

Editorial

Addressing National Needs: Design Thinking–Driven Engineering of a Multi-Purpose Logistics Vehicle for Indonesia’s Free Nutritious Meals (MBG) Program

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Abstract

Indonesia’s Free Nutritious Meals Program (MBG), launched in January 2025, aims to deliver daily meals to up to 80 million beneficiaries but faces persistent logistical challenges related to geographic dispersion, vehicle limitations, and food safety risks. Conventional delivery vehicles are often incompatible with Indonesia’s diverse terrain, resulting in inefficiencies, food spoilage, and service delays. Therefore, this article advances an evidence-based design argument that positions Design Thinking, augmented by Kansei Engineering principles, as a practical design logic for addressing these nationally significant challenges through real-world vehicle adaptation. Grounded in stakeholder engagement, field observation, and iterative prototyping, a Toyota GUN125-based multi-purpose logistics vehicle was developed to support end-to-end MBG meal distribution. Key design interventions include a reconfigurable rear cabin with a three-way door system, a dedicated food trolley, reinforced suspension, and ergonomically optimized loading and unloading mechanisms. These features were derived from operational pain points and translated into engineering solutions through an iterative Design Thinking process. Field validation along a 25 km distribution route provides empirical support for the proposed design. Performance evidence indicates 98.7% operational uptime, zero thermal breaches, food waste reduced to 2% from a 28% baseline, and a 42% reduction in delivery cycle time from 5.5 hours to 3.2 hours. The vehicle configuration supports a distribution capacity of up to 612 meals per school and achieved Kansei post-test scores averaging 4.6 out of 5 for reliability and user-friendliness. The integrated evidence demonstrates how user-centered automotive engineering, grounded in operational realities, can enhance public service logistics performance. The proposed vehicle concept offers a scalable and locally adaptable platform aligned with MBG objectives and provides a transferable design perspective for other perishable goods distribution systems.

Keywords: Design thinking; Kansei engineering; Logistics vehicle; MBG program; Evidence-based design

1. Introduction

Indonesia’s Free Nutritious Meals Program (*Makan Bergizi Gratis*, MBG), launched in January 2025, aims to provide daily meals to millions of schoolchildren, pregnant women, and vulnerable groups while addressing persistent challenges of stunting and malnutrition. The program aligns with an ambitious national target to reach up to 80

million beneficiaries by mid-2026. However, distributing hundreds to thousands of food packages per school across urban, rural, and remote island regions presents significant logistical challenges. These include the risk of perishable food spoilage during extended transit times, limited vehicle capacity for bulk distribution, and poor compatibility between



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existing delivery fleets and Indonesia's diverse terrain, which is characterized by potholes, ferry crossings, and flood-prone routes [1]. As a result, conventional logistics vehicles often fail to maintain food quality from central kitchens to classrooms, leading to food waste and service delays [2].

Addressing these challenges requires logistics vehicles that are specifically adapted to Indonesia's geographic and operational conditions. Multipurpose vehicle designs featuring reconfigurable rear compartments, dedicated food carts, and ergonomically optimized loading and unloading mechanisms offer the potential to improve distribution efficiency while ensuring compliance with food safety standards.

Therefore, this paper reflects on how Design Thinking can be operationalized to address nationally significant logistics challenges through a real-world case study of vehicle adaptation. By situating engineering decisions within Indonesia's environmental, infrastructural, and programmatic constraints, this paper offers implementable technical insights and design perspectives relevant to large-scale public service logistics.

2. Literature Considerations

This article draws on selected bodies of literature not to provide a comprehensive review, but to frame the design reasoning underlying the proposed vehicle adaptation. Design Thinking is considered a practical lens for navigating complex automotive challenges, particularly where user needs intersect with technical and environmental constraints (Figure 1). Its iterative and human-centered character supports the translation of operational realities into design decisions, making it relevant for logistics vehicle development in diverse contexts such as Indonesia [3], [4], [5], [6].

To complement this approach, Kansei Engineering is considered for its ability to bridge subjective user perceptions and objective engineering specifications. By quantifying emotional and ergonomic responses, Kansei-based methods enable user-centered considerations to be embedded directly into vehicle configuration decisions [7], [8]. Prior studies further suggest that hybrid approaches combining Design Thinking and Kansei

Engineering are particularly suitable for automotive and service-oriented applications, including logistics systems operating under cultural and environmental constraints [9], [10], [11].

Beyond user interaction and vehicle configuration, food safety emerges as a non-negotiable operational constraint in perishable meal distribution. Existing literature emphasizes the importance of cold chain continuity, multi-temperature transport, and hazard control throughout the delivery process, particularly in tropical climates [12]. However, most logistics vehicle studies focus on technical modularity while paying limited attention to Indonesia-specific challenges such as uneven rural terrain, ferry-based transport, and direct classroom delivery. These gaps underscore the need for an integrative vehicle design perspective that aligns human-centered design logic with food safety requirements and real-world operating conditions.

3. Evidence-Based Design Argument

3.1. Design Rationale and Implementation Logic

The design argument presented in this work is framed by a qualitative dominant mixed approach informed by Design Thinking, adopted not as a procedural methodology but as a practical design logic for addressing complex automotive engineering challenges under constrained resources [5], [6]. Its iterative and user-centered nature enables engineering decisions to emerge

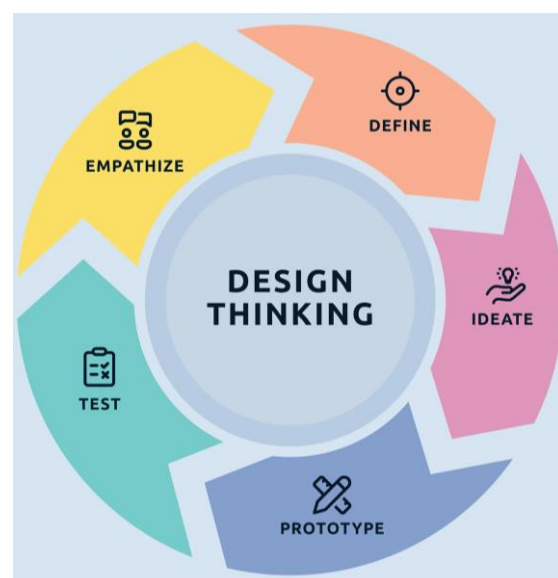


Figure 1. Design thinking five step

from operational realities encountered in the field rather than from abstract assumptions.

The design logic follows five interrelated phases consisting of empathize, define, ideate, prototype, and test, which together provide a structured yet flexible pathway for translating stakeholder needs into a functional vehicle solution [3]. Instead of relying solely on theoretical modeling, the argument emphasizes empirical validation aligned with established automotive engineering practices. Kansei Engineering principles are incorporated to ensure that ergonomic and perceptual considerations are systematically embedded into the engineering translation process [7].

3.2. Stakeholder and Operational Context

Evidence supporting the design argument is grounded in insights obtained from stakeholders directly involved in the MBG logistics ecosystem, including program coordinators, school logistics personnel, kitchen operators, and vehicle drivers operating in Karawang, West Java. These actors represent critical points within the distribution chain and provide contextual knowledge essential for identifying operational bottlenecks and design priorities.

Secondary sources, including Toyota GUN123 technical specifications, Indonesian road and vehicle standards, and MBG distribution records, complement stakeholder insights. Field observations conducted along two representative delivery routes simulate actual MBG meal distribution conditions and reveal environmental, infrastructural, and operational constraints that shape vehicle performance in practice. The geographic distribution of recipient schools that informed route selection is illustrated in Figure 2, highlighting the diversity of delivery contexts addressed in this study.

3.3. Translating Design Considerations into Engineering Evidence

Design considerations derived from stakeholder engagement were translated into engineering decisions through an iterative implementation pathway. Approximately twenty hours of field engagement were conducted to map end-to-end workflows from kitchen loading to classroom delivery. This process revealed recurrent challenges such as manual loading and unloading by kitchen staff, inefficient vehicle

access to school environments, and limited adaptability of conventional delivery vehicles across varied terrains [13].

These findings were synthesized into a focused design challenge, namely the need to develop a Toyona GUN125-based vehicle capable of safely transporting six hundred meals in a multi-purpose configuration across diverse Indonesian terrains. Concept generation sessions produced multiple vehicle configurations, which were subsequently narrowed to five viable alternatives using Kansei-based evaluation and feasibility scoring that balanced user perception with engineering practicality [13]. Baseline dimensional and structural constraints that framed the engineering adaptations are presented in Figure 3, which illustrates the Toyota GUN125 platform used as the reference vehicle. These constraints guided decisions related to rear cabin redesign, load distribution, and subsystem integration.

To support rapid iteration and real-world validation, a combination of qualitative instruments and engineering tools was employed.



Figure 2. Location of MBG school recipient

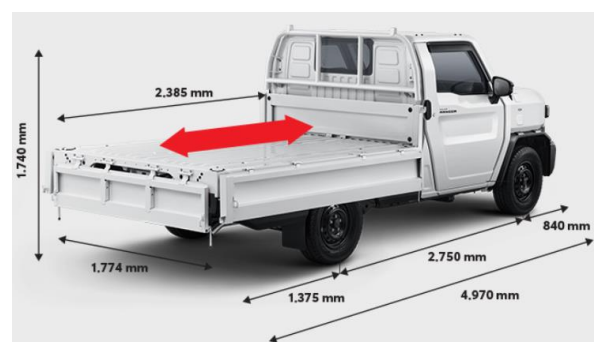


Figure 3. Toyota GUN125 dimension

Semi-structured interviews and Kansei semantic differential surveys using twenty bipolar adjective pairs captured user perceptions and latent requirements [9]. CATIA CAD was used for three-dimensional vehicle modeling, while ANSYS supported thermal and fluid simulations essential for food safety compliance. Arduino-based sensors were integrated into the prototype to monitor temperature, humidity, and payload strain during field testing. The cumulative translation from conceptual considerations to engineering configuration is visually synthesized in Figure 4, which presents the end to end journey mapping used to align design interventions with operational pain points.

3.4. Design Outcomes and Performance Evidence

The resulting vehicle configuration integrates several design features that directly respond to the identified logistical challenges. These include a redesigned rear cabin with three way opening access, a dedicated food trolley system to support food safety, reinforced suspension to accommodate varied terrain conditions, and a hydraulic tail lift to improve ergonomic loading and unloading. Key design considerations shaping this configuration are summarized in Figure 5, while the exterior vehicle concept and trolley lifting mechanism are illustrated in Figure 6.

Engineering embodiment of the proposed solution is further demonstrated through the

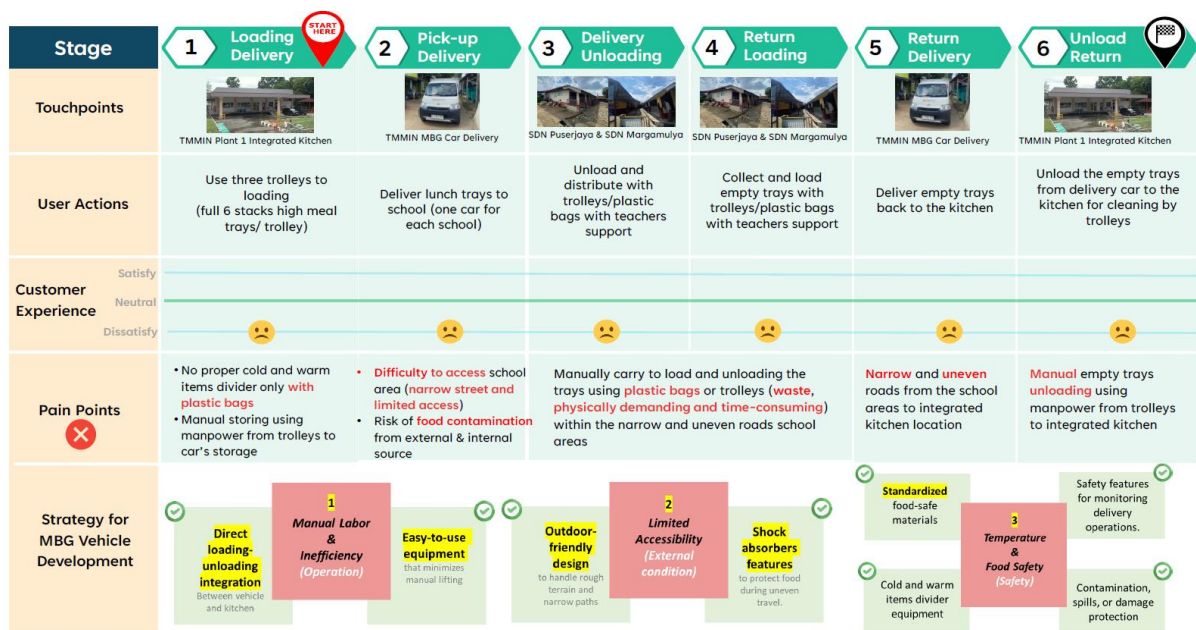


Figure 4. End to end journey mapping via design thinking approach

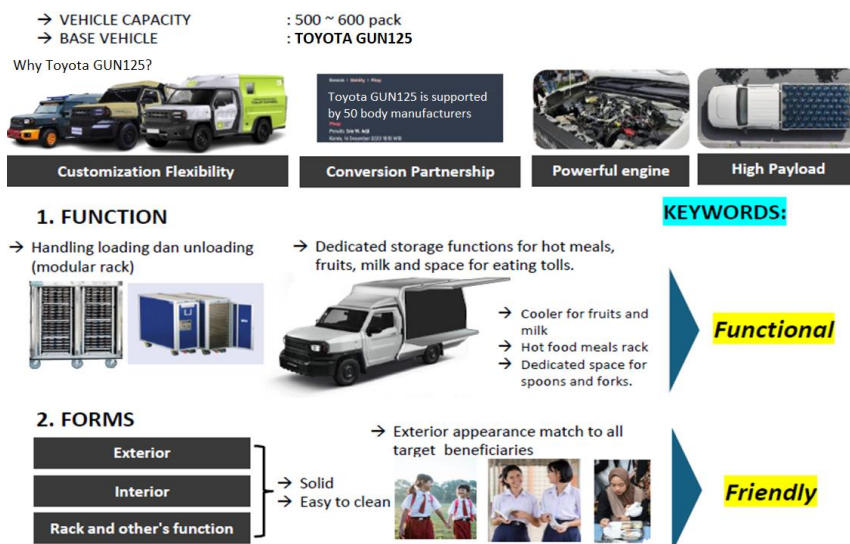


Figure 5. Key considerations for design concept



Figure 6. (a) Exterior concept (b) Trolley and lifting mechanism image

final three dimensional vehicle design shown in [Figure 7](#), alongside the detailed food trolley design presented in [Figure 8](#), which illustrates capacity and thermal containment considerations.

Performance evidence was obtained through validation along a 25 km real distribution route. Field trials recorded 98.7% operational uptime, with zero thermal breaches and food waste reduced to 2%, compared to a 28% baseline using

conventional vehicles. Distribution efficiency improved by 42%, reducing the total delivery cycle time from approximately 5.5 hours to 3.2 hours with the proposed design. Kansei post-test evaluations yielded average scores of 4.6 out of 5 for reliability and user-friendliness attributes, indicating strong alignment between user expectations and engineering outcomes. The field-ready prototype used in these trials is shown in [Figure 9](#).



Figure 7. 3D Data of vehicle concept (a) Front view (b) Side view (c) Top view (d) Rear view (e) Front quarter view (f) Rear quarter view

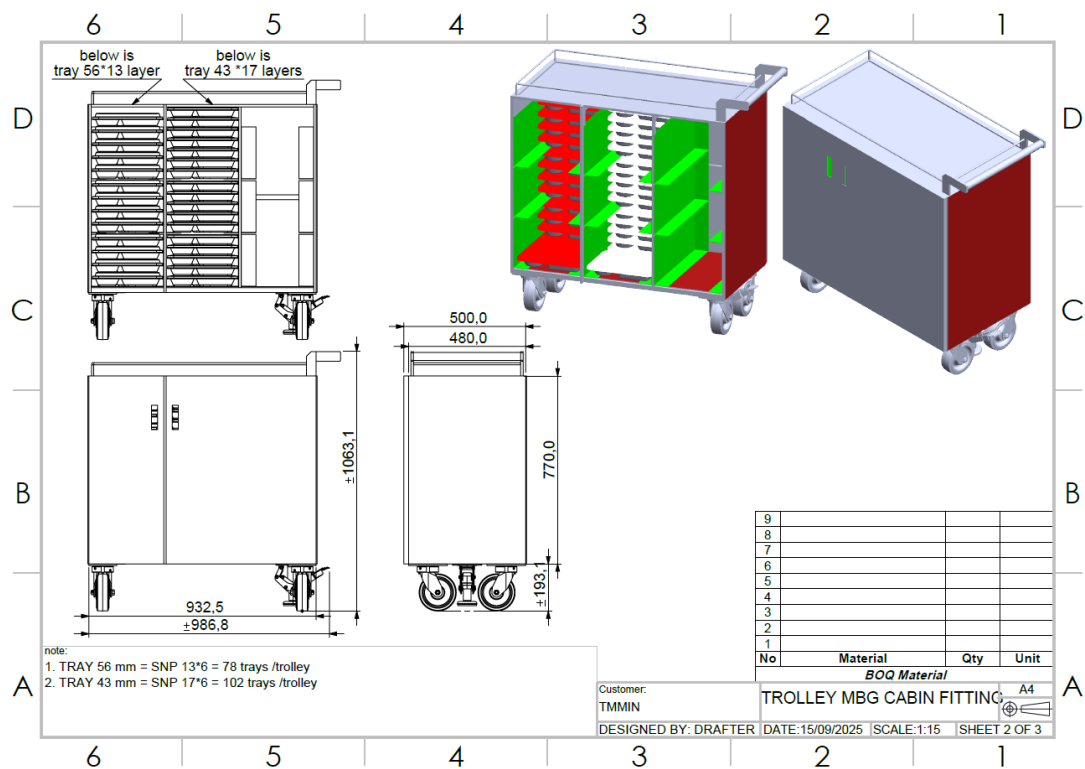


Figure 8. Food trolley design

3.5. Interpreting Evidence and Practical Implications

Qualitative insights were interpreted through thematic analysis using NVivo software, producing empathy maps and requirement matrices that informed engineering specifications [5]. Quantitative indicators, including thermal stability with a standard deviation below two degrees Celsius and handling efficiency, were

analyzed using descriptive statistics and t tests in Minitab. Kansei responses were further examined using principal component analysis to translate perceptual attributes into measurable engineering parameters [7].

Prototype performance was benchmarked against HACCP standards and compared with conventional logistics vehicles currently used in MBG distribution. The actual working prototype,



Figure 9. Actual working prototype of Toyota GUN125 MBG: (a) front quarter view; (b) cabin with food trolley

shown in **Figure 9**, demonstrates field ready implementation and validates the integration of design logic, engineering execution, and operational performance.

Taken together, the integrated visual and quantitative evidence supports the central design argument of this article. The proposed vehicle adaptation is not positioned merely as a technical artifact, but as an enabling infrastructure for reliable, scalable, and context-responsive public service logistics within nationally significant programs such as MBG.

4. Conclusion

This work demonstrates that Design Thinking, augmented by Kansei Engineering principles, can be effectively operationalized to produce a functional Toyota GUN125-based multi-purpose logistics vehicle capable of addressing critical distribution challenges across Indonesia's diverse environments. Core design interventions, including a modular rear cabin with a three-way door system, reinforced suspension, and ergonomically optimized handling mechanisms, achieved measurable performance gains, namely a 42% reduction in delivery cycle time, food waste reduced to below 2%, and a distribution capacity of up to 612 meals per school. These outcomes substantiate the proposed design argument by demonstrating end-to-end logistical integrity from centralized kitchens through rural road conditions, ferry crossings, and classroom-level delivery.

Beyond its technical contribution, this work advances national logistics capability by presenting a scalable and locally adaptable vehicle platform aligned with the MBG program's target

of serving up to 80 million recipients. The proposed design highlights how purpose-built engineering solutions, grounded in user-centered reasoning and validated through real operational evidence, can enhance public service delivery. More broadly, the vehicle concept establishes a precedent for applying automotive engineering to other perishable distribution systems, reinforcing food security initiatives through context-responsive and deployable design solutions.

Author's declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Competing interests

The authors declare no competing interest.

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Additional information

No additional information from the authors.

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