A System Dynamics Model for Integrated Resorts: A Case Study of Matsu Island

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Abstract

Integrated Resorts (IR) is an integrated form of entertainment consisting of leisure, food and beverages, shopping, exhibition, and casino. A casino is an integral part of IR that arouses extensive discussion from all social sectors. In the course of discussion and assessment of the establishment of IR in Matsu Island, a number of stakeholders and numerous complicated economic, social, and environmental factors are involved. In this study, the System Dynamics (SD) is adopted for proposing a systems thinking framework with the buildup of a SD analysis model from holistic perspectives to assess the economic, social, environmental influence and possible contribution of the establishment of IR on Matsu. This study is not only an attempt to supplement the inadequacy of the literature on IR planning studies, but also can serve as the platform for the experiment of policy by the planners, decision-makers, and the stakeholders. This platform can be used for observing the dynamic change of the influence under different policies, and as recommendation for policy making.

Keywords: system dynamics, casino, Matsu, integrated resorts

1. Introduction

Integrated Resorts (IR) is an integrated form of entertainment consisting of leisure, food and beverages, shopping, exhibition, and casino. It has played a vital role in the development of the tourist industry over the years. IR is taken as the catalyst of the tourist industry and can help boost a variety of industries such as hotel, catering, retailing, and transportation and attract a large number of tourists. IR will help to upgrade economic performance and create job opportunity and is a policy instrument affecting economic development (Lee and Back, 2003; Rephann et al., 1997; Walker and Jackson, 1998; Zagorsek, 2009). For this reason, many countries or regions seek to introduce IR to boost their tourist industry, create jobs, upgrade economic performance, improve the quality of living of the people, and bring about development in the regions and the cities. Examples are Las Vegas, Macau, and Singapore (Culver, 2009; Gu and Gao, 2006; MacDonald and Eadington, 2008; Ng and Austin, 2016; Winslow et al., 2015; Xi and Wei, 2010).

For maintaining a proper balance between the development of metropolitan areas and the offshore islands, Taiwan has been engaged in the discussion of the feasibility in developing IR on the offshore islands. IR covers casino facilities and is subject to a referendum of the residents on these offshore islands before introduction. Of the three offshore islands of Taiwan, Matsu has agreed to establish IR in a referendum in 2012.

Matsu is a group of 36 small islands in different sizes with total area of approximately 29.6 km^2, and is located at the northern part of the Taiwan Straits and about 211 km from Taiwan and just about 9.5 km away from Mainland China. The population of Matsu is about 10,000 people. Matsu features the island culture with a variety of landscapes, botanical ecology, and avian ecology, and also the architecture of eastern Fujian. Owing to its historical background and strategic location, Matsu is covered with sophistically designed secret tunnels for military maneuvers and military installation. These characterize the distinctive culture of Matsu in natural sights and the humanities. Indeed, the local government is also positive in the promotion of tourism. But Matsu is far away from Taiwan with inconvenient transportation means. This is echoed with the lack of financial support and other resources that severely hamper the development of tourist industry. For this reason, the Matsu government hopes to introduce investment, improve the means of transportation through the establishment of IR so as to promote tourist trade, create jobs, bolster economic performance, and improve the quality of living of the people there for the overall development of Matsu.

A casino is an integral part of IR that arouses extensive discussion from all social sectors. In the course of discussion and assessment of the establishment of IR in Matsu, a number of stakeholders and numerous complicated economic, social, and environmental factors are involved (Andriotis, 2008; Eagles et al., 2002). Many variables affect one another and make it difficult to quantify or correlate in linear relation. The mutual interference among the variables also yields time-delayed effect (Schianetz et al., 2009; Woodside, 2009; Xing and Dangerfield, 2011). In retrospect, studies on the evaluation of IR planning in the past tended to focus on the influence on the social environment (Andriotis, 2008), economic benefit (Zagorsek, 2009), and satisfaction of the residents (Nunkoo and Ramkissoon, 2010). Few have shed light on the overall situation from a broad view. In the analysis of the effect from the development of the program, the decision-maker simply cannot conduct an experiment on a district which has not yet been developed. They also neglect the dynamic factor of time and cannot observe the trend of policy development and the effect of such development (Jones et al., 2011; Walker et al., 1998; Xing and Dangerfield, 2011).

In this study, the System Dynamics (SD) is adopted for proposing a systems thinking framework with the buildup of a SD analysis model from holistic perspectives to assess the economic, social, environmental influence and possible contribution of the establishment of IR on Matsu. This study will serve as a supplementary contribution to the inadequacy of literature on the study of IR planning in the past and as reference for the planners, decision-makers, and stakeholders to conduct an experiment for observing the dynamic change of the effect from different policies in the process of IR development for communication and discussion.

2. Methodology

SD is a form of methodology for the study of the dynamic behavior of organizational system. Through the analysis of the internal feedback of information from the system, the structure, policy, delay and other factors of the system structure and the influence from the interplay of these factors on system development and stability could be observed through computer simulation. This is an analysis method for empirical and quantitative analysis, and can provide an integral, prolonged, and viable solution for time-delayed effect and dynamic complexity (Forrester, 1958, 1961, 1993). SD has been extensively applied to organization strategy, industrial economics, energy policy, and related disciplines. Many scholars also use SD to study the regional tourism planning mainly on island destinations from the economic, social, and ecological perspectives to probe the interplay between government policy and sustainable development (Provenzano, 2015; Schianetz et al., 2009; Walker et al., 1998; Woodside, 2009; Xing and Dangerfield, 2011). The establishment of IR in Matsu involves many stakeholders and complicated economic, social, and environmental factors. The issue has already featured “dynamic complexity of problem” and is suitable for studying with SD.

3. Model Structure

3.1 Framework

A casino is an integral part of IR that makes it distinctive from other facilities and arouses extensive discussion by all social sectors. IR can help to stimulate the development of different tourism related industries such as hotel, catering, retailing, and transportation, and upgrade economic performance and create jobs. However, the influx of tourists to IR may also cause an overload of the facilities and the environment of the tourist attraction. The casino in an IR may also trigger gambling problems and crime in the local community. As such, transportation, infrastructure such as power and water supply system, water pollutant treatment and handling of solid waste must be sufficient. The monitoring of the casino must also be effective with proper support measures so as to maintain a proper balance among the economic, environmental and social development (Eadington, 1997; Inskeep and Kallenberger, 1992; Ko and Stewart, 2002; Mieiro et al., 2012; Winslow et al., 2015; Wu and Chen, 2015).

The process for the assessment of the establishment of IR in Matsu involved a large number of stakeholders. Many factors interplay and are related with one another in dynamic complexity. In this study, systems thinking is the central idea whereby the factors related to the development of IR in Matsu are viewed from the dimensions of "IR Development", "Economic performance", "Population", "Utilities and infrastructure", "Water pollutants and waste treatment facilities", and "Social influence" (Figure 1). The influence on government policy is also considered as the basic framework for the development of the SD model in this study. This framework also includes the concerns of stakeholders like the IR investors, the local residents, and the government.

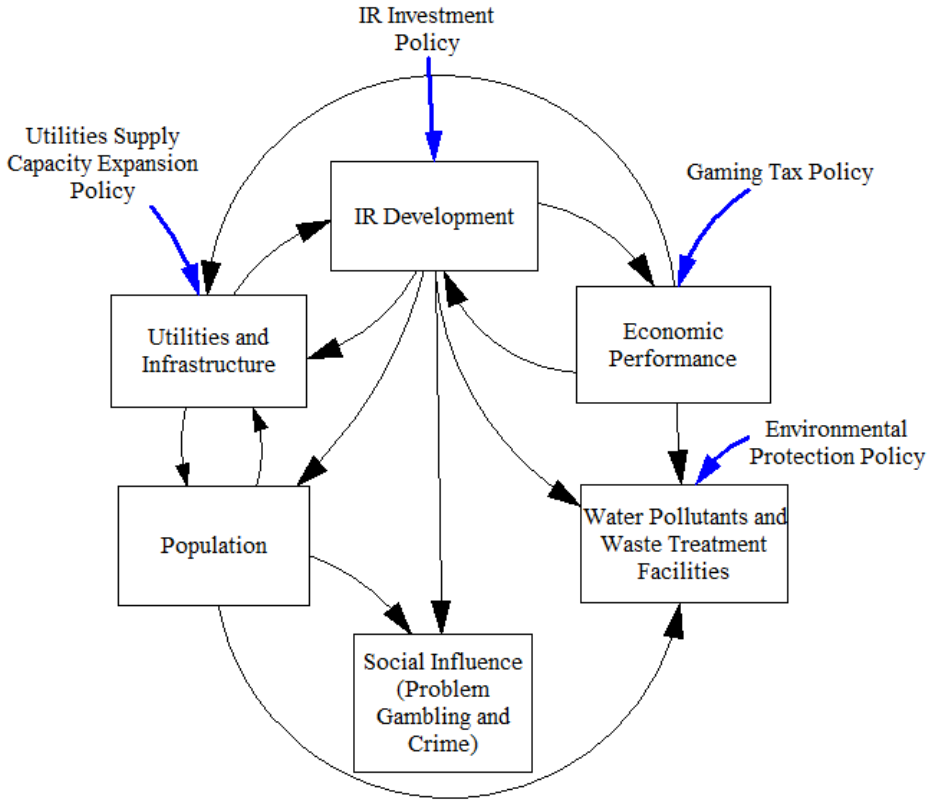

Figure 1: the conceptual framework of establishment of IR in Matsu

3.2 Causal feedback loop

Based on the systems thinking framework of the establishment of IR in Matsu as mentioned, literature on this topic and the experience of the development of the gambling industry in Las Vegas, Macau, and Singapore will be consulted. Interviews with official of Matsu, scholars, and experts in related fields (including the gambling industry, economic, transportation, tourism planning, environment, and social order), IR investors, and the residents of Matsu, key variables for each dimension will be sorted out for establishing the causal loop of the subsystems with the integration of the 6 subsystems into an overall causal loop diagram. (Figure 2)

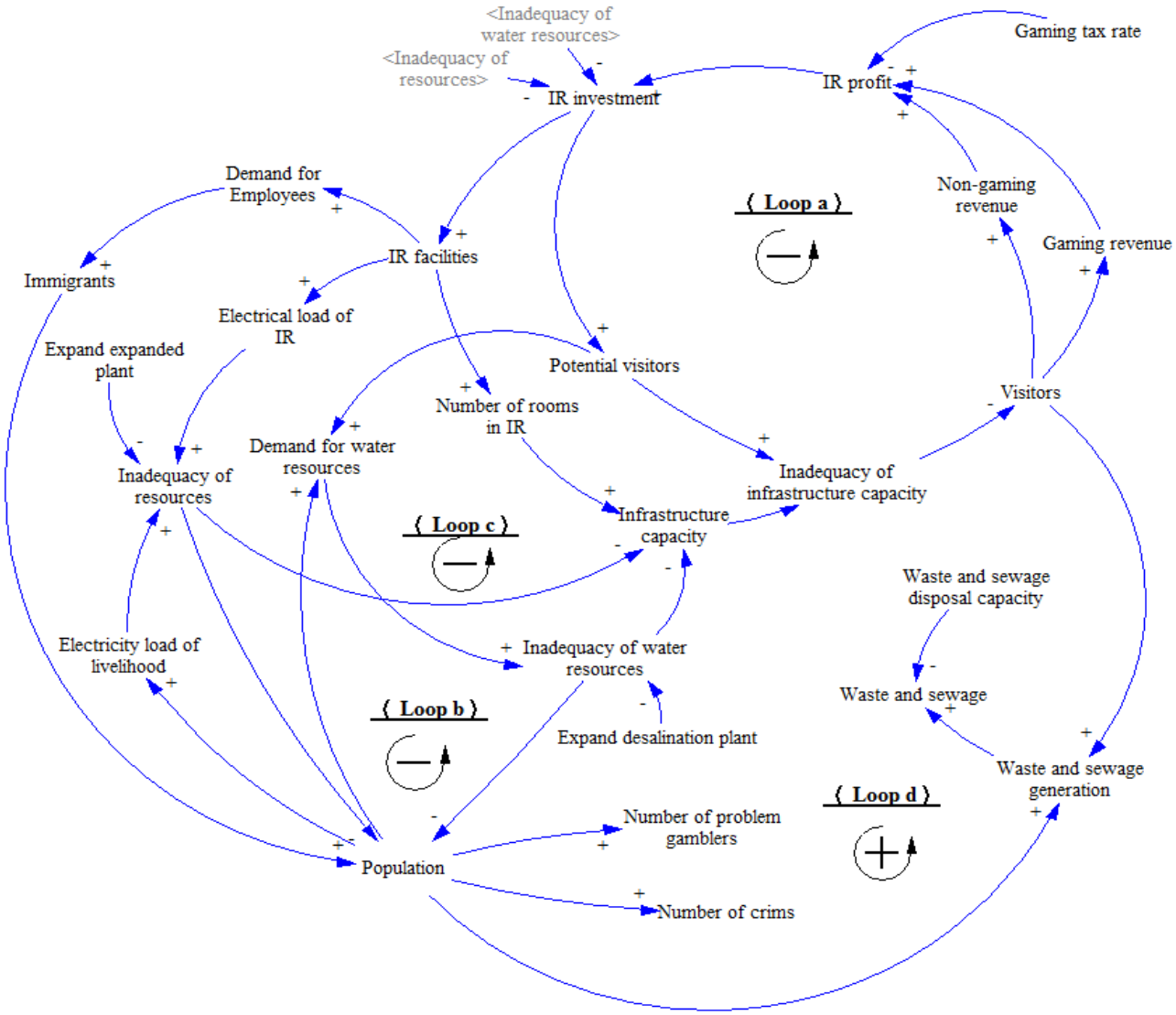

Figure 2: the causal loop diagram of establishment of IR in Matsu

The causal loop diagram is the essential procedure and foundation in the processing of building up the SD model. Through "systems thinking", the issue of the planning for the establishment of IR in Matsu will be addressed to in systematic and overall point of view to demonstrate the key variables of system features or attributes presented by the causal loop diagram. This helps to understand the problems and system boundary pertinent to the establishment of IR, and the causal relation among related variables and their interactions. For example, in Loop a, the investors make capital investment for the establishment of more facilities and provide better quality service to upgrade the attractiveness of IR that in turn help to attract more tourists. The activities of the tourists in lodging, food and beverage, shopping, gambling, and other entertainment will bring in gaming and non-gaming revenues for the IR for reinvestment and for attracting more tourists.

Loop b shows the dynamic relation between the growth of population in Matsu and the development of tourist industry. IR prompts for the development of the tourist industry in Matsu. Further to the attraction of more tourists, it also contributed to the growth of the population in Matsu. However, the influx of tourists and residents to Matsu also resulted in additional loading of the facilities there. The huge demand for power and water supply will result in a supply gap so that the number of tourists and residents cannot grow without limitation. In other words, Loop c is the growth constraint loop of Loop a. In addition, Loop d characterized the growth of the tourist population and resident population created much more solid waste and water pollutants that dictated for the increase of the capacity in the cleanup of trash and the collection and treatment of water pollutants so as to reduce the piling of trash and water pollutants and to avoid pollution.

As for the role of the government, it can affect the development and the trend of changes of the subsystems through the IR investment policy, utilities supply capacity expansion policy, gaming tax policy, and environmental protection policy.

3.3 Validation and Model Testing

In this study, related variables in the aforementioned causal loop diagram will be integrated with the Venism DSS 6.3 version software for building a quantified model. The model will be tested for validity with the model verification method (Forrester and Senge, 1980; Sterman, 2000), including the system boundary, model structure, and parameter tests. Experts in related disciplines will be requested to review, discuss, and participate in the building of the model to confirm the "trend" and "intensity" of the changes from system simulation can reflect the reality and satisfy the model in application. This will be essential to make this model valid and may be used as an empirical tool in simulation for policy analysis.

4. Discussion

In the past, the assessment of the influence from IR development tended to be done by mathematical models with a number of hypotheses, and few have shed light on an overall analysis and assessment from a broad view. It would be difficult for a decision-maker to conduct a policy experiment on an area that has never been developed and observe the development trend of the influence from policy. In this study, a systems thinking framework is proposed with the use of the SD method for the building up of a SD analysis model. This model aims at the assessment of the economic, social, and environmental effect of IR in Matsu and the influence from a broad view, and can serve as the platform for the experiment of policy by the planners, decision-makers, and the stakeholders. This platform can be used for observing the dynamic change of the influence under different policies, and can be used for policy experiment and discussion by planners, decision-makers, and stakeholders.

Simulation on the variables of three investment policies in different sizes and the concerns of different stakeholders will be conducted and refer to sensitivity analysis. As shown in Figure 3, the simulation result of the trend shows a change in the number of tourists. Simulation can help investors to assess market size and also help the government to make preliminary planning and policy on the basis of the number of prospective tourists.

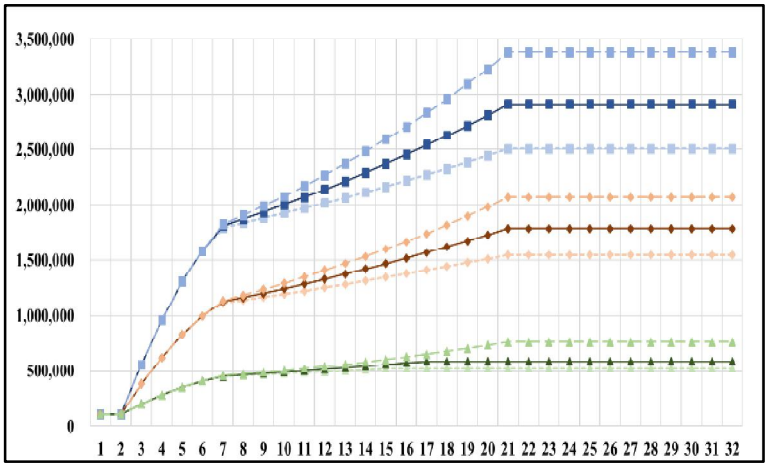

Figure 3: The simulated trend of the change in the number of tourists.

The resident population of Matsu is low and the number of tourists on ecological trips is small. The power and water supply on the island is for small quantities. If the IR is established, the facilities for water and power supply, treatment of waste will be the center of discussion. Figure 4 shows the simulated trends of the supply gap in water and power supply with existing facilities. We could see that after the establishment of IR, the demand for water and power supply will far exceed current supply level under the influx of tourists and residents. Figure 5 is the simulated trend of the gap between the demand and supply for trash cleanup and treatment. The simulation of this system may serve as reference for the government in preliminary planning.

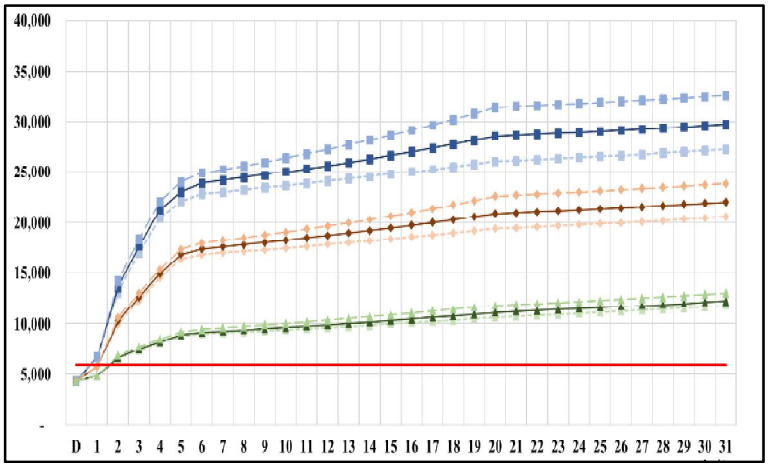

Figure 4: The simulated trends of the supply gap in water and power supply with existing facilities

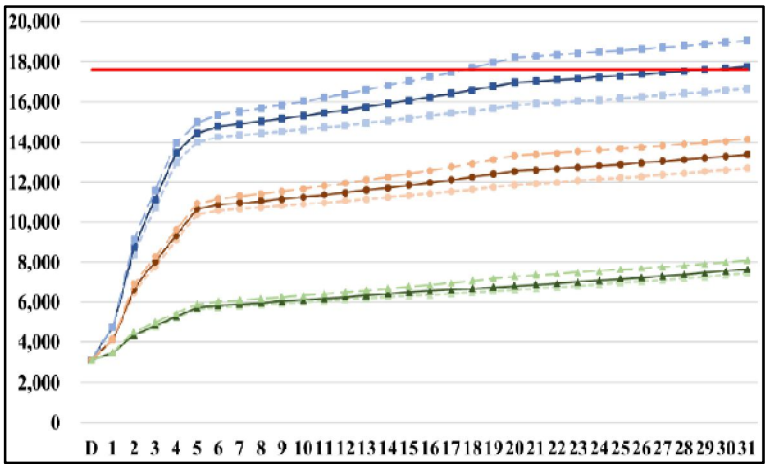

Figure 5: The simulated trend of the gap between the demand and supply for trash cleanup and treatment

For a big development project, IR investors will be more concerned about the return on investment. This model can also allow for the dynamic simulation of the cash flow for the IR investors in each period for the assessment of the speed of return on investment (Break Even Point) and profit size on the basis of cash flow volume. Figure 6 is the simulation of the trend of the change in net cash inflow for investors, which shows the size of return from big investment is fast and can help to bring in better profit for the IR investors. The simulation result also indicated that investment in development must be big enough for a better return.

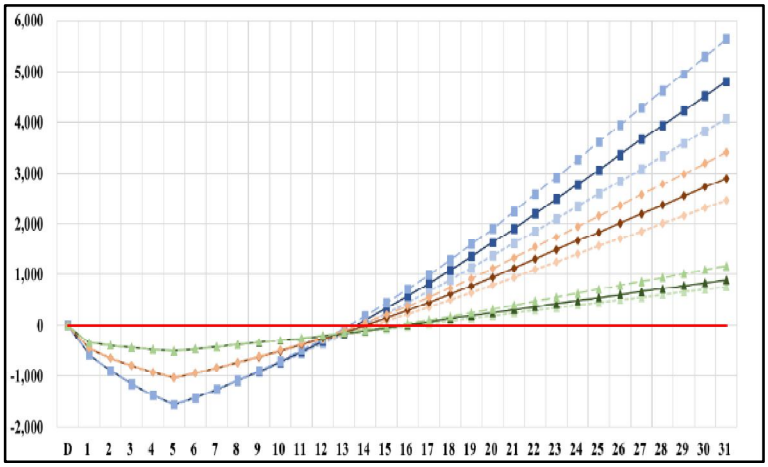

Figure 6: The simulated trend of the change in net cash inflow for investors

5. Conclusion

In the course of discussion and assessment of the establishment of IR in Matsu, a number of stakeholders and numerous complicated economic, social, and environmental factors are involved. However, Literature in the past on the assessment of IR planning seldom covered the topic from a broad view so that decision-makers cannot conduct policy experiments in advance. In this study, the SD is adopted for proposing a systems thinking framework with the buildup of a SD analysis model from holistic perspectives to assess the economic, social, environmental influence and possible contribution of the establishment of IR on Matsu. This study is not only an attempt to supplement the inadequacy of the literature on IR planning studies, but also can serve as the platform for the experiment of policy by the planners, decision-makers, and the stakeholders. This platform can be used for observing the dynamic change of the influence under different policies, and as recommendation for policy making. The model under this study may be expanded and adjusted in line with the actual development of IR and for analysis purposes, and could serve as a reference for building up assessment models in countries or regions wishing to develop IR.

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