Closed-loop supply chain network optimization for Thailand motorcycle industry

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Recently, logistics have been increasing rapidly. However logistics network is still not advanced and transportation is still ineffective.

In addition, number of the scraped equipment also increased which can be considered as environmental problem.

To deal with these problems, Closed-loop supply chain investigation which both forward and reverse logistics are needed.
In Thailand, there is no much data about logistics which make it difficult to figure out the real current situation.

The objective of this study is to propose, the reverse logistics by allocating the facility in the network.
Recently, the environmental issue has become more concerned, in developed country there is a law that manufacturer must take responsibility to collect the product at the end of life.

- **EU**: (2002～)
- **Korea**: 3Rs
- **Thailand**: no regulation currently but the tendency is high.
Current motorcycle transportation in Thailand

Number of new and 2nd motorcycles sales (Bangkok)

- New motorcycles sales
- 2nd hand motorcycles sales, approximately 2%
ESTIMATION OF MOTORCYCLE TRANSPORTATION DEMAND IN THAILAND

\[ P_t = (P_{t-1} + N_t) - \left( N_{t-1} + \sum_{n=1}^{\infty} N_{t-n-1} \right) + \sum_{n=1}^{\infty} N_{t-n} - (S_t + C_{per,t} + C_{temp,t}) + T_t \]

Where:
- \( t \): year
- \( n \): vehicle age
- \( P_t \): Number of vehicle that are being possessed in year \( t \)
- \( N_t \): Vehicle that registration suspended in year \( t \) due to being unable to pay the tax for consecutive 3 years, enacted in year 2004
- \( S_t \): Vehicle that registration was inquired to cancel from user permanently in year \( t \)
- \( C_{per,t} \): Vehicle that registration was inquired to cancel from user permanently in year \( t \)
- \( C_{temp,t} \): Vehicle that registration was inquired to cancel from user temporarily in year \( t \)
Minimum error = 1.8%.

The sudden drop in year 2004 is caused by the regulation that suspend the registration for those who do not pay tax for consecutive 3 years was first started.
ESTIMATION OF MOTORCYCLE TRANSPORTATION DEMAND IN THAILAND

Estimated number of new registered motorcycles

- New registered motorcycles

Estimated number of second hand motorcycle

- 2nd hand motorcycles

No. of motorcycles vs Years (2011-2039)
Development of evaluation model for reverse logistics network

Location fixed:
- Factory
- Warehouse
- Distribution Centre
- Dealer
- User
- Disposal Centre
- Main Collection Centre
- Collection Centre

Design variable: Location and number of facilities

Forward transportation cost:
\[
\sum_{t \in T} \sum_{d \in D} T_{wd}X_{wdt}^f + \sum_{t \in T} \sum_{d \in D} \sum_{s \in S} T_{ds}X_{dst}^f
\]

Reverse transportation cost:
\[
\sum_{t \in T} \sum_{s \in S} \sum_{c \in C} T_{sc}X_{sct}^f + \sum_{t \in T} \sum_{c \in C} T_{cCo}X_{cCo}^f
\]

Construction cost:
\[
\sum_{i \in I} C_iY_i
\]

Operation cost:
\[
\sum_{t \in T} \sum_{i \in I} f_tY_i
\]
Factory 2nd hand Centre City Hybrid distribution/collection centre

Forward flow

Dealer no. = 973

City
Factory
2nd hand Centre
Hybrid distribution/collection centre

Dealer
Factory
2nd hand Centre
The optimal number of Hybrid distribution/collection centre was found to be 39.

Comparing with the current system, with Hybrid distribution/collection being established the total cost are reduced and more benefit can be gained.
In this study, for motorcycle transportation as a case study, it has been found that by introducing distribution/collection facility in the logistics network, the cost can be reduced.

As a further study
- Regional cohort model should be performed
- Stochastic demand should be applied
Thank you for your attention