



Insights from BGP Routing Logic for Project Management Decision-Making

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Abstract. The core of project management lies in determining optimal decisions under various constraints and selecting reasonable paths to achieve objectives from a multitude of action plans. As the core technology for inter-domain routing on the Internet, the Border Gateway Protocol (BGP) shares a deep structural alignment with the decision-making logic of project management through its multi-attribute decision-making framework. This paper employs an interdisciplinary analogy to introduce BGP routing logic into management decision-making research. It analyzes core characteristics such as strategy taking precedence over metrics, multi-attribute trade-offs, loop prevention mechanisms ensuring system stability, and rapid convergence to reach consensus, thereby constructing a conceptual mapping model between this technology and project management elements. Based on this, a BGP-analogous framework for project decision-making is established, elucidating its application in scenarios such as task prioritization, resource allocation, risk response, and dynamic goal adjustment, thereby providing a structured decision-making tool for management practice.

Keywords: BGP routing, project management decision-making, analogy model, multi-attribute decision-making, path selection.

1 Introduction

1.1 A Subsection Sample

The essence of project management lies in the continuous accumulation of a series of decision-making actions. From the selection of technical approaches during the initiation phase, to resource allocation during the execution phase, and the formulation of response strategies when risks arise, each stage places stringent demands on the decision-making capabilities of managers. In real-world scenarios, the intertwining of time pressure, resource constraints, information asymmetry, and diverse objectives can easily trap managers in path-selection dilemmas. Research on cross-domain knowledge

transfer indicates that drawing upon established decision-making logic from other disciplines can open up innovative perspectives for management practice^[1].

The field of network technology has long faced similar path selection challenges. As the backbone routing protocol of the Internet, the Border Gateway Protocol (BGP) undertakes the core tasks of transmitting network reachability information between autonomous systems and selecting optimal transmission paths. After decades of development, BGP has evolved into a sophisticated multi-attribute decision-making mechanism capable of performing comprehensive trade-offs across multiple dimensions, including path length, policy constraints, and network state. Recent research indicates that routing protocols are evolving toward an intent-driven model. The integration of resource-aware and intent-translation technologies has made path selection more intelligent and further enriched the conceptual framework of BGP decision-making^[2].

Although project management and BGP route selection belong to different disciplinary fields, they share profound structural similarities at the level of decision-making logic. Interdisciplinary analogy, as an important method of knowledge transfer, enables managers to draw decision-making insights from seemingly unrelated fields. This paper attempts to transfer BGP decision-making logic to the field of project management, providing a new analytical perspective for route selection problems in complex scenarios. The research focuses on logical analogies at the abstract level and does not involve specific project execution details.

2 Analysis of the Decision-Making Logic in BGP Routing

2.1 Multi-Stage Decision-Making Process

Feasibility screening constitutes the first stage of the decision-making process. The router first eliminates infeasible routes, including those containing its own AS number—a design intended to prevent loops—as well as routes where the next hop is unreachable.

Attribute comparison constitutes the second stage of the decision-making process. BGP conducts multiple rounds of comparison in a fixed, strict order: First, the LOCAL_PREF attribute is examined; the route with the higher value takes precedence. If the values of this attribute are the same, the AS_PATH length is compared, and the route with the shorter path wins. If a tie still persists, the ORIGIN type is compared, followed by the MED attribute value. In cases of EBGp and IBGP routes, the system tends to favor the former. Finally, the IGP metric of the next hop is compared. As network complexity increases, modern routing protocols have gradually incorporated resource-aware capabilities, incorporating dynamic metrics such as real-time link status and transmission delay into the decision-making process.

The third stage involves the output of the decision. After the aforementioned rounds of filtering, the optimal route is entered into the local routing table, and the router also advertises this routing information to neighboring routers based on exit policies.

2.2 Core Characteristics of the Decision-Making Mechanism

BGP's decision-making logic embodies core characteristics of universal applicability: the primary feature is that policy takes precedence over metrics, with LOCAL_PREF holding the highest priority in attribute comparisons, meaning that human-defined policy intent can override objective path metric indicators. This design embodies a value-oriented decision-making principle, wherein organizational strategy takes precedence over local efficiency. It aligns closely with the concept of intent translation—that is, high-level business intent must be translated into specific routing execution policies.

Multi-attribute comprehensive trade-off is another core feature. BGP does not rely on a single metric to make decisions but conducts systematic comparisons across multiple dimensions. This comprehensive trade-off approach avoids the pitfalls of one-dimensional optimization, making the final path selection more robust. Research on multi-criteria decision-making in the field of public R&D project management also confirms that comprehensively considering multiple constraints can significantly improve the overall quality of decisions.

The implementation of anti-loop mechanisms ensures system stability; the anti-loop design of the AS_PATH effectively prevents routing information from entering an infinite loop, which corresponds to the principle of avoiding repetitive paths in management decision-making.

The fast convergence design aims to achieve network-wide consensus. When the network topology changes, BGP uses message updates and path recalculation to ensure that all routers quickly reach a unified determination regarding the optimal path; convergence speed has thus become a key indicator for measuring the operational health of the routing system.

2.3 Abstraction and Refinement of Decision-Making Logic

By abstracting the BGP decision-making mechanism into a generalized framework, six core elements can be identified: the decision-maker, which is the entity or system that must choose among multiple paths; the target set is the final state the decision aims to achieve; the feasible path set comprises the various action options available; the evaluation attribute set consists of multidimensional metrics for measuring the relative merits of different paths; strategy rules refer to the predefined order of attribute priorities and various constraints; the comparison process is the established sequence of operations for attribute comparison; and the convergence mechanism is the dynamic process through which the decision-maker reaches consensus.

This abstract framework lays the methodological foundation for interdisciplinary knowledge transfer. Cross-domain recommendation research achieves knowledge transfer between domains by mining knowledge associations, which resonates with the analogical research approach presented in this paper.

3 The BGP Analogy Model for Project Management Decisions

3.1 Concept Mapping

By mapping BGP decision-making elements to the project management domain, a clear conceptual mapping relationship can be established, as shown in the table 1 below:

Table 1. Conceptual Mapping of BGP Decision-Making Elements and Project Management Decision-Making Elements.

BGP Decision-Making Elements	Project Management Decision-Making Elements	Explanation of Mapping Logic
Routing Destination	Project Objectives or Milestones	Final State and Core Nodes Required for Decision-Making
Feasible Routes	Alternative Action Plans	Multiple paths leading to the project goal
AS_PATH Length	Task duration or workload	The "distance" cost required to complete project tasks
LOCAL_PREF	Strategic value of the task	The core priority assigned by the organization to each task
MED	Resource consumption and impact on other tasks	The overall "cost" of selecting a particular course of action
Next-hop IGP metric	Maturity of prerequisites	Prerequisites required to initiate a project task
Routing Policies	Organizational rules and resource boundaries	Hard constraints that determine the feasibility of a solution
Loop Prevention Mechanism	Task dependency management	Avoiding Ineffective Iterative Behaviors During Project Execution
Route Convergence	Decision Consensus and Steady State	The Final Determination Process of the Optimal Project Implementation Plan

The mapping relationships described above align closely with the theoretical framework of multi-attribute decision analysis. Research on public R&D project management systems indicates that regulatory feedback and adaptive constraints play a critical role in multi-criteria decision-making .

3.2 The BGP Process Model for Project Decision-Making

Based on the aforementioned conceptual mapping, the BGP decision-making process can be transformed into an analogous decision-making process tailored to project management: First, a preliminary screening of alternative solutions is conducted to eliminate all infeasible options based on criteria such as whether they violate organizational policies, exceed resource constraints, or lack prerequisite conditions. Next, the strategic value of the options is evaluated, with each option's strategic priority serving as the core comparison metric; options that align more closely with the organization's core objectives are given priority consideration.

When strategic value is comparable, a cost-efficiency comparison is conducted, analyzing the expected duration and workload of each option to select the more efficient one. Subsequently, an assessment of resource costs is carried out, comparing the extent of each option's impact on other concurrent tasks and the scale of resource consumption, with priority given to options causing fewer negative impacts. Concurrently, prerequisites are verified to assess the readiness of each option's initiation conditions, favoring those that are easier to launch and implement.

Finally, the decision-making process is finalized. After multiple rounds of multi-dimensional comparisons, the optimal solution is confirmed, and the project immediately enters the execution phase; when internal or external environmental conditions change, a new round of the decision-making process is initiated immediately. This model elevates project decision-making from the optimization of a single metric to a rational level of comprehensive balancing of multiple attributes, making value prioritization explicit through a clear decision-making sequence. In an environment fraught with uncertainty, this structured decision-making process can effectively reduce cognitive biases among managers.

3.3 Theoretical Explanatory Power of the Model

The BGP analogy model provides three-fold theoretical support for project management decision-making: the establishment of the decision sequence essentially reflects value orientations; the order of attribute comparison in the BGP is not randomly arranged but fully reflects the designer's prioritization of various attributes. Project managers must similarly clarify their own decision-making priorities and foster a high degree of consensus within the team to ensure consistent choices at critical decision points; the adaptive constraints within the public project management system are a concrete manifestation of this value hierarchy.

Comprehensive trade-offs across multiple attributes are superior to judgments based on a single metric; the effectiveness of multi-criteria decision-making methods in project selection has been widely validated. The core insight provided by the BGP model is that project management requires not only the establishment of a multidimensional evaluation system but also the establishment of a clear order of attribute comparison to prevent the decision-making process from falling into a cycle of indecision and non-convergence.

The stable operation of a system requires dedicated mechanisms to ensure it. In the BGP, anti-loop design and convergence mechanisms work in tandem to ensure the stable operation of the routing system. Similarly, the field of project management requires the establishment of robust task dependency management and change control mechanisms to prevent projects from falling into a vicious cycle of repeated revisions. Association mining techniques in cross-domain knowledge transfer methods can be used to identify potential dependencies between project tasks, providing a reference for the establishment of such mechanisms.

4 Application of the BGP Analogy Model in Project Management

4.1 Setting Task Priorities

At project initiation or phase transitions, managers often face situations where multiple tasks must proceed in parallel, making the determination of task priorities a core issue. The BGP model suggests using strategic value as the primary basis for task sequencing, combined with an assessment of task urgency, and concluding with a comprehensive evaluation of resource utilization.

Taking an IT infrastructure project as an example, when the project is simultaneously advancing two tasks—"Core Business Process Optimization" and "Peripheral Function Upgrade"—following the BGP decision-making logic, even if the peripheral function upgrade requires less time and yields faster results, the core business process optimization should be prioritized. The reason is that this task holds higher strategic value. Only when the strategic value of multiple tasks is at the same level should the duration of the task be used as a key indicator for prioritization.

4.2 Resource Allocation Decisions

When total resources are limited and multiple tasks compete for them, the multi-attribute comparison approach of the BGP model remains applicable. Managers can analyze metrics such as resource requirements, expected returns, and strategic importance for each task, simulate the BGP attribute comparison sequence to conduct a comprehensive ranking, and allocate limited resources to the task with the highest overall score. Research on project investment management indicates that improper resource allocation is itself a significant source of risk^[3], which underscores the critical importance of scientific resource allocation methods.

This resource allocation method, based on comprehensive multi-attribute ranking, can move away from intuitive allocation patterns, ensuring that resource allocation is grounded in sound rationality and avoiding the problem of resources being allocated to those who are most vocal.

4.3 Selection of Risk Response Strategies

When a project faces a risk event, managers typically have multiple response options to choose from, such as avoidance, transfer, mitigation, or acceptance. Research on project management in state-owned enterprises indicates that the selection of risk response strategies requires a comprehensive consideration of multiple factors, including risk level, organizational capacity, and cost-effectiveness. The field of project investment management also emphasizes that risk response requires a systematic approach as its foundation [5].

The BGP model provides a structured framework for selecting risk response strategies. First, it compares the strategic alignment of each option to determine whether it conflicts with the project's core objectives; second, it conducts a comprehensive assessment of the implementation difficulty of each option; and finally, it analyzes the potential impact of each option on other concurrent tasks. For example, when a project faces the risk of losing key technical personnel, possible response strategies include urgently recruiting replacements, outsourcing critical modules, or adjusting the technical approach to reduce reliance on specific talent. Through comprehensive comparison of multiple attributes, the optimal risk response strategy can be identified under current constraints. This structured decision-making approach effectively avoids the pitfalls of hasty decisions based solely on intuition.

4.4 Dynamic Adjustment of Project Objectives

During project execution, changes in the external environment often require managers to adjust the original objectives, a scenario that echoes the "routing update" mechanism in BGP. BGP's convergence mechanism offers insights for adjusting project objectives: such adjustments must drive the team to quickly reach a new consensus, minimizing the project's period of instability; simultaneously, one must guard against "routing oscillations"—that is, overly frequent changes in objectives can leave the team in a state of confusion. Research on public R&D project management systems confirms that adaptive constraints and regulatory feedback are key mechanisms for achieving dynamic goal adjustment.

Drawing on BGP's "route decay" mechanism, project management can establish a "cooling-off period" for frequently changing requirements. Assessment and adoption should only proceed once requirements have stabilized, thereby preventing the project from falling into a cycle of repeated revisions. In dynamic decision-making environments, such appropriate delay mechanisms can effectively filter out invalid changes in requirements and enhance the overall stability of project execution.

5 Discussion: Limitations of the Analogy Model and Practical Implications

5.1 The Model's Value Contribution

The core value of the BGP analogy model lies in establishing a structured, actionable

conceptual framework for project management decision-making. This model makes the previously implicit decision-making process explicit and systematizes the comprehensive balancing of multiple factors, thereby effectively enhancing the scientific rigor and consistency of project decisions. At the same time, the core concepts embedded in BGP—such as “policy over metrics”, “loop prevention” and “convergence”—provide managers with management wisdom that transcends specific technical operations.

From the perspective of interdisciplinary methodology, this study validates the feasibility of transferring decision-making logic from the engineering and technology fields to the management domain. Cross-domain research indicates that achieving knowledge transfer between fields by mining knowledge associations is not only feasible but also yields innovative research outcomes. As a mature protocol tested through decades of practical application, the decision-making wisdom underlying BGP warrants in-depth study and adoption within the project management field.

5.2 Scope of Application and Limitations

This model has certain limitations, and its scope of applicability must be clearly defined: during the model’s construction, human subjective factors were simplified. BGP’s decision-making relies entirely on predefined rules, whereas actual project management involves complex human variables such as team motivation, emotional states, and organizational politics—variables that are difficult to fully incorporate into the model’s scope.

The model’s construction is premised on clear and relatively stable objectives, making it more suitable for execution-oriented projects. For exploratory and innovative projects, where objectives themselves are in a state of dynamic evolution, the model’s applicability in such project management contexts is relatively diminished. The model is better suited to scenarios involving individual decision-making or decisions by a single entity; in project management environments involving team decision-making or multi-party negotiations, more complex negotiation and coordination mechanisms must be introduced, and the direct application of the model will face certain limitations.

5.3 Implications for Management Practice

Clarifying the decision-making sequence is key to translating values into action. Managers must clearly define their own decision-making priorities and foster a high degree of consensus within the team to ensure consistent choices are made at critical decision points, thereby embedding the organization’s values through decision-making behavior.

Comprehensive trade-offs across multiple attributes form the foundation of scientific decision-making. In project management, one must avoid the single-minded traps of “progress-only” or “cost-only” thinking. Establishing a multidimensional project evaluation system and systematically applying multi-criteria decision-making methods can significantly enhance the scientific rigor and rationality of project selection^[4].

The speed of decision convergence is just as important as decision quality; the ultimate purpose of decision-making is to guide execution, and the speed at which con-

sensus is reached directly impacts project advancement efficiency. Drawing on the rapid convergence mechanism of BGP, the project decision-making process should avoid getting bogged down in endless discussions and back-and-forth, and instead drive rapid implementation of decisions based on thorough consideration.

6 Conclusion

This paper introduces BGP routing logic into project management decision-making research and establishes an interdisciplinary analogical analysis framework. The study found that BGP's multi-attribute comparison sequence, loop prevention mechanisms, and convergence process provide a novel analytical perspective for understanding decision-making scenarios in project management, such as task selection, resource allocation, and risk response. When facing complex project decisions, managers can apply this mental analogy: if they were a router facing multiple paths to achieve a goal, how would they perform optimal filtering?

The unique value of interdisciplinary analogies lies in enabling researchers to discover shared structures and insights across seemingly unrelated fields. As a cornerstone protocol of the Internet, BGP's decision-making logic has withstood decades of practical testing and embodies profound principles of systems design. Transferring these principles to the field of project management can help managers better address various uncertainties during project execution and identify the optimal implementation path within complex project scenarios. Future research could further explore the analogous application of other BGP mechanisms—such as route reflection, alliances, and traffic engineering—in the field of project management to uncover additional interdisciplinary decision-making insights.

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Disclosure of Interests

The authors have no competing interests to declare that are relevant to the content of this article.

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