TRANSIT PLANNING AIMING TO INCREASE LABOR PARTICIPATION IN THE NEW INDUSTRIAL ZONE IN VIENTIANE CAPITAL, LAO PDR

Phanthaphap PHOUNSAVATH*
Baythone LOVANXAY**
Xuepeng QIAN***
Mamoru HARUNA****

1. Introduction

Following the main target in the development vision that has been set up towards the year 2020, is to become a modernized industrialization country. In order to achieve the industrialization, foreign investments are highly expected to invest in order to bring about advanced technologies and capitals. However, labor force is only a factor to achieve industrialization. Therefore, transport infrastructure system is the factor to facilitate people to access to the working place and as well as to ensure labor participation in the target industrial zone.

Hypothetically, the planning model composes of three key sectors: manufacturing firm, labor, and, transportation. The analysis was conducted based on planning model with 3 transportation infrastructure systems: current system, alternative system, and selected system. The current system was simulated to obtain labor demands, then transportation accessibility (Figure 1). For the alternative system, the calculation for bus passengers was conducted. Two conditions: existing and improved condition were compared in term of saving amount and total time available in economy.

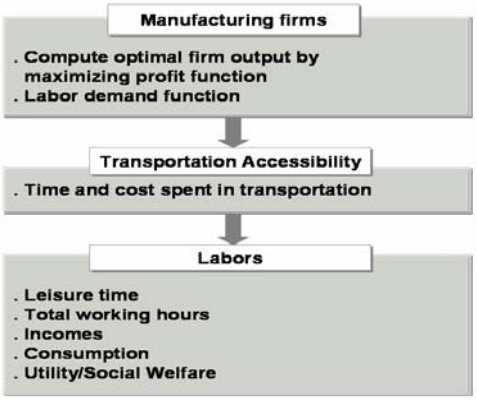

Figure 1: Planning Model with Three Sectors

For the selected system, the simulation was made in terms of the saving level, total time available in the economy, and transport accessibility to find the highest satisfaction factor for the solution. The results from analysis show that the two factors which encourage labors to participate in local economy are: saving amount and traveling hours. This paper contains sector 2 for modeling and analysis, sector 3 for findings and proposals based on analysis, and the last sector for the conclusion.

2. Modeling and Analysis

The model was developed for an attempt to find the regional development model for Vientiane Capital, Laos, based

* Master candidate, Graduate School of Science and Engineering, Ritsumeikan University (TEL: +81-77-561-2736)
** Engineer, Ministry of Communication Transport Posts and Construction of Laos (TEL: +856-21-414420)
*** PhD. candidate, Graduate School of Science and Engineering, Ritsumeikan University (TEL: +81-77-561-2736)
**** Professor, Faculty of Science and Engineering, Ritsumeikan University (TEL: +81-77-561-2736)

on the research of Transport Investment and Economic Development (Banister, D. and Berechman, J.[1)] 2000). Three key sectors which play the important role in the system: manufacturing sectors, labor sector, and transport infrastructure sector are given in the following equations:

(1) Industrial Sector

We denoted index *s (s=1,…,n)* as the types of manufacturing firms located in one industrial zone. We assumed that each manufacturing firm *(s)* produces non-homogenous products that would be sold out in the outside markets. Objective function of manufacturing firm is to maximize profit subject to their production function. Production function is given as the following:

$$y_s(A_s, l_s, k_s, x_s) = A_s(l_s)^{\alpha}(k_s)^{\beta}(x_s)^{\sigma} \quad (1)$$

Where, *(y_s)* is the production function output of firm *(s)* weighted in money term, (l_r) is labor from residential areas, *(k_s)* is private capital, and (x) is land lots, *(α, β, σ)* are labor, capital, and, land used elasticity parameters respectively.

(2) Household sector

We assumed that labors live in different locations which are denoted by r *(r = 1,…,m)* and they will get the certain incomes from working in manufacturing firms. Therefore, total time available in economy is denoted by *(T_{rs})* which is composed of: (T_s^{st}), (T_{rs}^{e}), and, (T_{rs}^{t}). It is supposed that workers supply their labors for firm *(s) with* time units denoted by *(T_s^{w})*. Labors will travel from their resident *(r)* to working places*(s)* and they will consume time unit as traveling hours (T_{rs}^{t}) to arrive working places and they will take two trips a day to commute. The equation is:

$$T_{rs} = T_s^{st} + T_{rs}^{e} + 2T_{rs}^{t} \quad (2)$$

(3) Transport Accessibility

Accessibility is measured as a combination of travel time and monetary cost, known as generalized travel cost, adjusted for the type of model used. The transportation accessibility is denoted by (T_{rs}) with following equation:

$$T_{rs} = \sum_m \eta_1^m * (w_{rs}^m * c_{rs}^m) + \sum_m \eta_2^m * (w_{rs}^m * t_{rs}^m) + \eta_3 * d_{rs} + \eta_4 * c_r^H + \eta_5 * \ln I_r^H + \varepsilon \quad (3)$$

Where *(η_1^m)* is the reduction of traveling cost by mode *(m); (w_r^m)* is proportion of people who use transport mode *(m)* from residents *(r)* to manufacturing firm *(s); (c_{rs}^m)* is travel costs; *(η_2^m)* is the reduction traveling hours; *(t_{rs}^m)* is travel hours by mode; *(η_3^m)* is the reduction in time of departure; *(d_{rs})* is time of departure; *(η_4)* is car ownership parameter; *(c_r^H)* is motorbike ownership by people; *(η_5)* is parameter of income level; *(I_r^H)* is worker's incomes; and (ε) is an error term.

(4) Estimation Input Data for Analysis

According to the Year 2005 data and from estimation, 523 manufacturing firms are expected to invest in the industrial zones by three phases, which means 115 firms of 17 manufacturing types will be involved in the industrial zone in Phase I, 136 firms of 18 types in Phase II, and 165 firms of 18 types involved in Phase III in the industrial zone.

Table 1 Estimation of Labor, Capital and Land

	Phase I (2006-2010)	**Phase II (2011-2015)**	**Phase III (2016-2020)**
Labors	40,491	83,135	107,610
Capital (1000$)	1,107,965	1,566,873	2,035,700
Land (ha)	181.01	356.81	534.06

(5) Calculation of 3 Alternative Systems

a) Current System (Figure 2 in appendix)

After obtaining total labor demands, we obtained labors from each resident by assuming total labor supplies from 13 residents. As the simulation result of equation (3), total labor demand for phase I, II, and III are 26,488, 40,491, and, 107,610 people respectively. Besides, we found that all labors from 13 residents who use buses and motorbikes had negative saving amount although they utilized extra working hours. This is due to high expenditure on consumption and transportation fees.

b) Alternative System (Figure 3, 4 and 5 in appendix)

Three alternatives with different condition were simulated for selecting the best solution (Table 2). We found that two main factors that will support labor participation: wage rate, and total available time in the economy which is influenced directly from traveling hours. Within the current condition, workers from 13 residents can not improve their living condition due to expenditures are higher than income. About 5 residents: (3-0-S), (7-0-S), (7.1-0-S), (8-0-S), and, (8.1-0-S) still have negative saving level although extra working hours are utilized while 3 residents: (7.1-0-S), (8-0-S), and, (8.1-0-S) can not utilize leisure time as extra working hours due to long traveling hours. Within the improvement condition, the saving level of three alternatives still remain in negative level although extra working hours are utilized.

Table 2 Comparison in Total Available Time

Phase I	**Alt. I**	**Alt. II**	**Alt.III**
7.1-0-S	**14.29**	**14.29**	**14.29**
8-0-S	**16.06**	**15.95**	**15.48**
8.1-0-S	**15.80**	**16.16**	**15.95**
Phase II			
7.1-0-S	**14.98**	**14.98**	**14.98**
8-0-S	**16.96**	**16.77**	**16.27**
8.1-0-S	**16.95**	**16.86**	**16.82**
Phase III			
7.1-0-S	**15.27**	**15.27**	**15.27**
8-0-S	**17.41**	**17.22**	**16.63**
8.1-0-S	**17.69**	**17.55**	**17.24**

c) Selected System (Figure 6 in appendix)

The simulation was made again to test the total time available in economy and saving level. It was assumed that traveling speed increases due to short traveling distance, good transport infrastructure system, and good traffic flows. From the simulation in the selected system, we found that if the buses can accelerate up to 65km/h and the wage rate from the first phase is 0.6dollars/hour. Finally, all residents from the 13 residents will certainly be able to have positive level and utilize over-time to generate extra incomes.

3. Findings and proposals based on analysis

(1) Findings

From analysis of three transport infrastructure systems, the following are the main findings:

a) There are two main satisfaction factors for workers to participate in manufacturing firms at the industrial zone: saving amount and total time available in the economy. Saving level receives direct influence from incomes in general, particularly wage rate, while total available time has direct influence from shorter traveling hours.

b) Average transportation speeds should be 65 km/h and wage rate should not be lower than 0.6 dollar per hour in order to meet the satisfaction level to encourage all workers from 13 residents.

(2) Proposals based on the Analysis

In order to achieve labor participation, some actions are proposed to the case study:

a) New bus service routes should be constructed along selected network and they should be able to connect with the rest network of the Capital with improvement in terms of rational traveling fees, time spending, and security. It is also

essential to consider the construction of high express way and/or introducing a rapid transit system such Bus Rapid Transit in order to obtain the condition; and

b) Various academic courses should be supplied in order to provide more opportunities for workers to gain higher education since this can help the increasing of higher wage rate in order to obtain 0.6 dollars/hour with possibility.

4. Conclusion

Labor participation in the economy can be achieved if labors satisfy their living standard, which is influenced from wage rate and traveling hours. In the future, it is essential to consider new transit system such Bus Rapid Transit in order to facilitate labors to manufacturing firms. This paper is a theoretical study and many assumptions have been made. In the future, detailed surveys should be carried out for manufacturing firms, labor, transportation infrastructure sector, and provision of education facilities in order to encourage labor participation in the industry.

Reference

1) Banister, D. and Berechman, J.: Transport Investment and Economic Development, UCL Press, pp.211-235, 2000

2) Berechman, J.: Urban and Regional Economic Impacts of Transportation Investment: A Critical Assessment and Proposed Methodology. *Transportation Research A* 28, no. 4:351-162, 1994

Appendix: Figures of Bus Networks

Figure 2 Current Bus Networks

Figure 3 Bus Network of Alternative 1

Figure 4 Bus Network of Alternative 2

Figure 5 Bus Network of Alternative 3

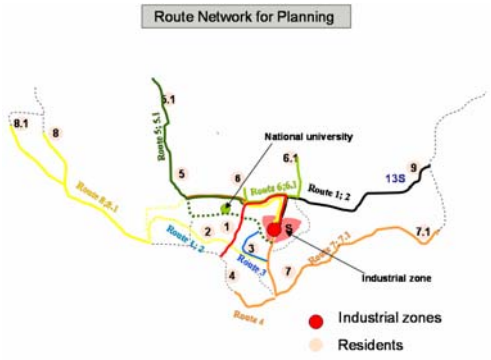

Figure 6 Bus Network of Selected System