not inevitably lead to a design solution the customer cannot afford.

The SEER tools can be used by a prospective bidder to track the current cost baseline of his approach to the customer's problem, for comparison to the range of funding the customer has available. By doing this from the very earliest stages of the proposal, the prospective bidder can always maintain awareness of the consistency of his approach with customer wants and ability to pay.

Conducting trade studies. Trade studies are a powerful way to use the SEER tools. Even before a proposal team has detailed product information, it can estimate industry norms for various design alternatives using "knowledge base only" estimates. These early estimates, even if not very accurate, can distinguish high cost approaches from low cost ones.

Using the Quick Estimate Report for Trade Studies

Quick Estimate

CSCI: COTS Software Integration

	Estimate	Reference	Diff.
Development Schedule Months	5.63	4.70	20%
Development Effort Months	3.03	1.77	71%
Development Base Year Cost	49,016	28,595	71%
Defect Prediction	1	1	0%
Constraints	MIN TIME	MIN TIME	

The SEER-H™ tool is well adapted to the task of helping find a minimal design from the earliest days of the proposal, because it requires so little information. SEER-DFM™ can be used to examine manufacturing options, to identify and avoid inefficient manufacturing approaches, once the product can be visualized in the form of preliminary drawings or sketches.

For software development, a frequent trade is between building software from scratch, and modifying pre-existing code. This is a trade that can go either way, depending on circumstances. The SEER-SEM™ model can quantify these circumstances, and help you make the right decision. Another frequent trade is to use COTS to obtain part of the desired functionality. Using COTS is often cheaper than developing code from scratch, but it is not free, and after careful analysis using SEER-SEM™, costs of implementing COTS may turn out to be much higher than would otherwise be expected.

Balancing customer wants and costs. The SEER tools cannot tell you what your customer wants, or the relative value of various elements of the desired product. Only your customer can do that. But the SEER tools can give you a reasonably accurate idea, even early in the design process, of what the corresponding costs will be. They will help you build a table of relative wants versus costs, as previously described in this paper.

The general approach is to begin by breaking down the desired product into a list of the principal wants of your customer. For each of these, use a SEER tool to estimate cost, then convert each cost into a percentage of the whole.

If a relative costs substantially exceed the relative value, that is a clue that the customer may be unaware of the internal stresses created in the project by wanting something that may be unaffordable. These situations should be explored with the customer, to determine what his true priorities are.

Educating your customer away from mistakes. A logically founded, well thought out estimate produced by a SEER tool may be a convincing factor in persuading your customer he is going down the wrong path. The SEER tools are widely respected for their ability to provide credible estimates in a variety of situations.

Making the team aware of affordability. The proposal team members should each have a copy of a document that shows the minimum amount the customer is believed to be able to afford, with the total amount allocated down to at least the third level of the work breakdown structure. The total comes from the customer, but the allocations to lower levels can be made with the aid of the SEER tools.

The process of making downward allocations tends to be an iterative one. Allocations may need to change over time as more becomes known. The allocations should consider the relative risk involved with each element of the product. The SEER tools estimate risks and costs simultaneously.

Bids from suppliers should not be accepted at face values unless they are known to be highly competitive. The SEER tools can evaluate a supplier's price, and can often assist you in negotiating a better one.

Following principles of affordable design. The search for the lowest cost way to perform a given function frequently leads to a review of vendor catalogs, and that approach often is successful. But sometimes vendors have not yet perceived any profitability in providing the particular functionality that you need. In that case, you will

need to brainstorm solutions. The SEER tools are natural allies of the brainstorming approach to functional analysis.

SEER-DFM is especially valuable as tool for finding lower cost solutions to hardware problems. If you can visualize a design solution that uses any of dozens of manufacturing processes, you can describe the manufacturing process, and the materials, in SEER-DFM and obtain an accurate cost estimate.

Creating efficient designs. SEER-DFM also helps find the most efficient manufacturing processes for hardware. You have not truly found the lowest cost way of achieving a given functionality until you have also found the cheapest way to manufacture it. Your design must be such that it can be manufactured efficiently, in accordance with the principles of design for manufacturability.

Testing costs as your customer will. Your customer may test your costs in a variety of ways. Often, he will make those ways known voluntarily. If not, he sometimes will be willing to answer a direct question about the matter.

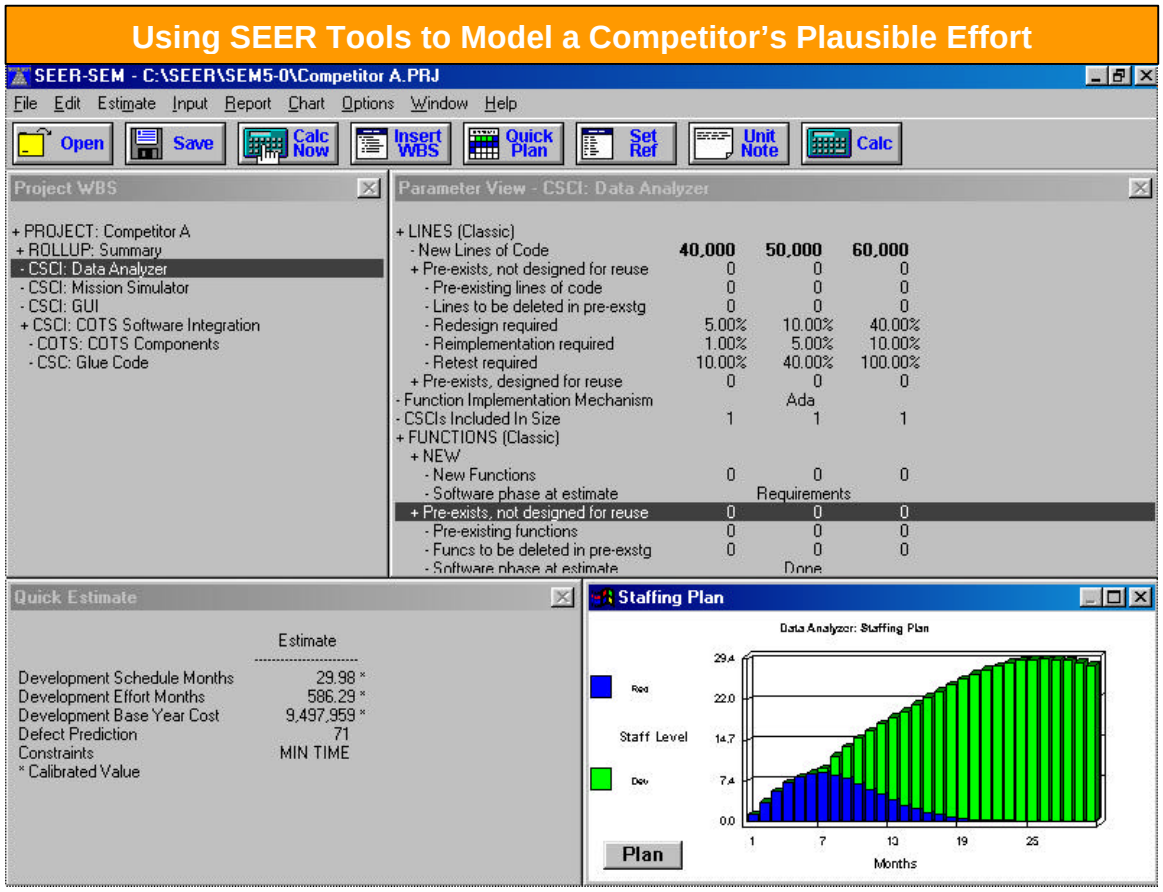
It is in your best interests to test your costs using all of the methods that you know your customer will use. Very often you will find that your customer intends to use one or more of the SEER models to evaluate your costs. If that is the case, you should conduct tests that are as nearly the same as his tests as you can, and long before he does. This will tend to flush out any problems your customer is likely to uncover, and give you time to fix them.

If you know that your customer intends to use SEER tools to evaluate your costs, you may want to volunteer the use of your SEER files. Or, your customer may specifically ask for them. It is always wise and best practice to annotate your SEER files with all ground rules and assumptions. But if your customer is going to see them, consider it *mandatory* to do this. Otherwise, your customer may arrive at a much different number than you do.

War gaming for improved competitiveness. War gaming, in the context of competitive bidding, can be defined as trying to anticipate all likely strategies of your credible competitors, and trying to counter them. War gaming is likely to be a useful activity if and only if you have stayed close to your customer and have followed principles of minimal design. If you have not, you may not win, regardless of how much war gaming you do.

Because you cannot be ethically privy to your competitors' deepest secrets, you must infer what he is likely to do based on public knowledge of past and current behavior, and observation through as many eyes and ears as possible.

Recall the premise underlying this paper, as stated earlier: the winner of a bidding competition in today's defense industry environment will be the bidder who convinces the customer that he can best satisfy the customer's wants at a price the customer can afford. War gaming attempts to estimate how well competitors can satisfy customer wants, and whether or not the approaches they propose will be affordable. This implies attempting to learn the design approach(es) you competition will use, then estimating their costs. It is in the cost estimation that SEER tools can help you.

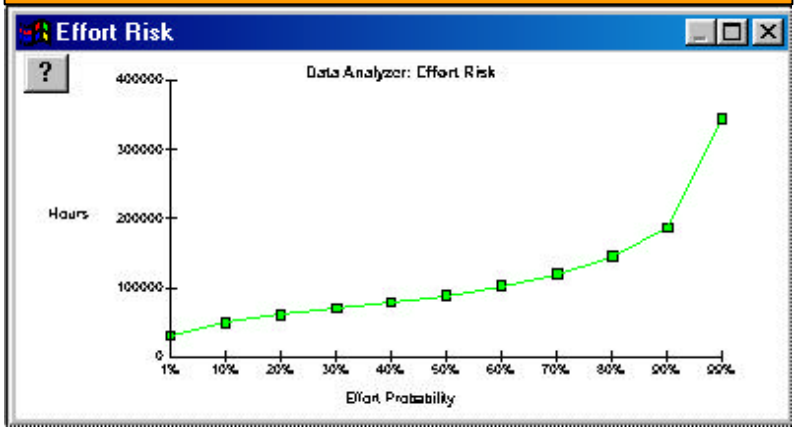


Because of their structure, as previously explained, SEER tools can make estimates with little information. The required information can be as little as a few knowledge base settings, and a setting for a primary sizing driver. As new information becomes available, the estimates can be further refined by adjusting secondary parameters. This unique structure makes it feasible to perform analyses of competitor costs that would never be attempted otherwise.

Because of the relatively large number of secondary parameters, SEER models tend to be able to use most of the information about a competitor that you are able to dig out. For example, if a competitor is located in an area where certain critical skills are in short supply, he may be forced to use recent graduates for many design tasks. If you know this to be true, or at least very likely, a SEER model of your competitor's offering can take this into account.

Honestly appraising risks. If you decide you are comfortable with discussing project risks with your customer, SEER tools can provide you with risk assessments at all levels of the work breakdown structure. Risk assessment is inherent in the way SEER tools structure estimates. Most parameters you set in a SEER estimate can be set at three different values, reflecting minimum, most likely, and maximum values. These settings allow SEER tools to develop risk profiles.

Typical SEER Risk Profile



The SEER risk profiles plot risk (effort, cost, schedule, or defects) at various levels of the work breakdown structure. These plots are essentially cumulative distribution functions with outcome on the vertical axis, and probability on the horizontal axis. The probability values represent the probability of the plotted outcome *or less* occurring.

If you estimate competitor costs, you can also concurrently estimate competitor risks. That added knowledge better prepares you to understand what your customer is likely to do in a bidding situation.

Summary

This paper has described a design / price to win strategy based on understanding what your customer wants, finding the minimal design solution for providing it, and bulletproofing your proposal to lock out your competitors. The paper shows how this strategy can be substantially augmented using Galorath's SEER tools.

The strategy is designed to be ultra competitive, and many project teams may find it difficult to think and act in such an aggressively competitive manner. Galorath Incorporated would be glad to provide or recommend support to any team interested in learning to use this approach. Support can be tailored to the team's needs.