Analysis of the Worthiness from Investing in the Program Reporting Results of and Investigating Traffic Light Violations Based on the Principle of Economic Engineering

Jetsada Kumphong
Faculty of Technical Education, Rajamangala University of Technology Isan
Khon Kaen Campus
E – mail : Jetsada.ku@rmuti.ac.th

Received 16 July 2025
Revised 26 August 2025
Accepted 2 September 2025

Abstract

This article was aimed at analyzing the worthiness from investing in the program to report the results of and investigate traffic light violations by comparing monetary and non-monetary data. The data was collected by interviewing a start-up company and the Office of Khon Kaen Provincial Police. An analysis was done on the initial cost and payback using the engineering economics tools, i.e., Equivalent Uniform Annual Worth (EUAW) and Benefit Cost Ratio (BCR) values; and the means in evaluating losses from road accidents. The study sites included 3 intersections in Khon Kaen urban area. The study results showed EUAW of 219,583.80 Baht – the value higher than 0 – indicating the worthiness of the Project. BCR is 2.2, which is higher than 1, showing also the Project worthiness. The loss value from road accidents was analyzed, and it was shown that the Project could reduce 12 cases of and 8 injured people from accidents per year. The yearly loss value from road accidents was 3,597,352 Baht (for major injury cases) or 458,648 Baht per year (for minor injury cases). The break-even of the Project was achieved within the first year after installation. In order to evaluate social benefit, a comparative study was carried out, and it indicated that the Project could reduce losses and create higher payback than the invested money. This research is thus proposed as a means underling policy decision related to traffic safety and development of start-ups of sustainable social technologies.

Keywords : Minor injury, Traffic safety, EUAW, Benefit Cost Ratio, Road accidents.

1. Introduction

The problem of road accidents still stands as a world challenge. The World Health Organization (WHO) (WHO, 2018) indicated that in a year, over 1.35 million people died from road accidents, or 3–5% of the Gross Domestic Product (GDP) of many countries (Byaruhanga, C.B. and Evdorides, H. 2021). In Thailand, the Thailand Development Research Institute (TDRI) (TDRI, 2024) assessed that the economic losses from road accidents amount to 2–3% of GDP, with over 20,000 deaths annually. There is thus a call for preventive measures and reduction of traffic violations, especially violations of traffic lights, the main cause leading to losses of life and assets.

Analyses have been performed internationally to show the worthiness of road safety measures, both in the form of investments on infrastructures and measures to control road users' behaviors. A study by Calvo-Poyo, F., et al. (2020) showed that an investment in road maintenance and in controlling measures over illegal actions can significantly reduce death. Another study by Ofori-Yeboah, A., et al. (2021) indicated that the use of engineering economics tools such as Cost–Benefit Analysis (CBA) and Net Present Value (NPV) have an important role in evaluating socio-economic paybacks from safety projects.

Thailand surveys of death rates indicated that road accidents stand among the highest three causes of death. Most road accidents occurred from drivers' behaviors, such as reckless driving or traffic violations. These accidents lead to losses in various aspects, both at individual and social levels (Klinjun, N., et al., 2021).

Khon Kaen is listed the sixth in the Northeast as far as the size is concerned, while its population ranks the third in the country, being 1,802,872 in total (Data of the Office of Central Registration, 2019). In 2019, Khon Kaen Province reported 6,891 road accidents, with 7,818 people injured and dead (Accident Center, 2019). The road accidents in Khon Kaen were caused from many things, particularly traffic illegal actions, such as failure to follow traffic lights or wear helmet.

A start-up has developed a program to follow-up and report illegal actions from traffic light violations. The program records an image during the course of the accidents or the picture showing the number plate of the wrongdoer's vehicle and then files it in its database. Police tickets will then be issued at a later stage. This lessens the burden from an officer working in controlling traffic regulations. The program was presented to agencies with the purchasing power, including Khon Kaen Provincial Administrative Center, Khon Kaen Municipality and the Provincial Police Office. The problem found was related to the investment worthiness that could not be clearly identified, making it hard for those agencies to decide. (Daowadueng P. and Kumphong J., 2022; Kumphong J. and Chawapattanayoth N., 2024; Satiennam, T., et al., 2020)

The program was created to automatically retrieve the video visual from each frame for identifying traffic light infractions. Its operational concept is based on the application's ability to recognize the traffic light's color. When the signal changes to red, the system monitors any vehicle that enters the intersection zone, which is recognized as a breach of the traffic signal. Following this, the application emits a warning beep and captures a video segment featuring a frame around the offending vehicle. Subsequently, the application transmits a command to an additional camera

to photograph the vehicle's license plate and stores that image. Both images are archived in its database along with other essential details for future police citation issuance, which includes the date, timing, and location of the intersection where the incident takes place (Wonghabut, P., et al., 2018).

Past studies of worthiness from investment of road engineering in Thailand were directed to cost and profit analyses. Two major road projects were carried out to assess economic returns. The Chiangmai's Sanpa Tong - Hang Dong Bypass Project showed the overall Profit Value (PV) of 286.59 million Baht from economization of expenditure and reduction of traveling time. Compared to the initial cost of 132.65 million Baht, the Net Profit Value was 153.94 million Baht, an amount higher than zero, which indicated investment appropriateness. The Benefit and Cost (B/C) Ratio) was 2.16%, and the Internal Return Ration (IRR) was 25.2%, both higher than the investment cost. Meanwhile, NPV of the intersection of Highway Project No. 331 – Nong Khla, Chonburi, was found at 233.69 million Baht, with the B/C Ratio of 3.20 and IRR of 35.9%, which were 12 percent higher than the initial cost. The two projects demonstrated worthiness and investment appropriateness according to the economic evaluation criteria. (Laopuangsak P., et. al., 2013; Laopuangsak P., et. al., 2011)

Nevertheless, present assessment of losses from road accidents commenced by setting a conceptual framework and types of relevant costs. The assessment covers both direct costs – namely, medical treatment, repair of assets, and compensation of losses – and indirect costs, e.g., economic value of loss from death or working capabilities of the accident victims. In this research, the primary data was collected by the questionnaire and indepth interviewing was performed with related organizations such as hospital personnel, rescue teams and police officers. The secondary data included accident statistics, traffic reports and related research. The Cost-Benefit Analysis, the Value of Statistical Life (VSL) or Human Capital Approach were conducted. Thus, the evaluation results reflected loss values in the dimension of economy, social and qualitative impacts. In order to obtain adequate information for road safety policy decision, evaluation is carried out annually and project by project, after which approaches in reducing losses are presented systematically as well as sustainably. (TDRI, 2024)

From the above issues, the team made a report on the worthiness from investing in the program that reports and investigates traffic light violations. Quantitative data was collected through interviewing agencies that have the decision power over the worthiness from installation of the program, based on engineering economics; after which losses from road accidents were evaluated.

2. Research Objectives

To analyze the worthiness from investing in the program that reports and investigates traffic light violations and compares both monetary and non-monetary data.

3. Methods

3.1 Population and Sample Size

The principle population included start-up entrepreneurs and clients who used the program that reports and investigates traffic light violations, namely, officers from Khon Kaen Provincial police Office or relevant officers. Peoples were purposively selected for the sample group.

3.2 Research Tools

The questionnaire was used to collect the following data: costs of the program (equipment, personnel and IT system) and benefit evaluation costs (decreased number of accidents, rewards for those behind ticket issuance).

3.3 Engineering Economics Analysis (To evaluate monetary data)

1). Analysis of Baseline Data in Engineering Economics

From Table 1, the items for engineering economics analysis included 1) Payback Period – the Project pays back within 2 years, 2) Net Present Value (NPV) from evaluation of worthiness and payback of the Project at 750,542.85 Baht, and 3) Internal Rate of Return (IRR) or the discount ratio that made the net present value of cash inflow and outflow all through the Project life zero. IRR was 48.8%, higher than the discount ratio of 6.60%, and the Project investment cost is 450,000 Baht. (Daowadueng P. and Kumphong J., 2022)

Table 1 Net Cash of the Organization

Year	Cash inflow	Cash outflow	Net cash flow
2017*	66,330	17,600	48,730
2018	535,688	116,811	418,877
2019	353,926	102,014	251,912
2020	892,500	145,794	746,706

Remark: In 2017, from the beginning of the program to report violations and investigate traffic lights, i.e., November and December (Daowadueng P. and Kumphong J., 2022)

2). Analysis of Benefit Cost Ratio (BCR)

The analysis of Benefit Cost Ratio (BCR) is an engineering economics approach used for evaluating the appropriateness and worthiness of a project and its costs in implementation. The objective is to compare the benefits arising from the project and the implementation costs. The approach firstly compiles the direct costs, for example, cost of construction design, operation and maintenance; and the indirect costs such as opportunity cost and environmental impact.

Meanwhile, the quantitative and qualitative benefits are evaluated, for instance, saving from traveling costs, decrease of energy cost, and increase of safety. Next, the cost and benefit values obtained are calculated into the present value, with the use of suitable discount ratio. The total benefit value is then divided by the total cost to find the Benefit and Cost Ratio (BCR). If the ratio is higher than 1, it indicates the project worthiness, as seen in Equation 1. (Cotter, T. S., 2021)

$$B/C = \sum Bt / \sum Ct \quad (1)$$

Where Bt = total benefit of the present year,
Ct = total cost of the present year.

3). Analysis of the Equivalent Uniform Annual Worth (EUAW)

The analysis of the Equivalent Uniform Annual Worth (EUAW) is an engineering economics method that evaluates the investment worthiness of a project by transforming the cash flow during the project course into uniform values each year. This provides convenience in comparing between projects with different life and initial cost patterns. The step begins by compiling expenditures and benefits of the project in terms of initial cost, operation cost, maintenance cost, and payback of each year. Next, the Net Present Value (NPV) of all cash flows are calculated to find EUAW, with the use of suitable Discount Rate. If EUAW is positive, it shows the project worthiness, as seen in Equation 2. (Pattanawasanporn, P. and Lekrungroenggid, N., 2021)

$$EUAW = NPV \times (A/P, i, n) \quad (2)$$

Where (A/P, i, n) is the coefficient that transform present value to annual value,
i = interest rate,
n = investment period (years).

3.4 Evaluation of Losses from Road Accidents (For non-monetary data)

To obtain the values that truly reflect reality, evaluation of the Value of Statistical Life (VSL) has been used to assess economic values in the price pattern socially accepted to prevent loss of a life, which is non-identified. However, such value cannot reflect the Actual Value of Life that is psychological. Moreover, real life value can only be realized by the life owner who can evaluate, build, and preserve the value. It cannot reflect the value that a person has accumulated all though his life through upbringing and education. See Table 2. (TDRI, 2024)

Table 2 Comparison of average losses per person (TDRI, 2024)

Severity of symptom	Average loss values (Baht/person)	
	Bangkok and the greater Bangkok	Upcountry
Death	4,477,981	3,256,304
Disability	5,760,601	4,537,509
Major injury	477,401	449,669
Minor injury	58,142	57,331

The Accident Frequency Method was applied in this research by counting the number of injured victims and deaths occurring at the intersections and then comparing the numbers of injured people and deaths. The data of road accidents from Khon Kaen Center Hospital was used (2017-2020).

Table 3 compares the average loss per person in Khon Kaen. Since the recorded data did not present the degrees of severity, the research analyzed injuries into two types: major and minor injuries.

Table 3 Statistics of deaths and injured people at the study sites (the intersections)

Year	Prior to the Project			During the Project								
	2017			2018			2019			2020		
Intersection	Number of cases	Injuries	Death	Number of cases	Injuries	Death	Number of cases	Injuries	Death	Number of cases	Injury	Death
1. Mitrapap – Lao Nadee	21	23	0	24	28	2	15	17	0	21	23	0
2. Mitrapap - Srichan	24	24	0	15	18	0	22	25	0	16	20	1

Table 3 (continued)

Year	Prior to the Project			During the Project								
	2017			2018			2019			2020		
Intersection	Number of cases	Injuries	Death	Number of cases	Injuries	Death	Number of cases	Injuries	Death	Number of cases	Injury	Death
3.Mitrapap - Khon Kaen University Gate	11	12	1	10	11	0	5	5	0	4	5	0

Remark: The Program was implemented in November and December, 2017. For equal monthly ratio, the data of November and December of each year were not compared.

4. Results

The study on the start-up group showed that the start-up offered a price of 150,000 Baht for the software for analyzing and investigating traffic light violations per one intersection. The development team worked on the use of this software at three intersections: 1) Mitrapap - Lao Nadee Intersection, 2) Mitrapap - Srichan Intersection, and 3) Mitrapap - Khon Kaen University Gate Intersection. The investment budget for analysis and investigation of traffic light violation is overall 450,000 Baht. Additionally, the derived data were computerized to evaluate the investment worthiness of the software, including the Payback Period, the Net Present Value (NPV), and the Internal Rate of Return (IRR). The results are as follows:

4.1 Results of Engineering Economics Analysis

4.1.1 Result from Analysis of Benefit and Cost Ratio (BCR)

The interview with police officers in Khon Kaen showed that the cash inflow of the police offices is from fining violators of traffic lights based on the ticket orders. In addition, the team obtained the data of the number of tickets issued by the violation report system and investigated traffic light violations from the number of fine payers (Revenue). The data was then computerized. Expenditures of the organization comes from those related to ticket issuance, including the initial cost of 450,000 Baht, the Internet cost, purchasing or renting cost for a printer, paper and postage service (Expense). Therefore, the total outcome of the analysis of cost and benefit ratio (BCR) is 2.2. If BCR is higher than 1, the Project is economic worth to invest, as shown in Table 4.

Table 4 Analysis of benefit/cost ratio (BCR)

Year	Total benefits	Expenses	BCR
Project initial investment cost		450,000	
2017	66,330	17,600	
2018	535,688	116,811	
2019	353,926	102,014	
2020	892,500	145,794	
Total	1,848,444	832,219	2.2

4.1.2 Analysis of Equivalent Uniform Annual Worth (EUAW)

Monetary value of each period was taken into account. As far as the discount ratio was concerned, the team conducted a study by the Mass Transit Authority in 2016 on the payback analysis project to replace NGV buses by electric buses. Tax benefits were also studied from businesses producing hard disk drives and parts promoted by BOI to see the worthiness and appropriateness of the promotion sector in 2018. It was found that the study applied the means to determine discount from the interest rate for loaning of big good clients (Minimum Loan Rate: MLR), which is the information from Thailand commercial banks. Thus, the team used the interest rate applied with big clients in 2017 (Thailand National Bank) as the discount rate, which was 6.60%. This rate was set stable all through the Project life, from the initial project investment cost of 450,000 Baht and the payback period by the year 2019.

Table 5 depicts the Net Present Value (NPV) all through 4 years of the Project at 750,542.85 Baht, which is higher than 0. This indicates that this Project provides higher payback than the investment cost. The Equivalent Uniform Annual Worth (EUAW) from the analysis is 219,583.80 Baht, showing a positive value of EUAW.

Table 5 Equivalent Uniform Annual Worth (EUAW)

Year	Initial investment cost (Baht)	Net cash flow (Baht)	Net cash flow Discounted as the present value (Baht)
2017	(450,000)	48,730	45,712.95
2018		418,877	368,614.24
2019		251,912	207,958.77
2020		746,706	578,256.90
		NPV	750,542.85
		A	0.0852
		P	0.2913
		EUAW	219,583.80

4.2 Evaluation of loss values from road accidents

The accidents occurring at the intersections under the Project were analyzed based on the frequencies of deaths and injured victims recorded by Khon Kaen Center Hospital under the Road Accident Data category (2017-2020). Table 6 depicts the analysis of road accidents based on occurrence frequencies. The highest number of deaths was found at the intersection of Mitrapap - Lao Nadee, indicating it as the dangerous intersection. Table 7 depicts the overall analytical results of accidents before and during the Project. Yearly data demonstrated that the Project decreased 12 cases of road accidents and 8 injuries in one year.

Table 6 Analysis of accidents before and during the Project

Intersection	Before the Project			During the Project			Total		
	Number of accidents	Injury	Death	Number of accidents	Injury	Death	Number of accidents	Injury	Death
1 Mitrapap - Lao Nadee	21	23	0	60	68	2	81	91	2
2 Mitrapap - Srichan	24	24	0	53	63	1	77	87	1
3 Mitrapap - Khon Kaen University Gate	11	12	1	19	21	0	30	33	1

Table 7 Overall analyses of accidents before and during the Project

Period	Number of accidents per year	Number of injured cases per year	Number of deaths per year
Before the Project	56.0	59.0	1.0
During the Project	44.0	50.7	1.0
Difference	12.0	8.3	0
Percentage of decrease (%)	21	14	0

Table 8 illustrates the evaluative results of losses from road accidents, in an average of losses (Baht/person). The program resulted in a decrease of 8 injured victims per year. It can be seen that the government can save 3,597,352 Baht from major injury cases, and 458,648 Baht for minor injury cases yearly. Considering the Project investment of 450,000 Baht, the payback period will be by 2019. The arithmetic rule of three was applied to find the payback period, which is 1 year.

Table 8 Project evaluation of losses from road accidents

Degree of severity of injury	Average loss value (Baht/person)	Value of losses from accidents per year
	Khon Kaen	8 persons per year
Major injury	449,669	3,597,352
Minor injury	57,331	458,648

5. Discussion and Conclusion

The analyses to find the investment worthiness of the program to report and investigate traffic light violations by comparing monetary and non-monetary data demonstrates that the engineering economics analysis of BCR was 2.2 and EUAW of 219,583.80 Baht. This furthered the analyses of the payback period, Net Present Value, and Internal Profit Rate. If an amount of 450,000 Baht is invested for the three intersections under study, the approximate payback period will be 2 years. The Net Present Value is 750,542.85 Baht, which is higher than 0 and shows that this Project yields higher return than the amount invested. This finding correlates to past research that showed positive parameters of NPV and EUAW, hence indicating that the return from this Project is higher than what is invested. With BCR of 2.2, which is higher than, it can be concluded that this Project yields higher returns than the cost and is a profitable project. (Daowadueng P. and Kumphong J., 2022)

From above, it can be seen that this Project is worth investing. It is a highway engineering project that correlates to Thailand's engineering projects, i.e., the Analysis of Initial Cost and Benefits of San Pa Tong - Bypass, Chiangmai and the Analysis of Economic Worthiness of the Intersection of Highway 331 - Nong Khla Intersection, Sri Racha District, Chonburi. Both of these projects proved the worthiness from investment, showing positive Net Present Value and higher Internal Payback Rate than the investment. (Laopuangsak P., et. al., 2013; Laopuangsak P., et. al., 2011)

Additionally, from evaluation of losses from road accidents, it was found that the Project led to a decrease of 12 accident cases and 8 injured people per year. Considering the injury cases, the payback period of this Project is 1 year. It is interesting to say that the evaluation of economics payback of this Project is based on an international approach, i.e., the Net Present Value (NPV) and the Internal Rate of Return (IRR), which are the approach widely accepted for project investment decision (Wijnen et al., 2009; Elvik, R., 2001; Bahamonde-Birke et al., 2015). A study by Byaruhanga, C.B. and Evdorides, H. (2021) reported that road accidents raised 3-5% of GDP of losses in many countries, and led to very high economic expenses if no preventive measures are taken. When

compared to an investment in the program to report violations, the program can be shown to use supporting technologies rather than to directly control drivers, 80% of whom are that major cause of accidents (TDRI, 2024). Although many of previous studies emphasized analyses of the worthiness of road structure improvements or safety equipment and devices (Calvo-Poyo, F., et al., 2020), what is still lacking is an integration of programs to investigate violating behaviors using IT systems and road safety index to evaluate paybacks that are based on efficiency (Pajković, V. and Grdinić-Rakonjac, M., 2021). Moreover, this research points out the limitations in the standard evaluation of VoSL (Value of Statistical Life (VoSL) in Thailand, which differs from the evaluation approach of the European Union that has been clearly spelled out (Wijnen, W., et al., 2009; Bahamonde-Birke, F., et al., 2015). In terms of policy, the impact from the analyses indicates that if a provincial organizations and the government sector use the data from the program that reports violations in order to develop controlling measures, the road accidents can be significantly decreased, especially when considering the expense incurred from accidents which amounts to 200,000 million Baht yearly (TDRI, 2024). This program can be called an only program to prevent road accidents and is worth investing owing to its efficiency and appropriateness for operations in urban areas where the quantity of vehicles and the statistics of traffic light violations are high.

The analytical study on the worthiness from investing in the program to report and investigate traffic light violations and compares monetary with non-monetary data of the three intersections in Khon Kaen urban area demonstrates that the investment money of 450,000 Baht is paid back through the use of the program in 2 years. The EUAW was found at 219,583.80 Baht and the BCR was 2.2, proving that the Project has the potentiality to raise higher payback than the amount invested and the worthiness in creating profits which are higher than the initial cost and is worth allocating resources. Besides, the evaluation of losses from road accidents showed that the Project could decrease 12 cases of accidents and 8 injuries per year. The yearly loss value is 3,597,352 Baht (in cases of major injuries) or 458,648 Baht (in cases of minor injuries). The program break-even point is within the first year of installation. It has an additional quality in integrating the real time data of violations and reporting the results to support ticket issuance systematically.

6. Suggestion

6.1 It is recommended, from the results of this research, that the governmental sector, local organizations or the local administrative organizations apply the outcomes from the engineering economics approach, for example, Payback Period, NPV, and IRR as the principle indicators for decision making in purchasing the program with technology to detect violations of traffic lights in order to reduce recurrences, officers' burden, and to increase safety of road users. Additionally, a

center database network should be supported to link violation results to the database of the Police Office and relevant agencies for increasing efficiency of law enforcement.

6.2 Academically, further research should be conducted to set the appropriate values of Accident Reduction Factor (ARF) and VoSL in Thai context. The principle of willingness-to-pay (WTP) should be developed alongside the damage-cost approach so that the economics evaluation shall cover all dimensions of direct and indirect values (Bahamonde-Birke, F., et al., 2015; Wijnen, W., et al., 2009).

6.3 The standard model of analysis of initial cost and profits from the investment in road safety should be activated for long-term road safety (Byaruhanga, C.B. and Evdorides, H., 2021).

6.4 This study suggests that future research should incorporate additional methodological approaches, including sensitivity analysis and Social Return on Investment (SROI), to enhance analytical rigor and practical relevance. Furthermore, it is advisable to address long-term system maintenance by providing detailed considerations of periodic software and firmware updates, data management strategies, and cybersecurity measures for both the system and its associated servers. Such inclusions would strengthen the sustainability and reliability of the proposed framework.

7. Acknowledgements

The research team is grateful to Assistant Professor Piyada Daowadueng, PhD. and Khun Warittha Leelayuwat, for their support over the implementation of the Project. This article has been completed owing to the “Capital investment analysis for the product of startup enterprise case study: the detecting program for traffic light violation” (HE633212) - This work is dedicated to and in good remembrance of my belated elder brother, Mr. Vutidach Kumphong, who passed away from a road accident.

References

Accident Center. (2019). *Road accident reporting information*. http://www.thairsc.com/

Bahamonde-Birke, F. J., Kunert, U., & Link, H. (2015). The Value of a Statistical Life in a Road Safety Context. *Transport Reviews*, 35(4), 488–511.

Byaruhanga, C. B., & Evdorides, H. (2021). A systematic review of road safety investment appraisal models. *Cogent Engineering*, *8*(1), 1993521.

Calvo-Poyo, F., Navarro-Moreno, J., & de Oña, J. (2020). Road Investment and Traffic Safety: An International Study. *Sustainability*, *12*(16), 6332.

Cotter, T. S. (2021). Benefit–cost ratio analysis. *In Engineering managerial economic decision and risk analysis: economic decision-making and risk analysis* (pp. 333-351). Cham: Springer International Publishing.

Daowadueng P. and Kumphong J. (2022). Capital Investment Analysis for the Product of a Startup Company Case Study: Detection Program for Traffic Light Violations. *Journal of Management Science Chiangrai Rajabhat University, 17*(2), 163-186.

Elvik, R. (2001). Cost–benefit analysis of road safety measures: applicability and controversies. *Accident Analysis & Prevention*, *33*(1), 9–17.

Klinjun, N., Kelly, M., Praditsathaporn, C. and Petsirasan, R. (2021). Identification of factors affecting road traffic injuries incidence and severity in Southern Thailand based on accident investigation reports. *Sustainability, 13*(22), 12467.

Kumphong J. and Chawapattanayoth N. (2024). Developing A CCTV-AI System with The Capability to Accurately Detect and Recognize Individuals Who Are Wearing Helmets, Specifically Targeting Riders and Passengers. *Industrial Technology Journal Surindra Rajabhat University. 9*(2): 210-224.

Laopuangsak P, Chantaranamchoo N and Dithawiroon N.(2011). Cost-Benefit Analysis of Sanpatong-Hangdong (Phase 1) Bypass Project, Chiangmai. *Journal of Business, Innovation and Sustainability (JBIS), 6*(2), 68–79.

Laophungsak P, Chantaranamchoo N and Dithawiroon N. (2013). Economic Value Analysis of Highway No.331 Intersection Project, Bannongkhla, Sriracha district, Chonburi. Songklanakarin. *Journal of Management Sciences, 30*(1), 1-22.

Ofori-Yeboah, A., Addo-Quaye, R., Oseni, W., Amorin, P., & Agangmikre, C. (2021). Cyber supply chain security: A cost benefit analysis using net present value. *In 2021 International Conference on Cyber Security and Internet of Things (ICSIoT)* (pp. 49-54). IEEE.

Pattanawasanporn, P. and Lekrungroenggid, N. (2021). Breakeven point analysis for investment in machinery for design of material handling systems in the production line of animal feed a case study of betagro company. *Engineering Journal of Research and Development, 32*(3), 97-112.

Pajković, V. and Grdinić-Rakonjac, M. (2021). Evaluation of road safety performance based on self-reported behaviour data set. *Sustainability, 13*(24), 13837.

Satiennam, T., Kumphong, J., Satiennam, W., Klungboonkrong, P., Jaensirisak, S. and Ratanavaraha, V. (2020). Change in helmet use behavior enforced by CCTV cameras with automatic helmet use detection system on an urban arterial road. *Traffic injury prevention, 21*(7), 494-499.

Thailand Development Research Institute (TDRI). (2024). *Loss of Value from Road Accidents in Thailand (TDRI Report No. 209)*.(In Thai)

Wijnen, W., Wesemann, P. and de Blaeij, A. (2009). Valuation of road safety effects in cost–benefit analysis. *Evaluation and Program Planning, 32*(4), 326–331.

Word Health Organization. Global Status Report on Road Safety (2018). *Global Status Report on Road Safety 2018 2018*; 2:227-249.

Wonghabut, P., Kumphong, J., Ung-arunyawee, R., Leelapatra, W. and Satiennam, T. (2018). Traffic light color identification for automatic traffic light violation detection system. *In 2018 international conference on engineering, applied sciences, and technology (ICEAST)*, IEEE, pp. 1-4).

Academic Value

The academic value of this research is extremely high as it applied engineering economics approach to analyze the worthiness of investment in the start-up technology in road safety. It incorporates monetary analyses, namely, the Net Present Value (NPV), the Internal Rate of Return (IRR), the Benefit-Cost Ratio (B/C), and the Equivalent Uniform Annual Worth (EUAW), with evaluation of loss value from accidents by the Human Capital Approach and Accident Frequency Method. Thus, the analytical framework led to accuracy and concreteness and can be extended to standard research work in traffic safety or other infrastructure investment projects. In terms of social benefits, this research encourages relevant agencies to acquire evident data that support their decision for investment of a detecting system and report of traffic regulation violations. With such system, officers' burden can be decreased, law enforcement can be made more efficient, and accident rate can be sustainably reduced. It can also truly promote start-up development in social innovations, leading to creation of safe and model cities in development of road safety policy both at the local and national levels.