Robust Criteria for Robust Decisions

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One goal of this short paper is to present a hierarchy of contexts in which decision making can occur. This paper takes the position that an Enterprise Architecture (EA) context enables the highest level of decision-making robustness. Another goal is to present some methods for developing a good set of decision-making criteria.

One hierarchy of contexts in decision making (there are others) includes the following six levels:

- Reactive decision making – also variously referred to as seat-of-the-pants, knee-jerk reaction, or gut-level decision making – relies almost exclusively on feelings and emotions to drive decision making. There is no consideration of relevant data, information, or knowledge. There is no standard series of steps through which the decision maker progresses in order to arrive at a decision. There is no focus on the organization's purpose or direction. There is no coordination or collaboration with other entities or individuals outside the decision maker's line of sight. And there is no enterprise-wide framework that guides the decision maker.
- Knowledge-based decision making – also referred to as rational or data-/information-based decision making – requires the collection, analysis, and interpretation of data, information, and knowledge that pertain to the issue that needs to be decided upon.
- Systematic decision making uses a documented, repeatable process to arrive at decisions.
- Aligned decision making is framed within the context of the organization's purpose, vision, mission, strategies, goals, objectives, plans, programs, projects, routine work and tasks, and performance metrics.
- Integrated decision making takes into account the effect of the potential decision on other parts of the enterprise (departments, programs, projects, processes) and stakeholders both within and external to the enterprise (suppliers, partners, collaborators, customers, employees, competitors, key communities, and society at large). Integrated decision making generally solicits and seriously considers input to the decision-making process from as many of these entities as possible.
- Architected decision making occurs within an enterprise-wide framework – like, for example, an Enterprise Architecture – that takes into consideration all (or, as close to "all" as is humanly possible) facets of the organization and its environment.

Because a decision is only as good as the criteria on which it is based, it is worth spending time consciously developing criteria before effort is devoted to making a decision. Criteria measure how well the alternatives resolve an issue. Often (but not

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always), criteria are captured in project goals and requirements. Research has shown, *inter alia*:

- The more effort put into understanding the criteria early in the process, the better the decision; and
- Too little effort is generally put into understanding criteria.

Thus, the primary goal of this paper is to present methods for generating criteria early in the decision-making process and give ideas about what criteria developing "effort" can lead to better decisions. Before presenting these methods, a little background is needed.

Criteria are needed to determine how well an alternative meets the need and to reveal differences between the alternatives. Let's look at a simplistic example. When I go to a store to buy a bicycle, I do not tell the dealer that one of my criteria for choosing my new ride is that it should have two wheels. All bikes have two wheels, so this criterion doesn't help me choose a bicycle or discriminate among the different models. A clever dealer will help me develop criteria to choose and discriminate among the bikes in the store.

Two examples from my consulting work will help illustrate the concept of *discrimination*. First, a company that required a custom piece of electronic equipment sent a request for proposals (RFP) to its vendors. In it were listed over 60 requirements for physical size, power required, signal conditioning, and so forth. When the company's decision makers received the proposals, they filtered them based on the requirements. Those that didn't meet the requirements were eliminated from consideration. Then came the hard part: figuring out how to discriminate among the remaining acceptable proposals. Unfortunately, the true "discriminating criteria" – i.e., those that could help in selecting the best from among acceptable alternatives – had not been well articulated in the initial set of requirements. Thus, there were no criteria to use to choose among the best proposals.

A second company, one that develops inkjet printers, formed a team to select the ink chemistry for a new delivery system. The team was composed of eighteen people from six different functions in the organization, (e.g., ink chemistry, manufacturing, and image quality). Altogether, they had over 100 requirements that had to be met before they could approve a new ink chemistry. Most of these filtered out inks that couldn't meet their basic needs. Only a few were used to discriminate among the strongest candidates. Developing the discriminating criteria based on the initial list of requirements took team effort, but helped the team develop a shared understanding of the problem and, ultimately, make a decision.

There has been a big push in the last 10-15 years to collect and manage the requirements or specifications for products and needed business decisions. These are generally of the form, "a feature must meet a target." A *feature* (also called an "attribute" or "parameter") is a characteristic of the alternatives that may be important to consider. A *target* is the stated or unstated goal for the feature. Often it is

recommended that the specifications be labeled as "must" or "want." A better classification is that when used as criteria, these requirements are either "filters" or "discriminators." Most requirements or specifications are, therefore, filter criteria that eliminate alternatives from consideration (as in the examples above). It is the discriminating criteria that more directly support decision making. Further, most discriminating criteria are *trade-off criteria* – in other words, you might have to give up some of "X" to get sufficient "Y." (For more detail on trades-offs, see Ullman and Spiegel, 2006.) For example, after the clerk works with me for a few minutes, we ascertain that I want a road bike that weighs less than 14kg (30 lbs) and costs less than $1000. The clerk then shows me a $1,100 bike that weighs 13kg and a $900, 15kg bike. I must trade off cost against weight if I am to choose one of these bikes.

One useful way to manage trade-offs is to set a *delighted* (actual target) value and a *disgusted* (threshold) value. Most methods only develop a single target, but defining two targets from the beginning leads to a better understanding of sensitivity among alternatives. Say, for example, that money is a major constraint and my delighted cost is $900 and my disgusted (threshold) cost is $1000. I am not as critical about weight, so I will be delighted at 14kg and disgusted at 17 kg. The choice between the two bikes is clearer now.

One additional note: Criteria and their targets may be qualitative or quantitative. Although good practice says to measure everything, doing so takes work, time, and knowledge to measure most attributes. In fact, the reason the discriminating criteria are often not made explicit is that they are qualitative and are only realized after the quantitative, filtering criteria are applied. Even the most refined technical disciplines usually use qualitative measures in their decision making.

There are five easy-to-apply methods for finding the discriminating criteria.

<u>Discriminating criteria from requirements or specifications</u>

If you already have a set of requirements or specifications for products and needed business decisions, then this is good starting point. The following steps should help:

- Step 1: Label each requirement as a filter (F) or a discriminating (D) criterion. To do this, ask of each requirement, "Do all alternatives <u>have to meet</u> this requirement?" If the answer is "yes," it is a filter (F); if "no," then it may be a discriminator (D).
- Step 2: Of the remaining requirements ask, "Can success in meeting this requirement be traded off to meet another requirement?" If the answer is "yes," then it may be a discriminator (D).
- Step 3: Of the remaining, unlabeled, requirements revisit Steps 1 and 2 and see if they can be reformulated to either filter or discriminate.
- Step 4: Review the discriminator list and ask, "What measures are still missing?" (Try using the Pro/Con Evaluation method below.)

- Step 5: Try to reduce the list of discriminating criteria to fewer than 10. Most choices amongst the best few alternatives come down to just a few discriminating criteria. See "Criteria for Criteria," below, for some ideas.

Discriminating Criteria from the Issue Description

Often the issue (i.e., the statement, question, or requirement about which a choice is to be made) is poorly defined. If you ask each member of a team, or each stakeholder, to describe the situation needing a decision, you may get a wide variety of statements, or fairly good agreement with varying caveats. One method to manage this situation is to use a variation of the Nominal Group Technique (Sample, 1984): Have each person write down the issue and then work communally to reduce it to a single sentence or question. The goal is agreement (or, at the very least, consensus) on one sentence before accepting it as the true issue. As the issue evolves, note all the caveats. For example, I want a bicycle that is light, good for road trips, is inexpensive, and looks fast. The issue is, "Choose a bicycle." The criteria (at least my initial set of them) focus on weight, roadworthiness, cost, and looks. Each item in the list is a potential discriminating criterion.

- Step 1: Have all members of the team or stakeholders write down what they think the issue is.
- Step 2: Extract all the features (the caveats) mentioned by each.
- Step 3: Work to reduce each issue statement to a single sentence, the list of issue statements to a single issue statement, and the features mentioned to a list of discriminating criteria.
- Step 4: Use the Criteria for Criteria method to refine the list of criteria.

Discriminating Criteria from Pro/Con Evaluations

In a 1772 letter (reprinted in Ullman, 2006) to his nephew, Joseph Priestly (the discoverer of Oxygen), Benjamin Franklin explained how he made decisions using a Pro/Con analysis in situations when he had a choice between two alternatives: Do this, or do something else (including do nothing). Franklin reduces decision making to five steps:

- Step 1: Make two columns on a sheet of paper and label one "Pros" and the other "Cons."
- Step 2: Fill in the columns with all the Pros and Cons of an alternative.
- Step 3: Estimate the importance of each Pro and Con.
- Step 4: Eliminate Pros and Cons this way:
    - When a Pro and a Con are of about equal importance, cross them both out; and

    - Find other importance equalities of Pros and Cons (e.g., the importance of two Pros equals the importance of three Cons), and then strike them all out.
- Step 5: When one or the other column becomes dominant, then "come to the determination accordingly."

You can extend the idea of using Pro/Con lists to include more than two alternatives, but the balancing step becomes increasingly complex with the number of alternatives. Still, NASA frequently uses this approach to help experts evaluate multiple project proposals at once. For each proposal, the experts list their Pros and Cons. They then informally balance the Pros and Cons to differentiate among the alternatives.

It is important to note that each Pro and Con is an application of a criterion to a single alternative. What is fragile here is that, in general, only the most glaring Pros and Cons are listed for each alternative. This means that the assessment may be very uneven and trade-offs not made very clearly. For example, weight may be important when considering one particular bike, but maybe not for another; with the second bike, some other measure may be a more glaring pro or con. But when two bikes are both close to being acceptable choices, it is necessary to trade off among all the discriminating criteria and a Pro/Con list does make this obvious.

To formalize the Pro/Con process and make it useful for discovering discriminating criteria, try the following:

- Step 1: Have each member of the team record Pros and Cons for each alternative (at least their favorites).
- (Step 1 optional): For selected pairs of alternatives, record the Pros and Cons. This pair-wise comparison can help tease out the Pros and Cons.
- Step 2: Identify and list the features being measured in each Pro/Con statement. Read the statement and find the clause that describes the feature or attribute that is the focus of the statement.
- Step 3: Use affinity methods to organize the features. Try to reduce the total number of features to fewer than 10.
- Step 4: For each measure, develop the delighted and disgusted targets. One method to do this is to review the alternatives and, for each feature, list the best value (if quantitative) or the best description (if quantitative). These are the delighted values. Do the same for the disgusted. Do not set your targets outside the rage of delighted/disgusted unless you have convincing proof that new alternatives can perform in the expanded range.
- Step 5: Apply Criteria of Criteria (see below).

<u>Discriminating Criteria from SWOT Analysis</u>

SWOT analyses (Sample, 1984) are often used to support business decisions. SWOT stands for internal Strengths and Weaknesses, and external Opportunities and Threats.

This method gives a refined structure to listing the Pros and Cons. To apply this method, replace Steps 1 and 2 in the Pro/Con technique with:

- Step 1: Have each member of the team record SWOTs for each alternative.
- Step 2: Identify and list the features being measured in each SWOT statement.

Criteria for Criteria

Irrespective of which method you use, apply the following criteria for criteria to help refine your criterion list:

- Does this criterion discriminate? When various alternatives are measured relative to this criterion, will the results differ? If they do, then this criterion discriminates. If not, then the criterion will not help in differentiating among the alternatives.
- Is this criterion independent of the other criteria? If two criteria are dependent, then you may be measuring the same thing twice. A test for independence is: Irrespective of the alternative considered, does a positive response to two criteria always result in the same change in satisfaction for the alternatives? If the answer is "yes," then they are dependent. For example, three alternatives A, B, and C are being evaluated *versus* three criteria 1, 2, and 3 (Table 1). Say that A satisfies criterion 1, and B and C do not. Both A and B satisfy criteria 2 and 3, and C does not. Criterion 1 is differentiating; but 2 and 3 may be dependent, as they provide the same measure on the alternatives. A single, reasonable counterexample to the question (one alternative whose satisfaction relative to the two criteria differs from the others) is sufficient to show independence.

	A	B	C
1	↑	↓	↓
2	↑	↑	↓
3	↑	↑	↓

Table 1: Criteria Dependency Matrix

- Does this criterion measure one thing? If a criterion is measuring more than one feature, it should be broken into multiple criteria. Multiple measures can, however, be combined into a single parameter that measures a significant feature, and this new parameter can be considered as a single measure. For example, in physics, engineering, and economics there are many dimensionless parameters – combinations of multiple measures that are very useful and make good criteria (e.g., NPV, ROI, Mach number, aspect ratio, or decibel).
- Is the criterion universal? A universal criterion characterizes an attribute of *all* the proposed alternatives. If a criterion only applies to some of the alternatives then it is not universal. If not universal, then either it is a poor criterion or the alternatives have features that are not consistent with the issue being addressed.

- Is the criterion positive? Criteria should be stated such that a "yes" response to it indicates a good feature of the alternative.
- Is the criterion important to some of the stakeholders? Generally, most criteria filter out weak alternatives. Only a few are important enough to discriminate among acceptable alternatives. If the criterion is not among the 10 most important, then it should be used as a filter.

Returning to the hierarchy of contexts: Attempting to discuss decision-making criteria in the context of reactive decision making is an exercise in futility. Criteria have no place in this type of decision making. Knowledge-based decision making may or may not make use of criteria. Similarly, systematic decision making may use criteria is a documented, repeatable process … or it may not.

Aligned decision, almost by definition, uses criteria by connecting the decision-making process to organizational purpose, vision, mission, strategies, goals, objectives, plans, programs, projects, routine work and tasks, and performance metrics. Integrated decision making, by considering internal and external factors and "players," comes closest to being a robust, criteria-based decision-making context. But still, aligned and integrated decision making may not make the most of criteria; consequently, the decision making process may not be as robust as possible.

Architected decision making – within, say, an Enterprise Architecture framework – is the context that enables the most robust criteria-based decision making. Framing decisions within a holistic context of the enterprise's people, processes, technology, leadership/ management infrastructure, and change-management approach, and *forcing* decision makers to construct criteria that reflect the totality of the organization's architecture, provides the most promise of robust decision making and decisions.

This paper has illustrated methods for helping to find criteria for robust decisions. What is important to realize is that the requirements developed for a project or product often do not necessarily give a complete and sufficient set of criteria for making decisions. The methods in this paper will help build the foundation for effective decisions.

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