A POLICY SUPPORT MODEL FOR THE SCHEDULING TRANSPORTATION PROJECTS

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ABSTRACT

The rapidly growth of trade industries on the developing countries can be predicted that on the near future occurs many problems, especially the problems like as piling up by the goods at the port and passing over of capacity by the trucks at the road. These problems can be solved by the improvement on both a port and a road. However, it is suggested that because the budget constraint these regards can not be conducted at the same time. The scheduling projects strategy which priories the vital projects as the first implementation is the one technique that can be considered. However, to appraise the economic impact of this implementation, an existing trade industries system model is required. This appraisal is an interesting regard as the consideration for the planner in case to decide the better transportation planning. Based on the existing trade industries, this paper proposes a model which can appraise the economic impact of the scheduling transportation projects by using System Dynamics Methodology.

1. INTRODUCTION

Recently, the growth of economy in some developing countries have been showing quite conspicuous. In actually, the trade industry as the power behind this growth is apparently developed rapidly. The growth of trade industry can be expressed as the increment on the number of factories and their facilities. To support the trade industries (foreign trade, domestic trade), the terminal of goods (i.e. port, airport) is the prerequisite facilities for the growth of themselves. In case of the factories located far from a port, the transportation infrastructure facilities are used to carry both of the products and the resources to/from a port.

In brief, caused by their rapidly growth of economy, it can be clarified that the problems such as piling up by goods at the port and passing over of capacity by trucks at the road, occurs in the near future. These problems can be expressed as the obstacle to the growth of the number of factories.

To alleviate these problems, it is best way that government improves both of a port and a road at the same time. However, the improvement policy on both of facilities at the same time is quite difficult especially for the developing countries, because the several reasons, such as the budget constraint, the limited funds, etc. Therefore, a policy by schedules the projects and implements the vital projects first is required. Furthermore, to decide the first implementation projects, the economic appraisal on each order in the scheduling have to be obtained first as the policy support for the better transportation planning.

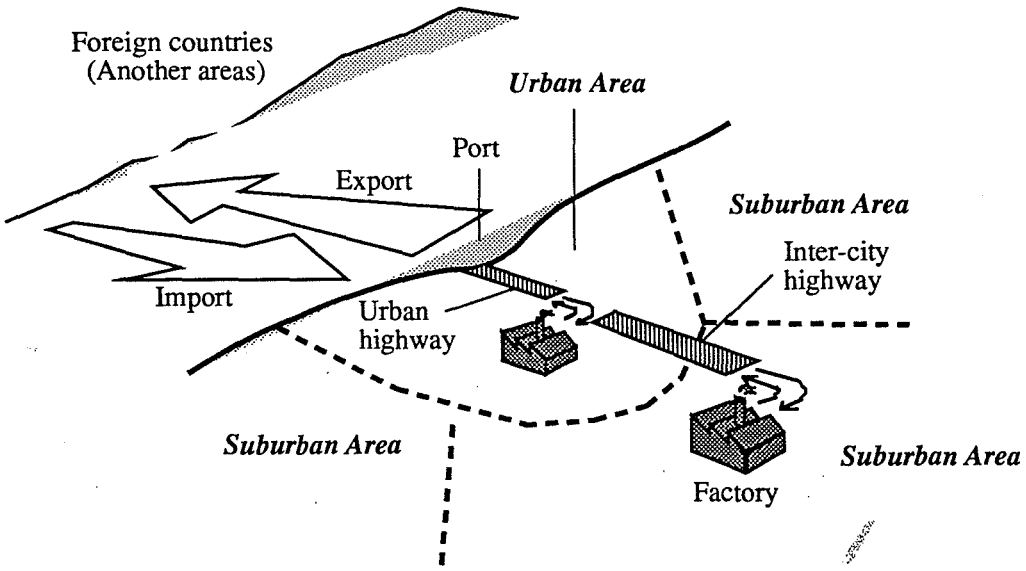


Figure 1 Image of existing trade industries

For the above reasons, it is interesting to propose a model which can analyze the economic impact of a scheduling transportation projects in developing countries.

2. IMAGE OF EXISTING TRADE INDUSTRIES AND FEEDBACK LOOPS

Hobeika (1981), suggested that the demographic sector is accepted to appraise the economic impact, because the factor like as population can not be neglected. Up to the present day, several model which accomplishing the demographic sector were proposed (Drew 1989, Pujantiyo 1991, etc.). In this paper, the economic impact is based on the relationship of an existing trade industry itself.

Trade industry (i.e. foreign trade, domestic trade) which are occurred by the presentation of a factory and a port, can be indicated as the determinant for the growth of economy. The transportation infrastructures like as a road or a railway, is the importance facilities in case to carry the products or resources. The image system of these relationship can be shown on Figure 1. The flow of goods from/to a port to/from a factory affects the capacity on a traffic and a port. It is assumed that the capacity both of a transportation and a port are the unity information which informs the factories. Of course, these informations can be divided on the good and the bad information. The good information affects the factories to add the products, and the bad information to be contrary. Both of these informations can be suggested as the attractiveness for the life of a factory in the area concerned. Therefore, when these relationships are expressed on the causal loops, it can be shown in Figure 2 as the trade industries flow system. In this figure, it can be explained that the system is consisted of three main sector namely (1) *Industrial Sector* at urban area and suburban areas, (2) *Transportation Sector* between the location of a factory and a port, and (3) *Port Sector* at the port area.

In the figure 3, it is assumed that each main sector is divided into several elements.

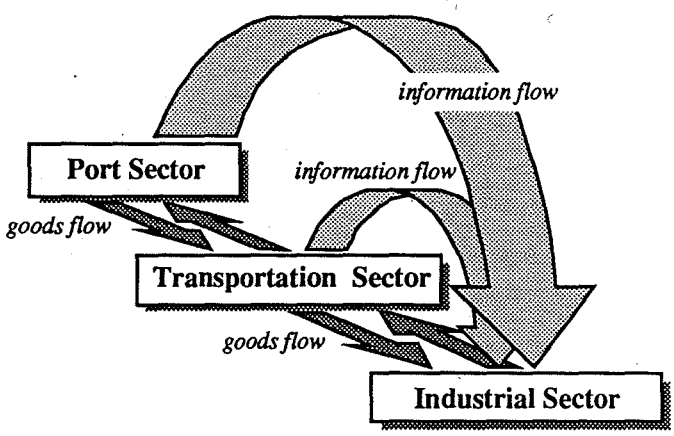


Figure 2 Trade industries flow system

For example, the industrial sector is divided into 3 elements such as; production, number of factories and attractiveness, the transportation sector is divided into several transportation modes which are used to carry the goods and the materials, and the port sector is decided as the expression of import and export. In this figure, 4 kinds of loops are shown, there are loop-1 as the (+) loop for the relationship of *attractiveness-number of factories-production-transportation-export*, loop-2 as the (-) loop for the relationship of *number of factories-production-transportation-export*, loop-3 as the (-) loop for the relationship of *attractiveness-number of factories-production-transportation*, and loop-4 as the (+) loop for the relationship of *production-transportation-export-import.*

On the relationship of loop-1, it is assumed that the increasing of attractiveness index gives a corresponding increase to the number of factories and also the production, furthermore, changes the transport capacity. The smooth of transportation to carry the products gives an increasing to the exported products. The increasing of exported products means the increasing on the revenue of factory, therefore, this information might be creates a high value into attractiveness index. This information can be expressed as an attractiveness for the factory investors to expand the factory or might be to construct a new factory. On the loop-2, it can be explained that the lack of port facilities to export the products gives the decreasing value on the revenue of factory, and this information affects not only the attractiveness index, but also might be the decreasing on the number of factories. The loop-3 indicates the lack of transportation facilities (i.e. road and railway) gives the decreasing value into attractiveness index. The loop-4 is explained that the increment production in a factory changes the transportation capacity and the export too. The growth of exported goods affects the growth of imported material. And this growth make the increment of a production.

By these feedback loops, the trade industries as an economic system has been mainly affected by the condition of both port and transport facilities is expressed. When the regional area consist of the several sub regional areas (i.e. urban area and it's suburban areas) the total transport capacity should be formulated as the sum of transport capacity at the urban and suburban area. The information of the condition both of a port sector and a transportation sector affects the condition of industrial sector not only in the urban area but also in each suburban area. Since the trade industries is the determinant for the long-term

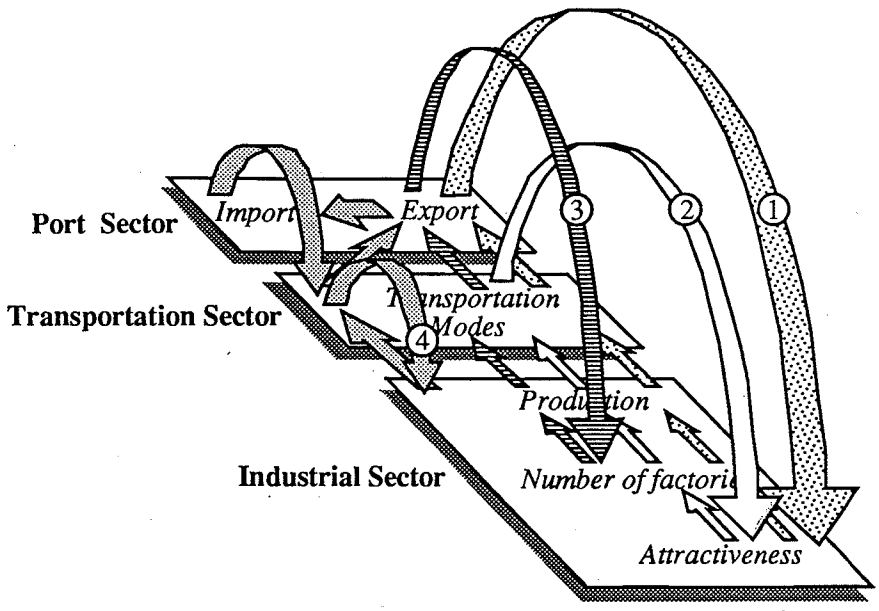


Figure 3 Causal feedback loops of trade industries

benefit in the regional area, the growth could be regarded by the policy in these sectors. However, even if the appropriation of industrial area is available policy, economic development could not be regarded without an improvement of both port and transport sectors. These policies are suggested as the factor which can increase the attractiveness index on industrial sector in both areas. The flow diagram of these relationship can be shown on figure 4. On this flow diagram, the transportation modes is divided into 2 kinds modes, there are the trucks and the railways. This sector can be decided according to the existing transportation modes which are used in the study area.

3. ATTRACTIVENESS INDEX FOR INVESTORS

On the section above, attractiveness is shown as an important element which had affected not only the number of factories but also the whole system. In deed, the investors whose want to invest in a factory, they consider the attractiveness (i.e. revenue, etc.) firstly. Therefore, the attractiveness equation (*FAC_ATT*) can be obtained on the following equation as an index by the condition, such as a factory revenue, a transportation capacity, a factory areas available.

$$FAC\_ATT(t) = FAC\_ATT \times e^{(area \times fac\_revenue - transp)t} \quad \ldots\ldots\ldots (1)$$

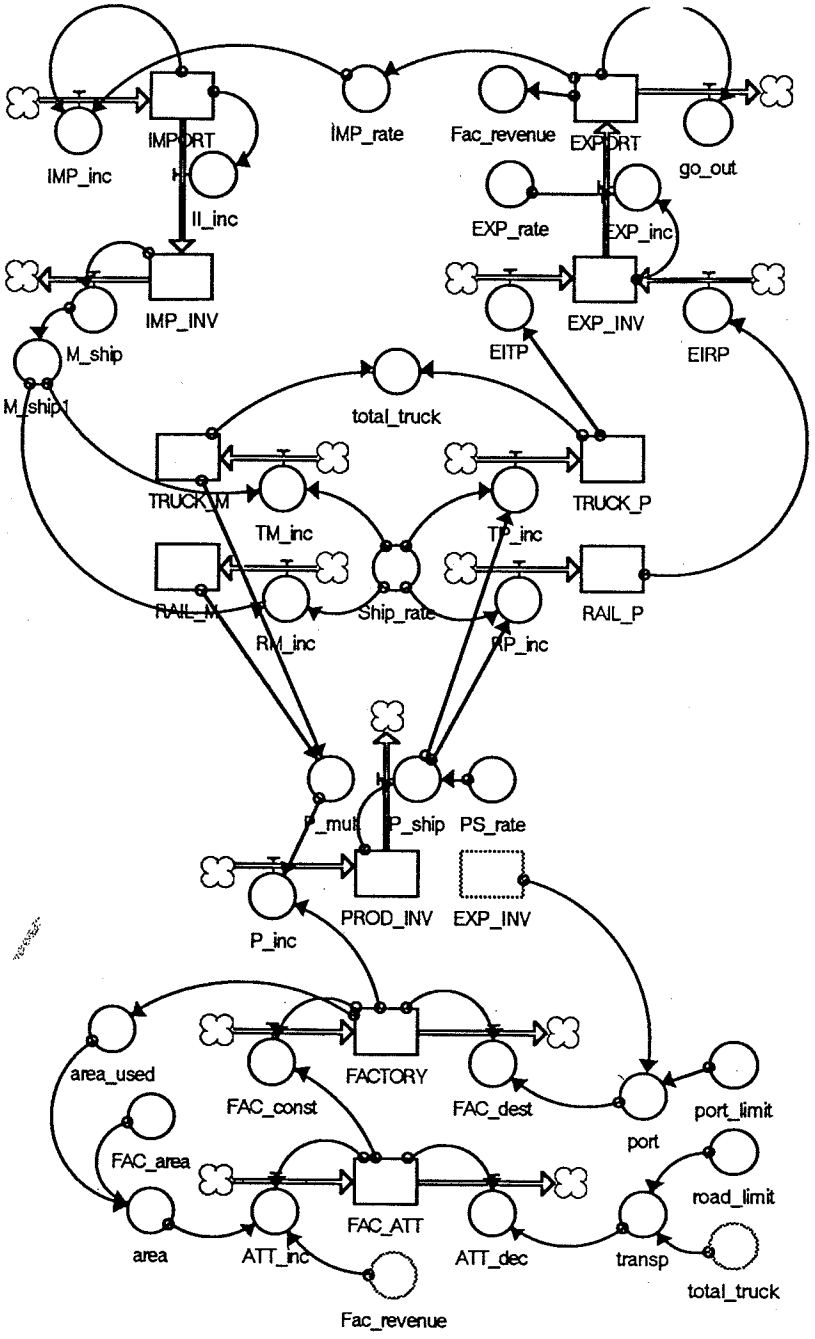


Figure 4 Flow-diagram of trade industries

where,

area	: area available for the factories
fac_revenue	: revenue of the factories
port	: the capacity condition of a port
t	: interval time
0	: initial time

The number of factories (*FACTORY*) which are widely affected by the attractiveness and the condition on a port (*port*), can be obtained like as the following equation.

$$FACTORY(t) = FACTORY(0) \times e^{(FAC\_ATT-port)t} \quad \ldots\ldots\ldots (2)$$

By the above equations, it can be obtained that the changes of attractiveness index gives the changes on the number of factories, while, the attractiveness is affected by the condition on a port and a road.

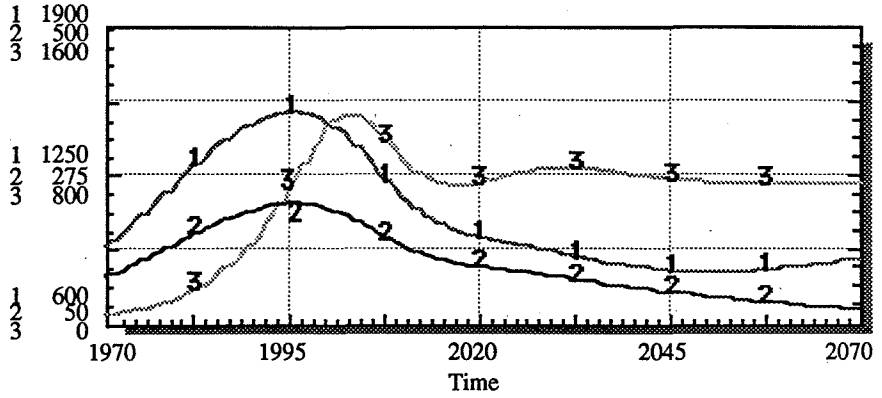
4. NUMBER OF FACTORIES AS THE RESULTS

In this paper, Jabotabek area (Indonesia) which consists of an urban area and four suburban areas, is the case under study. The simulation is conducted during 100 years, from 1970 to 2070.

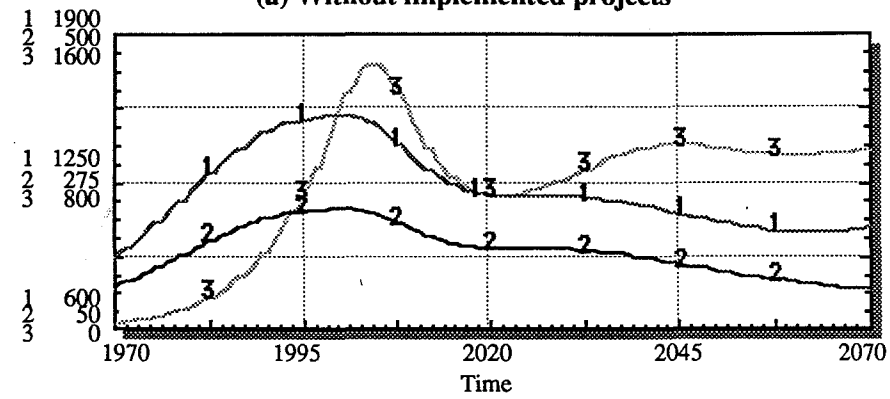
Figure 5 (a) is the results of the number of factories on each area without the implementation of both projects. The results between 1970 until 1983 are based on the actual data, and the results after 1983 are affected by an application of the problems on both a port and a road capacity. As the consequently, the results after 1983 are widely decreasing not only on the urban area but also on the suburban areas until 2070.

Figure 5 (b) is showing the results which the port improvement is implemented on 1995 and road improvement on 2005 (strategy 1). Comparing to the results of without projects, the increment number of factories are shown in all areas after the implementation of both projects. In area 1, the number of factories is increasing after the implementation of port improvement. Although, the number of factories is decreasing after the implementation of road improvement, the trend not so bigger than the results of without projects. In area 3, the number of factories is quite increasing after the implementation of port improvement, however, the implementation of road improvement could not increase continually the number of factories. It can be suggested that the increment number of factories in area 1 are already made the transportation capacity to be high precedence, therefore, this regard affects the attractiveness index in area 3. While, the growth number of factories in area 2 are not high because this area not directly involved with the projects.

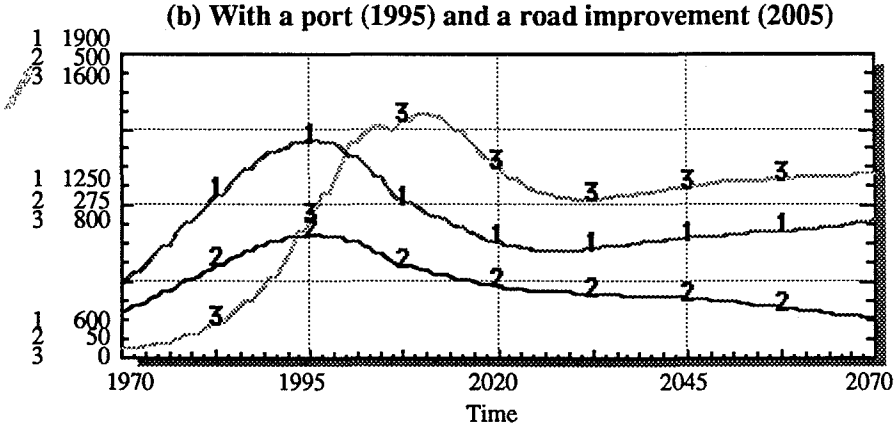
Figure 5 (c) is showing the results which the road improvement is implemented on 1995 and port improvement on 2005 (strategy 2). Similarly with the strategy 1, the growth number of factories are quite shown. In area 1, the implementation of road improvement could not increase the number of factories, however, after the implementation of port improvement the increment can be shown, and this growth is showing until 2070. In area 3, the implementation of road improvement is increasing the number of factories, further-



(a) Without implemented projects



(b) With a port (1995) and a road improvement (2005)



(c) With a road (1995) and a port improvement (2005)

legends:
1 : Number of Factories in Area 1
2 : Number of Factories in Area 2
3 : Number of Factories in Area 3

Figure 5 Simulation Results

more, the implementation of port improvement make more the increment of number of factories. It is pointed that the implementation of road improvement made the smooth of goods flow in area 3, furthermore, the port made both areas to increase the number of factories. While, in area 2 the growth not so higher than the growth on strategic 2. The reason can be explained because the growth number of factories in area 3 is more higher than strategy 1. Therefore, the transportation projects more beneficial for the area which directly involved with the projects.

5. CONCLUSION AND DISCUSSION

By the application of proposed model, the appraisal of scheduling transportation projects can be explained. And regarding to the results which were shown by the number of factories in each area on the study area, following regards can be concluded.

(a) By the strategy 1, the growth number of factories on an urban area which nearest to the port had been bigger than the growth on the suburban area. It can be said that the port improvement gives economic impact for urban area more bigger than on the suburban areas. Of course, the results had shown the increment on the suburban area too, however, the trend had not been bigger than the growth on an urban area.

(b) By the strategy 2, the growth number of factories had showed an equilibrium impact between the urban area and the suburban areas. The reason can be suggested by their results which had shown an approximately equal. Although, a higher increment of the number of factories on the suburban area were shown after the improvement of a road, the trend to be approximated after the improvement of a port. It can be suggested that this strategy support the suburban area to expand its industrial and it is capable to compete with the growth in an urban area.

The several parameters as the multiplier which were found in the simulation, can be pointed as the sensitively elements for the whole system. Therefore, if required, the additional table as a multiplier to support the proposed model can be developed.

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