

Cu Lao Cham Biosphere Reserve sustainability project in Vietnam: corporate framework for sustainable development management

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Abstract

The nature and practice of sustainable development can be defined as the extremely complex and dynamic integration of economic development, maintenance of the natural environment, as well as the improvement of the social dimension. There are many issues related to an open system that traditional project management models cannot deal with, including non-linear interaction among elements and a high level of dynamic of unforeseen and unpredictable environment changes with no obvious solutions, while the system of systems (SoS) approach is able to address the multi-dimensional and multi-disciplinary nature of complexity. The Cu Lao Cham Biosphere Reserve (CBR) sustainability project in Vietnam is used as a case study to illustrate the application of the SoS framework to a sustainable development area. This paper provides an overall CBR picture by analysing five components of the SoS, consisting of constituent systems, external factors, governance body, constraints and feedback processes between the SoS and the governance body. Additionally, systems archetypes mentioned in the system dynamic model, the relationship among constituents, the level of influence of external factors on the SoS and feedback processes are identified. From analysing the system, the root causes that prevent the development of CBR sustainability project are found to be the conflicts between stakeholders' perspectives and the lack of alternative tools dealing specifically with complex issues. This paper provides a deep understanding of the complex relationship among elements of the project to support local planners in their decision-making processes. This paper also provides a demonstration of applying system concepts of SoS management framework into the field of maintaining the biosphere reserve, together with developing the local economy.

Keywords: Cu Lao Cham Biosphere, sustainable development, system of systems.



1 Introduction

Recently, sustainable development, which is related to balancing the three key aspects of economic, environmental and social dimensions, is seen as a complex issue that traditional approaches cannot deal with. Addressing complex problems seems to transcend the jurisdiction and capacities of any single organisation, so it is necessary and important to integrate several parties and components into the system. Among the various methods available, systems thinking is seen as an intellectual theory providing a new way of thinking about understanding and managing complex problems. The Cu Lao Cham Biosphere Reserve (CBR) sustainability project in Vietnam is used as a case study for this approach. The CBR project is a system owned by Quangnam committee and the tourism ministry which aims to ensure sustainable development in the Cu Lao Cham (CLC) area by non-government organisations (NGOs) and the local community through the use of human resources, financial resources and supporting policies. Given the constraints of time, knowledge, regulations of United Nations Educational, Scientific and Cultural (UNESCO) and local customs to achieve the aim of maintaining the diverse biosphere reserve of the CLC islands, developing the economic situation and improving the people's way of life are important outcomes. The CBR project is considered as a system of system (SoS) with several constituents, external factors, governance body, constraints and feedback processes between the SoS and that governance body. By using several tools and techniques of the SoS management framework, we will analyse the project characteristics and illustrate five components of the SoS management framework. This paper also demonstrates the feedback processes between the governance body and the SoS by creating a dynamic model, together with employing archetype systems. Based on SoS analyses and findings, some lessons which contribute to managing and operating SoS effectively are presented.

2 Background information

2.1 Context for SoS of the CBR project

The CLC islands are a cluster of eight islands located in Quangnam, Vietnam [1]. The CLC islands have many unique landscapes that support animal and plant life integral to the livelihood of the local community. The population of these islands is over 2,700 people and most of them are fishermen: 85% of community income is generated from marine resources [2]. The CLC islands were officially recognized as a world biosphere reserve by UNESCO in 2009 [1], which promotes plans for maintaining the ecosystems carried out by the local government and organisations.

Because the concepts related to sustainable development and biosphere reserve are not widely understood by most people, due to their poor education level, as well as the low level of awareness in communities and poverty [3], there are a number of problems in this area. Firstly, the population of this area is increasing quickly, together with the huge demand of the local people, thus natural resources



from the sea such as crabs and, corals are subject to all-year-round exploitation. As a result, the animals and wild plants have recently reduced greatly compared to 2004 levels: 18–34% for reef fish, and 60–80% for corals [4]. Secondly, an increase in domestic and international tourism has led to the island's destruction. According to statistics provided by the Vietnamese Ministry of Culture, Sport and Tourism [5], the number of tourists has increased significantly from 30,000 in 2008 up to 105,000 people in 2012. This figure is predicted to reach more than 200,000 people by the end of 2020 [6]. This causes much damage to the environment and ecosystems of CLC islands, such as increasing waste, and destruction of the natural ecosystem due to over catching and over hunting of animals. Thirdly, the CLC islands has been facing a number of negative consequences in regard to agricultural activities, including using poisoning chemicals in floating farms, overuse of the underground water, and lack of renewable energy which contributes to environmental pollution. In addition, the increase in business sectors such as hotels, restaurants and tourism agents pushes up the need for infrastructure development in transport, energy, water and communication systems. Even though there are some new policies which have been created to encourage economic development and reserve natural biosphere together with develop tourism industry, lack of communication between involved parties including local government and communities, the tourism industry and environment regulators can lead to unsustainable development. Therefore, it is necessary to set up appropriate programs and strategies in both the short and long-term periods in order to solve these critical issues.

In terms of the CBR project, the secretary of Quang Nam Provincial Party Committee states that CLC should be an international tourism zone with a special operation mechanism which will provide high-grade services related to ecological tourism [7]. The most important task in developing the CLC zone is to harmonise economic development, natural preservation and protection of traditional values. This project will be sponsored by the Quangnam committee, related agencies, UNESCO and several NGOs. During the life of this project, a number of key stakeholders will need to be involved.

2.2 Research and prior development regarding SoS

2.2.1 Five characteristics of SoS

According to Jamshidi [8], the SoS consists of large scale integrated systems that are heterogeneous and dependently operable on their own, but are networked together for a common goal. There are five characteristics of SoS projects used to examine whether projects are SoS projects or not [8]. The first characteristic is autonomy. Each individual system has free abilities to make independent choices to pursue and fulfil its given purpose. Secondly, belonging, in which a system is willing to undergo changes in order to create new relationships with other autonomous systems in order to pursue the whole given purposes of system of systems. Thirdly, connectivity of SoS is considered as necessary when elements themselves create connection in order to achieve interoperability among components [8]. A further characteristic is diversity which refers to a variety of viewpoints, processes, technologies and functionalities used in SoS that are

different from components to other systems [8]. The final characteristic is emergence of new properties in the course of development or evolution.

2.2.2 Tools and techniques used in the CBR project

There are several tools and techniques used in this paper and these are discussed below:

Systems of system management framework has been developed with five individual parts consisting of system of systems, external factors, governance body, constraints and the feedback process between governance body and SoS [9].

In terms of systems thinking, Boulding [10] defined “*systems of thinking is a conceptual framework for problem-solving that considers problems in their entirety*”. Systems thinking demonstrates the various parts of the system and concentrates on the whole system which is more than the sum of its parts. It also provides a framework with which to manage complexity, which consists of holism, synergism; open systems view; input transformation output model; feedback; system boundaries, multiple goal seeking; equifinality of open systems; hierarchy; subsystems; entropy; steady state and internal elaboration [9]. This approach has been applied successfully in several fields such as natural resource management, environment conflict management, community development, agriculture product systems [11]. Thus it has the capacity to ‘enable integration across dimensions of sustainability’ [12].

Systems archetypes are used as highly effective techniques which support managers to be able to recognize patterns of behaviours in organisations or SoS [13]. In the case of CBR project, four situations or archetypes consisting of ‘limits to growth’, ‘fixes that fail’, ‘tragedy of the common’ and ‘shifting the burden’ are employed to analyse patterns of behaviours [13].

2.3 Knowledge gap

The various dimensions of sustainability need to be considered in an integrated approach, as suggested by various authors [14]. Particularly, Paehlke [14] asserts that sustainable development should be concerned with the relationship between the economy and quality of human life or the correlation between wealth and health in nations. Additionally, this author emphasises that “*sustainability analysis considers all aspects of the enormously complex relationship among the economic, social and environmental dimensions of human societies*”. According to Nguyen and Bosch [11], issues and challenges related to sustainable development are multiple and complex in nature, and any single organisation or profession well not have enough capacities to manage them. Bell and Morse [15] also assert that biosphere reserve projects for sustainable development are seen as complex projects which are considered as dynamic systems or open systems without common goals and directions. Therefore, applying the traditional and linear approach to this kind of project can be a major impediment to ensuring the projects’ success in meeting their common goals. Furthermore, some previous papers concerned with biosphere reserve sustainability projects, have used the theory and practice of systems thinking to demonstrate a high level of complexity in this kind of project. For instance, Nguyen and Bosch [11] used the systems thinking

approach and several tools and methods to develop a system model for the sustainability of the Cat Ba Biosphere Reserve and to identify leverage points for sustainability.

However, these papers have not assessed the level of complexity in the sustainable development projects, provided clear management framework; nor have they illustrated the constituents of the complex project. To fill this gap, our research paper tries to apply the concept of SoS and the SoS management framework in order to analyse typical characteristics of CBR project, to identify the project's scope, to illustrate project components and then to provide tools and techniques to deal with critical issues.

3 Findings and discussion

3.1 Constituent systems of CBR sustainability project

In terms of constituent systems of the CBR project, some main systems are mentioned including infrastructure, agriculture, conservation, education and tourism system (Figure 2).

- Infrastructure system consists of subsystems such as transport, energy, water and communication.
 - Transport subsystem of the CLC islands provides transport services such as transporting merchandise and travelling activities. The total number of vehicles and the proportion of private vehicles have significant impact on the natural environment of the CLC islands.
 - Energy subsystem is concerned with the type of energy that is most commonly used in recent years at the CLC islands.
 - Water subsystem provides clean water for daily life and agriculture; and it has a strong impact on the ecosystems of the CLC islands.
 - Communication subsystem refers to communication channels used to exchange information. There are numerous channels such as internet, phones, television and social networks. The communication channels create a connection between the 'governance body' and the other systems.
- Agricultural system refers to the activities of local people such as farming, fishing and traditional business activities. The balance among the agricultural business sectors has an important role in avoiding the overuse of natural resources.
- Conservation system is concerned with the diverse activities of both domestic and international organizations in order to achieve the aim in terms of protecting endangered species, marine resources and traditional values of the CLC islands.
- Educational system is considered a constituent system because the success of the project depends on the awareness level of community about the biosphere reserve.
- Tourism system embodies many services of hotels, resorts, restaurants and local agents.

3.2 Principles/characteristics

Based on characteristic description of Jamshidi [8], five characteristics of the SoS for CBR project are presented below:

Autonomy is the ability to make independent choices. All constituent systems are authorized by the local government but are operated independently. For example, although infrastructure, agriculture and communication systems are managed by Quangnam Committee, there are established specific policies and these are operated independently to achieve their own goals.

Belonging concerns the state of being happy which is found in a secure relationship. While there is minimum set of constraints and maximum freedom for each system, all systems make the integration to share the same mission which is maintaining the ecosystems of the CLC islands, together with the sustainable development.

Connectivity is the ability of a system to link to other systems. All systems of the CBR project interact together based on the network structure. The interactions among components are illustrated by Figure 3.

Diversity means noticeable heterogeneity (diversity in character or content); having distinct or unlike elements or qualities in a group. There are a number of diverse aspects existing in CBR project including communication, energy, transport, safe water, agricultural sectors and natural resources.

Emergence is the appearance of new properties in the course of development or evolution. For example, the number of tourists is increasing quickly and this can create unexpected forces on the conservation activities of the CLC islands.

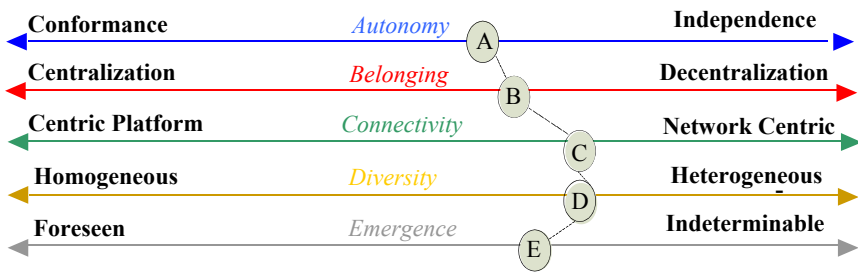


Figure 1: Characteristic assessment of SoS. Adopted from Gorod *et al.* [16].

3.3 The boundaries of CBR project

Based on 12 boundaries question of Ulrich [17], the boundary of the CBR project includes the following main aspects:

- The main customer of the CBR project is the local community.
- The measurement of CBR’s performance is based on different methods; for instance, statistics associated with tourism revenue, agricultural revenue, average income of local people, inflation rate every year, collected by local government; independent surveys carried out by non-government

organizations (NGOs) at protected areas of Cu Lao Cham, and statistics related to the number of endangered animals from conservation organizations.

- Tools and techniques applied to the CBR project consist of management framework for the SoS, systems thinking approach and systems archetypes.
- The financial resource mainly comes from the budget of Quangnam committee, aid of NGOs and donation of individuals and organizations.
- In terms of the role of governance body, both local government and involved organizations are collaborating to manage, monitor and control the CBR project to ensure its effectiveness.

3.4 External factors and constraints

Some major external factors are economic growth, number of tourists, the weather conditions, local politics, technology, the interests of investors and trends in migration.

- Through many economic indicators such as the unemployment rate, average income per person and that inflation rate, the influences of economy on the SoS of CBR project can be predicted. For example, an increase in the unemployment rate could lead to social issues such as crime and illegal behaviours related to cutting the forest and hunting endangered animals.
- The number of tourists will be significant to the local economy, especially to the income of local people. It contributes to the local budget used to implement projects maintaining the biosphere reserve of the islands. In contrast, the increasing number of tourists leads to destruction of the islands.
- Global warming has resulted in rising sea levels and a serious loss of beaches.
- Some political factors can affect the process of creating and implementing environmental policies of CLBR project.
- Modern technology is a key external factor which allows local government, agencies and local people to update information of CBR project quickly as well as improving communication processes.
- Investors have a significant impact on the sustainable development of the CLC islands. Even though, their investment increases the economic development, improving local living standards, most seem to focus on developing high quality services to maximize benefits, without consideration of ecosystem conservation.
- The recent increase in the immigration rate will create burdens on the local government in solving social issues related to the unemployment rate, rate of crime, illiteracy rate and pollution from human activities.

In terms of the constraints, the following factors should be considered:

- UNESCO has regulations related to maintaining conditions of a world biosphere reserve that the local government's actions need to satisfy.
- Financial resources will decide the scope of projects. Currently, financial packages are provided by the local government's budget and NGO's aid.
- Knowledge and experience are extremely important because decisions of the governance body are based on the level of understanding and solving issues.



- Timing of response contributes to the success level of each decision and policy because all issues of SoS are influenced by external factors.
- Understanding the customs of the local people is a critical factor determining the success of implemented policies.

3.5 SoS engineering analysis

The management framework provided by Gorod *et al.* [9] was used to produce the overall picture of the CBR project. All components of the CBR project illustrated in Figure 2, with some following aspect labels, A, B, C, D, E and F.

A – The SoS for CBR project consists of five constituents: infrastructure, agriculture, tourism, education and conservation.

B – External factors include economic growth, the number of tourists, the weather conditions, the local politics, technology, the interest of investors and the immigration trend.

C – Governing body consists of organizations and local departments which are able to influence the SoS.

- The Quangnam Committee has a vital role in creating and implementing policies related to the CLC islands in both the short and long-term periods.
- The role of NGOs is providing the financial packages to conduct project and training courses in order to improve capacities of local staff.
- The Tourism Ministry has responsibilities for supporting the Quangnam Committee during the process of implementing project.

D – Constraints concerns the knowledge related to methods of maintaining the biosphere reserve, the financial resources needed to implement conservation project, the total time needed to implement new policies and the customs of local people.

E – Feedback is the process of receiving the information from SoS by the governing body and then responding via establishing and implementing policies. In order to illustrate the feedback processes, the concept of system thinking and system dynamic model are applied to analyse and recognize potential system behaviours, as well as recognize leverage points which can produce huge changes for the whole system. The interaction among components of the system has been developed by Nguyen and Bosch [11] in the similar case study of Catba Island; thus some concepts of system archetypes are modified and applied in the CBR project. The details of feedback processes are shown in Figure 3.

In terms of ‘limits to growth’ archetypes system, for example, leverage points lie in the balancing loop, namely B_T3 which indicates that in order to achieve sustainable tourism development in the long-term, the governance body should attempt to remove existing constraints and limitations such as pollution from constructions, agricultural activities and tourism. Another archetypes system refers to ‘fixes that fail’, which is presented at the loop R_T1. To be precise, the increase in the number of tourists can create pressure on the tourism services related to accommodation, entertainment activities and food. The short-term solution suggested for this issue is building new constructions, but this can generate pollution affected to the natural environment in the long-term period.

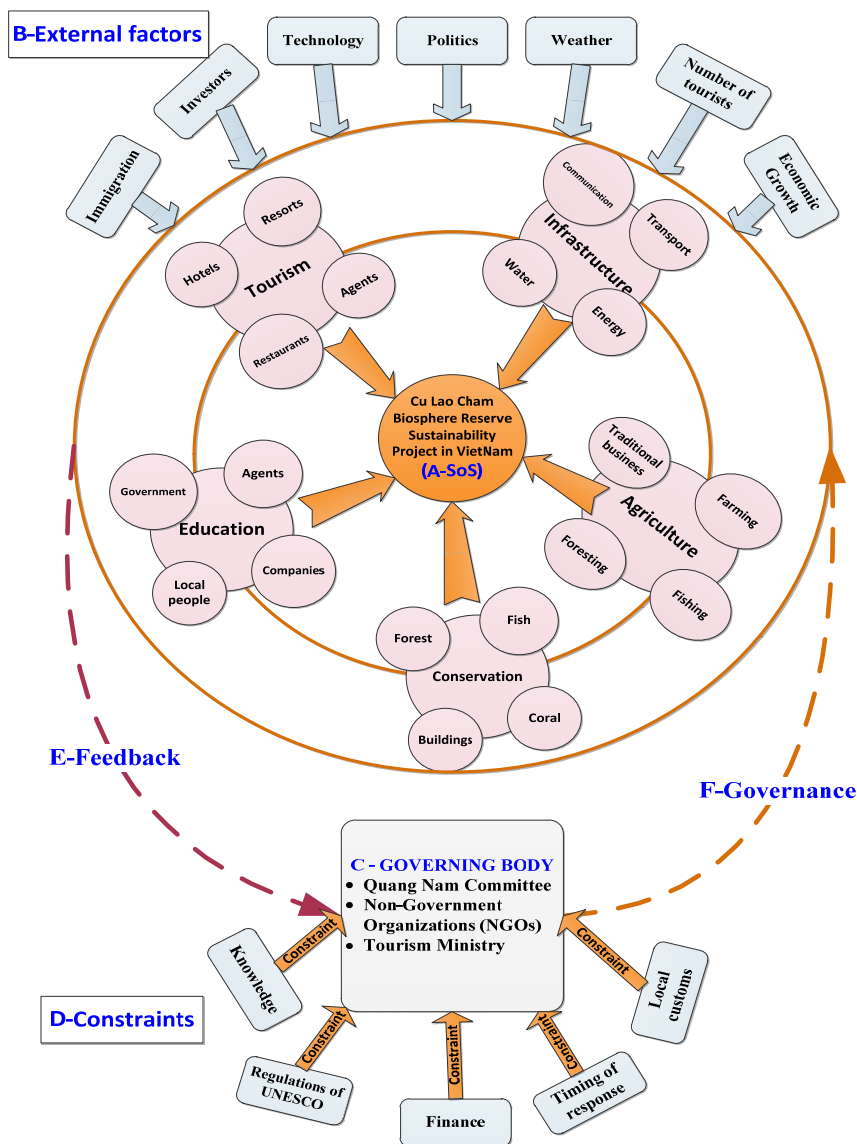


Figure 2: Management Framework for the CBR project. Adopted from Gorod *et al.* [9]. Legend: A, the SoS; B, external factors; C, governing body; D, constraints; E, feedback; F, governance.

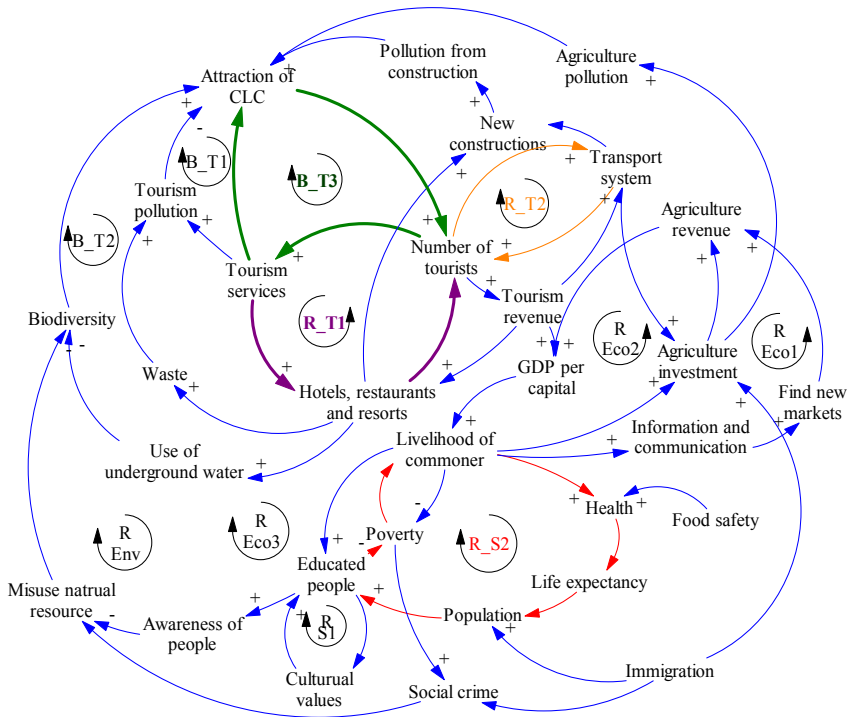


Figure 3: Feedback processes of the SoS. Adapted from Nguyen and Bosch [11]. Arrows describe the directions of influence. Legend: +, a positive arrow reads as “an increase in variable A leads to an increase in variable B”; -, a negative arrow reads as “an increase in variable A leads to a decrease in variable B”; R, reinforcing; B, balancing; T, tourism; Eco, economic; Env, environment; S, social. 1, 2, 3 refer to the loop number; for example, B_T3, balancing loop no. 3 of tourism.

Thus, local planners should not focus on creating and implementing quick solutions instead of considering them as interim approaches supporting for long-term strategies.

F – Governance feedback is a process by which the Governing Body provides feedback after receiving signs from SoS with given constraints. In the case of increasing the number of tourists, the Quangnam Committee and NGOs should focus on the following points:

- If they want to achieve sustainable and long-term tourism development, they should remove the constraints or limiting factors such as pollution, lack of fresh water, poor service quality.
- Dealing with the need of accommodation for tourists in the short-term, the Quangnam Committee has to establish a long-term plan to limit the pollution from executing new construction projects.

- To balance the demand of using natural resources and the needs of the tourism industries and agricultural sectors, the committee must consider an integrated master plan for the whole island.
- Recognizing core issues of the CBR project could help the Quangnam committee to gain positive feedback from international organizations.

However, because of given constraints related to resources, the Governing Body should create a list of priorities so that they have a sufficient capacity to undertake these at different points in time. In this circumstance, the integrated master plan should be undertaken first in order to ensure that all business sectors have a whole picture and recognize the role of each sector in maintaining a biosphere reserve of the CLC islands.

3.6 The conflicts between stakeholders of CBR project

The key stakeholders of the CLC islands are the local community, local government, NGOs, investors and local tourism agents. Each group has a different interest and stake in exploiting and managing natural resources of the islands.

- As Hai *et al.* [18] mentioned, local people do not recognize benefits from arising sustainable development programs. This raises big issues in how to increase awareness in the local people about the important role of maintaining a biosphere reserve of the CLC islands and what are benefits that people can gain when they participate in these kinds of programs.
- Investors focus on building construction projects such as hotels and resort, but they are less concerned about pollution when executing their projects.
- Local tourism agents place their interests on how to introduce the physical and unphysical values of the CLC islands to attract more customers. However, they lack sufficient knowledge relating to environment protection to provide guidelines for travellers.
- Tourists expect to experience new things, so they try discovering the natural resources and traditional values. However, some activities as diving and boating near protected areas can have negative impacts on the eco-systems.
- Local government, particularly the Quangnam Committee has tried to establish policies and strategies to balance the economic development, social issues and natural environment.
- Non-profit organizations (NGOs) place their attention on programs which can solve social and environmental issues, but they often expect results in a short period of time in order to make decisions on whether they should continue to support the project. This is an obstacle to find out root causes leading to these issues in the long-term period.

3.7 Lessons learned

Several things can be learnt from this process of analysis:

- It can be seen that the biosphere reserve sustainability project is one type of complex project. Therefore, we must employ appropriate tools and techniques to solve critical issues of this type of project. In this research,



corporate management framework is suggested to apply these tools for analyzing, monitoring and controlling the SoS.

- Using concepts related to systems thinking, system archetypes is an effective way to demonstrate the relationship among components of the system. Furthermore, these concepts can support researchers in finding leverage points of the whole system in order to produce alternative solutions.
- During implementation of a complex project, the level of the integration among the departments and organizations will decide the success level of the project. Understanding their interest as well as the influence level of key stakeholders will be important in knowing what the critical factors are contributing to the effectiveness of the project.
- Measuring the project's performance is a challenging task because it depends on many criteria that each organization selected, so there is a need to set up an assessment system. Also, the governance body should gain commitment from key stakeholders via organizing meetings and workshops, in order to ensure the sufficiency of the indices used.

4 Conclusion

In conclusion, the CBR sustainability project is one type of SoS in the sustainable development area. By applying the management framework for CBR project, together with using system thinking concepts, this research provides a clear picture about the constituent systems of the complex project. In addition, by illustrating the feedback process between the SoS and the governing body, the case study has modelled the real interactions among components of the dynamic system, especially for changes from external factors that create significant impacts on the SoS. Furthermore, the conflicts among the key stakeholders in the CBR project are considered as one of critical issues that most complex projects face.

The first important finding is identifying constituent systems of the CBR project. Secondly, via assessing the characteristics of the constituent systems of SoS, the level of complexity of the project is defined. The third finding concerns recognizing the constraints which can affect the success of implementing new policies or plans for the project, as well as illustrating the feedback processes between SoS and governance body.

The key contribution of this study is the recognition of the project's issues under the complexity approach and the use of appropriate tools to solve problems, as well as the expiration of alternative solutions for the project. This research also helps decision-makers and management authorities to make their long-term plans in order to achieve consensus among different key stakeholders.

This study of the CBR project could be used as a guideline for other projects related to sustainable development. However, in order to apply these findings to other projects, it is important to identify key stakeholders in the early stages as well as constraints related to resources, in order to proactively establish strategy.



References

- [1] Ecological Sciences for Sustainable Development; United Nations Educational, Scientific and Cultural Organization (UNESCO) Website, Paris,
www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/asia-and-the-pacific/vietnam/cu-lao-cham-hoi-an/
- [2] Ministry of Culture, Sports and Tourism. Vietnam National Administration of Tourism Website, Hanoi,
<http://vietnamtourism.gov.vn/english/index.php/items/7555>
- [3] Hai, P. H., Dung, T. A. & Hens, L., Influencing factors on sustainable development: a case study in Quang Tri province, Vietnam. *Environment, development and sustainability*, **12(1)**, pp. 103-116, 2010.
- [4] KHCN, www.125.235.3.98/dspace/bitstream/123456789/5289/1/250-261_TC%20Khoa%20hoc%20va%20cong%20nghe%20bien_2009_T.9_%20So%20Dac%20biet_Phu%20truong%201.pdf
- [5] DISANXANH,
www.disanxanh.com/ArticleDetail.aspx?articleid=61926&sitepageid=29
- [6] DULICH SINH THAI, www.dulichsinhthai-culaocham.com/tour-du-lch/201-mc-tieu-kh-thi-cho-du-lch-cu-lao-cham.html
- [7] Ministry of Culture, Sports and Tourism. Vietnam National Administration of Tourism Website, Hanoi,
<http://vietnamtourism.gov.vn/english/index.php/items/790>
- [8] Jamshidi, M., *System of Systems Engineering Innovations for the 21st Century*. US: John Wiley & Sons, pp. 44-76, 2009.
- [9] Gorod, A., White, B. E., Ireland, V., Gandhi, S. J., & Sauser, B., *Case Studies in System of Systems, Enterprise Systems, and Complex Systems Engineering*: CRC Press, pp. 89-90, 2014.
- [10] Boulding, K. E., General systems theory - the skeleton of science. *Management Science*, **6(2)**, pp. 127-139, 2004.
- [11] Nguyen, N. C. & Bosch, O. J., A systems thinking approach to identify leverage points for sustainability: a case study in the Cat Ba Biosphere Reserve, Vietnam. *Systems Research and Behavioral Science*, **30(2)**, pp. 104-115, 2013.
- [12] Smith, T., Using critical systems thinking to foster an integrated approach to sustainability: a proposal for development practitioners. *Environment, development and sustainability*, **13(1)**, pp. 1-17, 2011.
- [13] Braun, W., *The system archetypes*, System, p. 27, 2002.
- [14] Paehlke, R., Environmental politics, sustainability and social science. *Environmental Politics*, **10(4)**, pp. 1-22, 2001.
- [15] Bell, S. & Morse, S., Delivering sustainability therapy in sustainable development projects. *Journal of Environmental Management*, **75(1)**, pp. 37-51, 2005.
- [16] Gorod A., Brian, S. & John B., System-of-systems engineering management: A review of modern history and a path forward. *Systems Journal, IEEE*, **2(4)** pp. 484-499, 2008.



- [17] Ulrich, W., Critical heuristics of social systems design *Operational research and the social sciences*, pp. 79-87, 1989.
- [18] Hai L., Hai P., Dung T. & Hens L., Influencing factors on sustainable development: a case study in Quang Tri province, Vietnam. *Environment, Development and Sustainability*, **12(1)**, pp. 103-116, 2010.

