



Ranking Models – Budgeting, Business, and Military Applications

An Online Continuing Education Course for Engineers

Course Number: P-2022

Credit: 2 Hours / 2 PDH / 2 CPD

Ranking Models – Budgeting, Business, and Military Applications

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1.0 Introduction

This course describes several business applications and examples that have used structured decision-making processes to develop a framework for evaluating corporate and government ranking and resource allocation problems. Many of the other courses on this website that were developed by this author have discussed tools, methods, and approaches for developing decision-making frameworks. This course provides some additional examples where these tools can be used and applied in real-world applications.

The examples discussed in this course are examples of business and military applications. The projects describe examples where decision science methods are used primarily for ranking and where these methods are embedded in a broader decision-making framework. A detailed example is provided in a budgeting application model developed for the military. Other decision frameworks are discussed in the areas of Marketing Research Resource Allocation, Line Item Retention and Deletion and Manpower Skill Mix Planning and Resource Allocation, Strategic Planning, and New Product Development. Additionally, several military examples are provided for Officer Selection, Key Asset Protection, and a framework for facility inspection, maintenance, and project prioritization. A brief overview is also provided on the process to develop decision criteria and metrics which are critical to a decision-making framework and used to develop the evaluation structure for these different types of problems.

The following topics will be covered in this course:

- Overview of Developing Decision Criteria and Metrics
- A ranking-driven budgeting and resource allocation example
- A market research resource allocation example
- A line-item retention and deletion example
- A manpower skill mix planning and resource allocation example
- A product research and development example
- An officer selection example
- A key asset protection example
- A facilities maintenance and project prioritization example

2.0 Overview of Developing Decision Criteria and Metrics

This approach to metrics development has been used in many private sector and government evaluations. The approach is to relate metrics directly to the accomplishment of the goals and objectives of the organization. This process requires the management team to critically examine goals and objectives to ensure the decisions directly relate to these objectives. Decision-makers must first establish the goals and objectives and their relative importance in the final decision process. This requires a consensus to be developed across the key decision-makers to articulate corporate priorities and how to measure these priorities in the evaluation process. Group decision-making techniques are also utilized to provide a means for developing the goals and objectives, the decision criteria, and weighing their importance. All the decision-makers should have a say in the final selection decision to ensure objectivity and avoid having dominant personalities overly control the process.

Another course on this website, *Developing the Right Decision Framework*, walks students through this process in detail. A brief overview of these steps is given in this section to provide an explanation of the process. The decision framework is critical to ensure you are solving the right problem and doing so by incorporating the key considerations important to your organization. The steps involved in this time-tested approach follows:

Step 1 Establish overall objectives and goals.

Step 2 Weight the objectives to determine their importance.

Step 3 Select the decision criteria.

Step 4 Weight the criteria to determine their importance.

Step 5 Develop metrics.

Overall, this approach provides a consistent, traceable, and defensible basis for making decisions.

2.1.1 Step 1: Establish Overall Objectives and Goals

The first step is establishing objectives and goals for an organization. Goals and objectives are established, noting their common basis and required common theme to represent these objectives. These objectives are then used in the development of the preliminary metrics schema. The initial cut is continued to be refined until a final set of goals and objectives are established that satisfy the group. Group decision-making techniques are used to gain this consensus.

2.1.2 Step 2: Weight the Objectives to Determine Their Importance

The goals and objectives are then weighted to assess the relative importance of the selected goals and objectives. Group decision-making techniques are also utilized to facilitate this process. A resulting importance weighting scheme is then developed and reviewed with the decision-makers. In each step of the process, the decision-makers must understand and agree to the methodologies used in the process.

2.1.3 Step 3: Select the Decision Criteria

For each of the objectives established in step 1, the group must establish a hierarchy of decision criteria to represent the various objectives. Define the decision criteria so that there is a clear understanding of the criteria used and what metrics will be used to measure the criteria. This definition phase provides the framework for establishing the metrics associated with each of the decision criteria.

Group consensus-building techniques can be used to arrive at the decision criteria that support corporate goals and objectives. It may also be difficult to narrow down those key decision criteria that support accomplishing corporate objectives. However, the discussion and understanding that is developed in this process can be very beneficial to the corporate participants and leaders. The end result will be a focused understanding of what areas of measure are important to the company's success.

The decision criteria should then be defined to ensure that all corporate participants have an accurate understanding of the meaning of the decision criteria. Additionally, the units of measure should be agreed upon by the group. This involves determining the type of data that will be used for evaluation and any scaling associated with the data in the analysis. This provides a clear framework for evaluation for the corporate participants.

2.1.4 Step 4: Weight the Criteria to Determine Their Importance

Team members then weight the criteria established in step 3 for their relative importance in the decision process. Again, use group decision-making techniques to facilitate this process. The team must develop a "first cut" of the decision criteria weights and review and revise their findings to ensure reasonableness.

The resulting criteria weights show how important the team members as a whole viewed each of the individual decision criteria. This information is used further in our evaluation process.

2.1.5 Step 5: Develop Decision Criteria Metrics

From the decision criteria established in step 3, you can identify the metrics. This involves determining what data to use to measure and quantify the decision criteria. The criteria can be either subjective or quantitative in nature. You can measure criteria using "hard," quantitative data, or a subjective scale of the decision-makers. Expert opinion can be subjectively used when objective data is not available or when objective data is too costly or time-consuming to obtain. Again, the group must develop a "first cut" of the decision criteria metrics and review and revise its findings as needed to satisfy the decision-makers.

2.2 Data Used to Support Metrics

You can use either objective or subjective data to represent the metrics used in the decision process. Objective data usually can be described as data that can be quantified by some measure of known commonality. This may be data such as the number of items produced, number of trucks in a location, population of a city, and so on. This data is usually available in some form in company databases and information systems. Typically, statistics such as averages and trends are

generated based on a record of this objective data over some point in time. Objective or quantitative data represents a history of activities of a company that has been operating during a given time period.

Qualitative or subjective data can be easily used in a number of different situations. Surveys are good examples of subjective data used to represent the rating of a product or service. Use scales from 1 to 5 or 1 to 10 to represent high, medium, and low assessments for given metrics. Use assessments such as red, yellow, and green in other situations in which individuals (such as military personnel) might find more meaning in rating conditions. Numerical values with their verbal description provide the type of information that can be captured and utilized in a decision model when other information is not available.

Subjective data is data based on someone's opinion or best guess of a condition or a future event. Subjective data is more qualitative in nature in that it defines a situation or condition without specific data points. Subjective data can be generated by individuals within or outside of a company or experts within a given field of operation.

Typically, subjective data or opinions provide insights into a subjective assessment of a metric. Subjective data and expert opinions are typically forward-looking in nature, trying to predict what will happen in the future. Individuals make assessments based on what has happened in the past and what may happen in the future. Objective data, especially in the form of statistics, however, is based on historical data, thus projecting the future, what has happened in the past, which assumes that the future will behave much like the past. The entire business environment may have changed; thus, what has happened in the past may be a poor representation of the future; thus a new source of data is required.

Following is a simple scale example that you can use to represent the assessment of the future development potential of a given market.

Future Market Potential

Definition: The projection that this market will become a substantial market in future corporate activities.

Highly Probable	5
	4
Moderately Probable	3
	2
Unlikely	1

This type of information is good information to capture from the experts and decision-makers. Utilizing this type of information along with statistics, fills gaps that exist to get a better representation of factors that influence future activities.

In developing goals, decision criteria, and constraints, consider a number of parameters in the development process to ensure a set of well-structured, well-represented goals, and decision criteria. These development parameters are as follows:

- Goals and decision criteria must represent actual and important considerations in making decisions. Examples would include reducing logistics costs, improving call center response times, and so on.
- Decision criteria must differentiate one project from another in terms of higher or lower priority. This would involve capturing key project characteristics that differ among projects, such as impacts to different functional areas, costs, completion time, and so on.
- Decision criteria must be independent, not overlapping in content or intent, to avoid accounting for the same thought or idea more than once. This tends to overweight the importance of certain criteria. Instances may occur in which both a component cost and a total cost are considered. The component cost would overlap with the total cost value.
- Decision criteria must be defined as clearly as possible to ensure that the decision criteria in the evaluation process are viewed in the same context. Individuals have different perspectives associated with various terms and definitions. The definitions must be clear.
- Measures and scales developed for the decision criteria must be meaningful in the evaluation process and the data to perform the evaluation easily accessible. Objective data provides a basis for a relatively clear scale or measure. The use of subjective criteria requires that the scale components are clearly defined and represent a natural language intention and meaning.
- Constraints that represent types of mixes, qualifiers, and conditions that would be applied to a prioritized list of items must be identified and differentiated from the evaluation decision criteria. You must define the operating parameters. This may be a total budget, capacity constraints, and manpower availability. All of these components put bounds around the issue addressed.

2.3 Project Evaluation

The previous section provides a standardized evaluation process and will enable corporate participants to use a standardized process for making decisions. Once the decision criteria, metrics, and the importance weighting have been established, corporate participants can now begin to evaluate their products or projects within the established framework.

Weighting the importance of corporate objectives and decision criteria is accomplished with group consensus weighting. This is also done when evaluating projects and products. Each individual has a voice in the evaluation process, and a group evaluation is generated from these individual evaluation team project evaluations.

2.4 Ranking Models

A prioritization model is used to provide feedback to the evaluation team on the impact of their votes on the project and project prioritization. There are numerous prioritization methodologies that can be applied to a structured decision-making problem. The selection of these methods depends on the nature of the problem, whether or not attributes can compensate for each other and even the timeframe available for the analysis. Two methods that the author frequently uses are the Simple Additive Weighting Method (SAW) and the Technique for Order Preference of Similarity to the Ideal Solution (TOPSIS), based on their ease of use. Numerous other methods exist and can be used in these types of ranking problems. The prioritization process provides the foundation for establishing an objective, structured evaluation, and prioritization which provides the organization with a traceable and defensible basis for decisions.

The example applications described in the following sections use this general framework for the decision-making process and incorporate a ranking algorithm into the overall decision framework. This approach provides for a robust problem set-up and execution and results in defensible solutions.

3.0 Ranking Model Budgeting – Value-Based Budgeting

In this class of budgeting problems, a capability called value-based budgeting was developed. This capability is a budgeting approach that is different than zero-based budgeting, the traditional all or nothing approach to budgeting, or the salami slice approach to cutting budgets. The value-based budgeting approach was developed to assist management in a much more logical budgeting approach for allocating scarce resources.

Value based-budgeting is a capability that can be identified, measured, and funded based on the project's overall value. Projects are ranked based on the project's overall value relative to the total resources (a project's value is compared to the total resources available). Projects are funded to either the maximum level of support or the minimum level of support required, no additional funding is provided. If the number of available resources is less than the resource requirement, no additional resource requirement is provided. If the resource requirement is less than their maximum level of support, the project is funded to the maximum level. Then as budget cuts occur, the project is funded plus ups in the middle of the range. The rank score, which is the similarity to the ideal solution (TOPSIS) rank score, is used to determine the project's rank.

If projects are funded to the maximum level, the salami slice approach provides the total organizational need for resources.

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