Standing on Principle[1]

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You may be asked to cut corners on the quality of the work you do or the way you do it. Sometimes, the person making the request is a manager who doesn't appreciate the value of the quality activities you practice, or someone who feels budget and schedule pressures you may not. Sometimes, it is a customer who wants you to address only her specific needs, even though you have identified an opportunity to generalize beyond her requirements to provide enhanced value to a broader user community within your own company. Customers and managers alike may press you to skip key engineering steps from time to time. It would be nice to think we are beyond the stage of "don't bother with those specs, start writing code," but this call of the software dinosaur still echoes throughout the land.

It's not easy to resist these pressures from the people who pay the bill or your salary. Sometimes you have no choice: Do what is asked of you, or head out the door. But people working in a quality-oriented software engineering culture will do their best to follow established and intelligent practices in times of crisis, as well as in normal times. Developers and managers must adopt personal standards that motivate them to stick to their software process guns in the heat of battle. You might need to temper this idealism with the reality of keeping your job, but start from the position of quality being paramount. Whenever a situation arises that calls for a value judgment, an ethical decision, or a choice between doing what is right and doing what you are asked to do, remember this principle: Never let your boss or your customer talk you into doing a bad job.

Integrity and Intelligence: With Customers

Perhaps it sounds like heresy, but the customer is not always right; however, the customer always has a point. Too often, software developers incorporate every feature requested by a customer into a requirements specification without regard to how much effort it will take to implement, or whether it is truly necessary to achieve the customer's objectives. While you must respect the attitudes and requests made by every customer, don't be blinded by the notion that you are hearing the "voice of the customer" and therefore must do whatever that voice says. Much of the value that a systems analyst adds to the application development process comes from looking for solutions that address the true user needs with creativity, efficiency, and thoughtfulness.

Some years ago, our software group at Kodak developed a PC-based system for controlling some lab equipment. The customers asked us to write a pop-up calculator program the users could invoke while they were running the program (this was before the advent of windowing systems that made such features commonplace). After a little thought, we concluded it would be

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cheaper simply to buy a basic calculator for each of the hundred-odd anticipated users and slap one on the side of each monitor with a piece of Velcro®. The customer need was for a calculator function—it didn't really have to be built into the software. That was just a cute, but unnecessarily expensive, solution the customer envisioned. There are two lessons here:

> **Look past the customer's request for a feature to find the underlying real need; and, look for simple and cheap solutions for the real need, not just the solution that the customer initially requested or one that looks neat.**

Everyone is subject to tunnel vision. Customers think in terms of what functions they personally will use in the application, not those that should be included because of their potential value to other users. We ran into this situation on another project, which was requested by one area of the research laboratories at Kodak. Not surprisingly, the primary customer representative focused on the needs of the community she represented. However, the analyst spotted several places where the application could be made more generally useful without a lot of extra effort, thereby meeting the needs of other research departments.

This customer rep was reluctant to have us spend the extra time building in these generalizations. However, we felt they would enable Kodak to leverage the investment in this custom software over a broader internal user community. So, we went ahead and designed the system to incorporate these generalizations. In this case, we were willing to incur the unhappiness of the primary customer, because we were doing the right thing for the company. If her department had declined to pay for the extra work required for the more general solution, we would have funded it in some other appropriate way. The lesson here is

> **Look beyond the local interests of the primary customers to see whether you can easily generalize an application to meet a broader need.**

This rationale also applies to the identification of potentially reusable components in the course of application design. It will always take more time to design, implement, and verify a reusable component than to code a custom solution for one project. Think of designing for reuse as an investment you can cash in on multiple future projects, for the good of the company. Don't let resistance by your customer or your manager inhibit you from making smart strategic decisions.

Occasionally, you may encounter a customer who is a self-styled software engineer and who therefore wishes to provide a lot of technical input into how you design his application. This is usually a case of someone having just enough knowledge to be dangerous. The project leader must resist letting such customers become technically involved in design and implementation (unless, of course, the customer really *does* know what he's doing). Focus his energy on the requirements, or get him involved with testing and writing user aids, but do not let the customer drive the technical aspects of the project. The rule to remember is

> **Make sure you know where the customer's software expertise stops. Do not allow the customer to intimidate you into making poor design decisions.**

Developers must base their relationships with customers on mutual trust and respect. We expect our customers to be forthright with us about their requirements and constraints, and they expect us to be straight with them on cost and schedule. Conversely, when customers come to developers with changes in the established requirements baseline, we have to make sure they understand the impact of the changes they are requesting. New or modified requirements may not look so attractive once the customers know the cost, in terms of dollars or delivery time, of a late

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change. By the same token, if schedules slip as the project progresses, the customers have to be kept informed, even if they don't want to hear it.

I know of one developer who had originally promised to deliver a new application in October. He fell behind on the project, and as of September, it was clear that several months of work remained to be done. Unfortunately, the developer had not updated his delivery estimate with the customers: They still expected the system to be ready in October. We had to do some quick expectation management. As you might expect, the customers weren't happy about the "sudden" change in schedule. This developer didn't think about this principle:

> **Be honest with your customers. The project stakeholders are entitled to accurate information, whether or not it is good news.**

Do you ever say you will do something and then never get around to it? I feel this reflects a lack of personal integrity. Follow through on the commitments you have made. However, if something changes—you decided you won't do it, or you are unable to do it on time for whatever reason—talk about it! There are many reasons, some good and others not so good, why you might not be able to fulfill a commitment, but it is irresponsible not to notify those affected by your decision. So long as you are open about a problem, you can work out a solution. The message is this:

> **If you agree to a commitment, the other people involved expect you to do it. If anything changes, let them know as soon as you can, so you can work out an alternative.**

As a manager, I told my team members it was their right and their responsibility to tell me when their backlog pile became too high. Then it was *my* responsibility to help them deal with the pile. When I asked them to take on a new task, it was completely acceptable for them to reply, "Sure, I can do that, Karl. What would you like me to stop doing to free up the necessary time?" Until they told me the pile was too high, I had no way of knowing that this was the case. Naomi Karten suggests reasons and ways to "just say whoa" [1].

Integrity and Intelligence: With Managers

A colleague was once asked by a manager to estimate the delivery time for a planned large software application. He replied, "Two years." The manager said, "No, that's too long. How about six months?" My colleague’s response was, "Okay."

Wrong answer! What changed in the five seconds that elapsed between his first estimate of two years, and his second statement, agreeing to a schedule only one-quarter as long? Nothing, except that he thought the manager wanted to believe that six months was feasible. The project did not suddenly shrink by 75 percent, nor did the available staff increase four-fold or instantly become four times as productive. The project was not reestimated based on an improved algorithm. My colleague simply said what the manager wanted to hear, undermining his own credibility as a software estimator and project leader. To no one's surprise, the project extended beyond two years. Agreeing to unattainable commitments is unprofessional and unfair to all involved, including yourself.

How should this all-too-common situation have been handled? Here are a few approaches to try; there is no guarantee that any of them will work with unreasonable managers or customers, but try them first before caving in.

1. Explain your estimating method to the manager, and ask on what basis the manager's estimate is smaller. The manager may not really have an estimate, but he has a goal. You may not have an estimate, either, only a guess. It's harder to argue with an estimate based on some analytical, quantitative process than with a number pulled out of thin air. Historical metrics data can help build your case.

2. If you can't provide an accurate estimate because there are no written requirements, offer to provide a more precise estimate after some initial exploration of the project scope and general user requirements.

3. Point out that an estimate made very early in a project can be off by 80 percent or more. Present a range of estimates: best case, most likely, and worst case, with the approximate probability of meeting each one. Presenting a single estimate at the beginning of a sizable project sets an expectation that will persist in people's minds long after the original requirements and assumptions have drastically changed.

4. Negotiate for a larger team, fewer features, phased delivery, or reduced quality as ways to achieve an aggressively accelerated schedule. Make sure the stakeholders understand these trade-offs: They will not get something for nothing.

5. Redo your estimate with some different assumptions of project size, resources, or other factors, to see how close you can come to the manager's shorter goal. Make sure the assumptions are clearly communicated to everyone involved in the decision-making.

6. Make a counteroffer, showing the manager what fraction of the system's functionality realistically could be delivered in six months.

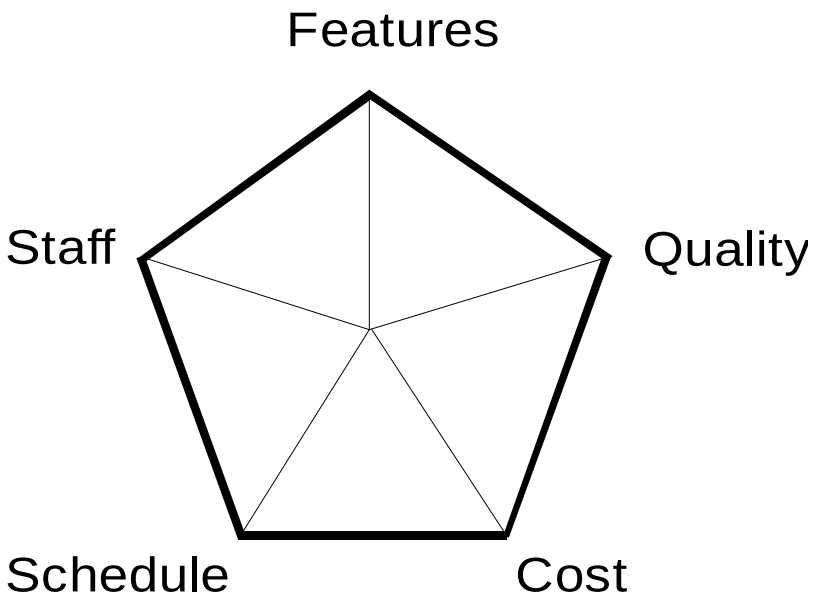
Concealing a project's scope from management is even more irresponsible than agreeing to a schedule you cannot possibly meet. One project leader was leading a long-term reengineering effort, but she never prepared a detailed project plan. She was afraid if her manager found out how extensive (and expensive) the project really was, the manager would squelch it. Both this project leader and her manager acted inappropriately. The project leader should have been forthright about defining the scope of the project and managing it properly, while the manager should have insisted on seeing a project plan and having some accountability. One purpose of project planning is to identify all the tasks that have to be performed to make the project a success. Pretending those tasks aren't there doesn't make them go away.

The Five Dimensions of a Software Project

There are five dimensions that must be managed on a software project: features, quality, cost, schedule, and staff (shown in Fig. 1). These dimensions are not all independent. For example, if you add staff, the schedule may be shortened (although not necessarily), and the cost may increase. A more common trade-off is to shorten the schedule or add features, and sacrifice quality. The trade-offs among these five dimensions are not simple or linear. For each project, we need to decide which dimensions are critical and how to balance the others so we can achieve the key project objectives.

Each of these five dimensions can take one of three roles on any given project: a *driver*, a *constraint*, or a *degree of freedom*. A driver is a key objective of the project. For a product that must ship on time to meet a marketing window of opportunity, schedule is a driver. Commercial desktop software, such as word processors and spreadsheets, are often created with features as the driver.

Figure 1. The five dimensions of a software project.



A constraint is a limiting factor that is not within the project leader's control. If a team of immutably fixed size is assigned to a project, staff becomes a constraint. Cost is a constraint on a project being done under a fixed-price contract, while quality will be a constraint for a project to develop software that runs a piece of medical equipment or an airplane's flight control system. Sometimes, you can regard cost as either a constraint or a driver, since it could be both a primary objective and a limiting factor. Similarly, a specified feature set may be the primary driver of the project, but you could view it as a constraint if the feature set is not negotiable.

Any project dimension that is neither a driver nor a constraint becomes a degree of freedom. These are factors that the project leader can adjust and balance to some extent, to achieve the overall project objectives. For example, on some internal information system projects, the drivers are features and quality, and staff is a constraint, so the degrees of freedom become schedule and cost. The implication for this profile is that the features demanded by the customers will all be included, but the delivery time for the product may be later than desirable.

An important aspect of this model is not which of the five dimensions turn out to be drivers or constraints on any given project, but that the relative priorities of the dimensions be negotiated in advance by the project team, the customers, and management. All five cannot be drivers, and all five cannot be constraints. This negotiation process helps to define the rules and bounds of the project. As in most games, we can play according to any set of rules, but all of the players must understand and agree to the rules that are in effect at any particular time.

A way to classify each dimension into one of the three categories is to think of the amount of flexibility the project leader has with respect to that dimension. A constraint gives the project leader virtually no flexibility, a driver has low flexibility, and a degree of freedom provides a wider

latitude to balance that dimension against the other four. A graphical way to depict this is to use a Kiviat diagram, which allows us to plot several values (five, in this case) as an irregularly shaped polygon on a set of normalized axes. The position of each point on its axis indicates the relative degree of flexibility of that dimension for a particular project, on an arbitrary scale of zero (completely constrained) to ten (complete flexibility).

Figure 2 illustrates a flexibility Kiviat diagram for one of our group's recent applications. This project was constrained to a fixed staff size, so the value plotted on the staff axis is zero. The project was driven to meet a desired schedule, so the point on the schedule axis also has a low value. The project had varying amounts of flexibility around the features that would be incorporated into the initial release, the product quality, and the latitude for cost overruns. Therefore, the values for these degrees of freedom are higher on their axes. As another example, Fig. 3 illustrates a flexibility diagram for a hypothetical project for which quality is a driver and the schedule shows the greatest latitude.

Figure 2. Flexibility diagram for an internal information system.

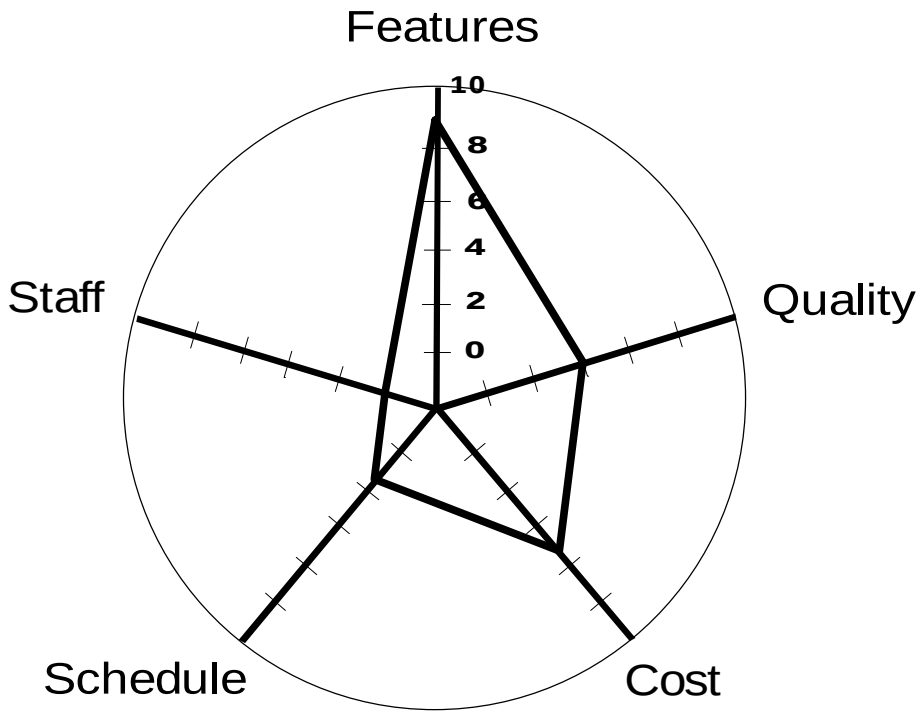
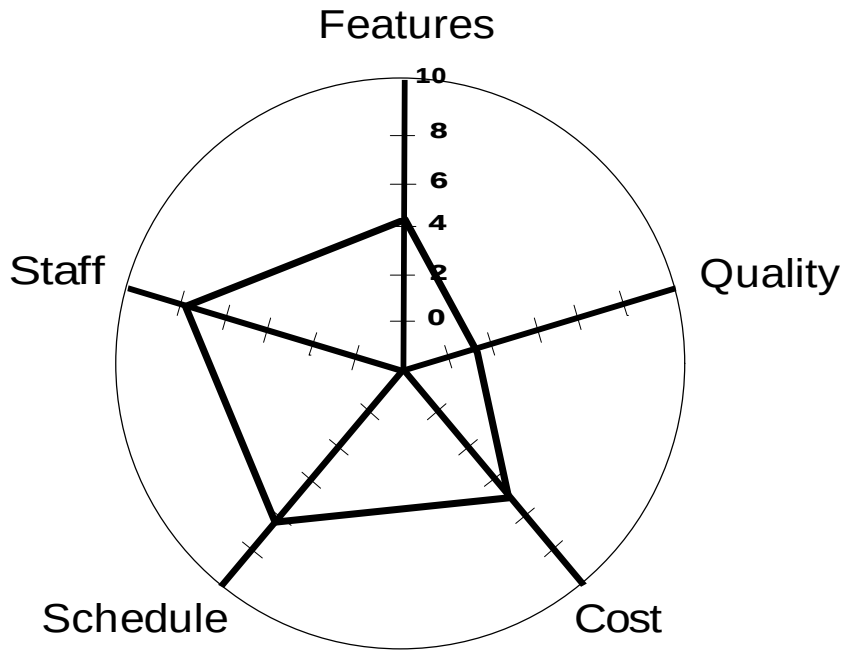


Figure 3. Flexibility diagram for a quality-driven application.



The shapes of the polygons in these examples provide a visual indication of the important aspects of each project. If you push the point on one of the axes inward to reduce the amount of latitude the project leader has in that dimension, you'll generally have to adjust the other dimensions to compensate: Nothing comes without a price. You can apply this sort of analysis to make management aware of the trade-offs and decisions they must make to meet a project's key objectives, and to negotiate realistically achievable commitments on each project. Be sure to document the negotiated goals for driver dimensions, the limits for constraint dimensions, and the range of values associated with those dimensions that are degrees of freedom.

Too often, we focus only on one driver aspect (usually features or schedule), and we overlook the impact on the other dimensions. This is the sort of behavior that leads to those software engineering surprises nobody likes to hear about. Customers, managers, and the marketing department have to accept that they cannot have all the features they want, with no defects, delivered very quickly and at low cost by a downsized development staff.

Another way to apply the five-dimension model is to renegotiate when the world changes. If new requirements come along that simply *must* be included in the upcoming release, ask management what you should adjust to accommodate this request:

- Should other features be deferred?
- Can the schedule be allowed to slip? by how much?
- Can you add staff or pay for overtime to meet the new schedule?

- Or, as usual, does quality slip because sound processes and quality control practices are neglected in the press to ship something—anything—out the door?

The specific answer is less important than the discussion that is triggered when project leaders and developers push back against unexpected changes in any of these five dimensions. Customers and managers have to understand the impact of such changes on the other project dimensions so they can make the right decisions.

One characteristic of both a healthy software engineering culture and a mature software development process is that project expectations and commitments are established through negotiation. To avoid unpleasant surprises late in a project's life cycle, the stakeholders all have to understand and agree on their objectives and priorities. Not everyone may be happy with the outcome of the negotiations, but people can commit to realistic schedules and deliverables only if all the parameters are discussed honestly. Unstated or unrealistic goals will rarely be achieved. A group with a culture in which people are afraid to say no or to discuss problem areas openly will always fall short of expectations [2]. Tools like the flexibility diagram can facilitate these frank, and often difficult, negotiations.

References

1. Karten, Naomi. *Managing Expectations*. New York: Dorset House Publishing, 1994. Karten provides suggestions for working with "people who want more, better, faster, sooner, NOW!" Chapter 11 provides guidance on how to say "No" so it sounds like "Yes."

2. Maguire, Steve. *Debugging the Development Process*. Redmond, Wash.: Microsoft Press, 1994. In Chapter 3, Maguire describes the importance of using goals to drive your decisions, rather than the desire to please everyone who asks for something. He presents several anecdotes that illustrate the importance of saying "No," and the need to rely on one's personal integrity when asked to do something inappropriate.