

## AN ANALYSIS OF DEVELOPING LOGISTICS STRATEGY OF CONVENTIONAL RAILWAY COMPANY: A CASE STUDY OF TAIWAN RAILWAY ADMINISTRATION

Yung-Hsiang CHENG  
Assistant Professor  
Department of Logistics Management  
National Kaohsiung First University of  
Science and Technology  
2, Juoyue Road, Nantz District, Kaohsiung  
811, Taiwan R.O.C.  
E-mail: yhcheng@ccms.nkfust.edu.tw  
Tel: +886-7-6010000-3215  
Fax: +886-7-6011040

Chin-Hyun CHEN  
Bachelor graduate  
Department of Logistics Management  
National Kaohsiung First University of  
Science and Technology  
2, Juoyue Road, Nantz District, Kaohsiung  
811, Taiwan R.O.C.  
E-mail: u9123325@ccms.nkfust.edu.tw  
Tel: +886-7-6010000-3201  
Fax: +886-7-6011040

Tsai-Lin MAO  
Bachelor graduate  
Department of Logistics Management  
National Kaohsiung First University of  
Science and Technology  
2, Juoyue Road, Nantz District, Kaohsiung  
811, Taiwan R.O.C.  
E-mail: u9123311@ccms.nkfust.edu.tw  
Tel: +886-7-6010000-3201  
Fax: +886-7-6011040

**Abstract:** This study aims on analyzing important decision factor of freight transportation and logistic development strategy of conventional railway company in Taiwan (Taiwan Railway Administration, TRA), after the entry of High Speed Rail into intercity transportation market. Yet, such decision process needs to have some tangible and intangible variables being considered. Therefore, this study applies the method of Analysis Hierarchy Process by expert decision process to establish TRA's logistics development strategy. The results of AHP analysis shows: financial planning is the most critical factor for TRA to develop logistic strategy. This study also finds the most appropriate alternative would be for TRA to continue to utilize current narrow-gauge railway system for the main freight transports between TRA's stations. In addition, TRA could fully utilize central downtown location advantages of current stations to cooperate with private motor carriers for transportation from TRA's station to final destination.

**Key Words:** conventional railway company, logistics strategy, AHP, TRA

### 1. INTRODUCTION

The subsequent entrance of High-Speed Rail (HSR) into intercity transportation markets require existing conventional rail companies in the market to alter their operational strategies. Conventional rail companies are principally affected HSR competition due to their slower operational speed in passenger transports services. In Taiwan, HSR is operated by a private

concession consortium (THSRC) and will commence revenue service operation by year-end of 2005, while Taiwan Rail Administration (TRA) is a public institution responsible for operating conventional railway system. These entities are two different rail companies. Therefore, TRA is faced with strong competition from HSR and necessitates target market distinctions with its competitor.

The Taiwan manufacturing industry is well established and has daily operational activities that demand greater logistic service advancements. Advantages for Taiwan Rail Administration to develop logistics activities include densely located stations and warehousing facilities nationwide as well as transport wagons and downtown main stations in each city.

However, several problems still exist in TRA's freight service. Currently transportation route frequency is at a maximum with the majority used for passenger transportation causing scarcities in freight transportation scheduling. In addition, freight transportation route cars are outdated and insufficient causing difficulties meeting customer demand. A managerial concept of "passengers first, freight second" will also cause limited freight transportation development. All demands are geared towards improving passenger transportation while overlooking the growing problems in freight transportation.

Hence, optimizing utilization of TRA's advantages, improving actual weaknesses, and cooperating with private logistic and express delivery companies toward developing logistic activities could be one possible future operational strategy.

## **2. LITERATURE REVIEW**

The downturn of highway and railway transportation markets have changed according to transportation environments of various countries. Railways are difficult to be completely replaced in freight transport because they possess the specific characteristics in high capacity and reliability. Railway transportation of various countries and governments have actively engage in railway organization reforms to meet the demands of the highly competitive transportation market. (Jan, 2001). This study reviews the railway freight transportation development experiences of several countries including Europe, United Kingdom, France, United States, and Canada, Japan and analyze these cases in detail for TRA's logistics development reference.

Japan freight transportation market is primarily occupied by highway and sea. Railway freight is operated by Japan Railway and a few other private railway companies. Highway transportation has an annual increasing trend while sea transportation is decreasing annually. For railway transportation, annual decrease eased until 1998 with a market share of 4.5%. Japan Railway Transportation Company (2003) views express delivery as possessing operation business opportunity but require complete transportation planning. Japan Railway Transportation Company is responsible for point-to-point delivery and provides railway freight delivery services.

Continental countries such as the United States, France and Holland, are geared towards combined transportation including the combined transportation development between railway and highway, railway and sea, and railway and air. The need for combined transportation is due to more dispersed land and longer transportation traveling distances. Taiwan railway operating mileages along the western coast from north to south is approximately 400 miles

(TRS website, 2003). Overly short mileages distance maybe increase the difficulty in developing railway-combined transportation.

In recent years, French national railway (SNCF) has invested approximately US\$1 million to strengthen cross-country railway transportation projects where funding sources come from central and local governments. SNCF has relatively low combined transportation profitability in comparison with other countries. Though accumulated growth rate reached as high as 23% for the past five years, accumulated income growth rate is merely 11%. Current combined transportation accounts for 4% of SNCF total transportation volume where transportation volume of greater than 500 miles accounts for 12% (Chen, 1998). Furthermore, Nierat (1997) explains the most appropriate operating mileages distance is between 400 and 500 miles for railway combined transportation development.

The United States has gradually relaxed railway transportation regulations since the 1980s and increased their value perception of railway transportation due to highway environmental pollution, traffic congestion and frequent accidents. (Chen, 1998) Additionally, the vast national boundary and tremendous freight and container transportation have increased delivery efficiency and lowered transportation costs through railway transportation (Jen, 2001). In order to increase the efficiency of various transportation modes and the development of freight transportation, railway freight transportation fee regulation was eliminated and incorporated into the Sea Law, allowing freight container shipping companies to provide combined transportation fees. In 1991, the Intermodal Surface Transportation Efficiency Act (ISTEA) was passed to establish a suitable environment for combined transportation. (Chen, 1998)

The US government cooperated with sea companies in 1996 to further increase international competitiveness. Rather than focusing exclusively on sea transportation systems, transportation efficiency increases, or cost reductions, the government concentrated on the integration of inter-railway transportation and sea harbor activities toward an integrated transportation system on combined transportation development. (Chen, 1998)

The US railway and highway combined transportation development adopts the railway for long distance transportation and truck deliveries through highways for short distance transportation. Such shared responsibilities are complementary and not mutually competitive. (Chen, 1998). Furthermore, US railway transportation could reduce highway system burden, meet environment protection demand, reduce environment damages, increase freight container transportation safety, and reduce freight damages (Chen, 1998)

Tsai (2000) British Railway cooperated with highway to provide door-to-door services; freight are delivered through railway express services and continued with the connected motor transportation. Such combined transportation services between railway and highway not only increase rapidity of delivery, but also increase freight transportation reliability. In 1980 British Railway, upon market demand, proposed a market oriented cost center railway privatization to enable stable growth in freight volume. The goal was to develop combined transportation in future logistic center exchange and cooperate with highway operators to reach home delivery objective.

In Canada, government policy encourages combined transportation and provides incentive to push railway operation mergers with sea transportation. Although combined transportation

development have increased transportation activity efficiency and resolved numerous transportation problems, they have caused significant conflicts in private institution competitive environment.

In Australia, the railway network is 35,000 km in total length where 8,000 km are major routes for various metropolitan cities. 75% of Australia's container freight transportation relies on railway transportation services. Train scheduling is divided into periodic (scheduled) and irregular (demand driven) scheduling. The Australian government, for the purpose of improving Australian export methods and increasing Australian commerce, industries and economies, encourage transporters to develop combined transportation to reach higher reliable services. The Australian government establishes basic freight transportation policies according to the following four principles: (Jan, 2001)

- Combined transportation system needs to apply the best technology to deliver on time at peak hours.
- Maintain flexibility to meet demand changes.
- Establish and maintain all commerce trading relationship to encourage alliances between all actors in manufacturing and transportation supply.
- Establish an international network-transportation model.

As for the freight transportation development in New Zealand railway, the privatization of New Zealand national railway has led to the establishment of 10 railway and highway multifunction freight trailers (Road Railers). The Road Railers have licensed approvals from U.S. Wabash Company are were first tested in 1989 becoming a new milestone in railway-highway combined transportation. (Chen, 1998)

According to railway freight development in various countries mentioned above, different countries all actively deregulate related regulations and gradually privatize national railway companies to have greater operation flexibility. In addition, they continue to develop railway long distance transportation and cooperate with motor carriers for short-term connection transportation in order to establish an excellent combined transportation environment. After privatization of railway companies, active cross-industry alliances are needed to compete with private freight transportation operators such as strategy alliances with freight container transportation, packaging activities, and home deliverie services to increase railway market competitiveness.

### **3. SWOT ANALYSIS OF DEVELOPING TRA'S LOGISTICS STRATEGY**

This study first analyzes the related problems of TRA's developing logistics activity. A SWOT analysis was conducted to form an AHP analytical structure in the chapter 4.

#### **3.1 TRA's logistic development strategy related problems**

TRA's development in logistic activity will face many problems and challenges. This study

divides these problems into four aspects as follows:

### **3.1.1 Technology**

Effective logistic processes utilize information system and technologies to conserve resources by minimizing redundant tasks and increase quality of service by providing ad-hoc customer information. Successful implementation of an effective logistic process allows preservation of current customers and concurrent exploration of potential customers. TRA's technology progression in freight service has yet to reach these levels of effectiveness. The majority of TRA's freight operation is not automated. In addition, financial limitations is TRA's greatest barrier to advance in logistics technology.

### **3.1.2 Financial**

Although TRA currently provides package transportation activity, except for few train stations equipped with conventional push-carts, no specialized package transportation facilities exist. TRA related transportation facilities are required to assist in logistic development activities by increasing overall efficiency through purchasing equipment such as pallets, forklifts, and cranes. Despite some larger train stations, most facilities do not have specialized staff responsible for freight transportation. The necessary specialized freight service personnel will increase costs for developing logistic activity. Warehouse will also need to be built to stock delivery goods. Larger freight stations can use spare land property to build warehousing, but such construction projects will require large capital.

TRA's current freight transportation consists of two specialized cars and two additional cars providing car temperature control. Freight allocation is determined by physical space rather than freight contents easily resulting in freight damages. The establishment of logistic activity will require large capital to remodel or purchase additional specialized delivery cars. During initial logistic activity planning, success will be determined by the ability to appropriately allocate profit and assets to assure a sustainable operation planning correspondence with future development objectives and directions.

### **3.1.3 Managerial**

After the development of logistic activity, organization structure will need to be altered or simplified. In addition to a new logistic freight management department, freight operations and freight services departments will require distinct responsibilities. Employee and managerial training are needed prior to the introduction of logistic activity on current and new employees. Although TRA has an employee training center, training is limited to basic package transportation activities and does not include any specialized logistic activity training plans. Therefore, managerial control is necessary to establish a specialized logistic activity employee training program. Afterwards, TRA will need to develop marketing strategies to compete with competitors and educate customers on TRA's freight delivery services and procedures. If TRA can capitalize its numerous freight transportation advantages, a diversified service and logistic activity market could be developed.

### **3.1.4 Regulation**

Though the Railway Law permits TRA to develop other business activities, detailed definition is lacking. Whether logistic activity is defined as other business activities or transportation could affect the feasibility of logistic activity.

### **3.2 SWOT analysis in developing TRA's logistics service**

#### **3.2.1 Superiority analysis**

TRA has a total of 214 train stations across the nation with a dispersed network that can be fully utilized for developing logistic activity. Moreover, TRA has dedicated right-of-way exclusive distribution routes allowing distribution adjustments with current passenger transportation. TRA's vast unused land and inventory accounts for approximately 84,962 meter squares (TRA website) that meet logistic activity development needs on large property areas for inventory, logistic refinement, and physical distribution. The large amounts of land available could be easier utilized by the TRA to develop logistic activity by cooperating with the private sector. Larger railway containers allow additional cars to increase transportation volume per scheduling creating a transportation capacity and efficiency competitive advantage over large sized private sector delivery trucks. After high-speed rail completion, additional scheduling can be allowed to increase delivery frequency and accurately maintain freight punctuality. Railway transportation is safer than highway transportation due to dedicated right of route that allow less traffic accidents, less traffic congestions, and higher on-time rates meeting strict time demands of logistic development.

#### **3.2.2 Weakness analysis**

Many difficulties still exist for TRA's development of logistic activity. Complex organizational structure with tall heirarchical departmental relationships lead to low operational efficiency. Current organization structure should be simplified to increase overall operational efficiency. Currently, TRA uses regular and low speed trains for freight transportation with low loading and unloading efficiency. Remodeling of current trains or new purchase on freight transportation facilities should be accommodated to meet customer freight transportation demand. TRA has long focused on passenger transportation as the major activity while freight transportation as a complementary activity causing increases in passenger transportation services but continuous decrease in freight transportation activities.

TRA is currently a public institution characterized by stable salaries and fixed office hours under government supervision as a monopolistic industry that eliminates the need to improve or increase staff capability and work efficiency for industry competition. Currently, TRA may have large freight and package transportation activities that function by manpower with no transportation automated facilities. In order to improve logistic activities, additional transportation facilities or technologies should be purchased to reduce transportation damages and increase transportation efficiencies. TRA currently provides only point-to-point package delivery. Customers need to arrive at train stations to pick up delivered items. In order to develop home delivery services, additional delivery trucks are needed to deliver items from the train station to customer homes. Home delivery services can be developed in cooperation with the private sector. In recent years, private sector has standardized pricing and delivery of home deliveries on a door-to-door basis that is significantly more convenient than services provided by TRA. Plus, advertising marketing of public institutions is difficult leading to minimal profit gains from package transportation activities that are unable to cover transportation costs. Therefore, TRA should improve its package transportation activity,

provide standardized operation procedures, simplify delivery categories, and increase advertising marketing to further develop logistic activity.

### **3.2.3 Opportunities analysis**

Recent increases in Taiwan quality of life and changes in consumption behavior have encouraged the development of home deliveries. Taiwan now has more than ten home delivery companies. TRA has advantages in developing new logistic activity and already has existing package transportation activity. If TRA could cooperate with the private sector, it may join the home delivery market to increase operation efficiency between TRA and private sector. After the completion of high-speed rail, mid and long distance customers will utilize such package transportation services. TRA's capacity will also increase for additional special freight wagon to increase utilization rate of overall railway routes. Currently, TRA is undergoing the process of privatization planning. Post privatization era can increase TRA's decision-making efficiency and attract cooperation from private sector in developing logistic activity. Railway transportation has advantages in reducing external costs including less air pollution, energy utilization and traffic accidents. These advantages encourage government support in TRA's development in logistic activity. The achievement of railway freight service could provide the most effective public service at a minimal social cost.

### **3.2.4 Threat analysis**

Though TRA's development in logistic activity has numerous advantages, many potential threats still exists including several already established home delivery companies. The question on how to capture freight sources for TRA and compete with private sector is a key problem on developing logistic activity. Strategy alliances with motor carriers could avoid operation difficulties after large investments in capital, facilities and technologies. TRA is currently a public institution that is regulated by law where political factors and lobbying of representative groups lead to non-market responsive transportation prices to reflect costs and demand. If such positive adjustments could be made, competitive advantages could be increased. TRA still has significant pressure from political policies causing low administrative efficiency. Without prudent planning and market analysis in entering logistic activity market, TRA would not be able to compete with the private sector and improve service quality in logistics activity.

## **4. STUDY DESIGN AND METHODOLOGY**

This study first collects and analyzes past literatures to identify competitive advantages of TRA and apply the SWOT (Superiority, Weakness, Opportunity, Threats) analysis to provide multiple feasible alternatives on logistic developing strategy. Questionnaire survey are then designed after the SWOT analysis and filled out by experts through face-to-face interviews. The AHP method is applied to interpret survey results for obtaining objective and criterion weightings. Most feasible alternatives and important factors are identified to increase competitive strategy.

### **4.1 Sampling Process**

The expert group consists of sixteen carefully chosen interviewees to complete questionnaire survey. They are five academic scholars in railway transportation, five government official responsible for railway enterprise supervision, and six managers from TRA responsible for

business strategy planning, freight transportation and station development. Questionnaire is designed to clarify objectives, criteria and alternatives for pair-wise comparison of expert opinions. Individual weights of objectives, criteria and alternatives were assigned through the application of the AHP method.

#### **4.2 AHP method**

The Analytical Hierarchy Process (AHP) is a decision-aiding method developed by Saaty. It integrates expert opinion and evaluation and divides the complex decision making system into a basic element hierarchy system. Ratio scale is employed to proceed with relative importance of pair-wise comparison among criteria to decompose complicated problems from higher hierarchies to lower hierarchies. This method also systematizes the problem by employing a subsystem perspective endowed in the system. Experts whom conducted the pair-wise comparisons reveal the comparative importance between two criteria and determine the AHP weighting. If there are  $n$  evaluation criteria, experts will conduct  $C(n,2) = n(n-1)/2$  pair wise comparisons during decision making. The comparative importance derived from pair wise comparisons allows a certain degree of inconsistency within a domain. Saaty used the principal eigenvector of the pair-wise comparison matrix contrived by scaling ratio to identify comparative weights among criteria. Procedures for AHP method application are as follows:

- (1) Define the problem and determine its goal.
- (2) Structure a top-down hierarchy consists of decision-makers' objectives and intermediate or lower level managerial.
- (3) Construct a set of pair-wise comparison matrices (size  $n \times n$ ) for each of the lower levels with one matrix for each element in the level immediately above by using the relative scale. The pair-wise comparisons are done in terms of which element dominates the other.
- (4) There are  $n(n-1)$  judgments required to develop the set of matrices in step 3. Reciprocals are automatically assigned in each pair-wise comparison.
- (5) Hierarchical synthesis is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy.
- (6) Having made all the pair-wise comparisons, the consistency is determined by using the eigenvalue,  $\max$ , to calculate the consistency index, CI as follows:  $CI = (\max - n) / (n-1)$ , where  $n$  is the matrix size. Judgment consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value. To obtain a consistent matrix, judgments should be reviewed and improved.
- (7) Steps 3-6 are preformed fro all levels in the hierarchy.

This study first adopts the SWOT analysis to investigate the advantages and disadvantages of TRA are developing logistics activity. Based on SWOT analysis in the first stage, we create the feasible alternatives by brainstorming. Decision factors on final alternatives of expert choice were selected based on references in past literatures and expert recommendations.

The analyzed decision structure is divided in two levels. The first level includes four objectives such as logistics operation, financial planning, business management, policy and social consideration. The second level attempts to identify ten key factors of TRA's development in logistic activity according to four determinant factors of the first level.

#### **5. EMPIRICAL RESULT OF AHP ANALYSIS**

According to result of AHP in Figure 1, analysis shows: financial planning is the most critical factor amongst the four determinant factors of first level. It shows if TRA was to develop logistic activity, large capital investment into terminal loading and uploading facility and equipment will be necessary as well as adjustments to current scheduling and purchases of new vehicles. Important key factors to the second level are: station location advantage, capital funding acquiring, asset utilization and cost control, staff training and quick responsiveness to customer, and policy implementation and regulation changes. This study finds the most appropriate alternative is “line-haul by train, delivery and pick-up by motor carriers” that means TRA should continue to utilize current railway system for the main freight transports between TRA’s stations. In addition, TRA could fully utilize central downtown location advantages of current stations to cooperate with motor carrier for transportation from TRA’s station to final destination. If TRA could effectively develop logistic activity service, it would not only bring new marketing activities, but also avoid excess external cost accrued by highway trucks and make Taiwan intercity transportation sustainable development and infrastructure utilization in the most efficient way.

For TRA’s logistic activity development objective, financial planning is found to be the most important factor that large retirement fund expenses is causing company profit losses. Logistic activity development requires large capital investment.

Criterion evaluation found important criterions include “station area advantages utilization”, “capital resource obtaining”, “asset utilization and cost control”, “employee training and customer reply” and “government policy execution and deregulation”.

Employee training and customer reply should also be evaluated highly in logistic operations development. Present employee training is characterized by non-professional logistic knowledge training that current and newly arrived employees to receive training in logistic operation management is a key success factor in logistic activity development.

However, government attitude also affects TRA’s logistic operations development. Government shows willingness in encouraging TRA to diversify into logistic operation and deregulate related regulation on TRA. In addition, the administration should provide related capital funding and incentive to encourage TRA in developing logistic operations.

Table 1 Explanation of objectives and criterions in the AHP analysis

Objective	Criteria	Explanations
Logistic operation	Station Location Advantage Utilization	Location affects freight mobility and accessibility. TRA's stations are mostly located in center metropolitan that can be appropriately utilized based on location advantage to increase operation efficiency.
	Warehousing completeness	Developing logistic activity requires numerous facilities including moving facilities, warehousing facilities and transportation facilities.
	Logistic capability increase	Logistic capability means transportation efficiency, information system buildups and other automated technology utilization to increase overall logistic operation.
Financial planning	Capital sources obtaining	Developing logistic activity requires large capital originated from the government, TRA or participating private investors.
	Asset utilization and cost control	Utilized appropriately TRA's current warehousing system and asset to control divers cost expenditures such as personnel, facility and operation management costs
Business management	Service quality improvement and marketing strategy	Enhance TRA's current service quality and provide dynamic marketing strategy
	Staff training and responsiveness to customer	Staffs could adjust to internal operation and external market according to market demand changes through training and management to have large effects on service quality and corporate competitive advantage increases.
Policy and social consideration	organization structure alternation and changes	Organization reform or privatization can perhaps alter current organization structure to increase corporate operation efficiency.
	policy execution and deregulation	Government policy execution and deregulation can allowed TRA in developing business with much more flexibility in recruiting and marketing strategy
	External cost reduction	Railway freight service can reduce external costs including environmental pollution, traffic safety and energy wastes.

Table 2 explanations of various alternatives

Alternative	Explanations
Maintain the present situation in freight service	Maintain currently adopted TRA's freight procedure and logistic moving facility but increase advertising marketing to promote
Line-haul by train, delivery and pick-up by motor carriers	TRA is responsible for line-haul transportation (from station to station) and motor carrier is responsible for home delivery from train stations.
Total logistics activity outsourcing	Allow TRA's freight activity to be privatized completely and to be operated by private sector

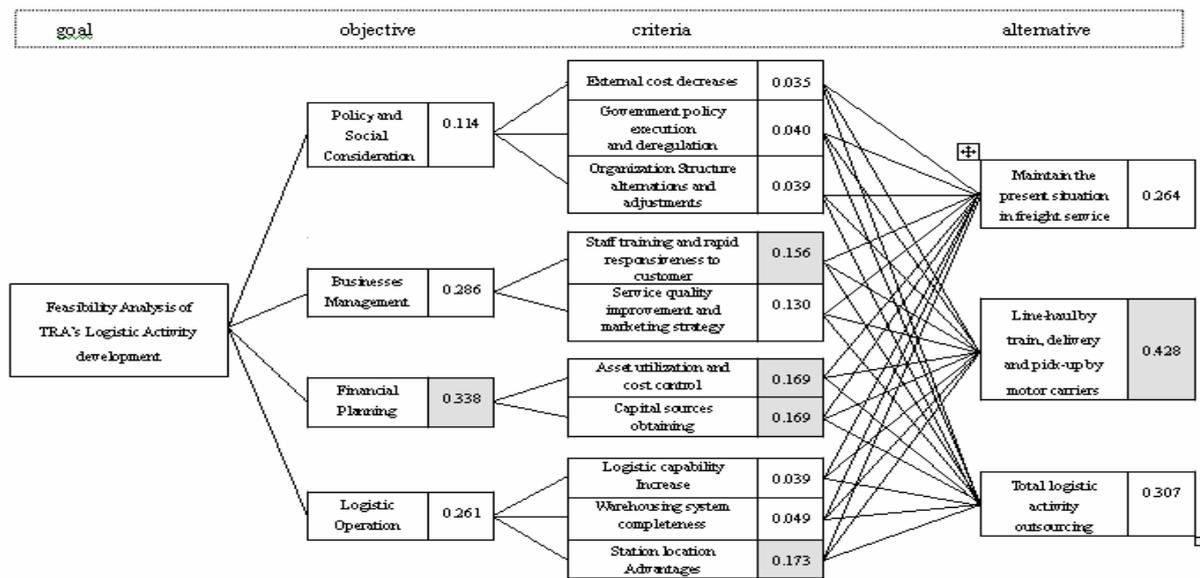


Figure 1. Result of AHP analysis

## 6. CONCLUSIONS AND SUGGESTIONS

### 6.1 conclusions

This study evaluates the feasibility of TRA in developing logistic activity through questionnaire investigation analysis by AHP method. Results show best-suited plan for TRA is to develop line-haul transportation, and to outsource physical distribution from station to final destination activity that requires deregulation of current regulations to enhance logistic activity between TRA and private operators. TRA will be responsible for long distance logistic transportation while private operators will be responsible for short distance home delivery services from train station to designated home addresses.

TRA, due to huge retirement fund causing continuous profit losses and operation of high-speed rail starting from 2005, is facing tremendous competition. Therefore, TRA must cut down on expenses; recent focus and potential market opportunity on logistics and home deliveries could be a direction to develop logistic operations to makeup profit losses and increase yield. However, TRA has the largest transportation network; specialized railway and many none utilized inventory property in addition to large transportation volume, frequent scheduling, high accuracy and excellent safety. These advantages allow a good logistic development for TRA

Current organization structure, policy execution and asset and capital utilization are restricted by national organization are enabling TRA to respond to market demand and made ad hoc changes. Privatization should speed up to fully utilize competitive advantages to increase service quality.

TRA's logistic development activity still needs thorough planning, coordinate with government policy on execution and related regulation changes and consider future logistic development in freight sources obtaining, asset capital utilization, cost control, operation management, staff training and marketing strategies, as well as possible inter-industrial competition pressure or oppositions on such development. All factors need careful consideration and planning.

## **6.2 Suggestions**

This study proposes three suggestions based on above conclusion:

TRA's current transportation process and delivery items of package activity is overly complex. It should be simplified in procedure and transportation freight categories and standardize transportation process plus enforced advertising marketing strategy to increase activity volume.

As for the organization structure in TRA, this study suggests TRA should alter organization structure gradually, starting from internal organization reform. The purpose is to give much flexibility in the operation strategy and staff mission redistribution. By organization reform, TRA could well define clear responsibility amongst all departments to execute logistics activity more easily and avoid negative response from staff. As well as, lowering transformation costs to maintain current resources and competitive advantages and to meet rapid market changes in demand is also important.

This study finally provides suggestions on execution plan procedure: TRA should first conduct a trilateral meeting on logistic activity development amongst industrial, governmental and academic fields. After discussion, feasible plans need to be created. The government should coordinate in policy execution and eliminate related constraints and provide incentives in developing logistic activity. At the same time, TRA and participating industrials should conduct bilateral resource integration and establish mutual technologies resources, finally proceed with public outsourcing and offering to seek cooperating manufacturers and set long term strategic alliances' negotiation and planning. After the establishment of hardware development, logistic process should mutually coordinate and support between TRA and industrial partner to effectively explore the capabilities of logistic activity.

## **7. FINDING AND DISCUSSION**

Previous related studies concentrate on examination of advantages and disadvantages of combined transportation. (Chen (1998), Nierat (1997), Tsai (2000)) In contrast, this empirical study aims at identifying the importance of financial planning as key success factor for railway companies and provides implementation procedure in logistic service engagement. This study also applies for the first time in related researches the application of AHP method that considers both quantitative and qualitative factors in logistic services.

In financial planning, government subsidies and other capital sources should be explored for infrastructure investments. In logistic operation, it is necessary for TRA to enlarge its logistic service beyond station-to-station service to door-to-door service. Specific employee training programs should be provided to TRA staffs to enhance service change. An option to enhance door-to-door service could be strategic alliance with motor carriers specialized in home deliveries and learn new know-how skills. Station area exploitation is suggested to bring more revenue generating activities, capital needed for logistic service development and establish into a major marketing channel in located metropolitan.

## REFERENCES

### a) Books and Books chapters

Saaty TL. **The Analytic hierarchy process**. New York: McGraw-Hill, 1980

Saaty TL, Kearns KP. Analytical planning: the organization of systems. **The analytical hierarchy process series** 1991; vol. 4 RWS Publications Pittsburgh, USA

### b) Journal papers

Jan Jacob Trip, Yvonne Bontekoning, (2002), Integration of small freight. Flows in the intermodal transport system, **Journal of Transport Geography**, 10 pp. 221–229.

L.Ferreira, (1997), Planning Australian freight rail operation; an overview, **Transport Research A**, Vo31.NO4, pp.355-348.

Nierat, P., Market area of rail-truck terminals: pertinence of the spatial theory, **Transportation Research Part A**. Vol.31, No.2. pp.109-127, 1997.

Saaty TL, Kearns KP. Analytical planning: the organization of systems. **The analytical hierarchy process series** 1991; vol. 4 RWS Publications Pittsburgh, USA

Saaty TL. How to make a decision: the analytical hierarchy process. **European Journal of operational Research**, North-Holland 199048:9-26

W.G. Wang, B.M. Han, L Ferreira, X.N Zhu, Q.S Sun, (2002), Evaluation of management strategies for the operation of high-speed railway in china, **Transportation Research Part A** 36, pp. 277-289.

### c) Papers presented to conferences

Chen, M.N., Chai, K.J. 2001, Discussion on developing Taiwan Railway transport distribution integration, **16<sup>th</sup> Chinese Transportation Academic Association Conference**, Taipei.

Huang, S.C., Fung, C.M. 2002. Urban distribution combined transporting model analysis, **17<sup>th</sup> Chinese Transportation Academic Association Conference**, Taipei.

### d) Other documents

Jan, Hong Chang. 2001, Feasibility Study on Taiwan Railway's Express Delivery Activity Development, Master Thesis, Transportation Studies Department, National Chao-Tung University, Taipei.