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Thesis for the Degree of Master of Landscape Architecture

Resilient Operation System for Large Parks

대형 공원의 회복탄력성 향상을 위한 운영 체계

February, 2014

Department of Landscape Architecture

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Resilient Operation System for Large Parks

대형 공원의 회복탄력성 향상을 위한 운영 체계

Under the Direction of Adviser

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ABSTRACT

Urban large parks are the ecological places that affect to urban ecology and are affected by urban ecology. At the same time, these places perform societal role and receive various actions. In this way, large parks where complex integration of ecological and social processes raises need interdisciplinary and integrated thinking from planning to management.

This research explores the concept of resilience in the field of landscape architecture, and suggests new park operation management system to work social and ecological process simultaneously.

Landscape architecture has tried to harmonize among ecology, aesthetics, and humans in the park. However, landscape architects have often met boundaries to integrate these three elements. Such limitations proceed from perspective that distinguishes between domain of ecology and human activities including aesthetics. Such separate thinking exposes limitations and problems in not only landscape architecture but also many other academic fields. And, to surpass the limitations, there are some movements that require interdisciplinary new thinking. Social-ecological system explains the need of new system combined ecology and society.

This integrated system stresses that since ecosystem is not isolated but always related with human society, separated thinking causes many problems and meets boundaries, at last. Social-ecological system that requires interdisciplinary integration could be realized through the concept

of resilience that changes conventional perspectives.

According to C. S. Holling, who introduces the concept of resilience, points out holes of existing view on ecosystem, and calls for conversion of view through new concept. He said that existing stability view understands ecosystem as equilibrium and predictable states. It focuses on maintaining these stable conditions. On the other hand, resilience view that has very different approaches comparing with stability view gives heeds to the element's attraction than the element itself and the need for maintaining attraction. This new view understands the ecosystem as a complex and unpredictable system.

Resilience as social-ecological system emphasizes the world we live is closely connected with each other. In other words, when we see the system surrounding us as the one big, and do not handle each factor of society or ecology separately, we could understand each factor correctly. It was not until that time that sustainability could be realized.

Resilience that draws integration of social and ecological processes through change in the mindset has great implications for landscape architecture. This new concept evokes importance of considering incorporations of society and ecology in planning, design, and management phases. These two factors have been handled in landscape architecture. However, up to now, this integration is just used rhetorically for concept setting up or concept development. Rather, it has been divided in phase of space zoning and organizing programs. Especially, in management phase, various problems have been occurred because society

and ecology is managed individually.

This thesis redefines the concept of resilience in landscape architecture, and sets up elements of both society and ecosystem of large parks. I suggest new operational system, the panarchic system, for large parks. This system helps us to consider both social and ecological process at the same time from planning to management phases of parks. It shows unstable cycles suggesting directions based on social-ecological resilience elements. These irregular cycle loops show that feedback in management phase goes back to the planning or design process in comparison with existing inflexible top-down system. This back loop in panarchic system is resilient movement that follows unpredictable ecosystem, not repeat caused by system's failure. Furthermore, it emphasizes the roles of experts and leaders in each phases. In planning phase, they will gather knowledge of interdisciplinary. In design phase, they will transform gathered informations to fit on the site. In management phase, they will perform regular monitoring and feedback to adapt to unexpected situations.

To verify panarchic system, it is applied to Seoul Forest Park that has most resilience elements among large parks in Seoul City. Through panarchic system, obstructive factors to park resilience are found. First, there is separation phenomenon of social-ecological system in several parts. With the separation in the phase of planning and design, separation in operation management of ecological and cultural program makes both ecological problems and ineffective management. Second,

there are defective relationships between management institutions. Seoul Forest Park has been managed by two institutions, Seoul Metropolitan Government and Seoul Forest Conservancy. Relationships of two groups have greatly impact on park resilience. However, Seoul Forest Park shows top-down structure that is hard to have feedback between management institutions. Also, there are no legal methods or stipulations for mutual communications between them.

Keywords: resilience, social-ecological system, large parks, park operational system, interdisciplinary and integrated thinking, Seoul Forest Park

Student Number: 2012-21139

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I. INTRODUCTION

1. Background and Objectives

Dividedness of Society and Ecology in Large Parks

We live in the time of global urbanization. The numbers of cities are increasing dramatically as years go by, with each city growing to previously unexampled sizes. Along with the increasing numbers of urban cities, urban ecology has begun to change the principle of ecology. Urban ecology, which combines the theories and methods from ecological and social sciences to research urban ecosystems, is now utilized by urban ecologists who are trying to seek the context shapes of social-ecological interactions and their role as both drivers and responders to the changing environment.[1)]

Åsa Jansson points out that what we should focus on in the context of ecological thinking is “the ecology of cities” as compared to “the ecology in cities.”[2)] She says that what we have been focused mostly on was “the ecology in cities,” such as increasing amounts of carbon dioxide and decreasing amounts of biodiversity. This view, however, focuses only on the efficiency of design and providing something to the inhabitants. This new perspective sees the city as an ecosystem. It lead

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1) Nancy B. Grimm, et al., "Global change and the ecology of cities," *Science* 319(756), 2008, p.756.

2) Åsa Jansson, "Reaching for a sustainable, resilient urban future using the lens of ecosystem services," *Ecological Economics* 86, 2013, p.286.

us to understand the complex urban systems worked in ecological and social processes.

Over the recent years, large parks have been formed continuously in the city, transforming what were once brown fields into green spaces. These parks, formed in deserted places, are asked to carry out two very different tasks simultaneously: ecological function and social function. Following the demands of the times, landscape architects have considered ecological and social elements in each phase: planning, designing, and management.

However, what has been taking place so far has overlooked the events that would occur when ecology meets human actions, such as the park programs. Moreover, in the development phases, ecological and social contexts are not separate dinfrequently. Due to the divide that exists between the natural and societal side, especially in the management phase, park managements have not properly responded to the unexpected problems, which has resulted from the combination of human behaviors and ecological processes.

Change in Perception about Ecology

Fundamentally, what causes the separation of ecological and social elements come from the narrow understanding on ecology. After the emergence of ecological planning, plethora of projects have been created under the names such as “ecological design” and “ecological park.” However, most of them have focused only on few aspects of the

elements or trends of ecology, such as carbon-zero. In landscape architecture, ecology is usually regarded as some specific element of nature, instead of what it actually is. Due to this narrow understanding, the “ecological parks” may encounter problems, because the parks are where humans and nature interact with each other.

In the field of ecology, there is a movement to integrate ecology and society in system thinking. Since the late 20th century, many scientists have studied the sustainability of ecology, when the whole world has faced unexpected disasters caused partly by human activities. The phenomena such as climate change, extinction of species, or landfill have urged us to concentrate on the environment and the cycles of the ecosystem, and many scientists have focused on biota or ecology itself. However, recent studies have revealed different aspects that have not been seen in the past.

Nowadays, many researchers stress that it is not enough to study scientific ecology alone, and that we should do an interdisciplinary study on both science and society. They claim that the true meaning of sustainability could not be shown in the insular range of the sciences. And as a result, a new integrated school of thought called “social-ecological systems,” which suggests that coexistence and cooperation of science and society would expand the capacity of both, has been garnering much spotlight.

Resilience, the Concept to Integrate Thinking of Ecology and Society

Resilience is the ability of social-ecological systems to maintain proper condition of ecosystems in the face of disorder and continuously evolving and changing world.[3] This concept points out the interconnections among the world we live in, and this can give some suggestions to the field of landscape architecture.

Resilience is the ability of social-ecological systems to maintain proper condition of ecosystems in the face of disorder and continuously evolving and changing world. This concept points out the interconnections among the world we live in, and this can give some suggestions to the field of landscape architecture.

In this day and age, there is no need to proclaim the importance of environment. We have to think about inter-relationships between nature and humans, and the concept of resilience rectifies our misunderstanding about ecology and helps us to do interdisciplinary thinking. Furthermore, this suggests us a way to integrate human behavior with the ecological processes in large parks.

Following these backgrounds, this paper has two objectives. The first objective is to study “resilience” as the key solution to the problems that I have mentioned above. This paper will research the concept of resilience as an integrated system thinking to get over the narrow and

3) Reinette Biggs, et al., "Toward principles for enhancing the resilience of ecosystem services," *Annual Review of Environment and Resource* 37, 2012, p.423.

insular views previously held about the ecosystem. Afterwards, I will discuss and organize resilience as a concept that can be utilized in landscape architecture. The second objective is to provide a new system for resilience of parks by analyzing the limitations and problems of the existing management systems.

2. Literature Review

Concept of Resilience

Brain Walker and David Salt explain how to think through resilience in their book *Resilience Thinking*.[4] They illustrate that ecological resilience focus on the events nearby edges of basin, not the events in the stability of equilibrium.[5] Developing concept of resilience, they apply resilience in the practice. In the *Resilience Practice,*[6] they discuss how resilience can be realized by researching some disturbed sites.

Actually, discussion about resilience was started with C. S. Holling. In "Resilience and Stability of Ecological Systems,"[7] Holling first mentions the term "resilience" in ecology. He tries to understand the ecosystem by viewing it as an integration of ecology and society, based on the concept of resilience. Fostering Holling's theory, G. S. Cumming gave concrete shape to the context of society in order to study resilience as social-ecological system. In his book, *Spatial Resilience in Social-Ecological Systems*,[8] he developed arguments for resilience from various angles.

In landscape architecture, discussions or projects related to the concept of resilience have been rare. However, some theorists and designers have

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4) Brain Walker and David Salt, *Resilience Thinking.*

5) Ibid., p.63.

6) Brain Walker and David Salt, *Resilience Practice*, Washington: Island Press, 2012.

7) C. S. Holling, "Resilience and stability of ecological systems," *The Annual Review of Ecology System* 4, 1973.

8) Graeme S. Cumming, *Spatial Resilience in Social-ecological Systems*, New York: Springer, 2008.

recently begun to discuss resilience.

The first mention of resilience comes from Anne Whiston Sprin's book, *The Granite Garden: Urban nature and Human Design*.[9] She understood resilience as a concept of maintaining a stable state that stands on the opposite side of the concept of sustainability. However, Sprin's understanding of resilience was incomplete, as unlike her grasp of the concept, resilience actually serves as a key to sustainability. Many researchers stress that the key factor of sustainability is in reinforcing resilience through social-ecological system,[10] not by utilizing a system that focuses on individual elements, and that resilience serves as a foundation to make sustainability possible.[11]

Elizabeth K. Meyer is also amongst those who have mentioned resilience. Meyer said that the meaning of resilience is cultural as well as ecological. In that context, she explained that the terms such as sustainability, combination, equilibrium, and balance are replaced with terms like resilience, adaptation, and disturbance.[12] Unlike Sprin, Meyer understood resilience as the concept that has the ability to overcome limitations of the conventional perspective about sustainability. However, Meyers could not guide resilience into a practical phase, and stopped at

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9) Anne Whiston Spirn, *The Granite Garden: Urban Nature and Human Design*, New York: Basic Books, 1984, p.245.

10) Brain Walker and David Salt, *Resilience Thinking,* p.9.

11) Ibid., p.150.

12) Elizabeth K. Meyer, "Sustaining beauty. The performance of appearance: A manifasto in three parts," *Journal of Landscape Architecture* Spring, 2008, p.20.

creating a manifestation.

Julia Czerniak, in comparison, has brought resilience to the very front in landscape architecture theory. In her essay “Legibility and Resilience,”[13] Czerniak discussed the large parks using concept of resilience. She roughly explained resilience in a park. Utilizing the view of a resilient park, she analyzed five parks:[14] Central Park, Downsview Park, Fresh Kills Lifescape, Orange County Great Park, and North Lincoln Park. Her discussion about viewing large parks through resilience serves as a great starting point for understanding on resilience as social-ecological system.

Management System for Resilience

Brian Walker and David Salt suggested some practical frameworks for ecological resilience.[15] F. Stuart Chapin, III, Gary P. Kojinas, and Carl Folke proposed ecosystem management principles based on resilience in *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World.*[16] In this book, they explained the elements of ecological resilience.

Reinette Biggs and researchers suggested seven principles for ecological resilience as social-ecological systems.[17] Their study gives us a

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13) Julia Czerniak, "Legibility and resilience," in L*arge Parks*, eds. Julia Czerniak and George Hargreaves, New York: Princeton Architectural Press, 2007, pp.215-251.

14) Ibid., p.268.

15) Brain Walker and David Salt, *Resilience Practice.*

16) F. Stuart Chapin, III, Gary P. Kojinas, Carl Folke, eds., *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World,* New York: Springer, 2009.

17) Reinette Biggs, et al., "Toward principles for enhancing the resilience of ecosystem services," *The*

framework for the components of resilience embracing various angles beyond the narrow scientific ecological view.

Annual Review of Environment and Resources 37, 2012, pp.421-448.

3. Contents and Methods

Perspectives and definitions of resilience are discussed in Chapter II. First, following many researches, this chapter arranges various contexts and definitions related to resilience to help understanding of this complex concept. Based on these understandings, I organized the concept of resilience in landscape architecture as social-ecological systems. Prior to this, there have been attempts to analyze similar discourses with resilient thinking, which have been actively discussed of late: landscape urbanism and discussion about large parks. Going through these deliberations, this paper suggests components of resilience for the large parks as ecological and social.

In chapter III, based on the understanding of resilience in large parks and suggested components, a new park management system will be suggested for resilient large parks. Before setting up this new system, we will go over some studies about conventional management system in terms of resilience and research existing studies about resilience-centered management. Using this knowledge, I will propose a new park operation management system, “panarchic system,” that can be used by large parks to build its resilience.

To verify the proposed “panarchic management system,” chapter IV will analyze the Seoul Forest Park using this new system to find some aspects of cooperation and separation focused on social-ecological systems. The overall park process of the Seoul Forest Park will be investigated from the planning phase to the management phase. In the

planning and designing phases, I will analyze Donsimwon's design report, which won the prize in the Seoul Forest Design Competition. In the management phase, the present Seoul Forest Park management system will be investigated by researching the structure of management system, park activities, and the relations of the park's stakeholders. For this research, interviews have been performed. After the analysis, I will suggest solutions for Seoul Forest Park's resilience based on the panarchic system.

In chapter V, taking in the whole analysis, panarchic system mentioned in chapter IV will be modified. Also, in the chapter, I will arrange the thoughts on the meaning of resilience in the field of landscape architecture.

Ⅱ. RESILIENCE AND LARGE PARKS

1. Concept of Resilience

1.1. Multidisciplinary Concept of Resilience

Perspectives of Resilience

When most people think about the term resilience, they think of the ability to bounce back. As a result, resilience is seen as a capacity of a person or the community to recuperate quickly after a shock or disturbance. However, resilience, as a concept discussed in this paper, does not refer to the speed of recuperation. Resilience in this paper is related with the events nearby the edge of basins, not the states of equilibrium point.[1)]

The concept of resilience converts our perspectives on the ecosystem. Crawford Stanley Holling, an ecological economist, who was the first to use the term resilience in ecology, explains ecological view by dividing it into two parts: stability and resilience.[2)] According to Holling, we have been misunderstanding the ecosystem by looking it through a stability view. This view understands ecosystem as equilibrium and predictable states, and it focuses on maintaining these stable conditions. This view tends to take getting excess product from nature for granted. Furthermore, it expects the ecosystem would not be affected by the

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1) Brian Walker and David Salt, *Resilience Thinking*, Washington: Island Press, 2006, pp.62-63.

2) C. S. Holling, "Resilience and stability of ecological systems," *The Annual Review of Ecology System* 4, 1973, pp.1-23.

actions following from this view. Stability view in its theory could not portray ecosystem as one large complex system. Some works based on these misunderstandings were inevitable to fail, faced by limitations or unexpected problems. Programs related to sustainability are held up as an example.

Conventional sustainablility management model has assumptions that serve, in turn, as limitations; these assumptions are as follow:[3] (1) model is made under assumption that the world where we live is linear and constantly increasing, (2) model does not consider higher or lower scales, (3) model is not mixed with social value.

In comparison to the stability view, resilience view has different approaches to viewing the ecosystem. The resilience view sees the ecosystem as a complex and unpredictable system, and it focuses on the ability of the system to react by changing rather than maintaining a state. For that reason, resilience view gives heeds to the element's attraction than the element itself and the need for maintaining attraction.

By changing the view on the ecosystem, resilient thinking requires the existing ecological management system to change, and it suggests various approaches to doing so. Resilient thinking on the ecosystem could propose a framework expressing social and economic processes in a same phase as bio-ecological and earth sciences to metropolitan system.[4] As

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3) Tun Lin Moe, "Aiming for resilience and adptation in managing environment," *International Journal of Disaster Resilience in the Built Environment* 3(1), 2012, p.44.

4) S.T.A. Pickett, et al., "Resilient cities: Meaning, models, and metaphor for integrating the ecological, socio-economic, and planning realms," *Landscape and Urban Planning*, 69, 2004, p.377.

urbanites, we have been agonizing about the ecological systems that have contradictions between effectiveness and sustenance, between persistence and change, and between predictability and unpredictability.[5] In this paradox, the concept of resilience has been emerging to change the perceptions on how ecosystem works. Folke and Gunderson point out that many people are beginning to realize the ecosystem as dynamic and complex social-ecological systems that need new schemes to build resilience, on the contrary to the conventional strategies that control optimal and short term production under the stability view, which misunderstands ecosystem.[6]

Recently, resilience has been used in many academic fields such as ecology, psychology, engineering and economy, and there have been many different definitions on resilience. Whilst there are many definitions, modern and combined definition is as follows:[7] (1) amount of changes that system can endure (i.e., amount of external ability that system could maintain), and maintaining conditions of system's structure and functions, (2) degrees to reorganize itself against organizations affected by lack of organization or external factors, (3) degrees to construct to improve system's adaptive and learning ability.

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5) C. S. Holling, "Engineering resilience verse ecological resilience," in *Engineering within Ecological Constraints*, ed. Peter Schulze, Washington, D.C.: National Academy of Press, 1996, pp.32-33.

6) Carl Folke and Lance Gunderson, "Reconncecting to the biosphere: A social-ecological renaissance," *Ecology and Society* 17(4), 2012, p.1.

7) Graeme S. Cumming, "Spatial resilience: Integrating landscape ecology, resilience, and sustainability," *Landscape Ecology* 26, 2011, p.900. Graeme S. Cumming reorganizes resilience definition mentioned by Steve Carpenter, et al., "From metaphor to measurement: Resilience of what to what?," *Ecosystems* 4, 2001, p.766.

C. S. Holling acquaints us with this term, resilience as ecological concept. Holling explains the differences between engineering resilience and ecological resilience.[8] According to him, engineering resilience focuses on efficiency, constancy, and predictability, as well as resist disturbance to return, and considers the maintanance of efficiency of function. On the other hand, ecological resilience focuses on persistence, change, and unpredictability: persist and absorb disturbance to flip a system into another regime, and consider maintenance of existence of function.

Developing Holling's description, Folke illustrates social-ecological resilience comparing with engineering, ecological, and social resilience in three parts:[9] characteristics, focus, context. Engineering resilience is described to return time. It focuses on efficiency, recovery, and constancy. Also, it is in the context of vicinity of a stable equilibrium. Ecological and social resilience indicate buffer capacity, withstanding shock, and maintaining function. It focuses on persistence and robustness. These are in the context of multiple equilibria and stability of landscapes. Unlike this, social-ecological resilience shows integrated aspects, which are demonstrated by interplay of disturbance and reorganization, and sustaining and developing. It focuses on adaptive capacity, transformability, learning, and innovation. The specificity of

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8) C. S. Holling, "Engineering resilience verse ecological resilience," in *Engineering within Ecological Constraints*, ed. Peter Schulze, Washington, D.C.: National Academy of Press, 1996, p.33.

9) Carl Folke, "Resilience: The emergence of a perspective for social-ecological systems analyses," *Global Environmental Change* 16, 2006, p.259.

social-ecological resilience is in the context of integrated system feedback and cross-scale dynamic interactions.

As a further study, there are resilience definitions explaining about space and landscape. Cumming expresses about spatial resilience.[10] According to him, spatial resilience indicates the way of spatial variation within relevant system resilience that affects and is affected to system of both inside and outside. In this system, resilience crosses multiple spatial and temporal scales. Also, it has factors in both internal and external to the system. To foster spatial resilience, Cumming arranges the term, landscape resilience.[11] It refers to the resilience of the whole landscape as a spatially located complex adaptive system that includes both social and ecological factors and their connections. He regards landscape resilience as related concept with landscape sustainability. These two things further stress the suitability of system memory and cyclical change as the 'panarchy'[12] of the adaptive cycle.

Researching various definitions of resilience, we could find that perspective of resilience has been developed over time. The old way of resilient thinking believed ecosystem as a stable and resilient (i.e., bounce back) environment at a steady state.[13] These old view led people to

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10) Graeme S. Cumming, *Spatial Resilience in Social-ecological Systems*, New York: Springer, 2011, p.21.

11) Graeme S. Cumming, et al., "Resilience, experimentation, and scale mismatches in social-ecological landscapes," *Landscape Ecology* 28(6), 2013, p.1140.

12) Panarchy is the term made by C. S. Holling. It will be handled in next page.

13) Carl Folke, et al., "Regime shifts, resilience, and biodiversity in ecosystem management," *Annual Review of Ecology, Evolution, and Systematics* 35, 2004, p.558.

think resilience as the enemy of adaptive change. This misunderstanding led to the nature of resilience as one-dimensioned and static concept in a structural sense.[14] However, on the contrary to old view, ecosystem is in the multi-scales. With this new perspective, resilient landscape view assumes that whole processes, including biotic and abiotic, could foster reinforcement of interactions.[15] Our perspective should move from old resilience to dynamic view of Nature Evolving.[16] The new perspective accepts that resilience could be and has been disturbed and reconstructs capacity itself. And we do not take such abilities as presumed.[17]

Panarchy

The term "panarchy" has been mentioned earlier in this paper to explain landscape resilience. This unfamiliar term appears in *Panarchy*[18] for the first time. In this book, Holling and researchers create new adaptive cycle that is called panarchy. This term is combination of "pan" and "hierarchy".[19] This term is a portmanteau of “pan,” which is derived

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14) C. S. Holling and Lauce H. Gunderson, "Resilience and adaptive cycles," in *Panarchy: Understanding Transformations in Human and Natural Systems*, eds. Lance H. Gunderson, C. S. Holling, Washington, D.C.: Island Press, 2002, p.32.

15) C. S. Holling, Lauce H. Gunderson, and Garry D. Peterson, "Sustainability and panarchies," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.72.

16) C. S. Holling and Lauce H. Gunderson, "Resilience and adaptive cycles," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.32.

17) Carl Folke, et al., "Regime shifts, resilience, and biodiversity in ecosystem management," *Annual Review of Ecology, Evolution, and systematics* 35, 2004, p.558.

18) Lance H. Gunderson, C. S. Holling eds., *Panarchy: Understanding Transformations in Human and Natural Systems*, Washington, D.C.: Island Press, 2002.

19) C. S. Holling and Lauce H. Gunderson, and Donald Ludwig, "In quest of a theory of adpative

from Greek God Pan to illustrate an image of unpredicted changes, and "hierarchy." The term "pan" represents instability following his paradoxical personality,[20] and "hierarchy" represents the crosses along the scales to indicate sustaining experiments, testing results, and allowing adaptive evolution, and it demonstrates top-down relationship.

Showing new cycles, panarchy is basically focused on rationalizing the interactions between changes and persistence, between the predictable and unpredictable.[21] Panarchy has hierarchies but not in a way how authoritative control operates in top-down sequences. In this new system, each phase is formed and communicated from inter-connections.[22]

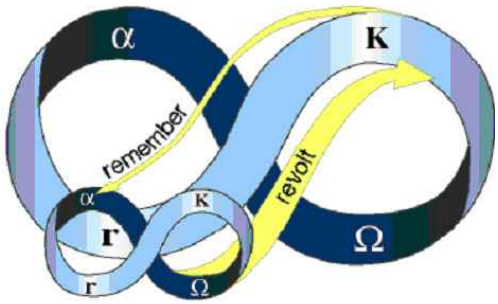

Fig. 1. Panarchy (Holling, et al., 2002)

Panarchy distinguishes from hierarchy, because of the interactions between levels. It has multiple connections among phases.[23] Panarchy

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change," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.5.

20) C. S. Holling, Lauce H. Gunderson, and Garry D. Peterson, "Sustainability and panarchies," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.74.

21) C. S. Holling and Lauce H. Gunderson, and Donald Ludwig, "In quest of a theory of adpative change," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.5.

22) C. S. Holling, Lauce H. Gunderson, and Garry D. Peterson, "Sustainability and panarchies," in *Panarchy: Understanding Transformations in Human and Natural Systems,* p.72.

has four phases[24]: r, K, Ω, α. "r" is growth and exploitation of resources readily available. "K" is conservation, where things change slowly, which is locked up. "Ω" is releasing things that change very rapidly. So, in that phase, locked up resources in the K phase are suddenly released. "α" represents reorganization and renewal of system's tenuous boundaries. In this phase, innovations could be emerged.

These four phases are closely connected each other. Also, one panarchy is connected with other panarchies as showing figure 1. These connections among panarchies are important in creating and sustaining adaptive capability.[25] "Revolt" connection could cause a crucial change in one cycle by jumping up to a vulnerable phase. "Remember" could promote renewal by potential that has been stored.

Resilience and Panarchy

Garmestani and his co-researchers explain panarchy model.[26] A panarchy consists of adaptive cycles. It has different conditions showing cross-scales cascading comparing with hierarchy such as “top-down” structure in the system. For this reasons, the panarchy performs capturing unpredictable dynamics of complex systems better than top-down system.

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23) Ibid., p.74.

24) C. S. Holling and Lauce H. Gunderson, "Resilience and adaptive cycles," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.34.

25) C. S. Holling, Lauce H. Gunderson, and Garry D. Peterson, "Sustainability and panarchies," in *Panarchy: Understanding Transformations in Human and Natural Systems*, p.75.

26) Ahjond S. Garmestani and Melinda Harm Benson, "A framework for resilience-based governance of social-ecological systems," *Ecology and Society* 18(1), 2013, p.2.

Since these cycles move over single scope of scales, a system's resilience relies on the interconnections between dynamics and structure at multiple scales. Panarchy specifically states dynamic cross-scales.

Cumming indicates that although panarchy is creative and is an original cycle that focuses on complex context of social-ecological changes, it is roughly vague and difficult to operationalize.[27] And he points out that it may not consider some important contexts of social-ecological systems.

Panarchy proposes that social-ecological systems consist of a sequence of co-related adaptive cycles at different scales.[28] According to panarchy, complex systems, i.e., social-ecological systems cannot be operated in stable, equilibrium conditions.[29] This adaptive systems operate with changes in the capacity of phases: internal connections, flexibility and resilience.[30] In this understanding, panarchy is the crucial aspect of resilience.[31] The resilience of system will depend on the effects from dynamic and cross-scales states, which are strongly interconnected.

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27) Graeme S. Cumming, *Spatial Resilience in Social-ecological Systems*, New York: Springer, 2011, p.38.

28) Ibid.

29) Steve Carpenter, et al., "From metaphor to measurement: resilience of what to what?," *Ecosystems* 4, 2001, p.766.

30) Brian Walker and David Salt, *Resilience Thinking*, Washington: Island Press, 2006, p.75.

31) Brian Walker, et al., "Resilience, adaptability and transformability in social-ecological systems," *Ecology and Society* 9(2), 2004, p.7.

Resilience Based on Social-ecological Systems

Fikret Berkes and Carl Folke made the term "social-ecological system" to emphasize the integrated concept of humans in nature to overcome the term "ecological system," which stands for conventional ecological perspective, to refer to the natural environment.[32] There have been many studies on the social resource and ecological management. However, most studies have concentrated on its own domain only. Folke points out the misunderstanding about social and ecological systems.[33] Many researches were treating the ecosystem based on the assumptions that if the social systems are organized to perform for sustainability, it will also manage the ecological resource on the same sustainable stage. Unfortunately, even if human society shows capacity to cooperate with the changes and adapt only through the perspective of social dimension, such adaptation could be part of processing changes in the ability of ecosystems to maintain adaptation.[34] It means that since narrow sight could make a wrong decision, we need to integrate social and ecological system to make decisions for resilience. Linkage of social and ecological system could be transformed through adaptations for maintaining resilience.[35]

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32) Fikret Berkes and Carl Folke, "Linking social and ecological systems for resilience and sustainability," in *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* eds. Fikret Berkes, Carl Folke, and Johan Colding, Cambridge: Cambridge University Press, 1998, p.4.

33) Carl Folke, "Resilience: The emergence of a perspective for social-ecological systems analyses," *Global Environmental Change* 16, 2006, p.260.

34) Ibid.

35) Ibid., p.21.

Reinette Biggs and researchers explain the concept of resilience to connect social-ecological systems. They said that resilience is the social-ecological system's ability to maintain ecosystem in the evolving and changing that we have been face with constantly.[36] It is because that we are living in social-ecological systems confusing and complex that are continuously changing. That is why we have to understand not only the ecosystem services but also social factors together as well, and consider interactions between ecosystem and society in discourse about resilience.

1.2. Resilience in Landscape Architecture

Resilience and Landscape Urbanism

In the past, there had been a similar movement to integrate the two different parts in landscape architecture, which is well known as “landscape urbanism” that emerged in the 1990s. As a hybrid discipline, it tries to understand the combination of all the elements of urban ecology. This paradoxical and complex concept gives priority to how they work and what they work rather than its appearance.[37] James Corner shows possibilities of landscape urbanism to explain the ability of this concept:[38] the ability to locate urban structures in local ecological

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36) Reinette Biggs, et al., "Toward principles for enhancing the resilience of ecosystem services," *Annual Review of Environment and Resources* 37, 2012, p.423.

37) James Corner, “Landscape urbanism,” in *Landscape Urbanism: A Manual for the Machinic Landscape*, eds. Mohsen Mostafavi and Ciro Najle, London: AA Publications, 2003, pp.58-63.

38) James Corner, “Terra fluxus,” in *The Landscape Urbanism Reader,* ed. Charles Waldheim, New

context, the ability to design relationships between urban form and dynamic environmental processes.

Diverging from landscape urbanism, a new discourse, “ecological urbanism” is now on the rise to explain, more precisely, the desire of urban practice based on environmental issues.[39] As a critical discussion about landscape urbanism, ecological urbanism amplifies active thinking of an urban area to embrace environmental-ecological concept and to expand conventional academic-professional framework for explaining present urban conditions.[40]

Through many discussions, we could organize the thought that landscape urbanism considers all elements in stage of urban including social, economic, politic to ecological element, and explain that interconnections recognized as ecological networks among elements are social ecosystem. In the same vein, as concept of landscape urbanism, Corner explains ecosystem as an integral flexible system that has the capability to absorb and denaturalize information about environment surrounding the urban, not as nature, which is far away from us.[41]

As we saw, landscape urbanism and resilience are similar in the way that they both try to integrate two academic fields such as sociology and ecology, to understand urban structure through ecological view. However,

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York: Princeton Architectural Press, 2006, pp.23-33.

39) Charles Waldheim, “On landscape, ecology and other modifiers to urbanism,” *Topos* 71, 2010, p.21.

40) Ibid., p.24.

41) James Corner, "Landscape urbanism" in *Landscape Urbanism: A Manual for the Machinic Landscape*, p.63.

there are crucial differences between the two as well. Landscape urbanism focuses on "landscape" to read urban structure, and tries to find a landscape's role as a solution or an intermediary to the solution of the problems that have been faced within the cities. Unlike this, resilience focuses on both society and ecosystem and puts them together in the same stage of thinking. And it concentrates on interactions between them.

Resilience and Large Parks

Julia Czerniak utilizes the concept of resilience to interpret large parks. In the discourse of large parks, she concentrates on changing relationships between parks and urban in the context and aspiration. To find the answers, she brings the concept of resilience as a useful method to conceptualize, plan, design, and manage large parks in an ecological sense; and she also notes the ability of resilience to absorb and facilitate change in maintaining its design sensibility.[42] In this context, she defines characteristics of resilience as a large park's capacity to embrace various and changing social, cultural, technological, and political aspirations while keeping its attribute. Resilience concept could help decision-making to embrace safe-to-fail trial-and error methods and feedback through phases of monitoring and plan or design evaluation.[43] Therefore, parks could be measured of the parks' ability to hold off colliding elements or processes

42) Julia Czerniak, "Legibility and resilience," in *Large Parks*, eds. Julia Czerniak and George Hargreaves, 2007, New York: Princeton Architectural Press, p.216.

43) Ibid.

by resilience.[44)]

Czerniak focuses especially on the tensions between efficiency and persistence, constancy and change, and predictability and unpredictability in both design and management phases to be a resilient park.[45)]

Large parks portray different aspects in the integration of each process. Sunhee Bark explains those integrating aspects in several ways,[46)] first being integrating governance to manage the parks. This proposes a citizen-centered management system, accommodating multi-level of public demand. Second is integrating the ecosystem into parks using ecological or environmental engineering. However, these integrations have been faced by some limitations. Bark points out that proposed management of large parks existing already hast majorly bdn focusing on constructing a physical infrastructure. So as a result, it could have limitations due to the lack of social-cultural groundwork that could control the unexpected activities or conflicts among different cultures. She also stresses that efforts to combine ecosystems into the park bring dichotomy of human nature in its trails, because most designs separate the space into conserved nature and human space.

Following Czerniak, we could solve these limitations by using the concept of resilience. To surmount the followed limitations in large parks, it is necessary to make a new park operation management system

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44) Ibid., p.268.

45) Ibid., p.216.

46) Sunhee Bark, "Contemporary large parks design in Korea: a critical study," Masters Thesis, Seoul National University, 2013, pp.76-77.

that includes planning, designing, and management.

Landscape Architecture Resilience as Social-ecological System

Being a new system, Resilience view through social-ecological system is full of suggestions to be carried out in the field of landscape architecture. Resilience as a social-ecological system emphasizes that the world is closely connected, and it is not enough to consider each side based on disintegrated thinking. When we understand ecosystem and society as one big system, not divided by factors, the true meaning of sustainable coexistence can be reached. Landscape architecture is the field that harmonizes three elements: ecosystem, design, and human. However, many landscape architects have found it difficult to make a space that considers all of these three elements and have faced limitations. Generally, ecological works and design works were regarded separately, as opposing parts. These dichotomous thinking prevents the designers and managers from integrated system view and makes for a tendency to focus on just one side. These tendencies begin with global requirements to ecological design. Since the beginning of ecological planning and designing, this is the challenge that landscape architect has to work through.

Because of the extraordinary power of the term, ecology and ecological design has been understood in very different contexts in comparison to aesthetical design, and as a result, many works have been made with no consideration for ecology. ecology presume un-ecological design. From

that moment, focus on ecological elements have begun to gain weight. However, the so called ecological designs and parks that were made with pressure and obligation rather than a full understanding of the professional knowledge about the ecosystem are hard to be processed with. The aspect of ecological design and dichotomy between ecology and art s in landscape architecture has come from a misunderstanding about ecology.

Resilience as a social-ecological system helps these designers and managers understand what ecosystem is and how they should integrate its three elements: ecosystem, design, and humans.

To deal with social-ecological dynamics, four critical factors are needed.[47] The first is learning to live with uncertainty and change. The second is combining different types of acknowledgements to learn. The third is creating opportunity of self-organization to realize social-ecological resilience. Last is fostering elements of resilience for renewal and reorganization.

Folke and his co-workers propose several principles for building resilience based on local social-ecological systems:[48] (1) designing management systems that process with ecosystem, (2) enhancing social mechanisms for building resilience, (3) promoting conditions for

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47) Carl Folke, et al., "Adaptive governance of social-ecological systems," *Annual Review of Environment and Resources* 30, 2005, pp.452.

48) Carl folke, Fikret Berkes, and Johan Colding, "Ecological practices and social mechanisms for building resilience and sustainability," in *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, p.430.

self-organization and institutional learning, (4) re-discovering adaptive management, (5) developing values consistent with resilient and sustainable social-ecological systems. Then, Reinette Biggs and researchers suggest developed seven principles for enhancing ecological resilience: (1) maintain diversity and redundancy, (2) manage connectivity, (3) manage slow variables and feedbacks, (4) foster an understanding of social-ecological systems as complex adaptive systems, (5) encourage learning and experimentation, (6) broaden participation, (7) promote polycentric governance systems. Upper three principles refer to key social-ecological system's properties to be managed. Rest four principles refer to key attributes of the governance system.

All researchers equally indicate four parts to building resilience as social-ecological systems. First, they mention the ability to reorganize itself. Second, they all point out the importance of learning the knowledge with professional understanding in all parts: society and ecosystem. Third, related with the second part, the researchers say that we should foster complex and unpredictable ecosystems as social-ecological systems. This is critical because all problems that we are faced with are caused by a misunderstanding on what ecosystem is. This third part is essential in overcoming conventional perspectives about the ecosystem. Fourth, there is an importance for governance, especially a poly-centric governance.

On the basis of resilience and several discourses in landscape architecture, I may define landscape architecture resilience. As Czerniak

mentioned, park resilience is the ability absolving diverse desires in the changing world while holding a parks' characteristics. Developing more from her definition, I suggest the definition that the landscape architectures' resilience is the capacity to keep and perform the parks' various societal functions while fulfilling ecological process in the changing world.

To improve the resilience in parks, we should consider both social and ecological process in phases from planning to management at once.

2. Resilience Components of Large Parks

2.1. Ecological Components

Chapin suggest considerations to sustain ecosystem functioning based on resilience:[49] (1) maintenance of soil resources, (2) water cycling, (3) carbon and nutrient cycling, and (4) maintenance of biological diversity, (5) maintenance of disturbance regime. Following Chapin, we could select ecological components of resilience: soil, water, energy, biodiversity. In fact, these elements have been considered in landscape architecture previously. However, we have ignored the interactions among them, and focused on individual elements. The four components are closely related, and they influence and are affected by each other. Especially, in large park scales, it could be affected by and also have effects on urban.

2.2. Social Components

Landscape architects have considered social aspects before designing to apply regional culture or people's special patterns to design. On that, for resilient large parks, government should be added in social considerations. Researchers explain that governments, civil society, and groups are the multiple stakeholders in social-ecological systems.[50] Importance of

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49) F. Stuart Chapin, Ⅲ, “Managing ecosystems sustainably: The key role of resilience," in *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World*, eds. F. Stuart Chapin, Ⅲ, Gary P. Kofinas, and Carl Folke, New York: Springer, 2009, pp.31-38.

50) Donald R. Nelson, et al., "Adaptation to environmental change: Contributions of a resilience

governments has also been arisen in the discourse of national urban parks.

Son said that recently, there have been active discussions about the need of government involvement on creating and managing urban park and institutionalization related that in Korea because many large urban parks have been faced with problems such as lack of finance, incongruous with existing irrational urban plans.[51)]

Considering the factor of culture, designers and managers should be thinking about: aesthetic values, inspiration, eduction about nature, recreation, and social relations.[52)] In thinking of rest of the factors, people and government, designers and managers should concern about coordinating community based on scientific knowledge, increasing public knowledge of ecological issues and problems in resilience, involving diverse and broad scales of stakeholders, and implement political system to support for experimental activities.[53)]

Resilience could suggest a way that could make flexible organizations and could reflect interdisciplinary knowledge to decision makers.[54)]

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framework," *Annual Review of Environment and Resources* 32, 2007, p.409.

51) Yonghoon Son, "Study on the meaning of national urban park system and the challenging in management operations: Focusing on the case of Japanese national government park system," *Journal of Korea Planners Association* 46(3), 2011, p.79, 80.

52) Johan Colding, "Creating incentives for increased public engagement in ecosystem management through urban commons," in *Adapting Institutions: Governance, Complexity and Social-ecological Resilience,* eds. Emily Boyd and Carl Folke, Cambridge: Cambridge University Press, 2012, p.117.

53) Carl Folke, F. Stuart Chapin, Ⅲ, and Per Olsson, "Transformations in ecosystem stewardship," in *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World*, p.122.

54) Emily Boyd, "Adapting to global climate change: Evaluating resilience in two networked public

Ⅲ. RESILIENT PARK OPERATION SYSTEM

1. Management System and Resilience Thinking

1.1. Conventional Management System

As the thoughts on ecosystems change, a change has also come to the management system that calls for ecological management. Holling explains ecosystems as shifting its targets with complex latent.[1] Following these thoughts, he stresses that the management should be adaptive, flexible, and provisional at interconvertible scales with the scale of important ecosystem functions.

Existing management systems have been showing limitations in social-ecological systems. Gunderson points out three aspects of conventional management system faced with crisis.[2] When established management encounters shifting stability domains and resulting problems, (1) it does nothing and just waits, expecting restoration to appropriate state, (2) it aggressively manages the system, then tries to restore to the state that managers wanted to, (3) it admits to system's irreversibly change. These aspects bring about troubles. First option could make social benefits desired condition to be foregone. Second option may incessantly cause same troubles that they have faced with before. Third

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institutions," in *Adapting Institutions: Governance, Complexity and Social-ecological Resilience* p.245.

1) C. S. Holling, "Engineering resilience verse ecological resilience," in *Engineering within Ecological Constraints,* ed. Peter Schulze, Washington, D.C.: National Academy of Press, 1996, p.32.

2) Lance H. Gunderson, "Ecological resilience in theory and application," *Annual Review of Ecological System* 31, 2000, p.432.

issue is that it is just a temporal strategy to adapt to the altered system that they just met. Folke and his researchers also said that conventional scientific management is not always operating, and indeed make problem worse[3]. They said that it is because management focuses on the misunderstood concept of sustainability and insular types of scientific practice, the existing management cannot afford to provide directions about how to interpret feedbacks or how to make institutional adaptations.[4] The conventional management was already constructed with building knowledge, vision and goals in comprehensive framework, and social networks. In other words, existing management clearly sets up an objective on fixed system. Such 'command and control' approach has been eroding resilience,[5] and separating and controlling variables. In that structure, many resilience theorists suggest adding one other phase, the window of opportunity, an adaptive co-management through resilience thinking.[6]

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3) Carl folke, Fikret Berkes, and Johan Colding, "Ecological practices and social mechanisms for building resilience and sustainability," in *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, eds. Fikret Berkes, Carl Folke, Johan Colding, Cambridge: Cambridge University Press, 1998, p.414.

4) Emily Boyd, "Adapting to global climate change: Evaluating resilience in two networked public institutions," in *Adapting Institutions: Governance, Complexity and Social-ecological Resilience,* eds. Emily Boyd and Carl Folke, Cambridge: Cambridge University Press, 2012, p.242.

5) Lance H. Gunderson, "Ecological resilience in theory and application," *Annual Review of Ecological System* 31, 2000, p.433.

6) Per Olsson, et al., "Social-ecological transformation for ecosystem management: The development of adaptive co-management of a wetland landscape in southern Sweden," *Ecology and Society* 9(4), 2004, pp.18-20.

1.2. Resilience-centered Management

Since scientists have been recognizing ecosystem to be complex and adaptive, having characteristics such as historical layers, dependency, nonlinear dynamics, threshold effect, multiple basins of attraction and unpredictability.[7] So, necessity of transforming management has been brought up in many fields. And in that calling, resilience concept has helped managers of systems to break conventional thinking of about management as something that aims at the unachievable goal of stability.[8] The framework based on resilience can embrace shifting perspective of ecosystem. This new management system does not require a specific capacity to forecast tomorrow, but it does require a capacity to make systems that can absorb and accommodate future unpredicted circumstances.[9]

Resilience management approaches would highlight the demand for keeping options open, viewing events in a regional rather than local context, and stressing heterogeneity.[10] For urban sustainability and resilience, researchers suggest five strategies:[11] considering biodiversity,

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7) Carl Folke, et al., "Regime shifts, resilience, and biodiversity in ecosystem management," *Annual Review of Ecology, Evolution, and Systematics* 35, 2004, p.559.

8) Steve Carpenter, et al., "From metaphor to measurement: Resilience of what to what?," *Ecosystems* 4, 2001, p.766.

9) C. S. Holling, "Resilience and stability of ecological systems," *Annual Review of Ecological System* 4, 1973, p.21.

10) Ibid.

11) Jack Ahern, "Urban landscape sustainability and resilience: The promise and challenges of integrating ecology with urban planning and design," *Landscape Ecology* 28(6), 2013, pp.1206-1210.

building and managing urban ecological networks and connectivity, focusing on multifunctionality in planning and design, building multiplicity and fulfilling modularization, and performing adaptive and experimental design implement, indicating "safe to fail". Important thing to remember for managing resilience is that it could be possible on the understanding of social-ecological systems through alternating regimes.[12)]

You may think resilience frameworks are similar with the adaptation context. However, there are differences between them. The resilience frameworks emphasize integrative thinking of complex systems and focus on functions of the social-ecological systems. It concerns the relationships between the systems elements, not on the each individual function of elements separately. Furthermore, resilience considers context, feedbacks, and interconnections of system components.[13)]

As you saw, resilient management approach has several assumptions to be implement in practice. Walker and his co-workers explain these assumptions.[14)] Researchers said that resilience is on the assumptions that: (1) social-ecological systems may include thresholds and can show unpredictable and irreversible changes, (2) accuracy of key decisions are fairly uncertain, (3) decision makers in social-ecological systems make decisions based on imperfect acknowledges, (4) since market is normally

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12) Brian Walker and David Salt, *Resilience Thinking*, Washington: Island Press, 2006, p.59.

13) Donald R. Nelson, et al., "Adaptation to environmental change: Contributions of a resilience framework," *Annual Review of Environment and Resources* 32, 2007, p.399.

14) Brian Walker, et al., "Resilience management in social-ecological systems: A working hypothesis for a participatory approach," *Conservation Ecology* 6(1), 2002, p.4.

imperfect, marker-based valuations are easy to distort, (5) organizations should hold not just over outcomes, but over the social, economic, and political processes, (6) since property rights do not exist for ecological goods and services, markets do not exist.

Under these assumptions, resilience management makes steady progress towards two goals: preventing the system from moving to undesired system and fostering and preserving the components that could make the system to restore and reorganize itself responding to a complex change.[15)]

15) Ibid., p.7.

2. Resilient Operation Systems for Large Parks

2.1. Existing Management Systems of Parks

Classification Method of Urban Parks

Urban park is defined as an area of a park and city's natural park decided by urban management plan to contribute to protecting urban natural landscape and to improving citizen's health, rest, and emotional life, in accordance with the provision of Article 30 of 「Act on Planning and Utilization of the National Territory」.

The Urban Park Act classifies park into two types by its function and theme: neighborhood park and theme park. Neighborhood park is made and managed as foundation of an urban life zone, categorized as mini-park, children's park, and neighborhood park. Theme park is made for the other purposes except for neighborhood park, categorized as historic park, cultural park, waterfront park, cemetery park, and park enacted by an ordinance.

Management Operation Type of Urban Park

Authority of establishment and management of urban park is on the mayor. Since local government has a responsibility to bear expenses of urban park management operation, management turns on security of budget of local government.

Urban park management operation is classified by government's operation method in three types: managed only by government,

contracting-out management, and private-public cooperative management.[16] Management only by government means that local government directly takes management operation of park green, and making up for lack of budget or labor shortage through volunteering activities of citizens. Contracting-out management is where government puts park's general management and operation in trust to the private, and supports the budget. The private-public cooperative management constructs partnership between government and private, and divides work according to each characteristic. Usually, the private takes work such as planning operation, promoting, fund-raising of programs while government takes basic configurational portions such as facility management and property management.

Most urban parks in Korea are managed only by the local government. Rarely, there are co-operative management types such as indirect management by consignment or partnership. The park managed only by government is operated by a top-down system. Administrative procedure of this type is unified to improve efficiency, to manage large scaled facilities effectively, to grasp actual condition of management.[17] However, such case frequently exclude park users management because it focuses on principal maintenance of park. So, this type raises concerns caused by biased management operation.

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16) Ministry of Land, *Policy Research about Strategies of Creating Urban Park and Operation Management*, 2011, p.42.

17) Ibid., p.44.

The private-public cooperative management has an advantage, because it has both the private and government management. Such advantages could improve operational efficiency. However, at the same time, it has several problems that, such as the fact that it is hard to assign accountability and maintain stability of private finance. Besides, system institution for collaborative operating system is inadequate in Korea.[18] The latest studies have shown that there was too much concentration on main agents administering park. Especially, they stress importance of cooperation between governments and civilian organizations.

Bulk of studies has focused on the subject of management, and not on object of management. And these conventional views make many problems that this paper mentioned in the earlier parts, explaining about the limitations of existing management systems.

As mentioned about complex characteristics of large parks, the place as combined society and ecology needs new management system embracing two different elements and processes at the same place. We have been through hard time to integrate them. Large parks, operating ecological processes and human activities have to consider these two elements on one stage, at the same time in management phase that could lead to a resilient park.

Conventional Management Processing of Parks

Existing management is system of top-down structure. At the

18) Ibid.

management phase, elements are divided into several parts for individual managing. (e.g., separated into ecological part, facility part, program part, etc.) Separated management processes are hard to see in a bigger picture and it is difficult to understand complex interconnections and its effects among elements. This torn and precise management prevents finding basic solutions fot the problems emerged in each part, and continues to make other problems since it provides just fragmentary solutions.

Top-down system structure is separated into three parts:[19] (1) maintenance of space and facilities, (2) administrative control for components functioning, and (3) user management. Following that, studies of park management aspect has changed from maintenance of facilities to ecological conservation and performing social functions as urban parks focused on participation. Recently, few but critical studies about ecological process and its effects in park areas have emerged. Also, in social aspect, some researchers have started to study about connections among inhabitants, civic groups, and administrative organizations.[20]

Looking at alteration of park management, it is divided into two parts, ecological and social part. Ecological management tends to lean towards maintenance, while societal management focuses on attracting citizen participations through park programs. However, parks need new system that could handle social-ecological relationships and help understanding

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19) Hyojung Kim, "A Study on the customized management methods of urban parks," *Masters Thesis,* The University of Seoul, 2010, p.22.

20) Sunju Choi, et al., "Analysis of social networks in the management organization of Seoul Forest park," *Journal of the Korean Institute of Landscape Architecture* 39(3), 2011, pp.74-82.

them. Furthermore, with social-ecological understanding, ecological management havs to proceed to adaptive and flexible system than maintaining the very first condition, because environment is not s stable state.

2.2. Panarchic System Framework for Large Parks

Co-management System Based on Resilience

To enhance resilience in parks, management system should proceed to the following three steps in social ecological systems.[21] First step is preparing the system for change as building ecological knowledge, developing social networks, providing vision and goals in a comprehensive framework. Next is taking a window of opportunity, which could be transforming the governance system toward ecosystem management. The last step is building resilience of the desired state after inception of local region. It is because that narrow-sight mechanism that considering a single aspect cannot assure maintenance of resilience. Only Considering multi-scales, developing and restoring sources, and sourcnig finance and skills sustain resilience.[22] Using such thinking of resilience, I propose a new management system, which has an integrated view to see social system and ecological system at the same time.

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21) Per Olsson, et al., "Social-ecological transformation for ecosystem management: The development of adaptive co-management of a wetland landscape in southern Sweden," *Ecology and Society* 9(4), 2004, p.18.

22) Lance H. Gunderson, "Ecological resilience in theory and application," *Annual Review of Ecological System* 31, 2000, p.436.

In fact, researchers already propose some renewal management, the co-management. Berkes explains co-management as a knowledge partnership.[23] It is being integrated with learning-based approaches. This new management represents the way to handle unexpected events and variability by sharing power, building trust and social capita as institutions and governance.[24] In constructing co-management, building resilience is particularly crucial. Berkes suggests some strategies for facilitating or improving co-management.[25] Co-management strategies are as follows: (1) connecting knowledge, (2) producing joint knowledge, (3) building integrated tactics, (4) researching stakeholders, (5) cooperated monitoring, (6) scenario building, (7) distributing power, (8) setting up not only upward responsibility but also downward responsibility such as organization's accountability to users.

New System, Panarchic Operation Management System

In this paper, I suggest operation management system developed from co-management, "panarchic system."

Even though, conventional park management system has considered both social context and ecological context, it has been suffering by integrating those two concepts in practical operating. Besides, sporadic programs which are not considering scales of large parks have been

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23) Firkret Berkes, "Evolution of co-management: Role of knowledge generation, bridging organizations and social learning," *Journal of Environmental Management* 90, 2009, p.1692.

24) Ibid., pp.1693-1694.

25) Ibid., p.1700.

made. Existing systems make it hard to manage park sustainably, and to see park with long-term view.

Pancarchic operation management system deals with stages that range from planning to management. Since park is a creation with ongoing planning and design phases, factors and processes in management phase are also considered from planning phase. So, panarchic system sees all these as an overall park phase, not just narrowing down on a management phase.

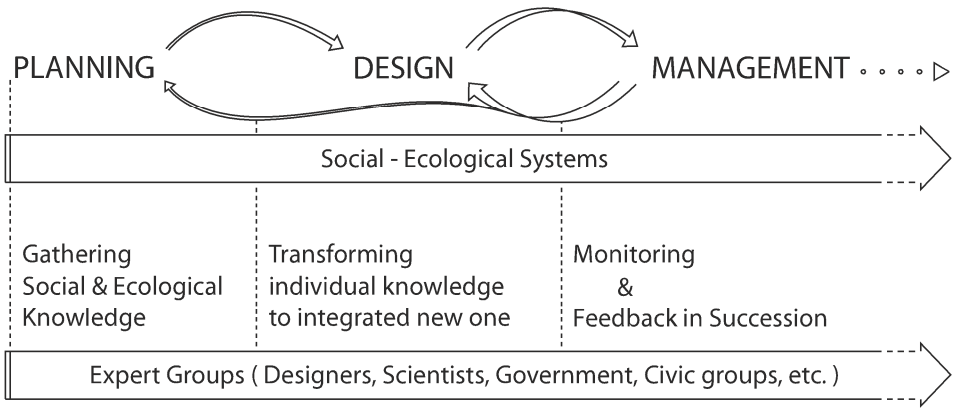

Fig. 2. Panarchic operation management system

This system shows four points in realizing resilient park. First, it draws new circular process among phases, enabling managers to make flexible decisions in unexpected conditions. Second, it indicates that this system is working based on integrated thinking, social-ecological system. To perform on social-ecological thinking, third, it suggests some actions. At planning phase, it talks about gathering each knowledge of ecology and society. Next, it stresses transforming individual information to integrated new knowledge, at design phase. Lastly, at management phase,

it recommends monitoring and feedback in succession to prepare complex unpredicted changes. In the end, all these actions and process should be moved with expert groups constituted with professionals from variety of fields.

2.3. Phased Considerations for Constructing Resilient Operation Systems

Planning Phase

Resilience offers important discourse to planning theory.[26] Social-ecological resilience could make us to think about binding two different contexts at the first time, the planning phase, because it stresses the inter-connections and problems in complex social-ecological systems.

Researchers offer key words for resilient planning.[27] They say that the term such as adaptability, recovery, capital building, adaptive capacity, transformability, connectivity, and adaptation is critical core to make plan's resilience.

Following the keystones, resilience planning has to present some aspects.[28] Firstly, it should be dynamic, not focuses on retuning to stable, equilibrium state, but adapting and controlling toward changing processes occurring in diverse dimension. Secondly, it should consider

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26) Cathy Wilkinson, "Social-ecological resilience: Insights and issues for planning theory," *Planning Theory* 11(148), 2012, p.164.

27) Ayda Eraydin and Tuna Taşan-Kok, "The evaluation of findings and future of resilience thinking in planning," in *Resilience Thinking in Urban Planning*, eds. Ayda Eraydin and Tuna Taşan-Kok, New York: Springer, 2013, pp.235-236.

28) Ayda Eraydin, ""Resilience thinking" for planning," in *Resilience Thinking in Urban Planning*, eds. Ayda Eraydin and Tuna Taşan-Kok, New York: Springer, 2013, p.29.

not only the form but also the function and process of urban systems in social, ecological, and economic contexts. Lastly, it should be analyzed for defining the points and events of vulnerable urban systems.

Design Phase

Designers have usually had trouble with how to make an the area that embraces unpredicted affairs emerging in complex systems. Despite these efforts, they do not notice what is the real solution of problems that come up in social-ecological systems.[29] In these situations resilience could be a starting point of the design process to integrate ecology and urban design.[30] Moreover, resilience requires several things from the planner. In planning practice, planners should find a balance between responsibilities and the power of the different actors to enhanc resilienc e.[31]

Scholars offer steps to accomplish resilience in urban design:[32] (1) recognizing resilience as metaphor to integrate ecologists and designers, (2) accepting resilience as cooperating social, ecological, and economic processes that acknowledging constantly modified and re-organized urban

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29) Graeme S. Cumming, et al., "Resilience, experimentation, and scale mismatches in social-ecological landscapes," *Landscape Ecology* 28(6), 2013, p.5.

30) S.T.A. Pickett, et al., "Resilient cities: Meaning, models, and metaphor for integrating the ecological, socio-economic, and planning realms," *Landscape and Urban Planning* 69, 2004, p.379.

31) Ayda Eraydin, ""Resilience thinking" for planning," in *Resilience Thinking in Urban Planning*, eds. Ayda Eraydin and Tuna Taşan-Kok, New York: Springer, 2013, p.33.

32) S.T.A. Pickett, et al., "Resilient cities: Meaning, models, and metaphor for integrating the ecological, socio-economic, and planning realms," *Landscape and Urban Planning* 69, 2004, p.379.

system, (3) expressing processes through ecological insights, (4) making route for communication within multidisciplinary groups including ecologists, social scientists, and designers to share and to understand theoretical base deeply, (5) searching potential design works that can participate multidisciplinary group, (6) exploring different knowledge by practicing design works with stakeholders, (7) evaluating ecological processes and quantifying social impacts influenced by created designs.

Management Phase

For resilience, process between monitoring and feedback should be emphasized.

In monitoring processes, there are two requirements. First is that it should be multi-scale monitoring. Especially, for ecosystems, it takes 30-40 years of data collection to see key processes and dynamics.[33] For adapting ecological changes and modulating social systems affected by changing ecological processes, monitoring covering cross scales that can incorporate social and ecological variables is required.[34] Next is that monitoring should be planned for long-term. To implement long-term monitoring, some actions are required from governance and management approaches. Cumming and researchers arrange some qualifying conditions for long-term monitoring.[35] They said that governance and management

33) Craig R. Allen, et al., "Managing for resilience," *Wildlife Biology* 17(4), 2011, p.344.

34) Ibid.

35) Graeme S. Cumming, et al., "Resilience, experimentation, and scale mismatches in social-ecological

approaches have to be adaptive so that could simulate social movements, support continuously changing knowledge and practices, and offer "immunity" to groups to encourage participating in unpredictable experimentation. Feedbacks that come after monitoring especially positive feedback will show instability.[36] Usually, negative feedbacks make stability or constancy, but positive feedbacks make instability. It can have unpredicted outcomes and can make the possibility for shifting regimes by self-reinforcing. Folke and his co-workers highlight the importance of relationships between ecology and society in monitoring and feedbacks.[37] They said that translated signals (feedback) from ecosystem complexity have to go into social systems for social incentives.

In this monitoring and feedback processes, the roles of stakeholders are strongly important to process them properly. Researchers must assort actor groups as follows[38]: knowledge deliverer, knowledge creator, managers, leaders, and people who make sense of available information. In panarchic system, a professional's role is stressed because it is crucial to learn different knowledge and to make use of this transformed knowledge by integrating them as social-ecological information.

In a complex and rapid changing systems, experts are given new role in decision making to carry out knowledge to managers.[39] Same as

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landscapes," *Landscape Ecology* 28(6), 2013, p.1144.

36) Craig R. Allen, et al., "Managing for resilience," *Wildlife Biology* 17(4), 2011, p.344.

37) Carl Folke, et al., "Adaptive governance of social-ecological systems," *Annual Review of Environment and Resources* 30, 2005, p.463.

38) Ibid., p.454.

professionals, leaders are asked to take a new role. It is as in the following[40]: leaders should (1) create and cooperate various thinking, view, and solutions, (2) talk and have a relationship with individuals in different field, (3) cross levels of politics and governance, (4) engage and manage experimentation at small scales, (5) promote innovation through integrating diverse networks. Such social actor group's role is important factors of social networks and are fundamental for making the adaptive conditions that could change and reorganize the complex systems. Linking networks are important for learning and fostering integrated maneuver.[41] Strengthening stakeholder partnerships are important in building and improving community resilience.[42] Researchers stress that relationships between public and private partnerships are important. And, community and volunteers' participation is also very influential relationships to building a community resilience.[43]

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39) Carl folke, et al., "Adaptive governance of social-ecological systems," *Annual Review of Environment and Resources* 30, 2005, p.445

40) Carl Folke, F. Stuart Chapin, Ⅲ, and Per Olsson, "Transformations in ecosystem stewardship," in *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World*, eds. F. Stuart Chapin, Ⅲ, Gary P. Kofinas, Carl Folke, New York: Springer, 2009, p.119.

41) Carl folke, et al., "Adaptive governance of social-ecological systems," *Annual Review of Environment and Resources* 30, 2005, p.455.

42) United Nations, *Economic and Social Commission for Asia and the Pacific, Building Community Resilience to Natural Disasters through Partnership*, New York: United Nations, ESCAP, 2008, p.20.

43) Ibid., pp.25-26.

Ⅳ. ANALYSIS OF SEOUL FOREST PARK

Seoul Forest Park has opened in June, 18, 2005. This urban park was made as a result of a public design competition. During the competition, the City of Seoul required three criteria to be fulfilled in the competition guide.[1] First, the participants were to incorporate the concept of nature-friendship into the design. Second, they were supposed to make the forest as plant oriented rather than facility-oriented. Last, the participants were to find characteristics of the space to be part of the civic culture. In essence, the guide book called for a forest that served as a community space that was also nature-friendly.

Most dissimilarity of Seoul Forest Park in comparison to other urban parks is that this is the first park operated by the private-public cooperative management. Seoul Forest Park is administrated by both the City of Seoul and a non-governmental organization, called, the Seoul Green Trust, for financing the funds, required for operating park. Furthermore, Seoul Forest Park has a civic group, the Seoul Forest Park Conservancy, which consists of volunteers.

In this area, many events that combine social and ecological processes occur. So, recently, many scientists have been researching the impact human activities had on the ecosystem, such as the amounts of carbon dioxide in soils or trees, and biodiversity in Seoul Forest Park area.[2]

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1) Sangmin Lee and Jungsong Cho, "A critical review of the Seoul Forest Park design competition," *The Korean Institute of Landscape Architecture* 31(6), 2004, p.19.

2) Seoul Forest Symposium: Diverse Views to Urban Forests, 2013. 3. 27.

Seoul Forest Park is the best place to observe interactions between human activities and cycle of nature. For this reason, I analyze Seoul Forest Park through panarchic system. Looking into this park using integrated social-ecological system based on resilience, I try to grasp aspect generated between social system and ecological system in the Seoul Forest Park.

To achieve that, this paper searches through the whole process of Seoul Forest Park by looking at: the planning process, design process, and the management process. In planning and design processes, I analyze the design report of Dongsimwon, the winner of the competition, to see the actions of the planners or designers actions in respect to the features of resilience. In management process, I analyze management system into three crucial factors that make up the Seoul Forest Park: stakeholders, management process, and operating programs.

1. Aspect in Planning and Designing Phase

1.1. Establishing Concept

Dongsimwon, who won the design competition for the Seoul Forest Park, presented design visions and strategies.[3] Designers set a goal to portray the 'changing culture', and not the 'fixed nature'. They recognized the urban forest as one living thing that merged nature and culture. Following through from that thought, they made a huge forest linked

3) Dongsimwon, *Planning and Final Design of Seoul Forest.*

with Han-gang (river) and Jungnan-cheon (stream) and made citizen participation program to realize the urban forest made by not only the designers but also by the citizens. The forest, made by citizen is their methods of creating the park, which also is their final goal they want to achieve. Designers pointed to ecological processes and not facilities, civic participations with government, and various active programs and not a static rest spot in park.

They suggest three keywords to the strategies: evolution, network, and reinvention. "Evolution" means flexible growth and process of park in the long-term view. "Network" indicates close relationships among the infrastructures in the park, or dynamic relationships between the city and park. "Reinvention" represents restoration of time overlapped in the site. These three strategies are used to explain Seoul Forest Park as living organisms. However, reading the whole reports and in detail, all points made about the phased process of structural work related with the outside of Seoul Forest Park, such as subway construction, are not about ecological succession or ecological adaptation. They use "Evolution" to explain phased business, and "Network" to express external connections.[4)]

1.2. Space Zoning and Program Organization

Designers used three concepts to the site: life, participation, and pleasure. First area, the "forest of life" focuses on ecological conservation

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4) Jeong-Hann Pae, *Theory and Critical Practice in Contemporary Landscape Architecture*, Paju: Landscape Architecture Publication, 2004, p.87.

and restoration. Second area called the "forest of participation" is the space made by citizens where there are variability by the human movement. Third area, "forest of pleasure" consists of ope spaces and walking trails where the citizens of Seoul can enjoy their activities.

Fig. 3. Forest of life
ⓒDongsimwon

Fig. 4. Forest of participation
ⓒDongsimwon

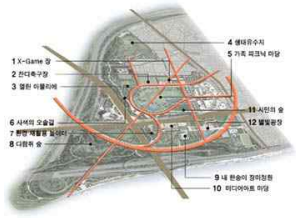

Fig. 5. Forest of pleasure
ⓒDongsimwon

Following the three concepts, they divided the space into three zones, as shown in figure. 6. A-Zone, which is dedicated to education avout ecosystem, B-zone, a space for recreational activities, and C-Zone, which serves as an area for culture and art. In each zone, particular space fitted with its characteristics is made. Hill of wind, Forest of squirrel, and Wetland for A-Zone, Plaza of four colors, Madang of family, Space of X-Game, Silvery Madang, and Blue Madang for B-Zone, Butterfly botanical garden, Madang of media art, Garden of bamboo sound, Playground of recycling, Waterworks museum, and Garden of memory for C-Zone are designed.

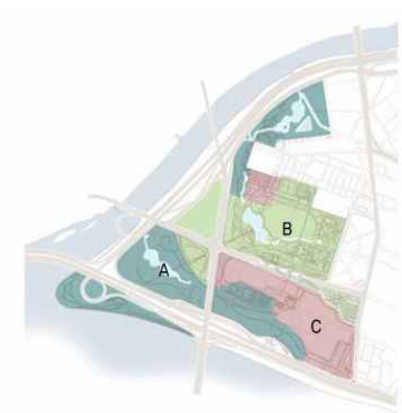

Fig. 6. Space division
ⓒDongsimwon

Dongsimwon suggests 51 spaces in their master plan. In those spaces, expected activities are mostly generic; for example, activities such as picnic, ecological education, walk, or sports. Especially, in ecological space, they used words like growth and succession, biodiversity, and network to explain cyclic ecosystem. However, designed ecological space are the place that are hard to see or experience ecological discussions they mentioned. Consequentially, Donsimwon's planning and design focused on physical segmentation of the space, and has not take into consideration the possibility of coexistence or combination of multiple activities taking place at the same time, or unexpected events creating conflicts among different groups.[5)]

1.3. Management Plan

In its design report, Dongsimwon suggests a plan for management operation.[6)] Setting the direction for the management, they try to tie their design objectives and goals with an actual management process. Their management planning proposes a way to reinforce solidarity between Seoul Forest Park and Citizens, and sets programs for systematic civic participation.

Management planning suggests four parts: maintenance management, natural resource management, facilities management, and users

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5) Sunhee Bark, "Contemporary large parks design in Korea: A critical study," *Masters Thesis,* Seoul National University, 2013, p.44.

6) Dongsimwon, *Planning and Final Design of Seoul Forest,* pp.203-240.

management. Most contents are about the facilities and are explained only quantity standards. It is hard to find contents that explain how to manage infrastructure. Also, they suggest 28 park events, which is made by considering seasons.

One point that draws attention is that they suggest several co-organizations for feedbacks to estimate the park management system and to complement programs regularly. They suggest a laboratory for collecting data about changes in the ecosystem and the impact the user's activities had on the system.

2. Aspect in Management Phase

2.1. Stakeholders

Seoul Forest Park has been run by partnerships of City of Seoul (Seoul Forest administration center) and the Seoul Forest Park Conservancy, the affiliated organization of Seoul Green Trust. Especially, in financial management, government takes a matching-fund system[7] with Seoul Green Trust as joint manager.[8]

Seoul Forest Administration Center

Seoul Forest administration center is in a government-affiliated project office on the greens of the park.

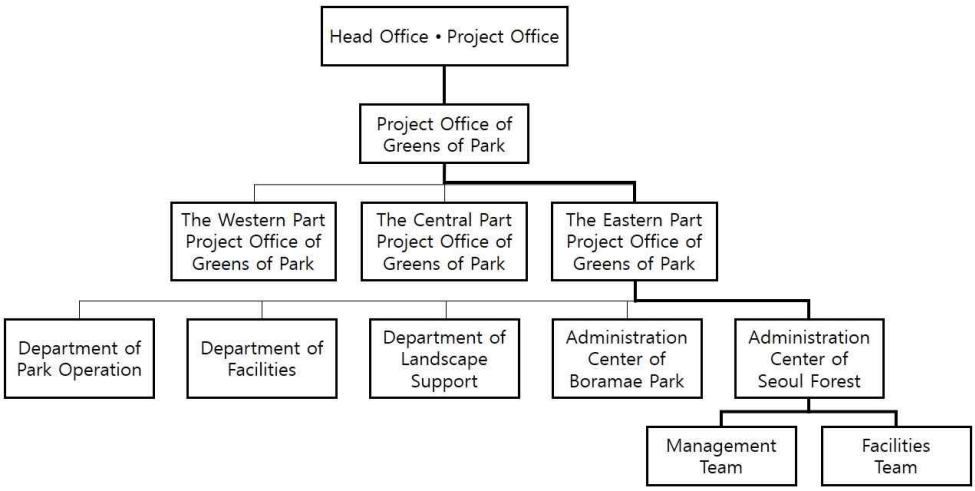

Fig. 7. Organization chart of Seoul Forest administrative center, reformation by researcher

7) Matching fund is the way that if central government budget supports local governments and private organizations, they received capital related with their self rescue effort. Following matching fund, Seoul Green Trust could be supported from Seoul government as much as they raised fund from companies, groups and persons.

8) Hana Lee, "The process of Seoul Forest Park's cultural establishment and the role of civil organization," *Masters Thesis,* Chugye University for the Arts, 2008, pp.58-59.

The center is divided into two teams, the management team and the facilities team. Management team handles operational activities such as budgeting, park planning, enforcing safety and other activities related with the operation of the park . Facilities team handles all amenities and equipments in the park. In handling some activities like managing human resources and ecological management, two teams work together, by allocating the work to the managers.

Seoul Green Trust

As a non-governmental organization, Seoul Green Trust is an organization that plants trees to improve urban environment and to help make the city as a space where people and nature coexist. They set a vision for green Seoul. "Seoul Green Vision 2020" suggests four movements: first, expanding one square meter green space for next generation, second, creating a park that citizens could participate in, third, recovering ecological health, and last, restoring the health of the community. To achieve these goals, they have conducted various projects. They made a civic group and encourage them to keep an interest about nature, by offering educational or cultural programs. Also, they establish a trust fund for projects. In addition, they carry on campaign and do public relations.

Seoul Green Trust has participated in the whole process of making Seoul Forest Park from planning to management. They have contributed by organizing Seoul Forest Park Conservancy.

Seoul Forest Park Conservancy

Seoul Forest Park Conservancy is affiliated organization of the Seoul Green Trust. This group is launched on Feb. 2005, for partnership to divide working roles and to operate the park collaboratively. This organization, which has no legal force, is a group made of volunteers to manage Seoul Forest Park made with fund raised by citizens. And they take on roles such as creating and developing programs, conducting campaigns, and caring for volunteer work activities. Details about Seoul Forest Park Conservancy will be discussed later in this chapter.

2.2. Management Process

Seoul Forest Park is regarded as the best private-public cooperative management.[9] However, in the case of Seoul Forest Park, since only program management part is entrusted by City of Seoul, it shows a unique phenomenon that combines government management and private-public cooperative management.

Establishment of Target in Three Phased Stages

As mentioned earlier, Seoul Forest Park has been managed by two institutions: government and civic organization. Seoul Forest administration center and Seoul Green Trust set up their phased goals

9) Ministry of Land, *Policy Research about Strategies of Creating Urban Park and Operation Management*, 2011, p.42.

and duties in stages.[10] The 1st stage (2005~2006) was the period of constructing park management system. During that time, they developed a park management program, and ran general ecological/cultural/communication program. The 2nd stage (2007~2009) was a transition period. During that time, they ran active programs of ecology, culture, rest, and employment programs. Now, the 3rd stage (2010~present) has been running. This is the stage where the citizens manage the park. Following that goal, they have been operating programs of ecology, culture, and recreation harmoniously.

Role Allocation of Management

Management operation is clearly assigned to each part.[11] Seoul Forest Park Conservancy takes tasks about the software of the park, such as developing and managing park's program, recruiting and managing volunteers, and advertising the Seoul Forest Park.

Administration center of Seoul Forest Park is in charge of managing facilities for the forest, providing basic services for the visitors.

Finances Management

Government bears expenses about most all management activities such as landscaping and facilities, except about program.

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10) Ibid., p.72.

11) Ibid., pp.60, 64.

Until 2008, Program management expenses come from the fund raised from donations of companies and citizens, facility rent, and funds from matching-fund with City of Seoul.[12] However, since 2009, City of Seoul has changed their relationship from matching fund which is based on private-public cooperative management to contracting-out management. Now, City of Seoul supports expenses only for park's program operation management, not including operating expenses of Seoul Forest Park Conservancy.

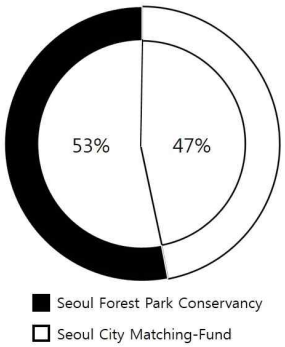

Fig. 8. Percentage of Operating Fund

The analyzed result from Seoul Forest Park Conservancy's reports of income and expenditure over the eight years (2005~2012) shows that support fund (including matching fund from 2005~2008) from government have captured about 47% expenses. This means that City of Seoul has covered almost half of the operating cost of Seoul Forest Park Conservancy. The ratio about support fund is increasing steadily every year. The most basic reasons about this increasing rate is that there have been large cuts in government by almost 40 percent (from almost 300 million won to 180million won).

Under this circumstance, it is easier to establish a top-down hierarchy rather than a mutual cooperation.

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12) Ibid., p.99.

2.3. Operating Programs

Programs of Seoul Forest Park have been operated by Seoul Forest Park Conservancy. Ongoing programs are classified in three types: ecological or using environmental resource program, culture program, and citizen-participation programs such as volunteer work or fundraising.

Changes of Programs

Since the opening in 2005 to 2012, proceeded programs are arranged as followed table 2. Programs have been changed with the public campaign of Seoul Forest Park. The changes of campaign concept are as followed table 3.

Programs take an environmental context since 2008, and have gradually been professionalized in operating ecological programs. Although campaigns also focused on ecological aspect from 2008 to 2010, from 2011, they have focused on participation of users.

Ongoing Programs

Current programs, in 2013, are divided into five parts: (1) youth leadership program, (2) senior program, (3) community program, (4) ecological / culture program, (5) small library in the forest, (6) public-service program.

Table 1. Chronological development contents of programs

Year	Program Development Contents
2005	Opening event, Program preparatory stage
2006	Program start: ecological / culture program
2007	Foster professional volunteers about Seoul Forest culture
2008	Conducting campaign and propose programs about environment change.
2009	Following context in 2008, start gardening and monitoring of insects in Seoul Forest
2010	Constructing Health Care Center for citizens
2011	Expanding monitoring species: insects, birds, warm-temperate tree species, Expert mentoring in natural ecology learning program
2012	Start nature experience program obtaining certification from Ministry of Environment, Creating diverse programs integrating ecology and culture

Table 2. Campaigns of Seoul Forest

Year	Motto	Actions
2006	The reading park, Seoul Forest	Leading new culture using park
2007	Smile, Seoul Forest	Upgrading park operation guide
2008	Protecting city by Seoul Forest	Creating values responding to climate changes like urban heat island
2009	Designing city with Seoul Forest	
2010		
2011	Happy place with youth, Seoul Forest	Focusing on youth participation-programs
2012		
2013	Seoul Forest, for the baby boom generations	Focusing on active senior programs

Youth leadership program which is called the "Out Door School" is proceeding with first year students from Seongsu High School which is nearby Seoul Forest Park. Students could choose an activity, among playing, drawing, reporting (of Seoul Forest), and art therapy. Asides from that, they sometimes have open lectures about the environment.

Senior programs consist of conducting seminars and lectures about a wide variety of subjects, and fostering volunteer activists through city gardener graduate program. During this year especially, the Seoul Forest Park Conservancy has focused on senior programs for the baby boomers.

An example of a community program is holding events such as forest neighborhood meeting, Seoul Forest guerrilla-gardening, community garden as form of urban agriculture, and various culture programs like watching movies, sewing in the forest, and field day, amongst others.

Ecological and culture programs are held by both the Seoul Forest administrative center and Seoul Forest Park Conservancy with different concepts. Administrative center has open programs on a regular basis, such as insect class and rare butterfly specimen exhibition. On top of that, they made program of filed work like "deer feeding". Conservancy have operated regularly scheduled programs like Seoul Forest visiting, and nature adventure, I like insects, and so on. Furthermore, they plan and offer many programs such as vacation program, wetland-learning program, gardening program, culture program, and others.

Small library in the forest is the program that rents books to park users.

Public-service program is conducted with the organizations like businesses. This program is operating candidate volunteer activist education or afforestation activities.

3. Inspecting Seoul Forest Park through Panarchic System

3.1. Analysis of Seoul Forest Park

I draw Seoul Forest Park management system (Fig. 9.) to compare it with the panarchic system.

Comparing the two systems, the panarchic system reflects some of the problems and limitations of the operation of the Seoul Forest Park management system.

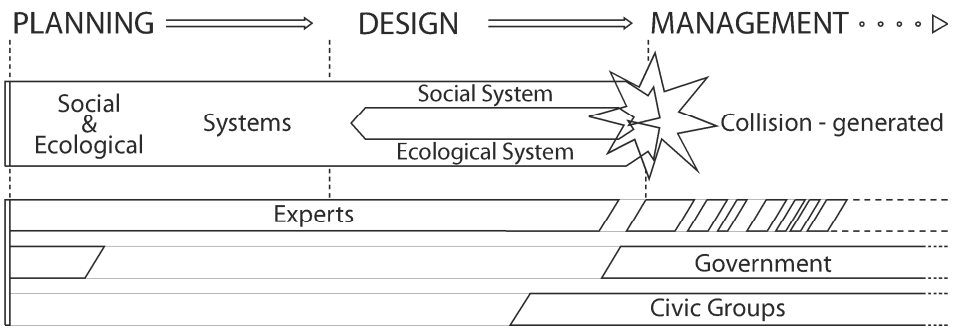

Fig. 9. Seoul Forest Park management system

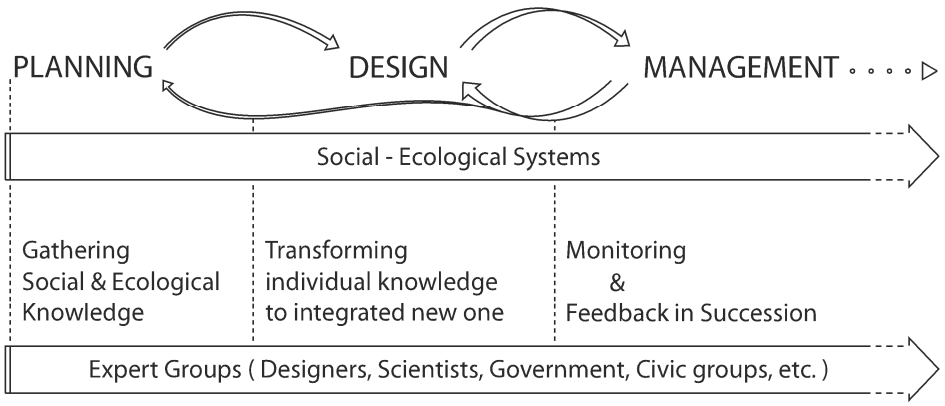

Fig. 2. Pancarchic management system

Separation Phenomenon of Social-ecological System

(1) Separation in the phase of planning and design

In planning and design phases, Dongsimwon try to consider some elements that may have resilience capacity and to integrate social and ecological elements in the design during the stage of concept setting and story telling. However, in the following steps, they show a tendency to separate the sections into nature area and human area, losing resilience integrated thinking they had just before. Although they drew a design concept and strategies integrating social and ecological system through precise interpretation about site, they failed to link the integrated context with practical and detailed design process.[13] The context indicating social-ecological systems in planning phase has disappeared in design phase.

(2) Separation in operation of ecological / cultural program

Although in the beginning, ecological and cultural programs were mainly pursued for elementary school students, now, various customized programs have been developed to embrace children of all ages.

Also, ecological contents that the program handles have been expanded to include subjects such as plants, insects, birds, wetlands, climate change, urban heat island, and others.

After it has been developed, there has been some problems in the

13) Sangmin Lee and Jungsong Cho, "A critical review of the Seoul Forest Park design competition," *The Korean Institute of Landscape Architecture* 31(6), 2004, p.25.

operation method. In the Seoul Forest Park, almost all programs, including social ones, are held in the natural area. So, it is obvious that these activities could have an effect on the ecosystems of Seoul Forest Park. However, the number of the activities that experts and ecologists has been involved from the preparation stage of the program are very small, even though the programs made without experts are hard to operate continuously; they only last temporarily.

(3) Limitations in ecological research and monitoring operation

There are activities researching about birds, soils, and trees by experts in the Seoul Forest Park. However, since their researches are performed separately, it is difficult for us to understand the whole ecosystem of the Seoul Forest Park. On top of that, there is no concrete way to apply the suggestions made as a result of their research to fix the errors of the practical management. Recently, they created new experiences in the ecological part. Seoul Green Trust and Korea Forest Research Institute held a symposium about various ecological discussions of the Seoul Forest Park.[14] These actions function as an encouragement to developing social-ecological systems.

In the same vein, ecological monitoring also has limitations in scales. Until now, monitoring has been performed on specific species of birds or plants, but to take a view of ecosystem cycle, monitoring is needed in large scales.

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14) Seoul Forest Symposium: Diverse Views to Urban Forests, 2013. 3. 27.

Defective Relationships between Management Institutions

Since the park's opening, managers has shown some efforts to make flexible governance through the cooperation with the government and volunteer organization as the first park operated by the private-public cooperative management. However, the management system of Seoul Forest Park shows a tendency of a combined aspect of government and private-public cooperative management. So, their relationship assumes a form of top-down system, because the civic organization is supported by the government in terms of finance management on almost half of the part. In this structure, it is hard to form correlation. Even if they are sharing the management tasks, they are not working together; the government and the civic organizations take on two individual tasks, facilities management and program development consecutively.

Besides, there are no institutional strategies for periodical and constant communication between the two organizations. Such divisions in tasks and difficulties in communications create misunderstandings about each other, only adding onto the conflicts.

Such aspect makes problems again and again in not only social but also ecological resilience. Repeated problems and short-sight solutions make park inefficient in consuming energy, managing fund, ecosystem, and causing inconvenience for visitors and residents.

3.2. Proposals to Seoul Forest Park for Improvement of Resilience

To cope with surfaced problems and limitations, I suggest establishing an operating/management committee to the Seoul Forest Park. This committee consists of Seoul Forest administrative center, Seoul Forest Park Conservancy, and an expert group that includes professionals from various fields such as ecology, landscape architecture, economy, to name a few. Adding onto that, there should be an institutional strategy to maintain the committee meetings persistently.

Also, there is requirement of legal procedure of long-term plan for parks. Present park plan, especially about park program, is hard to establish long-term plan because program is managed through contracting-out management by three-year contract with Seoul Forest Park Conservancy. In this condition, program managers should be limited to long-term plan. For effective operation management, looking social-ecological systems, the present legal processes of the park programs need to be changed.

With this suggestion, I expect to see three points based on resilience view. First, it will be expanded from secluded social or ecological scales to social-ecological scale. This integrated scale improves the ability to cope with unexpected problems by considering social and ecological processes at the same time. Second, it could show new directions and ways to adapt to the changing and complex urban ecology and to move together for landscape architect and organizations. Last, it could improve efficiency of operation management through a mutual understanding among stakeholders.

Ⅴ. CONCLUSION

The perspective about the ecosystem is changing. Ecosystem is not a stable, equilibrium state that we could control and predict, but an unstable, complex state that we could not control and predict. Important context in this change is that we consider the ecosystem as a social-ecological system because nature is not far away from us. Social-ecological systems appear clearly in urban place. And the large parks take some societal and ecological responsibilities and roles. Changing perspective suggests a keystone to leading us towards sustainability for nature and human. That is resilience. Resilience makes us to understand the ecosystem correctly, and to consider ecological system and social system at the same time and on the same stage.

Taking this concept to landscape architecture, I define landscape architecture's resilience: the capacity to keep and perform the parks' various societal functions while fulfilling ecological process in the changing world. Based on this definition, limitations and problems of existing conventional park process are revealed.

1. Designers and managers could not understand ecosystem as one big system that are related closely to each other but concentrated on individual elements.

2. Because of the lack of thinking about considering social system and ecosystem at the same time, there rarely are considerations about the relationships and interactions between the ecosystem and society.

3. At the managing phase, repeated problems have been occurring because of lack of professional knowledge in making the programs or managing nature and facilities.

4. There are no instrumental strategies for continuous professional monitoring. Furthermore, there is no legal device that could enforce application of feedbacks in practice.

5. Top-down relationships between the government and organizations are blocking regular and continuous communication.

These limitations raise various problems across the ecosystem to society.

To overcome such imperfections, I suggest a new park operation management system based on the concept of resilience, the panarchic system. This new system sets up elements of both society and ecosystem for resilient processing, and shows panarchic cycle, suggesting directions from feedback to the planning or design process, in comparison with top-down system. Also, it emphasizes the roles of experts and leaders in each phases. They will perform a role of the gathering, understanding, translating, and applying scattering informations of social-ecological systems. Panarchic system expresses that going the back loop is not the results of mistakes. Such cycle is the most natural aspect in consistently changing world.

In landscape architecture field, discussion about resilience helps us to readdress perspective about terms such as "sustainable," or "ecological". Also, it shows limitations of existing system separated into society and

ecology, and emphasizes necessity of new integrated thinking and systems that encompass societal actions and ecological process.

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국문 초록

대형 공원은 도시 안에 형성되는 생태적 공간으로 도시 생태계에 영향을 주고, 또한 영향을 받는다. 동시에 이 공간은 사회적 역할을 수행하며 많은 활동을 수용한다. 생태적 프로세스와 사회적 프로세스의 복잡한 결합이 발생하는 공원은 계획에서부터 관리 단계까지 다학제적이고 통합적인 사고를 요구한다. 본 논문은 다학제적 개념인 회복탄력성(resilience)을 조경의 범위에서 탐구하고 대형 공원에서 사회와 생태를 동시에 작동하게 하는 새로운 운영 관리 시스템을 제시한다.

조경은 지금까지 생태, 미, 인간을 공간에서 조화시키고자 노력해 왔다. 하지만 조경가들은 이 세 가지 요소를 통합하는데 종종 한계에 부딪혀 왔다. 이는 생태를 미나 인간의 활동과 다른 영역으로 인식하는데서 비롯된다. 이러한 분리적 사고는 조경에서뿐만 아니라 다른 학문 내에서도 한계점과 문제점을 드러내었고, 이를 넘어서기 위해 새로운 사고를 요구하는 움직임 나타났다. 사회-생태 시스템(social-ecological system)은 지금까지 분리되어 온 사회와 생태를 통합한 새로운 체계의 필요성을 설명한다.

이 통합적 시스템은 생태가 고립되어 있는 것이 아니라 항상 사회에 영향을 받을 수밖에 없기 때문에, 생태와 사회, 이 두 가지를 분리하여 생각하는 것은 문제를 유발하게 되고 한계에 부딪힐 수밖에 없다고 말한다. 다학제적 통합이 요구되는 이 체계는 기존의 사고를 전환하게 하는 회복탄력성 개념을 통해 실현 가능해진다.

회복탄력성을 처음으로 소개한 홀링(C. S. Holling)은 기존의 생태를 바라보는 시각의 맹점을 지적하며 새로운 개념을 통한 시각의 전환을 촉구

한다. 그는 기존의 정적 시각(stability view)이 생태를 평형적이고 예측 가능한 상태로 이해하며 그것을 유지하는 것에 초점을 맞추고 있다고 지적한다. 반면, 회복탄력적 시각(resilience view)은 정적 시각과는 다른 접근으로, 각 요소가 아닌 요소의 영역과 지속을 위한 요구 사항에 주목한다고 말한다. 생태를 예측 불가능하고 제어할 수 없는 복잡한 시스템으로 이해하는 것이다.

사회–생태 시스템으로서의 회복탄력성 개념은 우리가 살고 있는 세계가 매우 긴밀히 연결되어 움직인다는 사실을 강조한다. 즉, 생태나 사회를 개별적인 요소로 이해하여 다루는 것이 아니라 하나의 큰 덩어리로 인식하고 바라볼 때 각 요소도 제대로 이해할 수 있으며 그러할 때 진정한 지속적 공생이 가능하다는 것이다.

생태에 대한 사고의 전환을 통해 생태와 사회 프로세스의 통합을 이끌어내는 회복탄력성은 조경에 시사하는 바가 크다. 이 개념은 생태와 사회를 동시에 고려한 계획 · 설계 · 관리에 대한 중요성을 환기시킨다. 생태와 사회라는 요소는 조경이 지속적으로 다루어온 부분이다. 하지만 지금까지는 설계의 개념을 설정하거나 전개하는 과정에서 수사적으로 둘의 통합에 대해서 언급할 뿐 실제적으로 공간을 구획하거나 프로그램을 구성하는데 있어서는 둘의 영역이 분리되는 경향이 있어 왔다. 특히 관리 단계에서는 두 부분이 따로 관리되면서 여러 문제를 발생시키고 있다.

본 논문은 회복탄력성 개념을 조경의 영역 안에서 정의하고, 대형 공원의 회복탄력성 요소를 사회적 요소와 생태적 요소의 두 부분으로 추출하였다. 또한 대형 공원의 새로운 운영 관리 시스템으로 판아키 시스템(panarchic system)을 제안하였다. 이 시스템은 공원의 계획 단계부터 관리 단계까지 생태와 사회 프로세스를 동시에 고려할 수 있게 하는 것으로 공원의 회복탄력성 향상을 위해 각 단계별로 수행해야 할 사항들을

제시한다. 판아키 시스템은 공원의 사회적·생태적 회복탄력성 요소를 바탕으로 불안정한 순환을 보여준다. 이 불규칙한 순환 고리는 기존의 경직된 상하 위계의 체계와 달리 관리 단계의 피드백이 설계 단계 혹은 계획 단계로 다시 되돌아가는 고리를 보여준다. 판아키 시스템에서의 역순환은 실패에서 기인한 후퇴가 아닌, 불안정한 생태의 순환을 적절히 따르는 회복탄력적 움직임이다. 그리고 이 시스템은 다양한 분야의 전문가가 개입할 것을 강조한다. 전문가들은 계획 단계에서 여러 분야의 지식을 모으고 설계 단계에서 다양한 정보들을 주어진 공간에 적합하게 변형시킨다. 마지막으로 관리 단계에서는 지속적이고 정기적인 모니터링과 피드백을 통해 예기치 못한 상황에 적절히 대응할 수 있도록 돕는다.

제안한 시스템의 검증을 위해 서울의 대형 공원 중 회복탄력성 요소를 가장 많이 가지고 있는 서울숲에 시스템을 적용하였다. 판아키 시스템을 통해 서울숲의 회복탄력적인 가능성과 그를 방해하는 요소를 확인할 수 있었다. 서울숲의 회복탄력성을 저해하는 부분은 다음과 같이 두 가지로 나타났다. 첫째, 사회–생태 시스템이 여러 부분에서 분리되는 양상을 보이고 있었다. 계획·설계 단계에서 나타나는 분리 양상과 함께 공원 조성 후 생태와 사회 프로그램의 운영 관리가 분리되면서 생태적인 문제와 함께 관리 운영에 어려움이 나타나는 부분을 확인할 수 있었다. 둘째, 관리 기관들의 불안정한 관계에 있었다. 서울숲의 운영 관리는 정부와 민간단체가 함께 담당하고 있다. 두 기관의 관계는 회복탄력성 향상에 큰 영향을 끼친다. 하지만, 아직까지 서울숲에서 정부와 민간단체의 관계는 피드백이 어려운 상하 위계 구조를 보이고 있었고, 두 기관 간의 의사 소통을 위한 법적 체계 등이 마련되어 있지 않은 상태였다.

주요어: 회복탄력성, 사회-생태 시스템, 공원 운영관리 시스템, 대형 공원, 다학제적 사고, 통합적 사고, 서울숲

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