



## Ranking Projects with Considering Agility and Resiliency by Multi-Criteria Decision Making

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### ABSTRACT

Project agility and resiliency are two important qualities that can help projects to succeed in uncertain and dynamic environments. Agile projects are able to adapt to change quickly and efficiently, while resilient projects are able to withstand and recover from disruptions. Multi-criteria decision making (MCDM) is a method for evaluating and ranking projects based on multiple criteria. It can be used to rank projects by considering both their agility and resiliency. This paper presents a review of the literature on project agility, resiliency, and MCDM. It also proposes a new MCDM framework for ranking projects with considering agility and resiliency. The framework is applied to a case study of three software projects to demonstrate its feasibility and effectiveness. The results show that the framework can be used to successfully rank projects by considering both their agility and resiliency. This can help organizations to select the projects that are most likely to succeed in uncertain and dynamic environments.

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## 1. Introduction

Project agility and resiliency are two important qualities that can help projects to succeed in uncertain and dynamic environments. Agile projects are able to adapt to change quickly and efficiently, while resilient projects are able to withstand and recover from disruptions.

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Project agility is the ability of a project to adapt to change quickly and efficiently. It is enabled by a number of factors, such as a flexible project design, a strong culture of collaboration, and a commitment to continuous improvement [1].

Project resiliency is the ability of a project to withstand and recover from disruptions. It is enabled by a number of factors, such as a diverse supply chain, a robust risk management plan, and a strong team culture.

Both project agility and resiliency are important for project success. Agile projects are able to adapt to change quickly and efficiently, which is essential in today's rapidly changing world. Resilient projects are able to withstand and recover from disruptions, which is essential in today's uncertain and unpredictable world [2].



**Figure 1:** Pillars of projects.

Multi-criteria decision making (MCDM) is a method for evaluating and ranking projects based on multiple criteria. It can be used to rank projects by considering both their agility and resiliency.

MCDM is a useful tool for ranking projects because it allows decision-makers to consider all of the relevant criteria and to assign weights to the criteria that reflect their relative importance. This

can help decision-makers to make more informed and objective decisions about which projects to select and invest in (see Figure 1) [3].

This research is arranged into five sections. Section 2 defines the literature review and recent studies in area of ranking projects and tries to show the gap in research. Section 3 suggests methodology for calculation. Section 4 proposes the results of this research. Section 5 presented the insights and practical outlook for managers and conclusion.

## **2. Literature review**

Project agility has been defined as the ability of a project to adapt to change quickly and efficiently. It is enabled by a number of factors, such as a flexible project design, a strong culture of collaboration, and a commitment to continuous improvement.

The benefits of project agility have been well-documented. Agile projects are more likely to be completed on time and within budget, and they are more likely to meet the needs of their stakeholders. Agile projects are also more likely to be successful in uncertain and dynamic environments [4-5].

Project resiliency has been defined as the ability of a project to withstand and recover from disruptions. It is enabled by a number of factors, such as a diverse supply chain, a robust risk management plan, and a strong team culture [6-7].

The importance of project resiliency has been growing in recent years, as the world has become more uncertain and unpredictable. Disruptions can come from a variety of sources, such as natural disasters, economic downturns, and technological changes.

Multi-criteria decision making (MCDM) is a method for evaluating and ranking projects based on multiple criteria. It is a useful tool for ranking projects by considering both their agility and resiliency [7-8].

MCDM allows decision-makers to consider all of the relevant criteria and to assign weights to the criteria that reflect their relative importance. This can help decision-makers to make more informed and objective decisions about which projects to select and invest in [6-8].

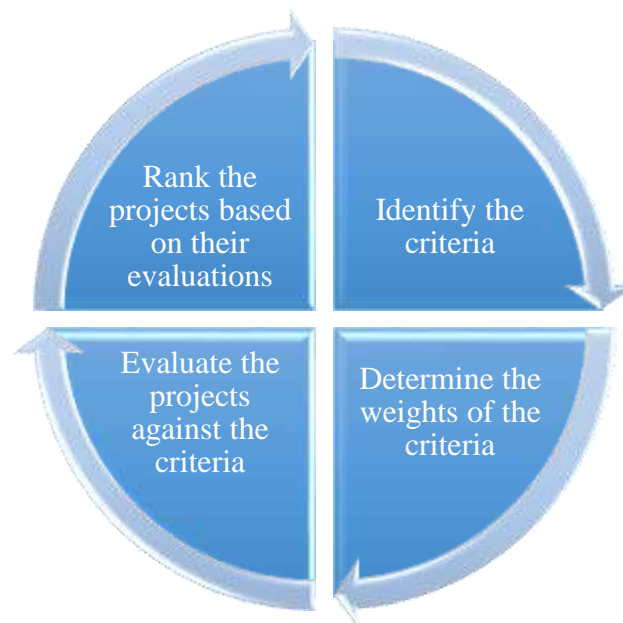
The main contribution and novelty of this research based on the research gaps are as follows:

- Ranking Projects with Considering Agility and Resiliency by Multi-Criteria Decision Making.

### 3. Methodology

The proposed MCDM framework for ranking projects by considering agility and resiliency consists of four steps:

1. Identify the criteria that contribute to project agility and resiliency. This can be done by reviewing the literature, consulting with experts, and interviewing project stakeholders.
2. Determine the weights of the criteria. This can be done using a variety of methods, such as the Delphi method or the analytic hierarchy process (AHP) [11-14].
3. Evaluate the projects against the criteria. This can be done using a variety of methods, such as expert judgment, surveys, or historical data.
4. Rank the projects based on their evaluations. This can be done using a variety of MCDM methods, such as the weighted average method (TOPSIS, VIKOR, COPRAS, MOORA, MABAC and ARAS) (see Figure 2) [9-15].



**Figure 2:** Ranking projects by MCDM.

#### 4. Results and discussion

The criteria to rank projects with considering agility and resiliency can vary depending on the specific organization and the type of projects being ranked. However, some common criteria include:

- **Agility:**
  - Flexible project design: The project design should be flexible and adaptable to change.
  - Strong culture of collaboration: The project team should have a strong culture of collaboration and communication.
  - Commitment to continuous improvement: The project team should be committed to continuous improvement and learning.
- **Resiliency:**
  - Diverse supply chain: The project should have a diverse supply chain to reduce the risk of disruptions.
  - Robust risk management plan: The project should have a robust risk management plan to identify, assess, and mitigate risks.
  - Strong team culture: The project team should have a strong culture of resilience and support.

Other criteria that may be considered when ranking projects with considering agility and resiliency include:

- Project alignment with strategic goals: How well does the project align with the organization's strategic goals?
- Potential return on investment (ROI): What are the potential financial and non-financial benefits of the project?
- Feasibility: Is the project feasible to complete on time, within budget, and to the required quality standards?

- Risk: What are the risks associated with the project, and how can they be mitigated?
- Urgency: How urgent is it to complete the project?
- Resources required: What resources are required to complete the project, and are they available?
- Stakeholder satisfaction: How important is it to satisfy the stakeholders associated with the project?

When ranking projects with considering agility and resiliency, it is important to consider all of the relevant criteria and to assign weights to the criteria that reflect their relative importance. This can be done using a variety of methods, such as the Delphi method or the analytic hierarchy process (AHP).

Once the criteria have been weighted, the projects can be evaluated against the criteria and ranked accordingly. A variety of different MCDM methods can be used to rank the projects, such as the weighted average method, the TOPSIS method, or the VIKOR method.

It is important to note that there is no one-size-fits-all approach to ranking projects with considering agility and resiliency. The best criteria and weights will vary depending on the specific organization and the type of projects being ranked (see Figure 3).



**Figure 3:** Criteria for ranking projects.

The decision matrix based on three scenarios for ranking projects are defined by experts as follow (Table 1, 2).

**Table 1:** Ranking projects.

| Projects  | Agility                 |                                 |                                 | Resiliency           |                             |                     | Project alignment with strategic goals | Potential return on investment (ROI) | Feasibility | Risk | Urgency | Resources required | Stakeholder satisfaction |
|-----------|-------------------------|---------------------------------|---------------------------------|----------------------|-----------------------------|---------------------|--|--------------------------------------|-------------|------|---------|--------------------|--------------------------|
|           | Flexible project design | Strong culture of collaboration | Strong culture of collaboration | Diverse supply chain | Robust risk management plan | Strong team culture |  |                                      |             |      |         |                    |                          |
| Weight    | 0.1                     | 0.05                            | 0.05                            | 0.1                  | 0.05                        | 0.05                | 0.1                                    | 0.1                                  | 0.1         | 0.1  | 0.05    | 0.1                | 0.05                     |
| Type      | -                       | -                               | -                               | -                    | -                           | -                   | -                                      | -                                    | -           | Cost | Cost    | Cost               | -                        |
| Project 1 | 60%                     | 80%                             | 85%                             | 89%                  | 87%                         | 85%                 | 89%                                    | 22%                                  | 82%         | 7%   | 83%     | 84%                | 86%                      |
| Project 2 | 59%                     | 87%                             | 84%                             | 86%                  | 82%                         | 81%                 | 87%                                    | 29%                                  | 86%         | 9%   | 81%     | 85%                | 86%                      |
| Project 3 | 40%                     | 89%                             | 88%                             | 86%                  | 89%                         | 84%                 | 86%                                    | 30%                                  | 80%         | 10%  | 84%     | 96%                | 93%                      |
| Project 4 | 47%                     | 86%                             | 88%                             | 84%                  | 88%                         | 88%                 | 85%                                    | 24%                                  | 83%         | 8%   | 81%     | 98%                | 99%                      |
| Project 5 | 43%                     | 89%                             | 80%                             | 88%                  | 83%                         | 81%                 | 87%                                    | 19%                                  | 82%         | 11%  | 81%     | 85%                | 85%                      |

**Table 2:** Quantify type of criteria

| Projects  | Agility                 |                                 |                                 | Resiliency           |                             |                     | Project alignment with strategic goals | Potential return on investment (ROI) | Feasibility | Risk | Urgency | Resources required | Stakeholder satisfaction |
|-----------|-------------------------|---------------------------------|---------------------------------|----------------------|-----------------------------|---------------------|--|--------------------------------------|-------------|------|---------|--------------------|--------------------------|
|           | Flexible project design | Strong culture of collaboration | Strong culture of collaboration | Diverse supply chain | Robust risk management plan | Strong team culture |  |                                      |             |      |         |                    |                          |
| Weight    | 0.1                     | 0.05                            | 0.05                            | 0.1                  | 0.05                        | 0.05                | 0.1                                    | 0.1                                  | 0.1         | 0.1  | 0.05    | 0.1                | 0.05                     |
| Type      | 1                       | 1                               | 1                               | 1                    | 1                           | 1                   | 1                                      | 1                                    | 1           | -1   | -1      | -1                 | 1                        |
| Project 1 | 60%                     | 80%                             | 85%                             | 89%                  | 87%                         | 85%                 | 89%                                    | 22%                                  | 82%         | 7%   | 83%     | 84%                | 86%                      |
| Project 2 | 59%                     | 87%                             | 84%                             | 86%                  | 82%                         | 81%                 | 87%                                    | 29%                                  | 86%         | 9%   | 81%     | 85%                | 86%                      |
| Project 3 | 40%                     | 89%                             | 88%                             | 86%                  | 89%                         | 84%                 | 86%                                    | 30%                                  | 80%         | 10%  | 84%     | 96%                | 93%                      |
| Project 4 | 47%                     | 86%                             | 88%                             | 84%                  | 88%                         | 88%                 | 85%                                    | 24%                                  | 83%         | 8%   | 81%     | 98%                | 99%                      |
| Project 5 | 43%                     | 89%                             | 80%                             | 88%                  | 83%                         | 81%                 | 87%                                    | 19%                                  | 82%         | 11%  | 81%     | 85%                | 85%                      |

**Table 3:** Python code for supplier selection in supply chain.

```

import numpy as np
from pymcdm.methods import TOPSIS, VIKOR, COPRAS , PROMETHEE_II, COMET, SPOTIS, ARAS,
    COCOSO, CODAS, EDAS, MABAC, MAIRCA, MARCOS, OCRA, MOORA

from pymcdm.helpers import rrankdata

# Define decision matrix (2 criteria, 4 alternative)
alts = np.array([
    [0.6,0.8,0.85,0.89,0.87,0.85,0.89,0.22,0.82,0.07,0.83,0.84,0.86],
    [0.59,0.87,0.84,0.86,0.82,0.81,0.87,0.29,0.86,0.09,0.81,0.85,0.86],
    [0.4,0.89,0.88,0.86,0.89,0.84,0.86,0.3,0.8,0.1,0.84,0.96,0.93],
    [0.47,0.86,0.88,0.84,0.88,0.88,0.85,0.24,0.83,0.08,0.81,0.98,0.99],

```

```

[0.43,0.89,0.8,0.88,0.83,0.81,0.87,0.19,0.82,0.11,0.81,0.85,0.85]
], dtype='float')
# print (alts)

# Define weights and types
weights = np.array([0.1,0.05,0.05,0.1,0.05,0.05,0.1,0.1,0.1,0.1,0.05,0.1,0.05])
types = np.array([1,1,1,1,1,1,1,1,-1,-1,-1,1])

# Create object of the method
topsis = TOPSIS()
# Determine preferences and ranking for alternatives
kkk1= topsis(alts, weights, types)
print ("topsis",kkk1)

# Create object of the method
vikor = VIKOR()
# Determine preferences and ranking for alternatives

kkk=vikor(alts, weights, types)

print ("vikor",kkk)

# Create object of the method
copras = COPRAS()
# Determine preferences and ranking for alternatives
kkk=copras(alts, weights, types)
print ("copras",kkk)

# Create object of the method
moora = MOORA()
# Determine preferences and ranking for alternatives
kkk=moora(alts, weights, types)
print ("moora",kkk)

# Create object of the method
mabac = MABAC()
# Determine preferences and ranking for alternatives
kkk=mabac(alts, weights, types)
print ("mabac",kkk)

# Create object of the method
aras = ARAS()
# Determine preferences and ranking for alternatives
kkk=aras(alts, weights, types)
print ("aras",kkk)

```

Finalize assessment decision matrix is calculated in Table 3. This matrix is for ranking projects. Results of running MCDM by TOPSIS, VIKOR, COPRAS, MOORA, MABAC and ARAS approach are obtained in Table 4 and Figure 4.

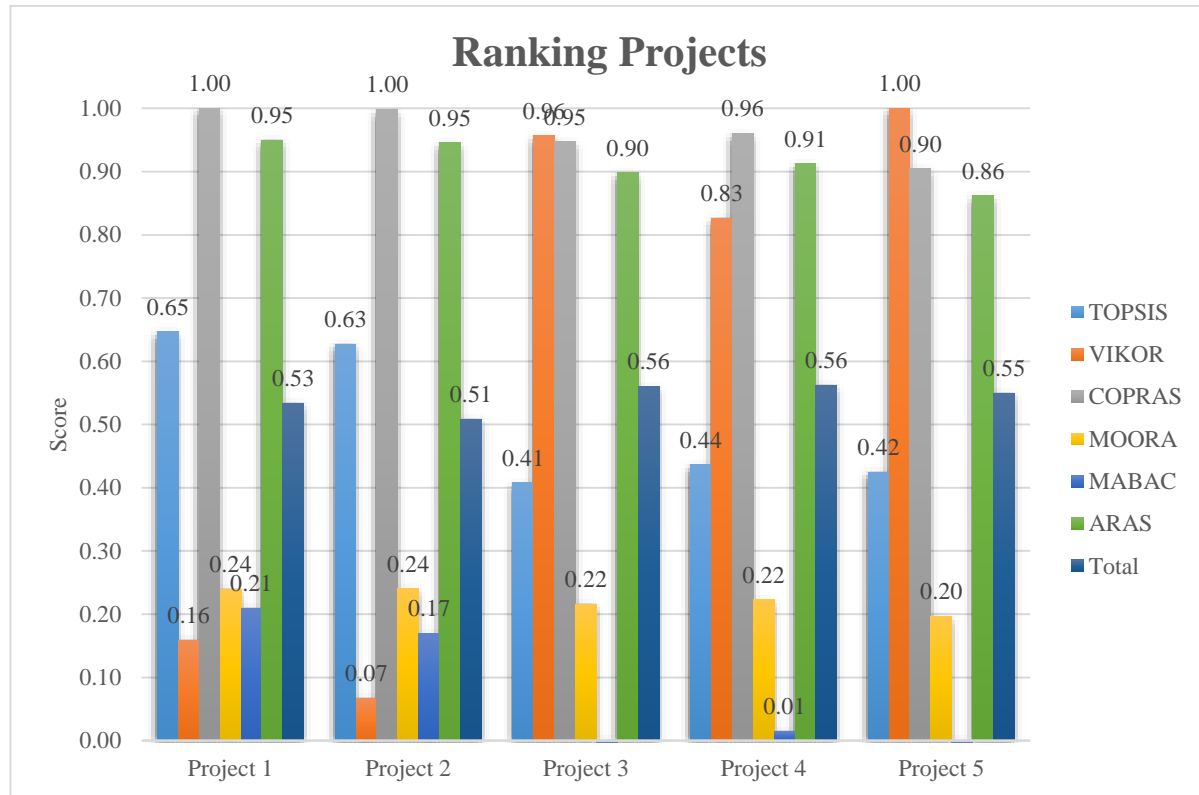


Figure 4: Results of running MCDM approach.

Table 4: Final ranking projects.

| Projects  | TOPSIS | VIKOR | COPRAS | MOORA | MABAC | ARAS | Total |
|-----------|--------|-------|--------|-------|-------|------|-------|
| Project 1 | 0.65   | 0.16  | 1.00   | 0.24  | 0.21  | 0.95 | 0.53  |
| Project 2 | 0.63   | 0.07  | 1.00   | 0.24  | 0.17  | 0.95 | 0.51  |
| Project 3 | 0.41   | 0.96  | 0.95   | 0.22  | -0.06 | 0.90 | 0.56  |
| Project 4 | 0.44   | 0.83  | 0.96   | 0.22  | 0.01  | 0.91 | 0.56  |
| Project 5 | 0.42   | 1.00  | 0.90   | 0.20  | -0.09 | 0.86 | 0.55  |

Table 4 shows the final ranking of projects using six different Multi-Criteria Decision Making (MCDM) methods, namely TOPSIS, VIKOR, COPRAS, MOORA, MABAC, and ARAS. The table presents the scores obtained by each project in each method, as well as the total score obtained by each project, which is the sum of the scores obtained in each method.

The projects are labeled as Project 1, Project 2, Project 3, Project 4, and Project 5. The scores range from 0 to 1, with higher scores indicating better performance.

For example, Project 1 obtained a score of 0.65 in TOPSIS, 0.16 in VIKOR, 1.00 in COPRAS, 0.24 in MOORA, 0.21 in MABAC, and 0.95 in ARAS. The total score obtained by Project 1 is 0.53, which is the sum of the scores obtained in each method.

The table shows that the ranking of projects varies depending on the MCDM method used. For instance, Project 3 obtained the highest score in VIKOR and COPRAS, while Project 5 obtained the highest score in MOORA. However, when considering the total score, Project 3 obtained the highest ranking with a score of 0.56, followed by Project 4 and Project 5 with the same score of 0.55.

Overall, the table demonstrates the importance of using multiple MCDM methods to rank projects, as different methods can lead to different rankings. The total score obtained by each project can provide a more comprehensive ranking that takes into account the results obtained by different methods.

## **5. Conclusion**

In conclusion, the process of ranking projects is a complex task that requires the consideration of multiple criteria and factors. In this study, we proposed a framework for ranking projects that takes into account both agility and resiliency, which are important factors for project success in today's dynamic and uncertain business environment.

We used six different Multi-Criteria Decision Making (MCDM) methods, namely TOPSIS, VIKOR, COPRAS, MOORA, MABAC, and ARAS, to evaluate and rank a set of projects based on their agility and resiliency. The results showed that the ranking of projects varied depending on the MCDM method used, highlighting the importance of using multiple methods to obtain a comprehensive ranking.

Furthermore, we found that the proposed framework can be used to identify the strengths and weaknesses of each project in terms of agility and resiliency, which can help project managers to make informed decisions and take appropriate actions to improve project performance.

Overall, the proposed framework provides a valuable tool for project managers and decision-makers to evaluate and rank projects based on their agility and resiliency, which are critical factors for project success in today's fast-paced and uncertain business environment

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