Developing an Economic Assessment Tool for the LGUs: Introducing the Transportation Infrastructure Impacts Calculator

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Abstract: The Sustainable Technology-Assisted Route Planning for Region VI (STARPLAN-VI) aims to support the development of a sustainable local public transport route plan that integrates the road and maritime transport network of Region VI through the use of developed technologies for the transport sector. The project will specifically train and provide both the software and hardware public transport planning tools to the local government staff and university faculty and staff for their use to sustain the public transport planning and management of Region VI. In light of this, an Excel-based economic assessment tool that generates a comparative assessment of proposals and policies is developed and presented. This facilitates the enhancement of the capabilities of local staff and researchers in assessing the effects of transport infrastructure projects and proposals using Co-benefit and Input-Output Analysis. This endeavour hopes to foster better local decision-making related to transportation planning and management.

Keywords: Transportation Planning, Co-benefit Analysis, Input-Output Analysis, Impact Assessment Tool

1. INTRODUCTION

1.1 Background of the Study

Transportation is at the heart of almost all economic infrastructures. On at least one link in the production chain, transportation is involved and is highly critical, be it for goods and/or services. Thus, optimizing the transport sector is critical in sustaining economic growth. As this thrust is also relevant in other cities and countries, many different institutions have put forward solutions. With this supply of knowledge and experience, transport planners are provided the opportunity to learn from past mistakes and follow or even improve on others' success. However, with the surplus of transport infrastructure development plans and possible directions for development but limited time and resources, there arises a need to determine the optimum future scenario, so the necessary developmental policies can be identified and implemented. With a guided strategy for transport development, the resources can be maximized, the vulnerabilities can be addressed, the problems can be given a sustainable solution, and consequently, the economic growth can be sustained or even further accelerated.

Over time, the transport planning paradigm has changed from focusing on mobility to putting more importance on accessibility (Litman, 2013). The new paradigm expands the range of modes, objectives, impacts, and options considered in planning. The assessment of transport plans are now expected to be more comprehensive as more impact measures and performance indicators are taken into consideration.

In 2018, transport planning specialists were commissioned to conduct a two-week hands-on training to municipal, city, and provincial representatives of Local Government Units (LGUs) to develop the Local Public Transport Route Plan (LPTRP). The expected output of the capacity building activity is the submission of LPTRPs, which only selected LGUs were able to achieve. Priority to strengthen capacities, however, remains high in accordance with the Public Utility Vehicle (PUV) Modernization Program. Limitations from the preliminary activity have been identified alongside recommendations to design the proposed capacity development module. Evident from the training was the limited time and exposure of the participants to the use of both QGIS for spatial land-use planning and JICA STRADA v. 3.5 for public transport planning. While there was more familiarity with QGIS, operating JICA STRADA is highly complex, which participants were unable to use when developing the route plans. Easier to use transport planning software that utilises actual transport network data is therefore proposed.

To adopt a more systems-oriented approach and considering the archipelagic nature of the country, it is essential to plan towards an interconnected maritime and road transport network. Noting the case of Region VI wherein maritime transport services are available to provide linkages between Negros Occidental and Guimaras with Panay Island. Sustainable Technology-Assisted Route Planning for Region VI (STARPLAN-VI) is a research program funded by the Department of Science and Technology under the Philippine Council for industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD). The main thrust of the program is to support the development of a sustainable local public transport route plan that integrates the road and maritime transport network of the Western Visayas Region through the use of technologies developed for the transport sector.

1.2 Problem Statement

Designing a transport system with its relative function towards the rest of the economy as a primary point of consideration is not only ideal, but also an absolute necessity. Its critical role in sustaining productivity across all sectors of the economy can also be considered as one vulnerability that needs to be looked into. As it is under emergency situations with which the true importance of transportation and accessibility is justly demonstrated, this study aims to investigate the transport infrastructure's resilience and its impacts to other economic sectors as well. Tierney and Bruneau (2007), Rose and Krausmann (2013), and Gilbert et al. (2015) quantified resilience using the economic loss reduction metric. In Hasegawa et al. (2009), Okuyama and Santos (2014), and Roquel, Fillone, and Yu (2017), economic loss is estimated using an input-output (IO) model.

The IO model encapsulates the interdependence between different branches of an economy to show how parts of the system are affected by a change in one part of that system. This procedure, a quantitative economic technique capable of accounting for the overall impact of a change in one sector of an economy (e.g. a proposed transport infrastructure development), is highly relevant to the new transport planning paradigm. By incorporating the resilience metric, quantified as economic loss savings, the assessment approach undertaken made for a more sustainable approach.

However, public health should never be overlooked. The strong relationship between transportation and health necessitates a more inclusive approach - one that would cover the interests of both the stakeholders and the society. In light of the broad evidence that climate change is occurring with potentially expensive and far-reaching health consequences, urgent and substantial actions are needed. Kwan et al. (2017), Shaw et al. (2017), and Alam et al. (2018) employed the co-benefits (CB) framework to assess transport projects and policies beyond just transportation metrics. Its use has become a predominant concept in scientific writing that focuses on reconciling environmental and developmental goals. This appears to be very promising for developed economies and emerging economies, as it offers a way of not compromising economic growth while still allowing environmental aspects to be taken into account.

Mayrhofer and Gupta (2015) accredits the CB approach as a positive and constructive "win-win" way to operationalize how economic, environmental, and social aspects can be integrated within the concept of sustainable development, instead of framing them in terms of trade-offs. In this study, by incorporating the benefits of travel time and vehicle operating cost (VOC) reduction with the primary CB of savings in accident losses and emission costs, an all-inclusive and long-term assessment will be performed, aiming to determine the optimum development roadmap that caters to the interests of both the industry and the community.

Through the STARPLAN VI, several computers installed with the necessary public transport planning tools and trainings are provided to the local government staff and partner educational institutions for their use to sustain the public transport research, planning, and management of Region VI. The program objective is very timely and appropriate as various projects are being constructed and many are still in the planning process. In this light, the trainings provided to the staff are quite apt. The level of understanding of the various concepts of the transportation planning process and the skills are further enhanced. In the various trainings, different participants have different level of understanding of the transportation planning concepts. In order to further streamline this process, the Traffic Infrastructure Impacts Calculator was conceived. This will enable LGU personnel and researchers to be able to easily estimate the effects of certain policies and proposals from their simulations.

1.3 Objectives

The main objective of the study is to develop an Excel-based economic assessment tool to compare alternative transport infrastructure projects.

The following are the specific objectives:

- To generate a comparative assessment of infrastructure projects such as bridges, toll roads, ports and vessels, transport terminals, among others using the IGES co-benefit analysis approach.
- To make use of the (Multimodal Transport Planning Software) EMME transportation planning output as input to the model to compute for the co-benefits
- To be able to apply the input-output analysis as a sub-module in the tool
- To provide local planners and university partners a simple yet efficient tool of assessing transport infrastructure projects in the locality.

1.5 Scope and Limitations

The study covers the following topics in the Philippine setting which are analyzing the impacts of transportation infrastructure planning, and the development of the Transportation Infrastructure Impacts Calculator (TIIC) tool.

The variables considered by the tool are based around EMME. In the CB analysis of the tool these are Average Speed, Total Vehicle Distance Travelled (VDT) and Total Vehicle Hours Travelled (VHT) of the road network and model. For the IO analysis, a simple yes or no is needed for the different transportation infrastructures (e.g. If Railway Transport is present, "yes" or "1" would be the input to the tool). Furthermore, the tool analyzes the impacts of transportation infrastructure and policies based on CB and IO.

The study is limited by the capability of the core program of the tool which are Microsoft Excel and VBA (Visual Basic Advance). Also, it accepts only specified inputs with corresponding units based on the EMME software and format. Furthermore, the development and calibrating period of the program was limited to a year. Other variables and types of transportation analysis that are not mentioned in the paper are not considered.

1.6 Significance of the Study

The output of this study will greatly benefit transportation planning personnel. This will enable them to instantly compare various transportation proposals and policies using the Co-benefit analysis. The tool streamlines this process since local policies can be easily evaluated based on this tool, in conjunction with the EMME simulation. This way, the implementation of plans will be more guided and that the proposal has somehow undergone a proper evaluation.

2. REVIEW OF RELATED LITERATURE

2.1 Transport Sustainability

The health of residents in urban areas is affected by their environment. Proper Urban and Transport Planning is needed to promote a healthy lifestyle. Key elements to consider in healthy transport planning are Physical Activity, Air pollution, Noise, Heat and Green Spaces (Mueller et al., 2017). Also, in Mueller's paper it was found that nearly 20% of deaths in Barcelona were attributable to higher than recommended levels of air pollution, noise, heat while lower levels of access to green spaces. Furthermore, it was recommended that there is a need for promoting greener infrastructure and reduction of motorized traffic by promoting public and active transport. Both of which can reduce air pollution, noise, and heat which may improve the health of the residents. The TIIC aims to provide local municipalities with an easier way of transport infrastructure planning by showing the effects of transportation infrastructure projects before they are constructed.

In a study done in Rondonópolis, Brazil, evidence of physiological changes was found in house sparrows that proved air pollution is evident in poorly planned urban areas (Angeoletto et al., 2019). Lack of proper transport planning can result in harmful urbanization of a location, resulting in environmental impacts such as poor air quality and negative health effects. Programs that only considers economical but not ecological effects may done more harm than good. The TIIC considers both the environmental costs and economic impacts of transport infrastructure projects.

Transport planning, post-COVID-19 pandemic, might face changes especially in public transport design in order to avoid crowded conditions which is important in hindering the spread of the virus (Gkiotsalitis & Cats, 2020). Whereas before the design and planning of transport infrastructure projects focuses mainly on maximizing service performance (i.e., Level of Service), health risks and the travelers' confidence may play a key role now.

2.2 Transport Planning

In transport planning there are hierarchies, networking, and collaborations between local and regional municipalities which brings advantages and disadvantages (Paulsson et al., 2018). It can provide both parties with improvement of services and quality of projects by easier establishing of common objectives, more transparent and mutual sharing of information. However, collaborations can also add additional delay, unnecessary duplication of work and conflict of goals of the local and regional organizations involved. The disadvantages may be bought on by the lack of tools of one organization to understand and check the information provided to them by the other. For example, the local municipality might lack the necessary experience, knowledge, and tools to comprehend the data of a regional transport infrastructure project given to them. This lack of comprehension and tools might delay the project. That is why simpler but still capable transport planning programs are needed to provide local municipalities the ability to plan and check the effects of transport infrastructure projects.

Both academic researchers and transport planning believes that data is important for effective collaboration and planning transport infrastructure projects. However, their goals are sometimes misaligned and their interest diverts (Crist et al., 2018). In the study, it was found that academic researchers tend to divert from a transport agency's original policy plan and is driven the data collected. While transport planners are driven by policy making first, before the data collection. Furthermore, the data collected and presented by both are different from one another. It was recommended that a more formalized collaboration between the two parties would aid in aligning their interests and goals. This would allow for a quicker and more effective implementations of transport policies and infrastructure projects.

Transport planners and modelers also encounters some barriers when collaborating. For a more effective collaboration, the sharing of knowledge should be simplistic and presenting of data easy to visualized in terms of graphs and charts (te Brömmelstroet & Bertolini, 2008). A common ground such as using the same tools, applications, and data could alleviate the hindrances of both planners and modelers when collaborating in a project. Furthermore, it was recommended that further transfer of additional information should be done during discussions via laptops. With these considerations, the TIIC is made to be computationally lightweight and easy to use.

2.3 Transport Infrastructure Impacts and Co-Benefits Analysis

Transport infrastructure projects have short and long-term impacts to their target location and surrounding areas. Different types of transportation projects can have beneficial impacts such as an increase in economic activity and population, or negative environmental impacts (Mejia-Dorantes et al., 2012). In their study, it was found that public transport stations can help fortify economic connections of surrounding municipalities. Knowing the impacts of a transportation project is important to urban planners and developers for effective economic growth and transport planning.

CB analysis includes a variety of fields such as Climate, Economic, Environmental, Social, and Political and Institutional. The concept is not rigid and may be subjected to change as time goes on. However, the main essence of CB is that there is a “win-win” in the combining of multiple goals of the different fields for a sustainable development plan (Mayrhofer & Gupta, 2016). The study also noted that co-benefit is an umbrella term and may be influenced by politics and current issues. Sometimes even placing more weights to a certain field such as placing importance in economic benefits when a location is lacking economic activity.

3. METHODOLOGY

3.1 TIIC Process

The TIIC uses both Excel's and Visual Basic for Applications (VBA) Userform's functions. Opening the TIIC Userform for the first time requires the enabling of macros for Excel by clicking "Enable Content" as shown in Figure 2 for it to function properly.

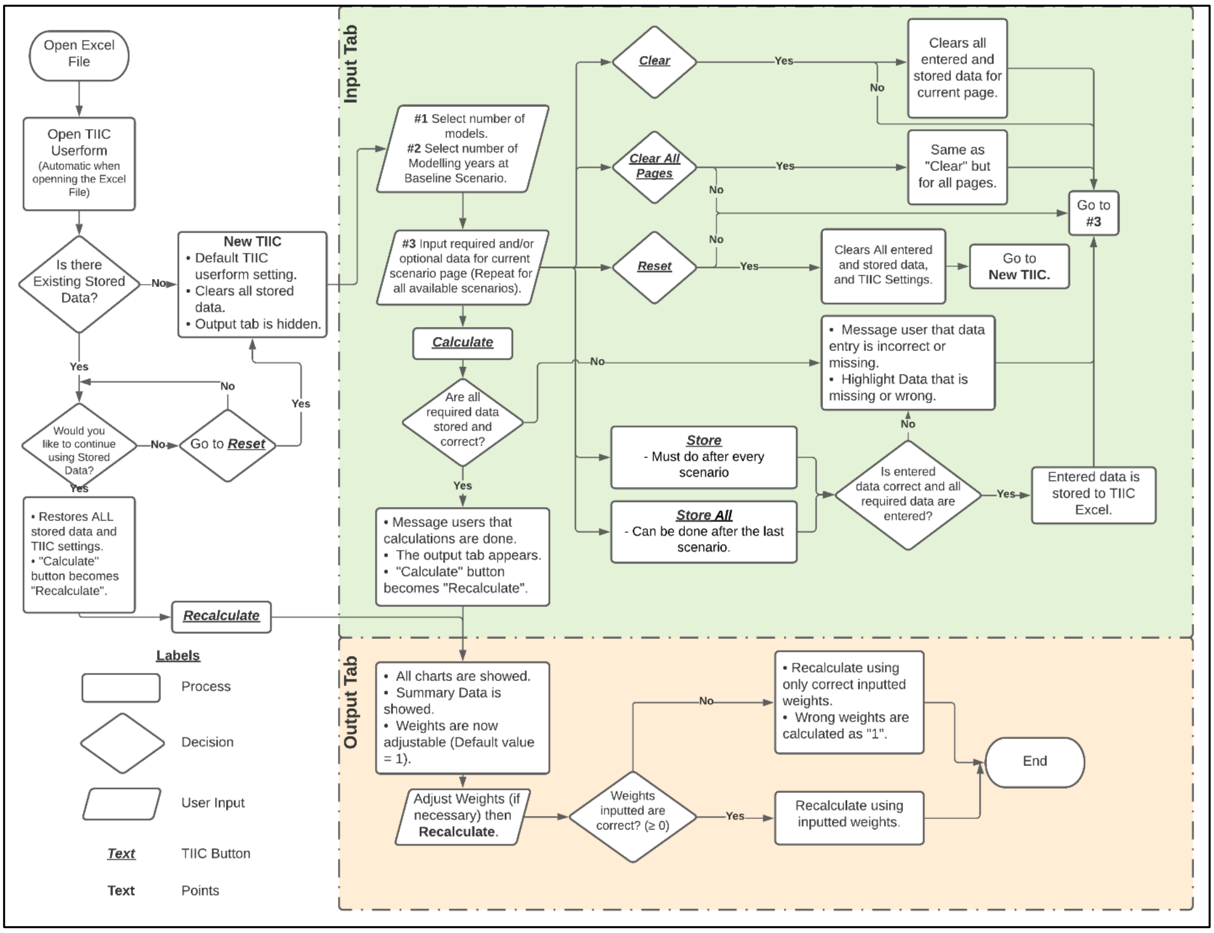

Figure 1. TIIC Flowchart

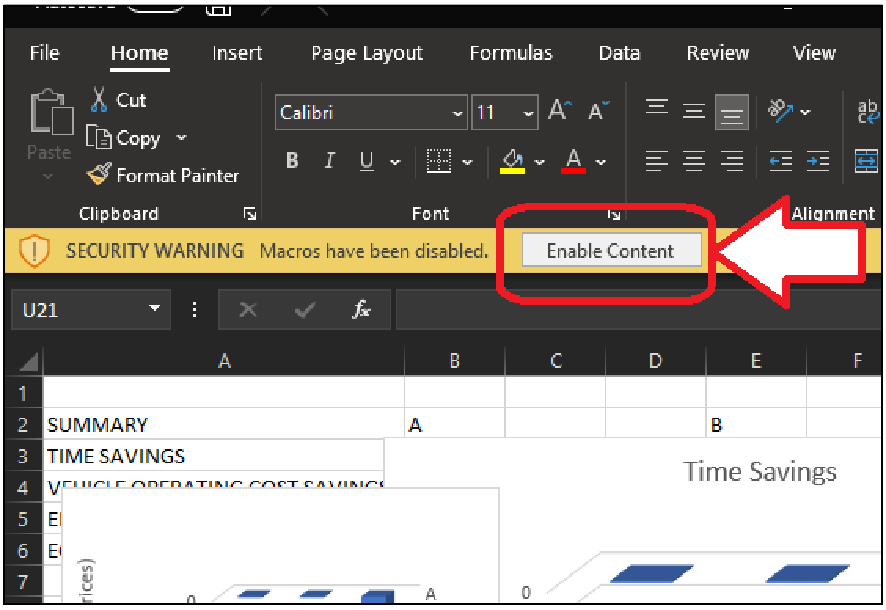

Figure 2. Enabling Macro for TIIC

The TIIC Userform will open automatically whenever the TIIC Spreadsheet file is opened. When the TIIC Userform is opened, it will first check if there is stored data. The user is then asked if they want to continue and use it or reset and start anew. If they continue, the TIIC would restore all TIIC settings and fill in data text boxes with the stored data. Furthermore, it changes the “Calculate” button with “Recalculate”. If there is no stored data, the Userform will not ask the user and will show the blank default TIIC input tab as shown in Figure 3.

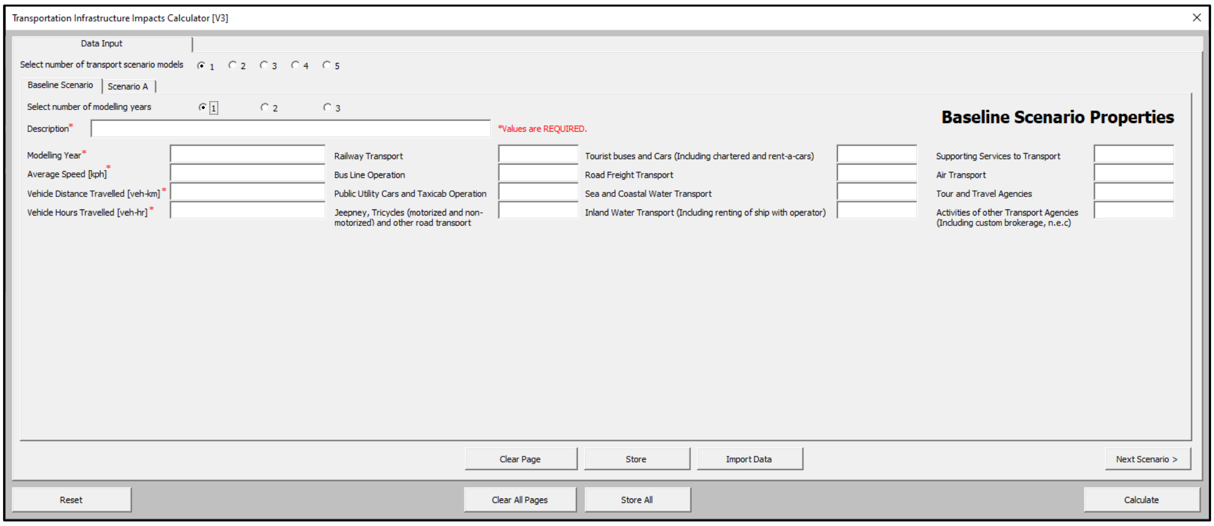

Figure 3. Blank Default TIIC Input Tab

At the input tab, the user can select how many scenario models they would use not including the Baseline Scenario up to a maximum of 5. For example, selecting “2” would mean there would be a total of 3 scenarios: The Baseline Scenario, Scenario A, and Scenario B. Next at the Baseline Scenario, the user can select how many modelling years they would use up to a max of 3 Modelling years. The number of modelling years would be based on the Baseline Scenario and cannot be changed in other scenarios. The number of scenario models and modelling years can be changed anytime during data entry.

Once the number of modelling years and scenario models have been picked, the user should then input the required data (indicated by red asterisks) per scenario. Required data can also be imported from .csv files following EMME output format or similar. In addition, the user can also enter optional data. After entering all the required and optional data for the current scenario, the use can navigate to the next or previous scenario by either using the "Next Scenario" and "Previous Scenario" or clicking the tab as shown in Figure 4.

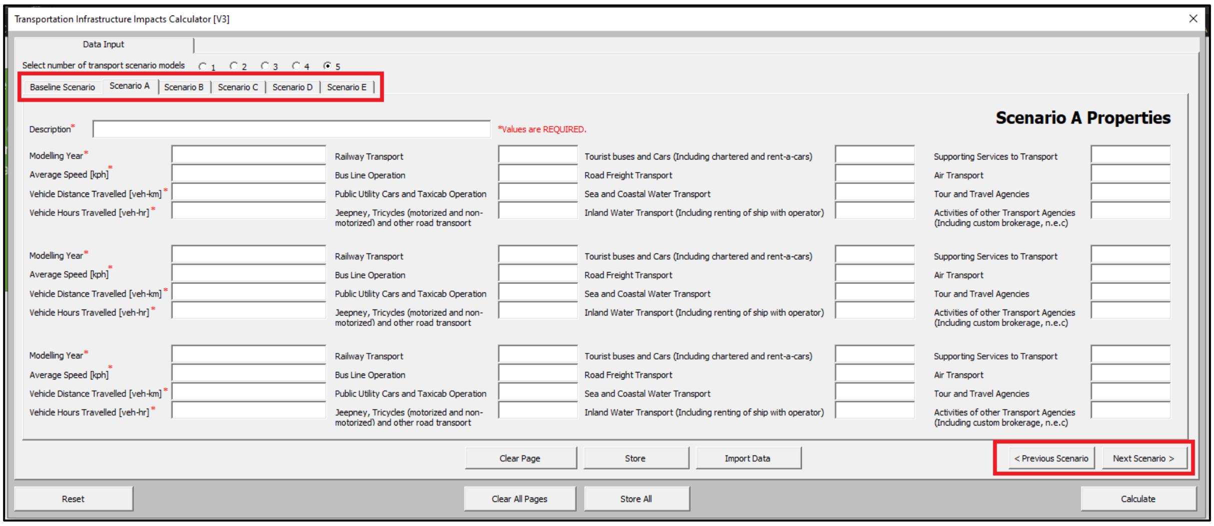

Figure 4. TIIC Userform Navigation Options

During inputting data, the user has two options in storing the data. First, the user can click "Store" after entering the data for the current scenario. Second, the user can input all data for all scenarios, then click "Store All". Both options would check the data first for any missing required inputs and if they are correct. If all required data has been entered and there is no wrong data, they would then be stored into the computation sheet for calculations. If there is something wrong, the TIIC Userform would notify that there is a missing or incorrect data by message and then highlighting the text boxes of the data that caused it. An example of this can be seen in Figure 5. Lastly, editing stored data can be done by editing the data at the TIIC Userform then storing it.

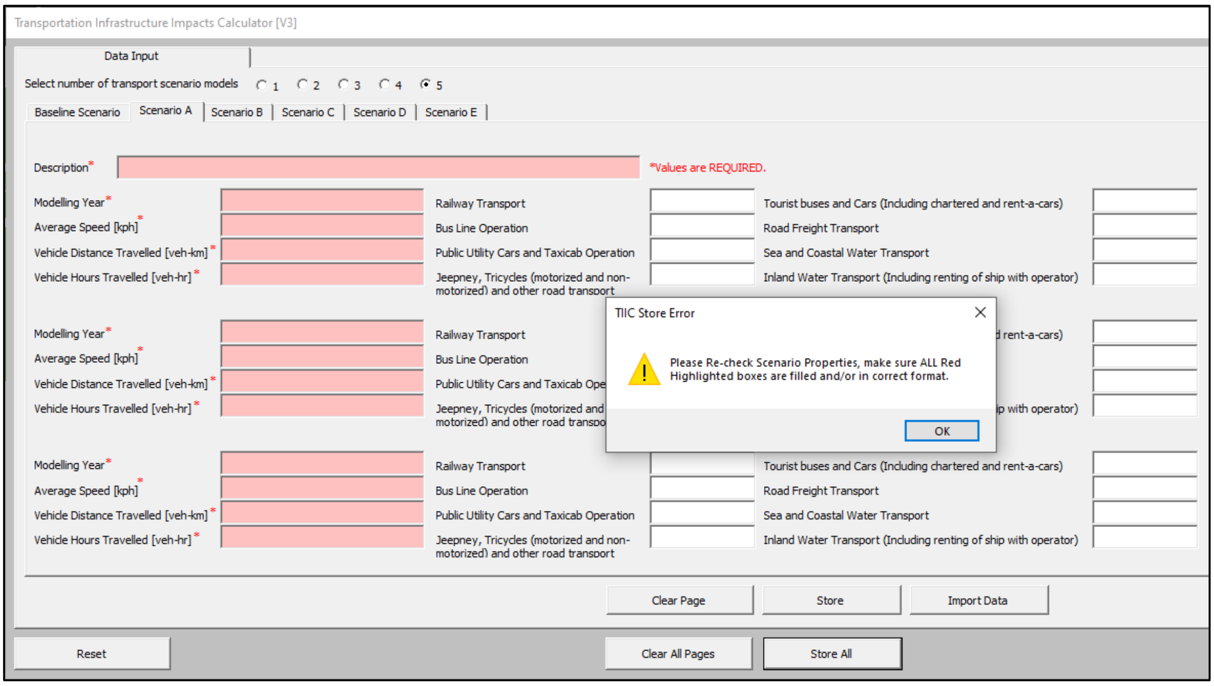

Figure 5. Example of TIIC Userform Store Error

In deleting stored data, the user can click the "Clear", "Clear All Pages", or "Reset". Using "Clear" would clear all entered and stored data for the current scenario but keeps the TIIC settings such as modelling years and number of scenario models. "Clear All Pages" would do the same but for all scenarios. Using "Reset" would clear all entered and stored data, and TIIC settings. The user would then have to start from the blank default TIIC input tab. The TIIC Userform would ask the user first for confirmation before performing these actions.

The final step at the input tab is clicking "Calculate" which would do a check if all stored required and/or optional data is correct. If not, it prompts a message to the user like the "Store" function. If correct, the Userform would then do the computations then prompts a successful message, unlocks the Output Tab, and changes "Calculate" to "Recalculate" as shown in Figure 6.

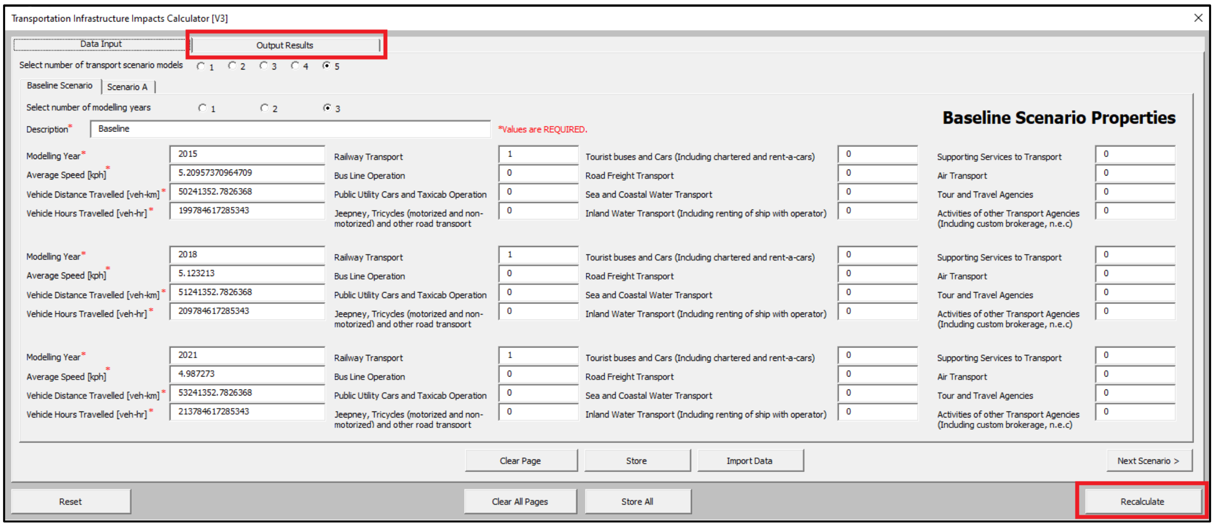

Figure 6. TIIC Userform after successfully storing and calculating.

At the output tab, they would be shown graphical charts and a summary data table with adjustable weights as shown in . These weights can be adjusted to any value greater than or equal to zero. If the weights are less than zero, it would default it into "1". Furthermore, the user can recalculate as much as they need and even adjust stored data by going back to the input tab. Lastly, a copy of the latest graphical charts is saved to a folder called "TIIC Graphs" which is located where the TIIC Spreadsheet file is located. The units of the values seen at the summary table are in billions of Philippine pesos per year.

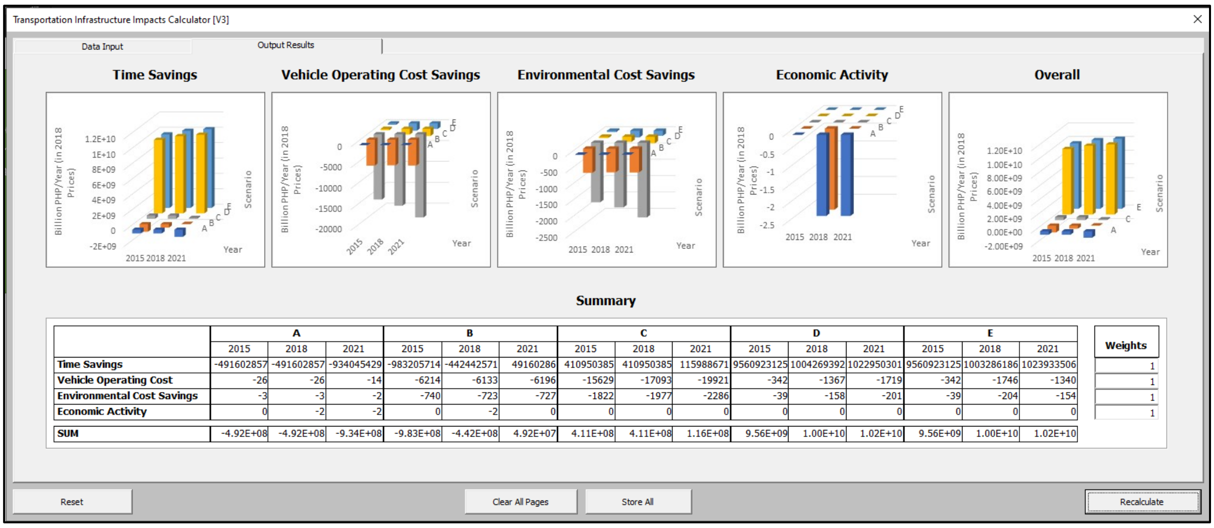

Figure 7. Example of TIIC Output Tab

3.2 TIIC CB and IO Analysis

The CB analysis of the tool is based on Institute for Global Environmental Strategies which allows transport planners both local and regional to see if their transport policies and projects are not just economically beneficial but also sustainably. The tool uses input based around EMME's output variable which are the Average speed of the network, Total VDT, and VHT in order to do the CB analysis. The output of the analysis would be in billions of Philippine Pesos per year for Time Savings, Vehicle Operating Cost, and Environmental Cost Savings.

The IO analysis included in the tool is optional and can be left blank. If to be used, it requires the user to input the number of available and planned infrastructures at the network to facilitate the computation of the change. Its output would also be in billions of Philippine Pesos per year for Economic Activity.

Note that the tool is designed to require the CB analysis but is optional to do the IO analysis. The output is made so that planners can easily see the effect of their policies and projects with just a few clicks.

4. TRIAL RUN RESULTS

4.1 Program Strengths

The tool was tested using calibrated EMME model data samples. Which allows a realistic output for the program and provided a trial run to further enhance the UI design of the tool. The tool demonstrated how various plans and policies can be easily tested using the TIIC which streamlines the process.

A user manual was also drafted in order to guide the users of the tool. The tool is lightweight and needs only a Microsoft Excel to work. The output of the program can also be screen captured or be copied from one of the spreadsheets of the tool. Furthermore, it also saves the latest charts at a folder located at the same directory of the tool.

4.2 Audience and Use of TIIC

The targeted audience of the TIIC are LGUs, specifically those who are in charge of making small policies, transport projects and infrastructure. STARPLAN also provides training in various transportation tools and software to Region 6 LGUs and adding the TIIC can provide a huge benefit to them. This is because the TIIC can provide LGUs a way to quickly test policies, infrastructures, and projects on their own.

5. CONCLUSION AND RECOMMENDATIONS

By partnering and collaborating with the LGUs and SUCs in Region 6, the STARPLAN 6 research team expects that the objectives of the research will be sustainable even after the project is completed. By first providing the research partners with a transportation planning software that is housed in the SUCs, the faculty, researchers and even senior students could be able to help the LGUs in their transport planning needs especially now that all LGUs from the municipality, city and province are required to develop their own local public transport route plan and update them on a regular basis. To further enhance their capabilities in assessing transport infrastructure projects, the TIIC was developed to use the output of the transport planning software when comparing several transport infrastructure projects. The TIIC is designed to be easy to use and run in MS EXCEL software making it accessible to anyone who has a computer. Hopefully, better decision making in choosing transport infrastructure projects will come out of this endeavour in the local level.

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