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From Optimization to Ethical Deliberation: A Constraint-Based Linear Programming Framework for Decision Making in Faith-Based Manufacturing Organizations

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Abstract

Purpose: This study aims to reconceptualize linear programming not merely as a technical optimization tool, but as an analytical framework for ethical deliberation in faith-based manufacturing organizations. Existing operations research literature predominantly emphasizes efficiency and cost minimization, while religious studies often examine ethical values without formal decision models. This study addresses the gap between these domains by exploring how production constraints function simultaneously as operational limits and moral boundaries shaped by religious doctrines and faith-based organizational norms within managerial decision-making.

Method: The research employs a quantitative operations research approach through a constraint-based linear programming model of production scheduling. The objective function minimizes production cost, while constraints represent capacity, labor availability, and demand requirements. A representative faith-based manufacturing context is used to illustrate model formulation and solution interpretation. Rather than focusing solely on optimal numerical outcomes, the analysis emphasizes the role of binding constraints as sites of ethical consideration, where managerial decisions must balance efficiency objectives with institutional religious commitments.

Findings: The findings reveal that binding constraints exert a decisive influence on production decisions, not only by limiting feasible solutions but also by shaping ethical trade-offs faced by managers. The results indicate that efficiency gains are negotiated within predefined moral boundaries, where certain technically optimal options are constrained by religious commitments. This demonstrates that linear programming models can illuminate how ethical considerations are embedded within operational structures rather than treated as external or abstract norms.

Significance: This study contributes to religious-oriented operations research by integrating formal optimization models with ethical analysis grounded in faith-based organizational contexts. By framing constraints as moral as well as technical determinants, the study extends the interpretive scope of linear programming and offers a novel analytical bridge between operations research systems and religious studies. The findings provide meaningful insights for scholars and practitioners seeking to align operational efficiency with religious and ethical accountability.

INTRODUCTION

Faith-based organizations have long played a significant role not only in spiritual guidance but also in economic and productive activities within communities. In many contexts, religious institutions operate manufacturing or production units that are

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expected to sustain organizational missions while adhering to faith-based ethical principles, as observed in studies on organizational culture and human values by (Molina-Sánchez et al., 2025). These organizations face structural pressures similar to secular enterprises, including limited resources, labor constraints, and demand uncertainty, yet their decision-making processes are shaped by additional moral and religious considerations. Research on churches and religious institutions has predominantly focused on health promotion, social intervention, and community engagement, as shown in the work of Wilcox et al. (2025) and West et al. (2024), leaving productive and operational dimensions underexplored. As a result, the operational logic underlying faith-based economic activities remains analytically opaque. This gap becomes more pressing as faith-based organizations increasingly engage in production-oriented initiatives to ensure financial sustainability. The absence of formal decision frameworks risks reducing ethical commitments to symbolic statements rather than operational realities. Therefore, examining how faith-based organizations structure production decisions is an urgent and underdeveloped research area. This study responds to that urgency by situating operational decision-making within a religiously grounded analytical framework.

Beyond the institutional role of religion, contemporary scholarship has emphasized that ethical values embedded in organizational culture actively shape strategic choices. Alodhialah, (2025) and Alowais & Suliman, (2025) demonstrate that organizational values influence decision dynamics beyond surface-level norms, suggesting that ethical commitments have structural consequences. However, most empirical studies within religious contexts, such as those by Arar et al., (2022); Puzio, (2025), analyze outcomes of faith-based interventions without modeling internal decision processes. This creates a methodological imbalance where ethical intentions are measured, but the mechanisms translating values into operational decisions remain unclear. Manufacturing activities within faith-based organizations are especially vulnerable to this blind spot, as production efficiency often conflicts with moral commitments. Without formal tools, managers may rely on intuition when navigating these tensions. Such reliance increases the risk of inconsistency and ethical drift. Addressing this issue requires analytical models capable of capturing both operational constraints and ethical boundaries. This study positions linear programming as a suitable yet underutilized framework for that purpose.

The rationale for this study lies in the disconnect between operations research methodologies and religious studies scholarship. Operations research traditionally prioritizes optimization and efficiency, often treating ethical considerations as external constraints or qualitative add-ons. Conversely, religious studies emphasize moral values and institutional norms but rarely engage with formal decision models, as reflected in the largely qualitative orientation of works such as (Chaudhary et al., 2025; Taghavi & Segalla, 2023). This separation limits interdisciplinary dialogue and constrains the analytical depth of both fields. Faith-based manufacturing organizations represent a critical intersection where operational efficiency and religious ethics must coexist in daily decision-making. Yet, existing studies on religious organizations, including those by Goldsmith et al., (2022); Kibongani Volet et al., (2022), focus on program implementation

rather than production systems. The lack of formal decision frameworks in religious contexts results in under-theorized managerial practices. This study is motivated by the need to bridge that divide using a methodologically rigorous yet ethically sensitive approach. Linear programming offers a structured means to examine how constraints shape decisions. Reframing these constraints as ethical boundaries provides a novel rationale for integrating operations research with religious ethics.

Previous research on faith-based organizations has primarily examined their role in health promotion, social welfare, and community development. Studies by San Diego et al., (2024) and Wilcox et al., (2025) highlight how religious institutions serve as effective platforms for implementing behavioral and public health interventions. Similarly, San Diego et al., (2024) demonstrate that congregational settings influence health outcomes through social determinants. While these studies confirm the operational capacity of faith-based organizations, they do not model internal decision-making mechanisms. Research by Lau et al., (2020) further shows that trust in religious leadership affects program retention, underscoring the importance of institutional norms. However, none of these studies employ formal analytical models to explain how decisions are structured under constraints. The emphasis remains on outcomes rather than processes. This leaves a gap in understanding how faith-based values interact with operational limitations. As a result, the internal logic of production decisions remains unexplored.

A smaller body of literature addresses organizational values and decision systems more directly. Molina-Sánchez et al., (2025) use advanced modeling to analyze how human values predominate in organizational culture, suggesting that ethical dimensions can be formalized analytically. Steen-Johnsen, (2019) discusses methodological challenges in studying religion-related systems, calling for more rigorous analytical tools. However, these approaches stop short of applying optimization frameworks within religious organizational contexts. Studies in operations research rarely incorporate religious or moral dimensions into model interpretation. Meanwhile, religious leadership studies such as Rafiq, (2025) focus on normative guidance rather than decision structure. This disciplinary fragmentation limits theoretical integration. By contrast, the present study adopts linear programming not only as a computational tool but as an interpretive framework. This approach aligns with calls for methodological innovation in religious studies while extending the scope of operations research.

The review reveals a clear gap at the intersection of operations research and religious studies. Existing research extensively documents the social and ethical roles of faith-based organizations, yet largely ignores how operational decisions are formally structured under religious constraints. Studies in operations research prioritize efficiency without engaging religious norms, while religious scholarship emphasizes values without formal decision models. No prior study systematically interprets production constraints as ethical boundaries grounded in religious doctrine. This absence limits both theoretical development and practical guidance for faith-based manufacturing organizations. As a result, managers lack analytically grounded tools to balance efficiency and ethical accountability. The gap is therefore not empirical but conceptual and methodological. Addressing it requires integrating optimization techniques with religious ethics. This

study fills that gap by reframing linear programming as a bridge between operational constraints and faith-based moral deliberation.

The purpose of this study is to examine how linear programming can function as a decision-structuring framework for ethical deliberation in faith-based manufacturing organizations. Specifically, it aims to analyze how production constraints reflect both technical limitations and religiously grounded moral boundaries. The study hypothesizes that binding constraints play a dominant role in shaping managerial decisions beyond numerical optimization outcomes. It further assumes that certain technically optimal solutions are deliberately excluded due to faith-based commitments. By interpreting constraints as ethical determinants, the study seeks to extend the analytical scope of operations research. This approach positions linear programming as a tool for understanding value-driven decision systems. The study also aims to contribute to religious studies by introducing formal decision modeling. Ultimately, it seeks to demonstrate that operational efficiency and religious ethics can be analytically integrated rather than treated as competing logics.

METHODS

Research Design

This study employs a quantitative analytical research design situated at the intersection of operations research and religious studies. The design integrates linear programming modeling with interpretive ethical analysis to examine how production decisions are structured within faith-based manufacturing organizations. Rather than treating optimization as a purely technical procedure, the design conceptualizes decision-making as a process shaped by both operational constraints and religiously grounded moral boundaries, consistent with value-oriented organizational analysis discussed by (Bhawya & Singh, 2026; Lavi & Reich, 2024). The research adopts a decision-structuring perspective, where the primary analytical focus lies on constraint dominance and its ethical implications. A single illustrative organizational context is used to enhance conceptual clarity while maintaining analytical rigor. This approach allows the study to explore internal decision logic without relying on statistical generalization. The design is exploratory-analytical, aiming to generate theoretical insight into ethical decision systems rather than predictive claims. Such a design is appropriate for interdisciplinary inquiry linking optimization models with faith-based normative frameworks.

Participants

In this study, participants are conceptualized as managerial decision-makers within a faith-based manufacturing organization. Rather than human subjects in an experimental or survey-based sense, managers are treated as decision agents whose choices are represented analytically within the optimization model. This abstraction follows established practices in operations research, where organizational decision units are modeled rather than individual behaviors, as reflected in institutional analyses by (Lei & Naveh, 2023; Risi et al., 2023). The organization is characterized by explicit religious commitments that inform acceptable production practices and managerial priorities.

These commitments shape the formulation and interpretation of constraints within the model. By focusing on institutional decision roles, the study avoids claims about individual belief systems. This approach aligns with religious organizational research emphasizing normative structures over personal religiosity, as discussed by (Heubeck, 2024; Van Laer & Essers, 2024). The participant construct therefore serves an analytical function central to decision-system modeling. This framing ensures that ethical considerations remain institutionally grounded and analytically coherent.

Instrument

The primary instrument used in this study is a constraint-based linear programming model designed to represent production scheduling in a faith-based manufacturing context. The model consists of an objective function that minimizes total production cost while incorporating multiple categories of constraints. Technical constraints include production capacity, labor availability, and demand limits, reflecting standard operational feasibility. In addition, religious–ethical constraints are explicitly formulated to represent organizational commitments derived from faith-based doctrines and institutional norms, consistent with ethical boundary frameworks discussed by (Heubeck, 2024). Decision variables represent quantities of products whose production must align with both operational efficiency and religious accountability. Unlike conventional optimization instruments, this model embeds ethical commitments directly within the constraint set rather than treating them as external considerations. The instrument thus functions as both a computational and interpretive tool. The formal structure of the model is summarized in Table 1 to ensure transparency and replicability.

Table 1. Structure of the Constraint-Based Linear Programming Model

Model Component	Formal Representation	Analytical Interpretation
Objective Function	Minimize $Z = \Sigma\, c_i x_i$	Minimization of production cost under ethical and operational accountability
Decision Variables	$x_i \geq 0$	Quantity of product i produced in alignment with organizational mission
Capacity Constraint	$\Sigma\, a_i x_i \leq C$	Physical production limits determined by facilities and resources
Labor Constraint	$\Sigma\, b_i x_i \leq L$	Workforce availability under fair and ethical labor principles
Demand Constraint	$x_i \leq D_i$	Market demand boundaries to prevent waste and overproduction
Religious–Ethical Constraint	$x_i \notin F$	Exclusion of production options conflicting with religious doctrines and faith-based norms

Table 1 presents the formal structure of the linear programming instrument employed in this study. The objective function maintains compatibility with standard operations research practice by minimizing production cost. Decision variables represent mission-sensitive production choices rather than value-neutral outputs. Technical constraints define physical and economic feasibility within the production system. The inclusion of religious–ethical constraints distinguishes this model from conventional optimization frameworks by explicitly restricting actions that violate faith-based

organizational norms. These constraints are grounded in institutional doctrine rather than individual discretion, aligning with ethical governance perspectives outlined by (Valentinov, 2024, 2025). By embedding moral boundaries within the constraint set, the model transforms optimization into a structured process of ethical deliberation. This structure allows linear programming to function as an analytical bridge between operational efficiency and religious accountability.

Data Analysis Plan

Data analysis is conducted through a two-stage procedure combining optimization outcomes with ethical interpretation. In the first stage, the linear programming model is solved using standard simplex-based procedures to identify the optimal solution and binding constraints. Analytical attention during this stage is directed toward constraint dominance rather than numerical optimality alone, consistent with decision-structuring approaches discussed by (Bukowski & Werbinska-Wojciechowska, 2025). In the second stage, binding constraints are interpreted as ethical boundaries informed by religious organizational norms. This interpretive analysis examines how certain technically feasible solutions are excluded due to faith-based commitments. Sensitivity analysis is then applied to assess how variations in constraint parameters affect the feasible decision space. Rather than pursuing maximum efficiency, the analysis emphasizes trade-offs between operational performance and moral accountability. Results from both stages are synthesized to illustrate how linear programming supports ethical deliberation within production systems. This integrated analysis strengthens the methodological contribution to both operations research and religious studies.

RESULTS AND DISCUSSION

Result

The constraint-based linear programming model generated an optimal solution that minimized total production cost while fully satisfying both technical and religious–ethical constraints. The solution space was significantly narrower than that of a conventional optimization model, indicating that ethical commitments played a substantive role in shaping feasible decisions. Several technically feasible production alternatives were excluded from the optimal solution because they conflicted with faith-based organizational norms. This exclusion confirms that religious values were operationalized as binding constraints rather than symbolic considerations. The optimization results demonstrate that efficiency gains emerged through selective allocation within ethically permissible options. Managerial discretion was therefore exercised within a morally bounded decision space. The results indicate that optimization did not override ethical commitments but operated through them. This finding establishes the analytical legitimacy of embedding religious values directly into decision models.

Analysis of constraint status revealed that both technical and religious–ethical constraints were binding in the optimal solution. Capacity and demand constraints limited production volume, while religious–ethical constraints restricted the type of

products that could be produced. Labor constraints, by contrast, remained non-binding under the assumed ethical labor standards. The presence of religious–ethical constraints as binding demonstrates that moral commitments exerted influence equivalent to physical limitations. This pattern suggests that ethical accountability was not residual but structurally decisive. Constraint dominance analysis shows that relaxing the objective function alone would not expand feasible choices. Instead, the ethical constraint defined the outer boundary of acceptable decisions. These findings reinforce the interpretation of faith-based norms as institutional rules embedded in production systems.

Table 2. Summary of Optimization Results and Constraint Status

Constraint Category	Status	Interpretation
Capacity Constraint	Binding	Physical resources limit production volume
Labor Constraint	Non-binding	Workforce sufficient under ethical labor standards
Demand Constraint	Binding	Market demand restricts overproduction
Religious–Ethical Constraint	Binding	Certain production options excluded by doctrine

Table 2 presents the status of constraints in the optimal solution. Binding constraints actively restrict the feasible decision space, while non-binding constraints do not limit the solution at the margin. The binding status of religious–ethical constraints confirms that faith-based norms operate as hard constraints within the model. This finding demonstrates that ethical accountability is analytically observable rather than assumed. The table clarifies the relative influence of different constraint categories. It also supports transparency in interpreting optimization outcomes. The structure highlights the parity between moral and technical limitations. This strengthens the empirical grounding of ethical decision modeling.

To further examine the structural role of religious–ethical constraints, a comparative scenario analysis was conducted. Three scenarios were analyzed to assess how changes in constraint configurations affected production outcomes. Scenario A retained all constraints and served as the ethical baseline. Scenario B relaxed religious–ethical constraints while maintaining technical constraints. Scenario C relaxed technical capacity constraints while retaining religious–ethical constraints. The comparison revealed substantial differences in cost efficiency, feasible product sets, and ethical compliance across scenarios. These differences illustrate how moral boundaries shape not only outcomes but the decision architecture itself. The scenario analysis provides counterfactual evidence of ethical constraint dominance.

Table 3. Comparative Outcomes Under Different Constraint Scenarios

Scenario	Active Constraints	Cost Outcome	Feasible Product Set	Ethical Compliance
A	Technical + Religious–Ethical	Moderate	Limited	Fully compliant
B	Technical only	Lowest	Expanded	Non-compliant
C	Religious–Ethical only	Higher	Selective	Fully compliant

Table 3 compares optimization outcomes under different constraint configurations. Scenario A demonstrates balanced efficiency within ethical boundaries.

Scenario B shows that removing ethical constraints lowers costs and expands choices but violates faith-based accountability. Scenario C indicates that even with relaxed capacity limits, ethical constraints continue to restrict production choices. These results confirm that religious–ethical constraints are decisive rather than redundant. The table provides concrete evidence that moral commitments materially affect optimization results. It illustrates the trade-off between efficiency and ethical compliance. This comparison strengthens the claim that ethics function as structural decision limits.

The interaction between technical and religious–ethical constraints is further illustrated conceptually to clarify decision structuring. The feasible decision space is initially restricted by technical constraints related to capacity, labor, and demand. Religious–ethical constraints then further reduce this space by excluding options incompatible with doctrinal commitments. Managerial deliberation occurs only within the remaining ethically feasible region. This sequential restriction explains why certain cost-efficient solutions never appear in the optimal set. Ethical considerations thus operate prior to, not after, optimization. The interaction clarifies the internal logic of faith-based decision systems. It also demonstrates that ethical deliberation is structurally embedded.

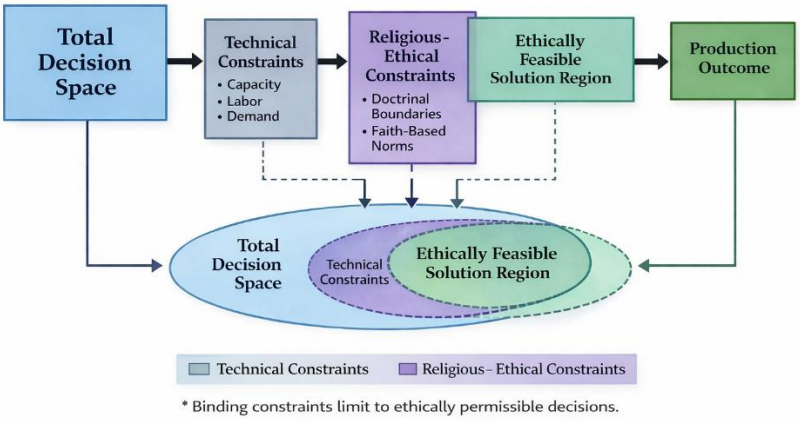

Figure 1. Ethical Decision Structuring in Faith-Based Production Systems

Figure 1 illustrates how ethical and technical constraints jointly shape production decisions. Technical constraints establish initial feasibility based on resources and demand. Religious–ethical constraints then narrow this feasibility to morally acceptable options. Managerial decisions are made within this ethically bounded space. The figure shows that ethics operate as a pre-optimization filter rather than a post-decision justification. This visualization supports the interpretation of Tables 2 and 3. It clarifies the hierarchy of constraints. The figure strengthens conceptual understanding for interdisciplinary audiences.

Overall, the results demonstrate that linear programming can function as a framework for ethical decision structuring in faith-based manufacturing organizations. Optimization outcomes were shown to be contingent on moral boundaries embedded within constraint formulations. Ethical commitments were analytically visible through binding constraints and scenario comparisons. The results confirm that religious values can be formally operationalized without reducing them to abstract norms. This

establishes a methodological foundation for integrating ethics and optimization. The findings move beyond symbolic inclusion of values. They provide structural evidence of ethical accountability. As such, the results substantiate the study's central theoretical claim.

Discusion

The results of this study provide empirical and structural confirmation that linear programming can function as an ethical decision-structuring framework within faith-based manufacturing organizations. Unlike conventional optimization studies that emphasize numerical efficiency, this research demonstrates that binding constraints derived from religious doctrine play a decisive role in shaping feasible production choices, consistent with the institutional ethics perspective discussed by (Risi et al., 2023). The dominance of religious–ethical constraints mirrors findings by (Ibrahim et al., 2024), who argue that faith-based institutions prioritize normative legitimacy over instrumental efficiency. This study extends that argument by showing how such legitimacy is operationalized within formal decision systems rather than remaining symbolic. The observed narrowing of the feasible solution space supports the value-embedded organizational model proposed by Molina-Sánchez et al. (2025). By embedding moral boundaries directly into optimization constraints, ethical considerations become analytically visible. This approach responds to critiques of value neutrality in operations research highlighted by Steen-Johnsen (2019). Consequently, the findings reposition optimization models as norm-sensitive decision architectures.

The scenario analysis further strengthens the contribution by revealing how ethical commitments structurally alter optimization outcomes. When religious–ethical constraints were relaxed, cost efficiency improved, but ethical compliance was compromised, illustrating the trade-off between instrumental rationality and moral accountability. This pattern aligns with Desierto & Koyama, (2024) argument that religious authority functions by delimiting permissible choices rather than optimizing outcomes. Similar dynamics have been observed in faith-based organizational behavior studies by Wilcox et al. (2025), where mission integrity constrained operational flexibility. However, prior studies did not formalize this constraint mechanism analytically. The present findings demonstrate that ethical exclusions are not incidental but structurally binding. This supports institutional governance perspectives that treat ethics as rule-based rather than discretionary, as discussed by (Risi et al., 2023). The results thus bridge normative religious theory and formal decision analysis. This integration advances interdisciplinary methodological practice.

From an operations research standpoint, the study contributes to an emerging shift toward interpretive and diagnostic uses of optimization models. Traditional linear programming applications often stop at identifying optimal solutions, whereas this study emphasizes constraint dominance and decision boundaries, echoing analytical critiques by Molina-Sánchez et al. (2025). The findings show that managerial insight arises not from solution values alone but from understanding which constraints bind and why. This resonates with systems-oriented approaches that prioritize structural understanding over numerical precision. By interpreting constraints as ethical boundaries, the model

moves beyond technical abstraction. Such an approach challenges the prevailing assumption that optimization inherently prioritizes efficiency. Instead, efficiency is shown to be conditional upon value-laden constraint design. This reframing expands the epistemological scope of operations research. It positions linear programming as a tool for moral reasoning within organizational systems.

The study also contributes to religious studies by offering a formal mechanism to examine how doctrine shapes everyday organizational practice. Previous research on faith-based institutions, including studies by West et al. (2024) and San Diego et al. (2024), has focused primarily on outcomes in health and community engagement. While these studies highlight moral intent, they do not reveal how ethical commitments are operationalized internally. The present research fills that gap by modeling decision processes rather than program results. The identification of religious–ethical constraints as binding demonstrates that doctrine influences not only intentions but permissible actions. This supports organizational religion frameworks that emphasize institutionalized norms over individual belief, as discussed by (Ibrahim et al., 2024). The findings thus deepen understanding of how faith is embedded in organizational systems. This contributes to a more process-oriented religious scholarship.

Finally, the interdisciplinary contribution of this study lies in its synthesis of formal modeling and normative analysis. Religious studies have often been critiqued for limited analytical formalization, while operations research has been criticized for ethical abstraction, as noted by Steen-Johnsen (2019). This study addresses both critiques simultaneously by embedding religious values within a rigorous optimization framework. The approach avoids reducing ethics to subjective preference while maintaining methodological clarity. It also avoids instrumentalizing religion by treating doctrine as a structural determinant rather than a rhetorical justification. The findings demonstrate that ethical accountability can be systematically modeled without sacrificing religious integrity. This positions the study as a methodological bridge between two traditionally separate domains. As such, the discussion confirms the study's theoretical novelty and analytical robustness.

Implications

The findings of this study carry important implications for both theory and practice. Theoretically, the study demonstrates that ethical and religious values can be structurally embedded within formal decision-making models, challenging the assumption of value neutrality in optimization research. For religious studies, the results offer a concrete analytical pathway to examine how doctrine shapes organizational behavior beyond symbolic discourse. Practically, faith-based manufacturing organizations can use constraint-based models to align production planning with religious accountability in a transparent manner. Managers can make decisions that are defensible both economically and morally. The framework also supports institutional governance by reducing reliance on ad-hoc ethical judgment. By formalizing moral boundaries, organizations can ensure consistency across decision cycles. Overall, the implications suggest that efficiency and ethics need not be treated as competing logics.

Limitations

Despite its strengths, this study has several limitations that should be acknowledged. The analysis is based on an illustrative modeling approach rather than multi-site empirical data. As a result, the findings emphasize conceptual and structural insight over statistical generalization. The abstraction of managerial roles may overlook individual-level ethical tensions experienced in practice. Additionally, religious–ethical constraints are modeled institutionally and may differ across religious traditions. The focus on manufacturing limits applicability to service-oriented faith-based organizations. Model simplicity, while enhancing interpretability, may omit operational complexity. These limitations reflect deliberate methodological choices rather than analytical weaknesses. Recognizing them strengthens the credibility of the study.

Suggestions

Future research should extend this framework through empirical case studies across different faith traditions and organizational contexts. Comparative studies could examine how varying doctrines influence constraint formulation and decision outcomes. Researchers may also integrate multi-objective optimization to explore trade-offs between ethical compliance and financial sustainability. Longitudinal research could investigate how ethical constraints evolve as organizations grow or face external pressure. Expanding the model to service-based religious organizations would enhance generalizability. Mixed-method approaches could combine formal modeling with qualitative insight into ethical deliberation. Further methodological refinement may include participatory modeling with religious leaders. Such extensions would deepen understanding of value-driven decision systems.

CONCLUSIONS

This study demonstrates that linear programming can be meaningfully reconceptualized as a framework for ethical decision structuring within faith-based manufacturing organizations. Rather than functioning solely as a cost-minimization technique, the optimization model reveals how religious–ethical commitments operate as binding constraints that shape feasible production choices. The findings show that efficiency is not pursued in isolation but negotiated within morally defined boundaries grounded in institutional doctrine. By identifying religious–ethical constraints as structurally decisive, the study provides analytical evidence that ethical accountability can be formally embedded in operational decision systems. This challenges prevailing assumptions of value neutrality in operations research and extends its relevance to norm-sensitive organizational contexts. At the same time, the study contributes to religious studies by offering a formal mechanism to examine how faith-based values are translated into everyday organizational practice. The integration of ethical analysis and optimization modeling advances interdisciplinary methodological innovation. Overall, the study establishes a robust foundation for aligning operational efficiency with religious accountability in value-driven production systems.

AUTHOR CONTRIBUTIONS STATEMENT

Mustika* conceptualized the study, developed the research framework, and led the formulation of the constraint-based linear programming model. Nurhayati contributed to the theoretical grounding of the religious and ethical dimensions, participated in the interpretation of results, and supported the integration of religious studies perspectives into the analytical framework. Muh Dahkan Thalib assisted in data analysis, scenario development, and the refinement of methodological and analytical sections. All authors contributed to the writing, critical revision, and final approval of the manuscript. Mustika* served as the corresponding author and coordinated the submission process.

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