Research on System Dynamics of Highway Construction Effects on Socio-economic Benefit

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Abstract. Highway construction obviously led to the social and economic benefits. This article uses the basis data of economic and social statistics in 2005-2014 of Guangdong Province, combines the qualitative and quantitative methods, Index system and analyze the impact of the economic and social benefits of the highway, establish and simulation the system dynamics causal diagram and system dynamics flow diagram. Research on the effects of highway construction of the socio-economic within the system dynamic model, proposed the method of development and construction of the highway project. Provide theoretical support of relevant policy recommendations to promote economic and social development to give full play to highway function[1].

Introduction

Transportation is a nonprofit community-based service system, as an important part of the essential, highway linked with all walks of life, highway has a significant effect for economic, social promotion. The economic benefits of the process of building the highway project is limited, however, after completion of the project, it direct and indirect impact on the economy and society is far greater than investment in highway construction. This paper combined with the requirements of government departments closely, research on the influence of Expressways on the socio-economic, estimating the different social and economic benefits under different investments of highway.

This paper researches the socio-economic impact of highway, aim to establish a more accurate and quantitative method of highway construction, evaluation and calculation the impact of social and economic of highway. Construction a model which uses data to illustrate the effect of the economic and social impact of highway.All manuscripts must be in English, also the table and figure texts, otherwise we cannot publish your paper.

The significance of System Dynamics Research on the Impact of Socio-economic of Highway Construction.

This study has important significance both in theory and practice.The research improves the investment decision-making ability of highway construction. The study deepens the method of the impact of socio-economic of highway construction. The study could establish the foundation of the impact of socio-economic of highway construction

Through establish the model to make a comprehensive analysis of the factors affecting by the highway construction on socio-economic. Finding the optimal results of the model. To sum up the research of mechanism of the impact of socio-economic of highway construction and presented the optimization theory. The research could guide the planning theory and evaluation methods.

Establishing the model of the impact of socio-economic of highway construction
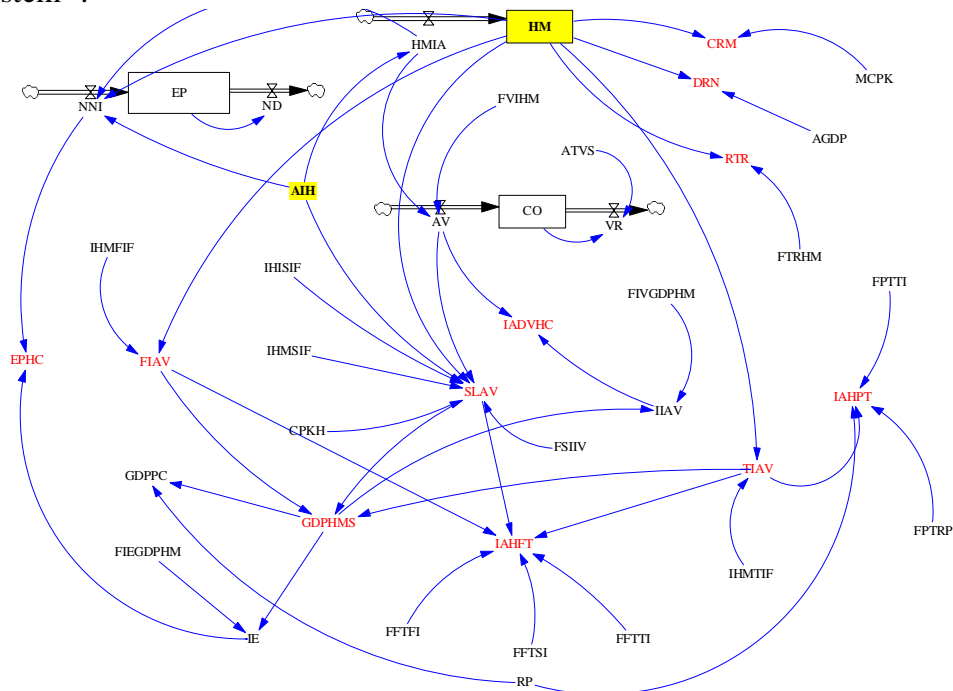
Establishing the Index System

To establish the system dynamics model, it is necessary to determine the evaluation index system of highway construction on the economic and social impact.

Tab.1 Evaluation System of Highway Construction to Socio-economic

Firstly indicators System amount	Secondary indicators Feature amount	Tertiary indicators Explanation amount
Economic impact[2] A1	Capital[3] B1	C1：GDP
		C2：Total Investment in fixed assets[5]
		C3：Total fetail sales of consumer coods[6]
		C4：Per capita GDP
	Structure B2	C5：Primary Industry added value
		C6：Secondery industry added value
		C7：Tertiary Industry added value[7]
Social Impact[8] A2	Life B3	C8：Regional population[9]
		C9：Employed population[10]
	Traffic B4	C10：Highway passenger turnover[11]
		C11：Highway freight turnover[12]
		C12：Road network density
	Tourism B5	C13：Tourism revenue
		C14：Tourist arrivals

Establishing System dynamics flowchart

In order to describe the system configuration clearly, System Dynamics uses the concept of "flow" to describe the decision-making process and build the flow graph model by a special symbols. The next step is to establish a flow graph model, which could make the computer to recognize the causation within the system[13].

Fig.1 System Dynamics Model flow diagram of "Highway-- Socio-economic"

Establishing the flow diagram to determine the mathematical relationship model from each quantitative to variables. It could build a foundation for running the model[14].

Tab.2 Meaning of the symbol in the Flow Diagram

No.	definition	implication	unit
1	HM	Highway mileage	KM
2	AIH	Annual investment Highway	One hundred million yuan
3	HMIA	Highway mileage increased amount	KM
4	FIAV	Primary Industry added value	One hundred million yuan
5	SIAV	Secondary Industry added value	One hundred million yuan
6	TIAV	Tertiary Industry added value	One hundred million yuan
7	GDPHMS	GDP increment of highway mileage stimulation	One hundred million yuan
8	IAHFT	Increasing amount of highway freight turnover	One hundred million tons per kilometer
9	IAHPT	Increasing amount of highway passenger turnover	One hundred million person per kilometer
10	NNI	The number of new inauguration	Ten thousand people
11	EP	Employed population	Ten thousand people
12	ND	The number of departure	Ten thousand people
13	IE	Indirect employment	Ten thousand people
14	EPHC	Employed population from highway construction	Ten thousand people
15	RP	Regional population	Ten thousand people
16	CRM	The cost of Road maintenance	yuan
17	DRN	The density of road network	Dimensionless
18	RTR	Regional tourism revenue	One hundred million yuan
19	CO	Car ownership	Ten thousand vehicles
20	AV	The addition of vehicle	Ten thousand vehicles
21	VR	vehicle reduction	Ten thousand vehicles
22	IIAV	The Indirectly increasing amount of vehicle	Ten thousand vehicles
23	IADVHC	The increase amount of drive vehicles by highway construction	Ten thousand vehicles
24	MCPK	Maintenance cost per kilometer	yuan
25	AGDP	Area of Guangdong province	Million passenger-kilometer
26	ATVS	The average time of vehicle scrapped	year
27	CPKH	Consumables of per kilometer highway	Ton
28	GDPPC	GDP per capita	yuan
29	IHMFIF	The influence of highway mileage of primary industry factor	Dimensionless
30	IHISIF	The influence of highway investment of secondary industry factor	Dimensionless
31	IHMSIF	The influence of highway mileage of secondary industry factor	Dimensionless
32	IHMTIF	The influence of highway mileage of tertiary industry factor	Dimensionless
33	FIEGDPHM	The impact factor of indirect employment from the stimulation of GDP highway mileage	Dimensionless
34	FIVGDPHM	The impact factor of indirect vehicle from the stimulation of GDP highway mileage	Dimensionless
35	FFTFI	The impact factor of freight turnover from the primary industry	Dimensionless
36	FFTSI	The impact factor of freight turnover from the secondery industry	Dimensionless
37	FFTTI	The impact factor of freight turnover from the tertiary industry	Dimensionless
38	FPTTI	The impact factor of passenger turnover from the tertiary industry	Dimensionless
39	FTRHM	The impact factor of tourism revenue from Highway mileage	Dimensionless
40	FVIHM	The impact factor of vehicle from the increase of Highway mileage	Dimensionless
41	FSIIV	The impact factor of secondary industry from the increase of Vehicle	Dimensionless
42	FPTRP	The impact factor of passenger turnover from the Regional population	Dimensionless

System Simulation and Analysis

Highway construction played a leading role to the factors of socio-economic by running the model. This paper collected the data of highway construction and national economic statistics of Guangdong Province 2006—2014.Using system dynamics model to simulate the data and analyzing the changes of economic and social indicators in 2006-2014, to observe the socio-economic impact of highway construction of Guangdong province[15].

Tab.3 Impact of economic and social of the highway during the 2006-2014

Time (Year)	2006	2007	2008	2009	2010	2011	2012	2013	2014
Highway mileage	3340	3518	3823	4035	4839	5049	5524	5703	6280
Primary Industry	198.8	209.3	227.5	240.1	287.9	300.4	328.7	339.3	373.7
Secondary Industry	1493	1824	2409	3169	4624	3818	3981	5949	6630
Tertiary Industry	454.3	478.4	520	548.7	658.1	686.7	751.3	775.6	854.1
GDP increment of highway mileage stimulation	2146	2512	3156	3958	5570	4806	5061	6764	7858
The number of new inauguration	436	522	645	839	1096	1029	1037	1477	1651
Highway maintenance cost	23382	24624	26764	28242	33874	35345	38669	39921	43960
The density of road network	0.019	0.019	0.021	0.022	0.027	0.028	0.031	0.032	0.035
Regional tourism revenue	3320	3497	3801	4010	4810	5019	5491	5669	6242
The addition of vehicle	18.9	22.8	28.4	37.2	48.8	45.6	45.8	66	73.8
Increasing Amount of Highway freight turnover	71.3	79.6	94.2	110.7	147.6	135.9	145.1	177.6	202.9
Increasing Amount of Highway passenger turnover	8.1	8.5	9.3	9.8	11.7	12.2	13.3	13.8	15.2

Conclusion

1) With the increase of highway mileage and investment, it shows significant impact on the primary industry, the secondary industry and the tertiary industry, especially for the secondary industry. It is shown by comparing the leading role from other industries to GDP that the leading role of highway construction in GDP increment over 10%.

2) After run the SD model, it can be seen that the correlation of the impact from highway mileage to obtain employment is closer than the impact from highway investment to obtain employment. The more highway mileage of increased, the more Employment growth, it can account for about 20% of the whole society jobs per year.

3) The highway mileage driven the increase of vehicles ownership accounted for about 6% of the increase in the amount of vehicles ownership in the whole society. This ratio is lower than the impact of the new vehicles from other industries. In terms of the pace of development of highway construction, the rapid of vehicles ownership growth too fast. This article is recommended to control the growth of vehicles ownership by policy instruments.

4) The results of model simulation shows a significant effect of freight and passenger turnover by highway construction. The effect of the freight turnover is more strength than the passenger turnover. The highway mileage driven the increase of freight turnover accounted for about 10% of the increase in the amount of freight turnover in the whole society.

Summary

This article established the index system of social-economic of highway construction, analyzed the various indicators. Establishing the system dynamics flow diagram on the basis of the highway and national statistical bulletin data from Guangdong province. Simulating the flow chart to measure the

leading role of the social-economic of highway construction of Guangdong provincial during 2006 to 2014. This article make a suggestion to highway construction on how to promote economic and social development more effectively.

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