# Integrating Axle Configuration, Truck Body Type, and Payload Data to Estimate Commodity Flows

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# Outline

1. Introduction
2. Source data
3. Methodology
4. Results
   a) Configuration-body type
   b) Gross vehicle weights (GVWs)
   c) Payloads (illustrative)
5. Concluding remarks

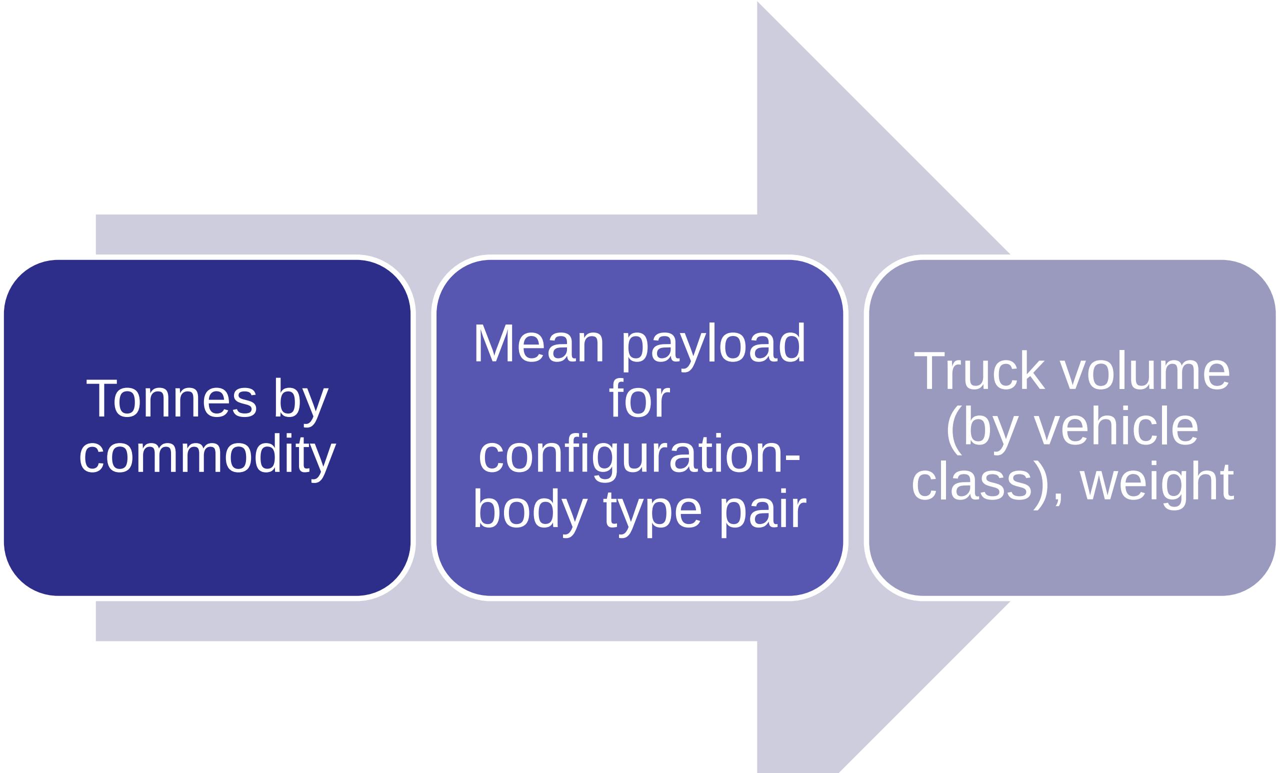
# 1. Introduction: purpose

- To illustrate potential to utilize **axle configuration**, **truck body type**, and **payload** data to estimate industry-specific commodity flows

- Motivation:
  - Transportation planners make regional transportation infrastructure investments based on expected industry activity
  - Infrastructure design features should reflect expected truck traffic characteristics
  - Key Manitoba example: development of a trimodal inland port in Winnipeg (CentrePort Canada)

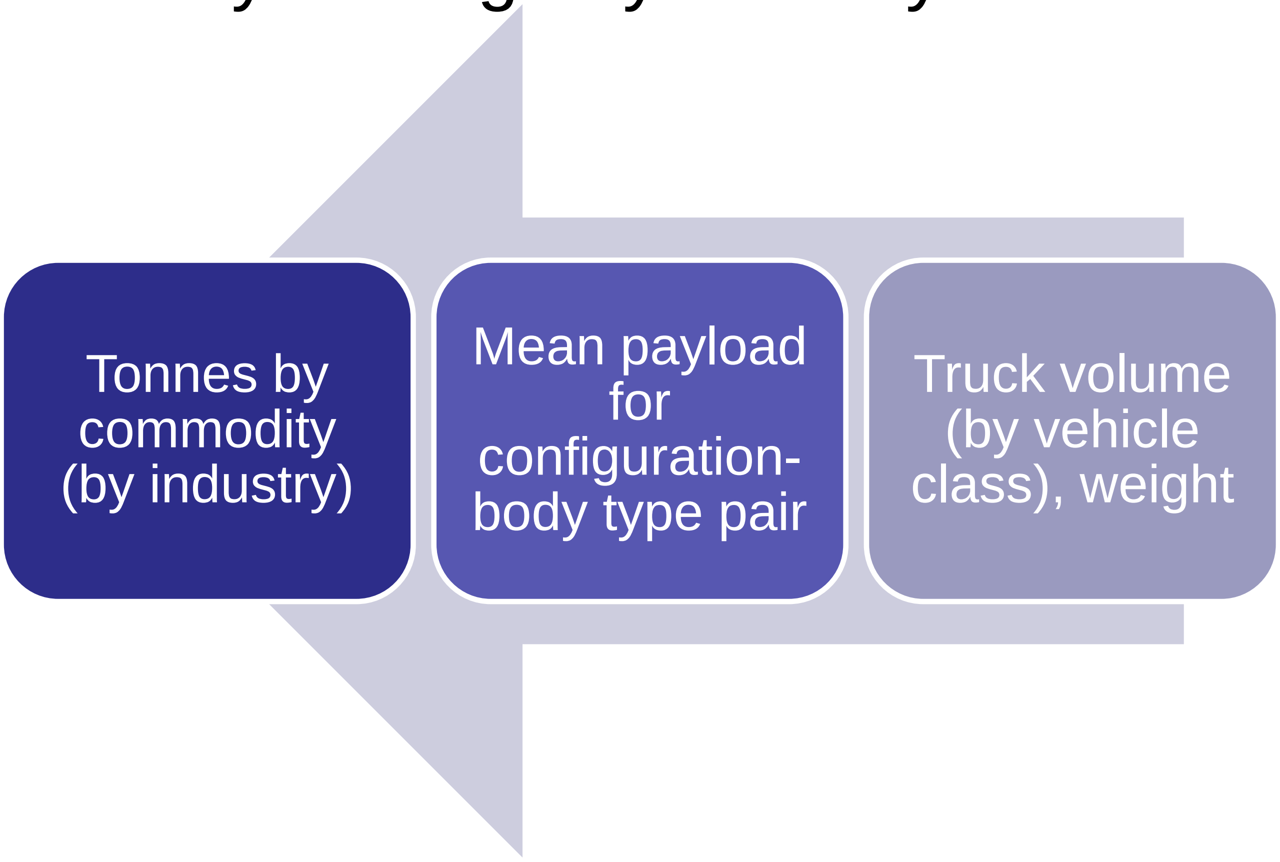
# 1. Introduction: background

- Typical freight demand modelling process (e.g., Freight Analysis Framework):



# 1. Introduction: background

- Truck traffic monitoring programs could provide data that would enable prediction of commodity tonnage by industry



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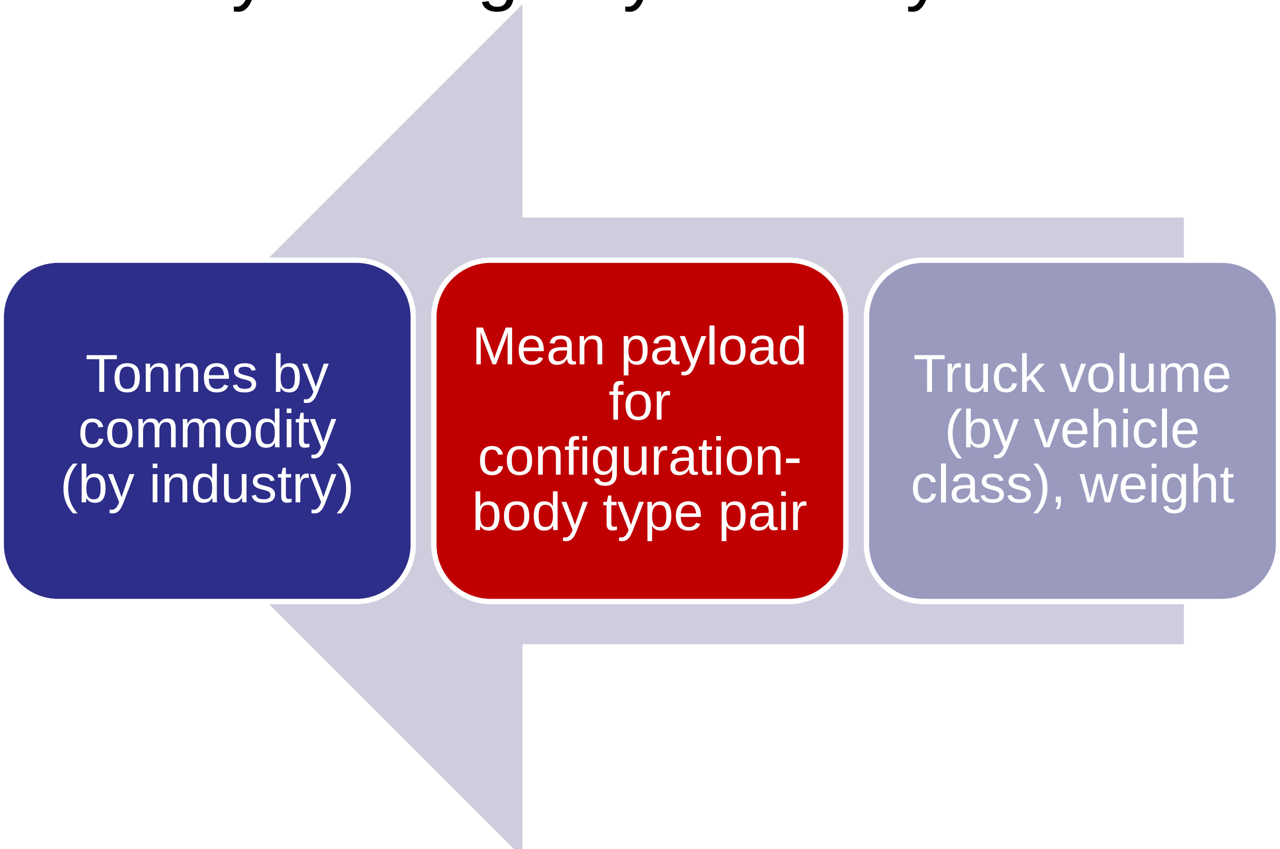
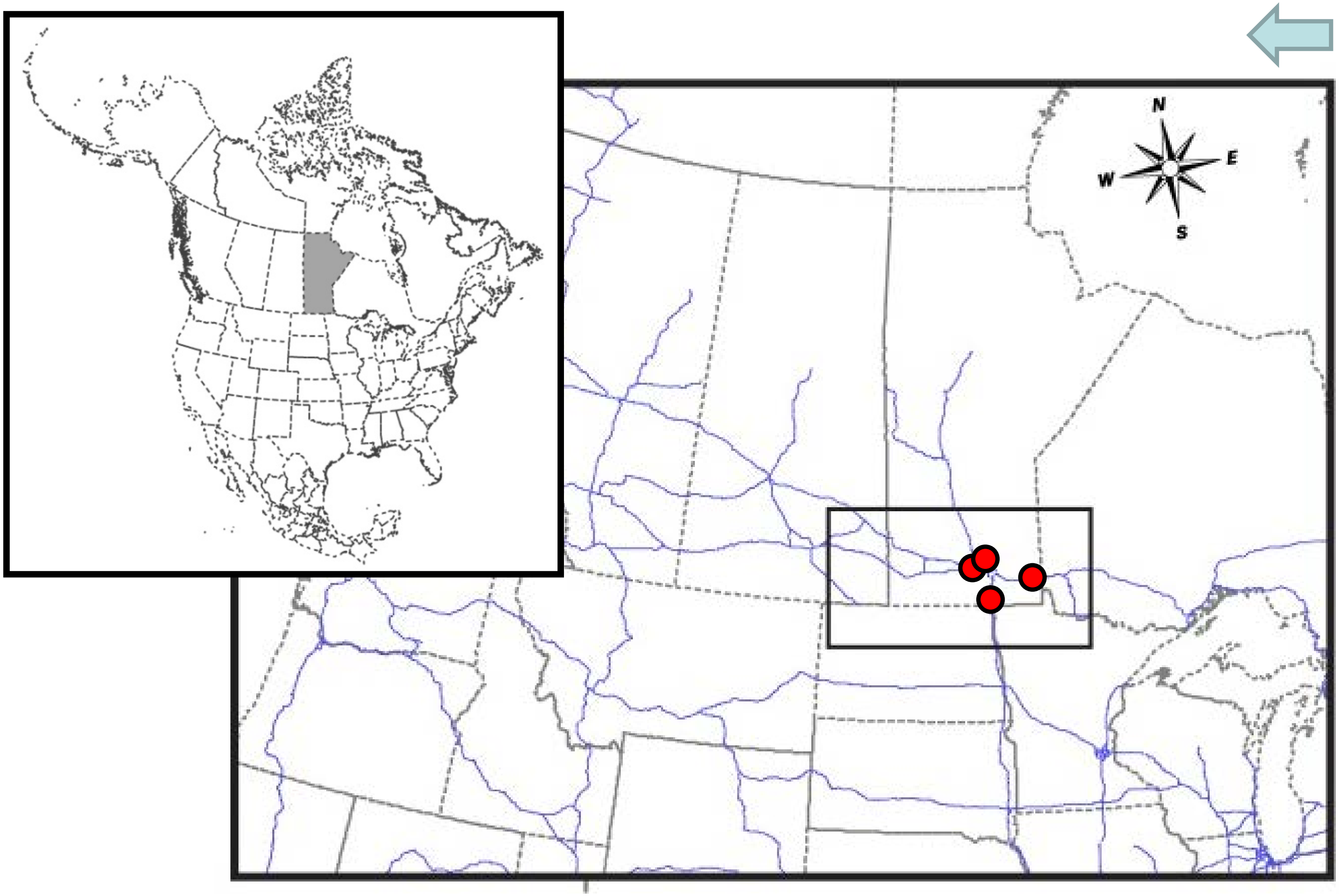


# 2. Source data

- Manual roadside surveys and sample photo weigh-in-motion (WIM) data
  - Three fixed static weigh scale locations
  - One new piezo-quartz WIM site (with photo)
  - Sites on Manitoba’s National Highway System (divided highways)
  - 48 continuous hours at each location
  - Nearly 6500 truck observations
  - Similar historical data available

- Each observation records:
  - Vehicle class (compatible with 13-class scheme)
  - Axle configuration
  - Body type (e.g., van, tanker, hopper bottom)
  - Axle weight

# 2. Source data: survey locations



# 3. Methodology

1. Clean and aggregate sample data

2. Identify relationships between axle configuration and truck body type to select predominant configuration-body type pairs

3. Analyze GVW distributions to determine mean loads and loading patterns

4. Estimate mean payloads for predominant axle configuration-body type pairs

# 4. Results: configuration-body type

- Aggregated results show predominant configurations and body types
- Typical commodities and industries are inferred

| Configuration | Body type | Typical commodities | Typical industries |
|---|---|---|---|
| Five-axle tractor semitrailer, 3-S2  (59%) | Vans/reefers (63%) | • Palletized cargo<br>• Refrigerated goods | • Retail<br>• Produce |
| Six-axle tractor semitrailer, 3-S3  (19%) | Flat decks (16%) | • Equipment<br>• Building supplies | • Construction<br>• Manufacturing |
| Nine-axle turnpike double, 3-S2-4  (8%) | Hoppers (6%) | • Grain<br>• Granular fertilizer | • Agriculture |
| Eight-axle B-train double, 3-S3-S2  (7%) | Tankers (4%) | • Petroleum products<br>• Chemicals | • Petroleum<br>• Chemical |
| | Dumps (6%) | • Aggregate<br>• Grain<br>• Refuse | • Construction<br>• Agriculture |
| | Containers (2%) | • Palletized cargo<br>• Freight of all kinds | • Retail |

Note: Percentages do not sum to 100% because "other" configurations and body types are excluded

# 4. Results: configuration-body type

- General findings by axle configuration:

| | | |
|---|---|---|
|  | 3-S2 | Majority are vans/reefers |
|  | 3-S3 | Range of body types (vans/reefers, flat decks, containers, hoppers) |
|  | 3-S2-4 | Effectively always vans/reefers |
|  | 3-S3-S2 | Effectively never vans/reefers |

# 4. Results: configuration-body type

**Predominant configuration-body type pairs (% of total observations)**

| | 3-S2 | 3-S3 | 3-S2-4 | 3-S3-S2 |
|---|---|---|---|---|
| Van / Reefer | 43 | 7 | 8 | ~0 |
| Flat Deck | 7 | 6 | 0 | 3 |
| Hopper | 3 | 1 | 0 | 2 |
| Tanker | 1 | 1 | 0 | 2 |
| Dump | 3 | 1 | 0 | 1 |
| Container | 1 | 1 | 0 | 0 |

Notes:

- Percentages do not sum to 100% because “other” configurations and body types are excluded
- Total observations, n = 6471

# 4. Results: GVWs

**Mean GVW for predominant configuration-body type pairs (kg)**

| | 3-S2 | 3-S3 | 3-S2-4 | 3-S3-S2 |
|---|---|---|---|---|
| Van / Reefer | 25,778 | 30,155 | 45,784 | N/A |
| Flat Deck | 25,454 | 27,895 | N/A | 46,759 |
| Hopper | 29,382 | 31,467 | N/A | 38,957 |
| Tanker | 23,767 | 28,764 | N/A | 45,734 |
| Dump | 29,310 | 33,755 | N/A | 44,569 |
| Container | 22,359 | 26,457 | N/A | N/A |

Note: 1 kg = 2.2 lb

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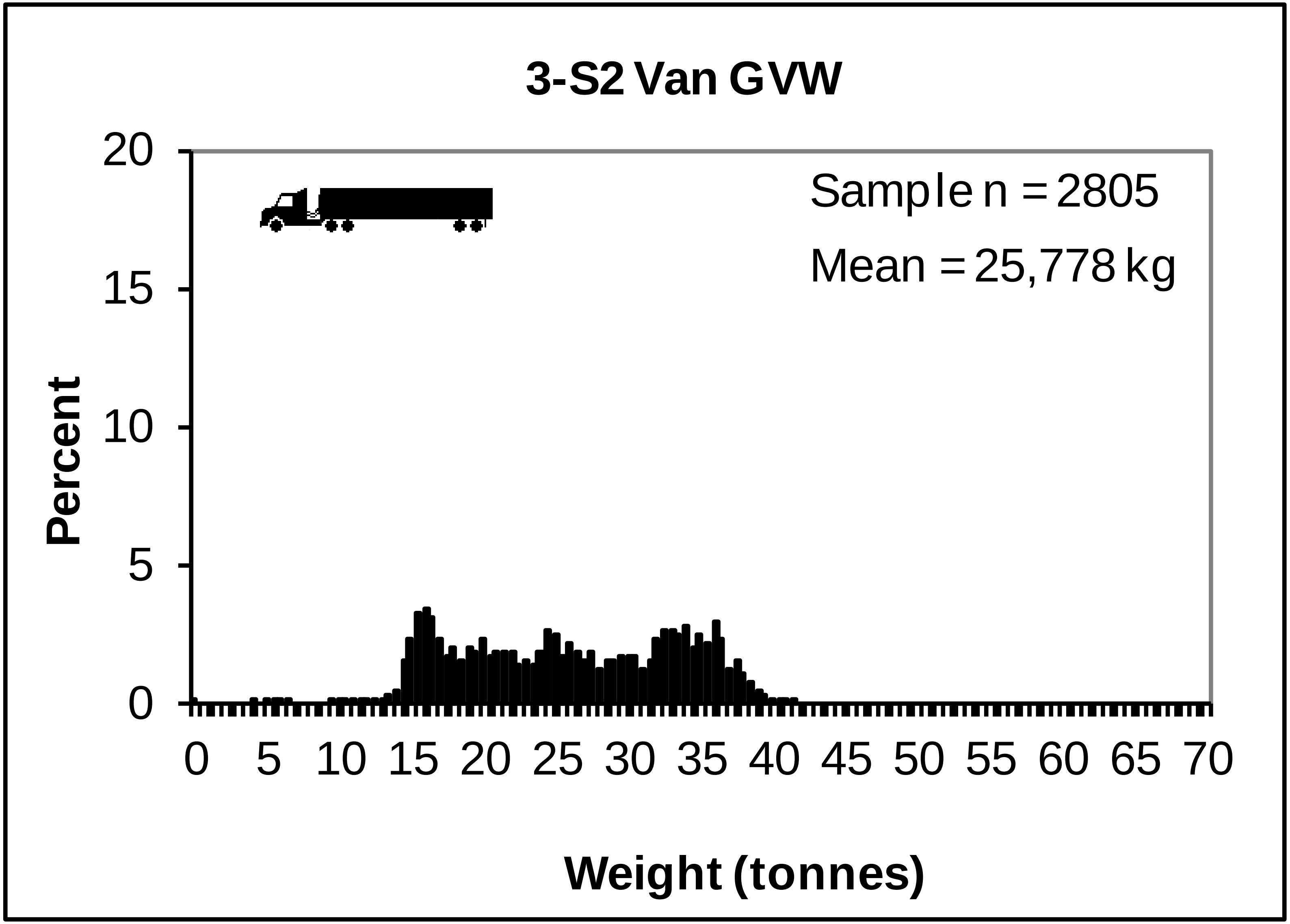

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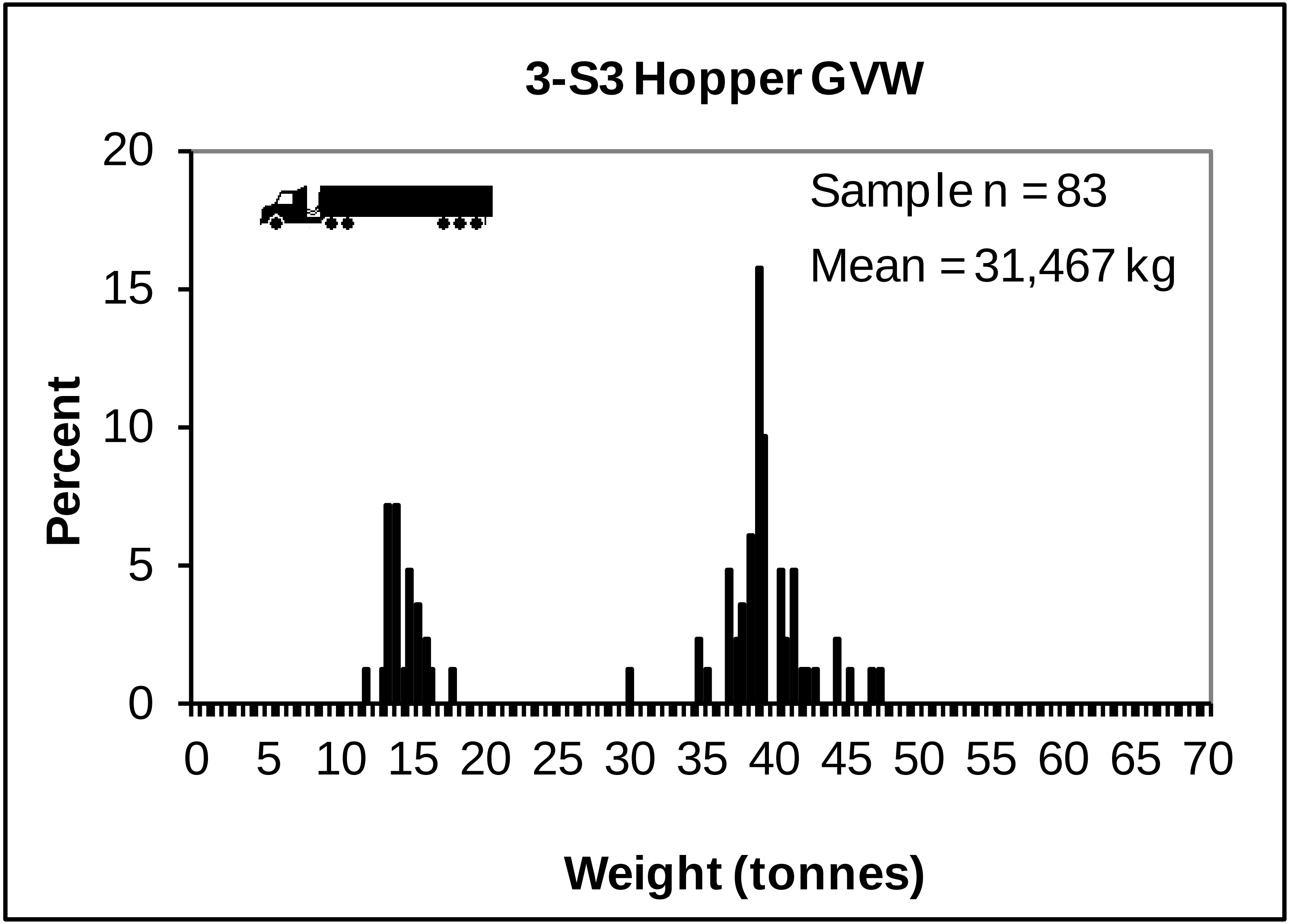

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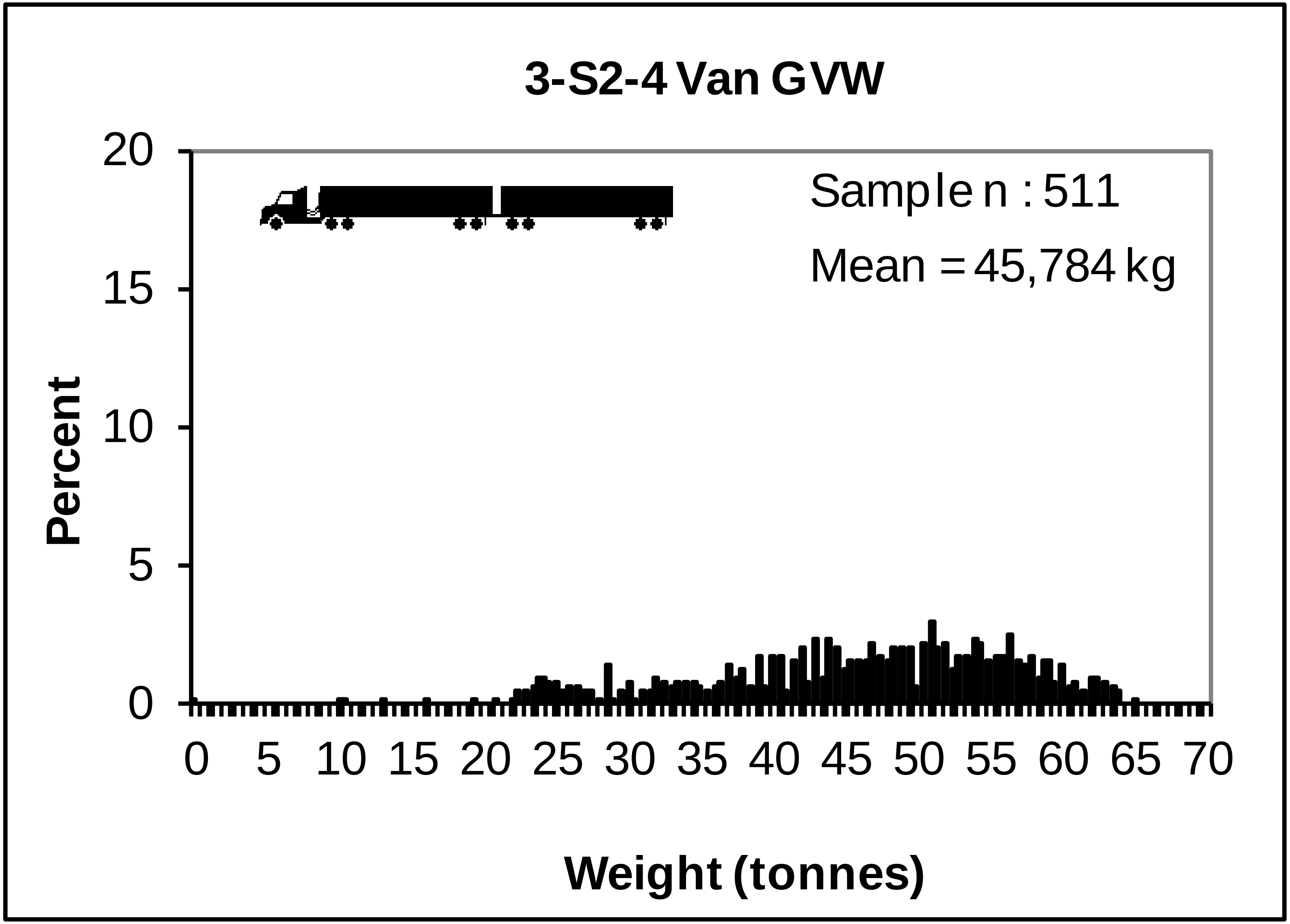

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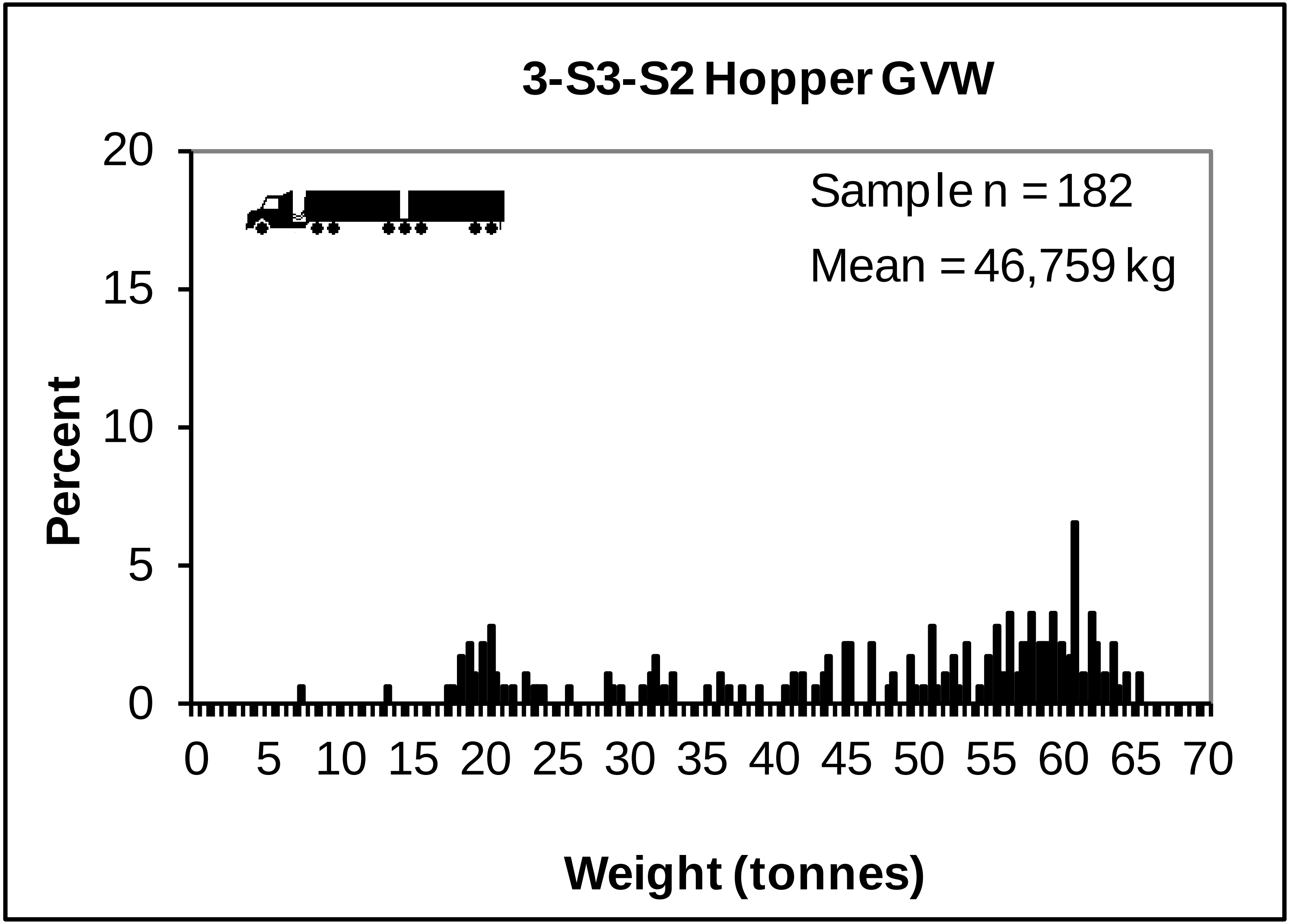
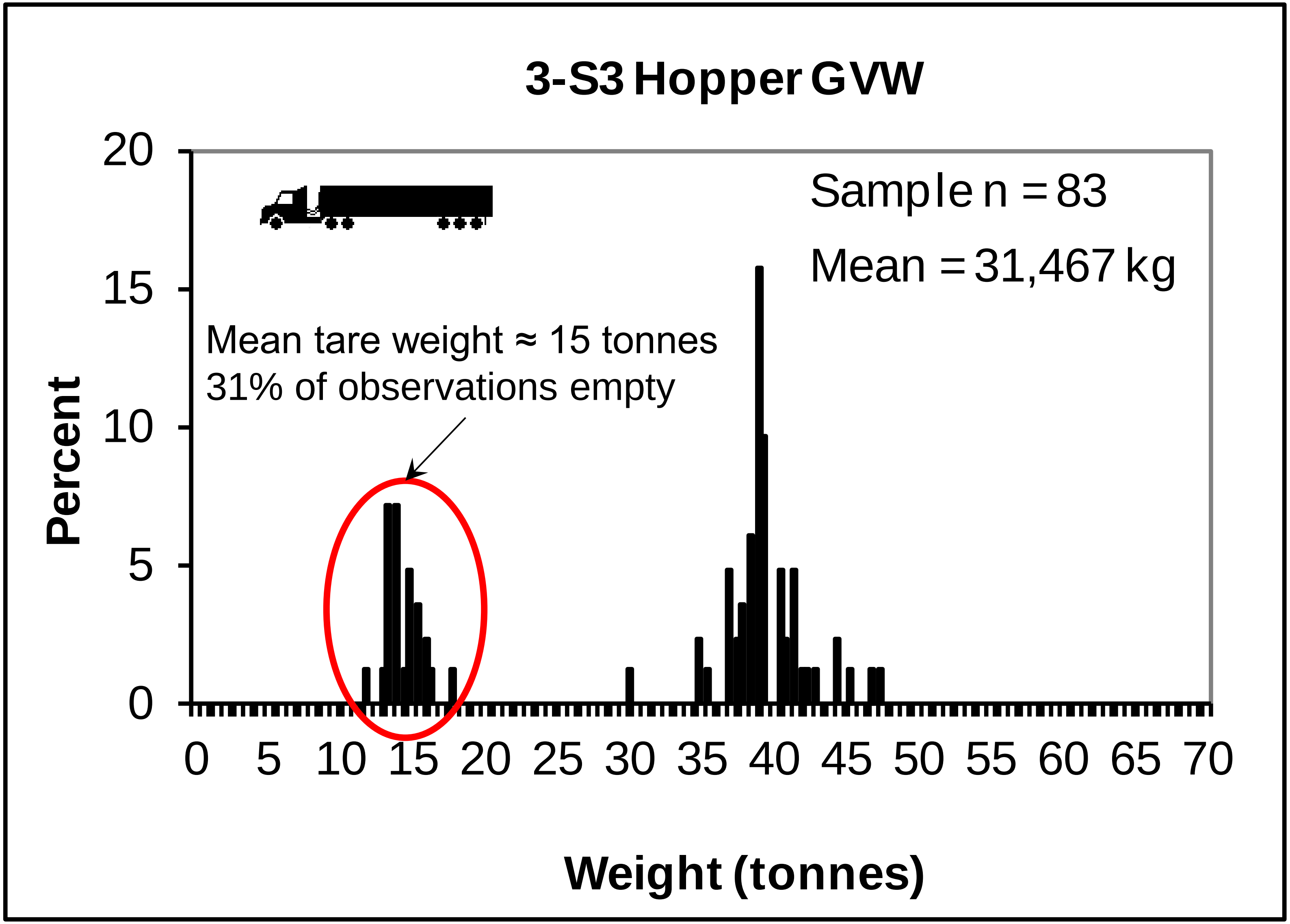


# 4. Results: payloads (illustrative)



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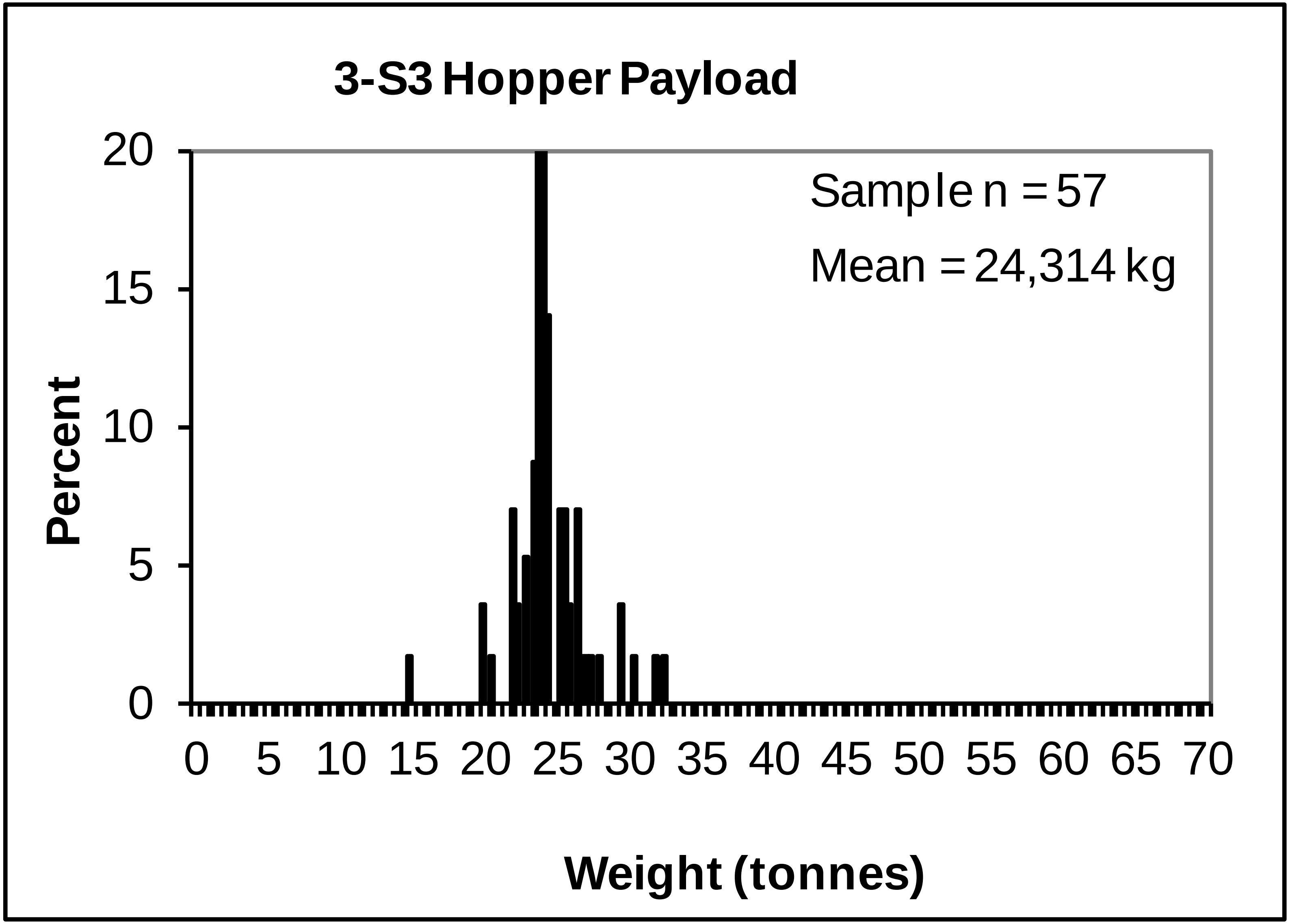

# 4. Results: payloads (illustrative)

**Mean payload for predominant laden configuration-body type pairs (kg)**

| | 3-S2 | 3-S3 | 3-S2-4 | 3-S3-S2 |
|---|---|---|---|---|
| Van / Reefer | ✓ | ✓ | ✓ | N/A |
| Flat Deck | ✓ | ✓ | N/A | ✓ |
| Hopper | ✓ | 24,314 | N/A | ✓ |
| Tanker | ✓ | ✓ | N/A | ✓ |
| Dump | ✓ | ✓ | N/A | ✓ |
| Container | ✓ | ✓ | N/A | N/A |

Note: 1 kg = 2.2 lb

# 5. Concluding remarks

- Truck traffic monitoring programs provide a critical data for highway management decisions, but cannot be easily related to industry activity

- Opportunity to leverage truck traffic data
  - Body type can be linked to commodity/industry
  - Relationship between configuration and body type
  - Unique data set provides GVW and payload means and distributions for predominant axle configuration-body type pairs

- Data collection process is onerous, but new technologies available to automate this

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