Master's Thesis

Tailoring Government as a System Toolkit for Sustainability Transition of Gwacheon National Science Museum (GNSM)

Byeong Kuk Kwak

Department of Creative Design Engineering

Graduate School of Creative Design Engineering, UNIST

2023

Tailoring Government as a System Toolkit for Sustainability Transition of Gwacheon National Science Museum (GNSM)

Byeong Kuk Kwak

Department of Creative Design Engineering

Graduate School of Creative Design Engineering, UNIST

Abstract

As sustainability issues gain increasing global importance, the demand for efforts extends beyond governments to include art museums and cultural institutions. In Korea, museums and related organizations are striving to address these issues. However, their focus is primarily limited to operational and facility aspects, making it challenging to grasp the broader policy perspectives. The National Museum of Modern and Contemporary Art (MMCA) in Korea had a successful opportunity to engage in discussions on specific policy ideas that encompassed not only resource usage and technical solutions but also the acceptability of change and the aspirations of citizens.

This project, titled "A Carbon Neutral Art Museum through speculation with future citizens," utilized a toolkit called "Government as a System" developed by the UK Policy Lab. The toolkit encompasses 56 government actions and aids policymakers in connecting specific policy ideas with corresponding actions. Using this toolkit, policy ideas from citizens were mapped, and MMCA played a pivotal role in this endeavor. Inspired by MMCA's success, the Gwacheon National Science Museum (GNSM), a renowned science museum, expressed an interest in adopting a similar approach to assess the suitability of the toolkit within their own context and role.

This research, conducted as part of the GNSM project, aims to identify the key areas of focus for Gwacheon National Science Museum in Korea and determine which areas require greater attention concerning sustainability issues. The "Government as a System" toolkit serves as the primary instrument for achieving this objective. Through interviews conducted with 10 employees involved in sustainability or long-term planning, qualitative insights were obtained. These insights clarified the actions necessary for sustainability and highlighted the areas where the museum seeks to expand its role as a prominent science museum. The "Government as a System" toolkit was employed to organize and distribute these actions effectively.

The research conducted at Gwacheon National Science Museum enables the identification and prioritization of areas requiring attention for sustainability. Furthermore, similar institutions can adopt this model to assess their current status and develop future plans. Given that museums and cultural institutions are greatly influenced by higher-level governments, the establishment of policies and evaluation criteria based on this model becomes imperative for driving long-term changes.

Contents

List of Figures

I Introduction

Ensuring a sustainable future has become imperative in the face of the climate crisis, resource depletion, and other pressing issues. The field of sustainability transition has emerged as a response to these challenges, exploring radical changes to socio-technical systems. The growing interest in this field is reflected in the number of publications, surpassing 500 in 2018 [Köhler et al., 2019]. As nations and companies around the world seek to address these issues, carbon neutrality and ESG principles are becoming increasingly popular in policies, products, and services. This trend is driven by the need for sustainable change, and the investment directed towards carbon neutrality and related policies is gradually increasing.

Many exhibition centers and related policies worldwide are not exempt, as sustainability concerns become increasingly complex and pressing. To address these issues, the International Committee for Museums and Collections of Modern Art (CIMAM) has developed a toolkit for promoting environmental sustainability in museum practices [Chambers et al., 2021]. This toolkit provides a range of solutions and best practices that are currently being implemented by museums and curatorial projects. These practices include efficient exhibition and program design, sustainable hiring practices, and building efficiency. In an effort to build a more sustainable future, the Museum of Modern Art (MoMA) has established a Sustainability Department and the Emilio Ambasz Institute for the Joint Study of Built and Natural Environment [MoMA, 2020]. Furthermore, MoMA is actively working to transform its building systems and operations to minimize energy consumption and carbon emissions, with a goal of achieving zero waste with the resources it consumes. Additionally, MoMA is engaging communities in dialogue while taking action towards a more sustainable future. Art Council England has made environmental responsibility a key investment principle to encourage artists and organizations to reduce their carbon footprint [England, 2023]. Meanwhile, the Government of Ireland has launched the Creative Ireland Programme, which includes the Creative Climate Action Fund project [Programme, 2022]. This initiative aims to foster creative solutions that address the environmental, social, and economic challenges arising from climate change and engage people in the process. Numerous art museums and governments are making efforts to achieve carbon neutrality through various means, including exhibitions, programs, funding, and policies.

I experienced one case of these efforts in 2022, while working on a project at the National Museum of Modern and Contemporary Art (MMCA) of South Korea. MMCA is a typical museum of South Korea and an influential institution among the art museums in the country. The project focused on achieving carbon neutrality of MMCA, which is one of many sustainability issues of the museum. The project, titled "A Carbon Neutral Art Museum through speculation with future citizens," provided an opportunity to discuss specific policy ideas that addressed not only resource usage and technical solutions, but also the acceptability of change and the desires of citizens. In this progress, one of core activity was connecting latter ones, socio-technical viewpoints such as economics and social acceptances from citizens, to specific government actions that policymakers in the museum are accustomed to using. At this moment, the Government as a System toolkit is used.

The reason for the birth of the toolkit is to propose various roles of the government so that policy-makers can use them when creating new ideas for policies. Based on over 50 projects, UK Policy Lab has developed various forms of government that are local, central, and international government. Siodmok (2020) mentioned that she and her team mapped the actions that the government can take based on systems thinking, thereby broadening the government's perspective on the roles it can play and creating a tool that allows for consideration of the necessary government roles at the appropriate time. [Siodmok, 2020]

This toolkit considers the government's policy decision-making process as a single system and effectively organizes various actions that the government can take. This toolkit includes 56 actions that are arranged along two axes: from soft power (above) to hard power (below) of government related to actions vertically, from initial engagement (left) to actions for adjusting policy (right) based on Double diamond horizontally. This toolkit enables policy ideas from citizens to be translated and mapped with appropriate government actions.

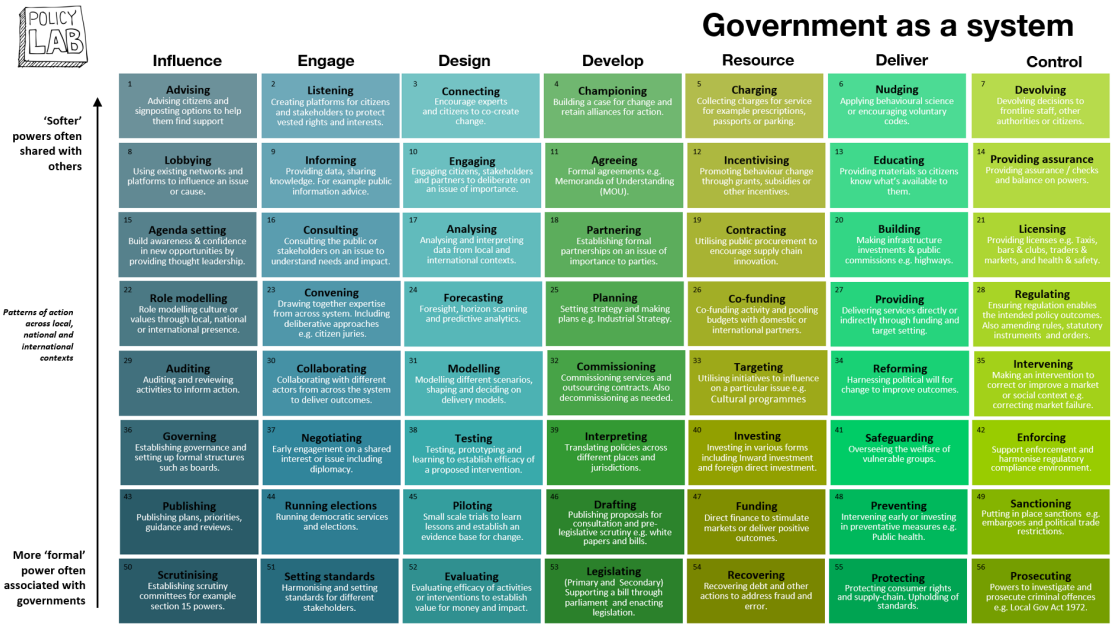

Figure 1: Government as a System Toolkit developed by UK Policy Lab

In the carbon-neutral project with MMCA, this toolkit was utilized as a mapping framework. It was used to categorize and match policy ideas freely imagined and proposed by citizens with specific government actions. The matrix not only included hard government actions such as regulations and legislation but also encompassed various soft government actions such as participation, listening, and delegation, which are informed by socio-technical viewpoints present in citizens' policy ideas.

While connecting and delivering these specific government actions as policy tools was successful, there were certain limitations. The toolkit was designed to align with various forms of government in the UK, but its suitability and functionality within executive agencies and national institutions were not validated before its application to MMCA. Nevertheless, the project concluded, leaving behind implications

that further exploration and investigation are necessary.

This master's thesis is conducted as part of the GNSM project, and the following aspects were highlighted. It explores whether modifying the toolkit to suit the Science Museum of Korea, a representative hub in South Korea similar to MMCA, would result in effective policy tools. It also investigates which tools would work and which would not, as well as how the toolkit could be modified if the Gwacheon National Science Museum effectively utilizes this matrix. Therefore, this paper aims to guide research and analysis of the toolkit's effectiveness and potential adaptations to the specific context of Korean museums, by tailoring the toolkit for sustainability transitions in these institutions.

The key findings are as follows: Based on the activities currently being undertaken by Gwacheon National Science Museum and the directions it needs to focus on in the future, it was possible to grasp at a glance the current state of the museum and the activities that need to be pursued for sustainability. Furthermore, by examining the distribution of policies at Gwacheon National Science Museum, the possibility of applying it to similar institutions was identified, and it is expected that this distribution pattern will gradually evolve according to the vision and goals of the institution.

The contributions of this work are that this toolkit provides an opportunity for domestic science museums, which are currently required to address sustainability and change, to assess their own state and future direction. By proposing a modified toolkit that can be applied to domestic landmark science museums, it provides a direction for policy efforts required for sustainability.

The upcoming content will be grounded in the research proposition that sustainability transitions within Korean public museums can be effectively managed through a Government as a System Framework. This framework enables the translation of policy ideas into precise policy tools, taking into account social acceptance. Subsequently, this paper modestly elucidates the process of tailoring the toolkit by providing specific details regarding the interviewed individuals, the questions posed, and the interview structure employed. Building upon the findings from these interviews, the paper examines the distribution of policies encompassing the ongoing actions of Gwacheon National Science Museum and highlights the areas that warrant further attention. It presents a modified version of the toolkit that aligns with the unique characteristics of a science museum and delves into the ensuing direction and significance derived from this adaptation.

II Related Works

2.1 Sustainability transitions are causing an increase in "wicked" problems within the policy field.

There are numerous environmental problems that cannot be addressed solely through incremental improvements, such as climate change, loss of biodiversity, and resource depletion [Köhler et al., 2019]. These problems are accompanied by radical shifts in socio-technical systems, which are highly interconnected with user practices, technologies, value chains, organizational structures, and even political structures [Markard et al., 2012]. These radical shifts are referred to as sustainability transitions, which are emerging rapidly, as evidenced by the increasing number of publications on the topic annually [Köhler et al., 2019].

Policy problems have become increasingly difficult to address using traditional policy approaches, as prevailing sustainability challenges involve complex coalitions of various socio-technical systems [Rittel, 1973]. It is no longer sufficient to handle problems within fixed system boundaries, while traditional policy planners attempt to solve problems using incremental changes [Markard et al., 2012]. Environmental problems such as climate change are considered wicked problems [Rittel, 1973], as they are not easily solvable tame problems. These wicked problems, also known as grand challenges, resist traditional policy approaches and require a more advanced and collaborative approach [Rosenbloom et al., 2020].

2.2 Policy meets design to solve wicked problems

Public sectors have increasingly adopted design methodologies to tackle wicked problems in the policymaking process. Approaches such as system thinking, human-centered design, co-design, and prototyping have been utilized to find responsive solutions and validate them against societal needs. The application of design in public administration has grown significantly, with an average number of publications increasing from 1.1 in the 1990s to 6.9 between 2010 and 2016. This trend has introduced creative collaboration and flexibility to policy development, allowing for a more inclusive approach to problem-solving.

III Methods

This paper aims to find a proper tailoring approach for the 'Government as a System' toolkit that is suitable for the context of Gwacheon National Science Museum. Since sustainability capability is required for various national institutions, it is necessary to explore whether the toolkit, which was developed in the UK and tailored to the UK environment, is also suitable for Korean museums. Additionally, the specific reasons and logic behind the development of this toolkit need to be examined before it is developed and applied to real policymaking processes. The initial research design was structured in the following two steps: (1) interviews with design experts who have either contributed to the development of this toolkit or have used this toolkit in their projects, and (2) interviews with GNSM staff members to understand their perspectives on the 'Government as a System' toolkit in their own context and workflow.

For the design experts interviews, relevant designers were identified based on the contents of the 'Government as a System' toolkit available on the UK Policy Lab website and social networks. A total of five UK-based designers were found: two were involved in the toolkit design process, while the others had experience using it in their own projects or workshops. The researcher contacted them via social networks starting in March, 2023. Unfortunately, the interviews could not be conducted as three of them did not respond, one was disconnected, and another had non-disclosure issues regarding her project. As a result, the research solely rely on interviewing GNSM staff members based on the basic information and structure of the 'Government as a System' toolkit.

The GNSM staff interviewees were selected based on two criteria: (1) staff members belonging to departments involved in mid- or long-term policy projects, such as the Management Planning Division, General Services Division, Exhibition and General Affairs Division, Exhibition Support Division, and Education and Culture Division, and (2) staff members who are division leads or have 2-3 years of experience in their respective roles. All recruiting process was aided by our counterpart in GNSM, resulting in a total of 10 interviewees who have worked at GNSM for at least 5 years, excluding the GNSM director, as shown in Figure 1.

3.1 Interview Structure

The interview structure consists of two phases. In the first phase, a brief description of the research and the interview is provided, and the interviewees are requested to introduce their work and share their thoughts about GNSM. Afterward, the interviewees were given time to familiarize themselves with the Government as a System toolkit while the author provides a brief description. In the second phase of the interview, the interviewees identify which actions out of the 56 government actions in the toolkit are relevant to GNSM. They also mark which actions they believe should be implemented more at GNSM. The interview concludes by asking for the interviewees' feelings and opinions upon seeing this toolkit. Detailed questions are listed in Figure 2.

	Division	Experience (years)	Interview time (min.)
A	Director	1	80
B	Exhibition Coordination	9	100
C	Science Exploration	10	62
D	Planning & Management	5	52
E	Planning & Management	8	65
F	Planning & Management	15	41
G	Education & Culture	6	65
H	Education & Culture	6	49
I	Exhibition Coordination	10	32
J	General Affairs	10	103

Figure 2: List of interviewees

Phase	Interview questions
Phase 1 About individual work and experience	– Could you please introduce yourself briefly? – How long have you worked at GNSM? – What are your current responsibilities and tasks? – Where did you work before joining GNSM? Are there any notable differences between your previous workplace and GNSM? – What are the distinctive goals, responsibilities, and vision of GNSM compared to other companies or public institutions?
Phase 2 About framework	(Request to mark on Interview material) – What are your initial thoughts on this framework after reviewing it? – In your perspective, which actions should GNSM focus on more? – Do you have any suggestions or ideas to add to the framework? – Do you currently use any tools in the policymaking process? – If yes, how do you utilize them? Are there any differences compared to using this framework?

Figure 3: Interview questions by phases

3.2 Interview Material

An interview material was utilized to facilitate interviews with GNSM staff, which consisted of a translated version of the Government as a System toolkit in Korean. (Figure3) The entire matrix was translated into Korean to enhance the understanding of the toolkit among GNSM staffs. The translation version of toolkit was developed thorough a series of process. The first translated version is made by research team

when MMCA project is ended in 2022. After that, translated version is examined and revised by an external expert who stay on top of Korean government and NGO environments. Lastly, the author led final detail revision process to fix detail words naturally with four researchers in same research laboratory.

이 름

Originated from UK Policy Lab | Translated by New Design Studio

시스템으로서의 정부 | Government as a system

Softer

보통 다른 이해관계자와 공유하는 '소프트 파워'

지역, 국가, 국제적 맥락에 걸친 행동패턴

보통 정부가 가지고 있는 '공식적인' 힘 (권력)

Formal

영향력	참여	디자인	발전	자원	결과	조정
안내/조언 시민에게 조언을 제공하고, 직접 도움을 구할 수 있는 옵션을 비치	**경청** 시민과 이해관계자가 가진 관리와 이익을 보호하기 위한 플랫폼(장구/장치) 만들기	**연결** 전문가와 시민이 함께 변화를 만들도록 독려하기	**변화주도** 변화를 위한 사례 구축 및 행동을 위한 연대 유지	**과금** 서비스 비용(요금)을 징수 (예: 처방전, 여권발급, 주차)	**넛지** 행동경제학을 적용하거나 자발적인 (강제적이지 않은) 규칙 만들기	**위임** 일선 직원, 다른 조직 또는 시민에게 결정을 위임
로비 기존의 네트워크나 플랫폼을 활용해 문제 또는 목표에 영향을 미침	**정보제공** 데이터 제공, 지식 공유. 예: 공공정보 활용법 안내	**소통** 시민, 이해관계자, 협력자 등이 중요한 문제에 대해 숙고할 수 있는 기회를 마련	**협약** 공식적인 계약 (예: MoU)	**촉진** 장려금, 보조금 혹은 기타 인센티브를 통한 행동변화촉진	**교육** 시민들이 활용할 수 있는 것들에 대한 자료제공	**보장** 권리(권한)의 보장, 권력에 대한 견제와 균형
의제 설정 새로운 관점과 통찰력을 바탕으로 새로운 기회에 대한 인식과 기대감을 형성	**상의** 시민, 이해 관계자, 조력자(협력기관)에게 중요한 문제에 대해 상의하기	**분석** 지역 및 국제적 맥락에서 데이터 분석 및 해석	**파트너십/제휴** 여러 이해관계자에게 중요한 문제에 대한 파트너십 구축	**조달** 공공조달을 활용해 공급망 혁신 촉진	**건설** 인프라 투자 및 위탁운영 (예: 고속도로)	**인허가** 인가, 허가, 면허, 특허, 등록, 신고 등 (예: 택시, 바, 클럽, 상인 및 시장, 건강 및 안전관련 업소)
롤 모델 지역, 국가, 세계적 존재를 통해 문화와 가치에 있어 본받을 만한 모델로 삼음	**소집** 생태계 전반의 전문가들을 소집. 시민 배심원과 같은 심의 기구도 포함됨	**전망/예측** 다양한 예측적 분석 방법론을 통한 미래 전망	**계획수립** 전략 및 계획 수립 (예: 산업 전략)	**공동예산** 국내외 파트너와 공동예산투여 및 공유예산 형성	**도입** 예산투여와 목적설정을 통해 서비스의 직 • 간접적 도입	**규제** 규제를 통해 의도한 정책결과 달성을 보장. 또한 규칙, 법문서 및 행정명령을 수정함
감사 적절한 조치를 알리기 위한 감사 및 감수	**협력** 생태계의 다양한 전문가/주체와 협력하여 결과를 제공	**모델링** 다양한 시나리오 모델링, 정책이나 서비스 도입을 위한 모델 형성 및 결정	**발주** 위탁운영 및 외주계약 (혹은 운영 및 계약 종료)	**타겟팅** 특정 이슈에 영향을 미치기 위해 새로운 계획/프로그램을 활용 (예: 문화 프로그램)	**개혁** 변화를 위한 정치적 의지를 활용해 결과 개선	**개입** 시장이나 사회적 상황을 바로잡거나 개선하기 위한 개입 (예: 시장실패 교정)
거버넌스 거버넌스 확립 및 이사회와 같은 공식적 조직구조 설정	**협상** 외교를 포함, 공통된 관심사/이슈에 대한 조기 참여	**실험** 제안된 정책이나 서비스의 효과입증을 위한 테스트 및 프로토타이핑	**통역** 다양한 장소와 관할권에서 정책을 해석(해설)	**투자** 내국인 혹은 외국인 직접투자 등 다양한 형태의 투자	**안전장치** 취약계층의 복지를 관장	**시행** 서비스나 정책시행 지원 및 규정준수를 위한 환경조성
공개 계획, 우선순위, 지침과 감수내용의 게시	**선거운영** 민주적 서비스 및 선거운영	**시범사업** 변환을 위한 실증데이터 수집과 개선점 파악을 위한 소규모 시범사업	**입안** 백서, 법안과 같은 입법 사전검토 및 협의를 위한 제안서 작성 및 게시	**재정지원** 시장을 활성화하거나 긍정적인 성과를 위한 직접적인 예산투여	**예방** 조기 개입 혹은 예방 조치에 투자 (예: 공공보건)	**제재** 제재 조치 (예: 입출항 금지, 정치적 무역제한)
감시 조사위원회 구성 (예: 영국의 수색영장 관련법 Section 15)	**표준설정** 다양한 이해관계자를 아우르는 조화로운 기준(표준) 설정	**평가** 도입된 서비스나 정책의 비용대비 효능과 영향력을 확인하기 위한 활동 및 개입의 효과 평가	**입법** 국회를 통한 법안지지 및 제정	**자금회수** 부정행위 및 오류해결을 위한 부채 회수 및 기타 조치	**권익보호** 소비자 권익과 공급망 보호 (표준 준수)	**기소** 기소 형사조치 (예: 1972년 지방정부법)

Figure 4: Korean-translated Government as a System toolkit

3.3 Data Collection

As described in the interview structure, each interviewee marked whether the specific government actions in the toolkit were actually implemented in GNSM or not, using 'O' and 'X'. A total of nine results were obtained from the marking process, as there was no time to discuss the toolkit with the director.

Each interview was conducted individually in a small conference room at GNSM and lasted for three days. All interviews were conducted in Korean. Participant J joined later due to his vacation, and his interview was conducted via the online meeting service, Zoom. The planned duration for each interview was 40-60 minutes, with the length of the interviews ranging from 32 to 103 minutes, averaging 65 minutes. In total, the interviews lasted for 10 hours and 49 minutes. Interviewee B and J in particular had longer interview durations, lasting for 100 minutes. The reason for the longer duration in these cases was that interviewee B showed great enthusiasm about the direction of GNSM and provided repetitive and detailed descriptions. In the case of J, as the only participant responsible for facility operation and energy consumption at GNSM, discussing detailed energy policies and strategies being implemented by the institution led to delays during the interview.

All recorded voice files from the interviews were transcribed using an AI-enabled transcription service. The author listened to all the files and checked for any typos or inaccurately transcribed sentences. The author reviewed the transcripts of all the interviews and coded them to identify insights. The nine interview materials were also synthesized to create a specific tailored version of the Government as a System toolkit for GNSM.

IV Results

The goal of this research is to tailor the Government as a System toolkit to the context of GNSM. Interviews were conducted with 10 GNSM staff members who are involved in museum policies to gain detailed insights into the current state and vision of the museum through their perspectives. During the interviews, the interviewees identified which actions on the Korean-translated toolkits were relevant to GNSM as they reviewed it. As a result, nine marked toolkits and ten transcribed interview data sets were generated.

The actions that GNSM is sufficiently performing on and those that GNSM should put additional efforts to actualize were derived from the interview data. The following results illustrate the distribution of responses from GNSM staff members regarding the Government as a System toolkit. In Figure 4, the lighter-shaded areas indicate areas where GNSM is performing well, while the darker-shaded areas represent areas for improvement. As shown, the softer actions (located above in the toolkit) generally have a brighter shading compared to the formal actions. GNSM also appears to have focused more on the central actions rather than the actions on the left and right, particularly the Control actions. Figure 5 depicted what actions GNSM staffs think that the museum should put more efforts to perfom on. As deeper color gets, as more the staffs said it important. Many shaded color boxes are in Design actions, especially Analysing and Forecasting actions. Some soft actions such as Connecting, Engaging, and Planning were also emphasized by the staffs.

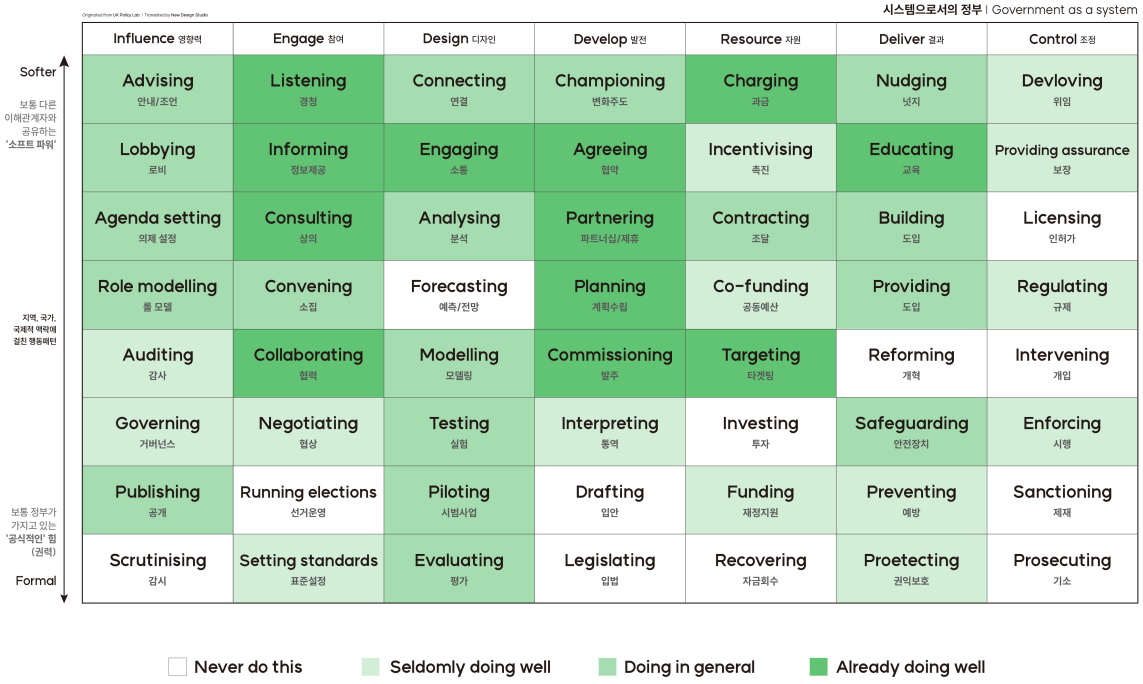

Figure 5: What GNSM is sufficiently performing on

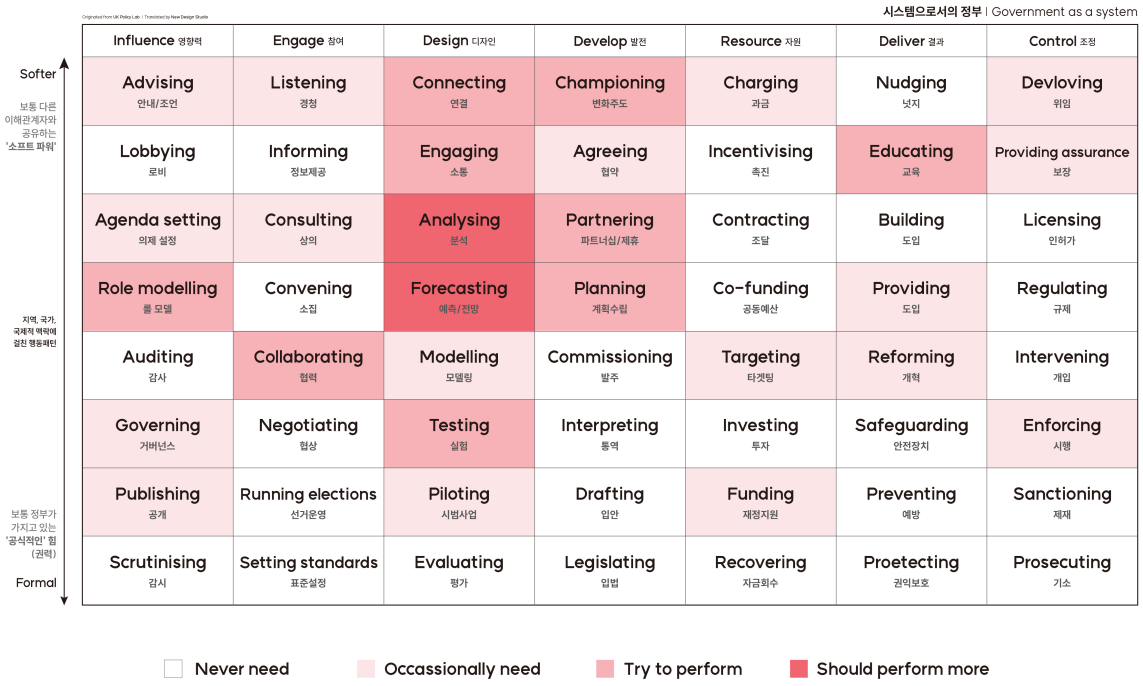

Figure 6: What GNSM should put additional efforts to actualize

Each government action in the toolkit has a pair of characteristics, including both areas where GNSM is performing well and areas where GNSM should put in more effort. A total of 16 possible pair cases were derived based on Figure 4 and Figure 5, and some of them were combined, divided, or eliminated based on qualitative interview data. Subsequently, the 56 actions in the toolkit were categorized as shown in Figure 6. First, all government actions were divided based on whether GNSM is already performing them: (1) Already doing, (2) Not doing but should try, and (3) Unrelated actions. Already doing and Not doing but should try are connected to what GNSM is currently doing, whereas Unrelated actions indicate that all staff members unanimously agreed that those actions are obviously not related to GNSM's role. Furthermore, the Already doing category was further divided into (a) actions that GNSM should try to improve, (b) actions that are being adequately performed, and (c) actions that are seldom performed, based on the importance of the actions as determined by the staff members. Finally, each category includes both external and internal actions. External actions involve directing other stakeholders of the museum, such as citizens, other museums, exhibition-related companies, and so on. Internal actions were clarified through interviews and pertain to enhancing the museum's internal capabilities or operations, with examples including auditing, devolving, and regulating. All actions in the toolkit are classified based on their characteristics, and each category is color-coded on the toolkit (Figure 7) to illustrate their distribution in distinct zones.

Category		External/Internal	No. of actions
Already doing	We shall try better	External	9
		Internal	
	Doing enough	External	22
		Internal	3
	Seldom doing	External	3
		Internal	2
Not doing but shall try		External	2
		Internal	
Unrelated actions			15
Total			56

Figure 7: Government actions classified by categories

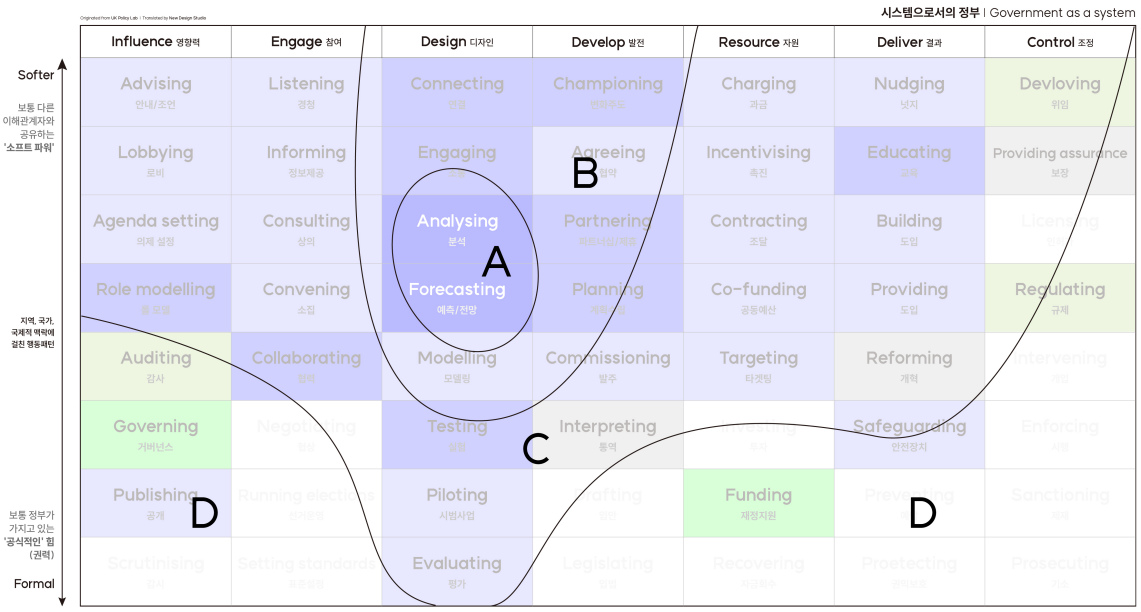

Figure 8: Government as a System toolkit divided based on GNSM context

4.1 Total distribution: GNSM is an implementation institution but still focuses on designing and planning

Some formal actions from each column have been excluded, except for the Design column. As an implementation institution and a public organization that directly engages with citizens, GNSM receives core policy directions and legislation from supraorganization and government. Therefore, formal and strong government actions such as Drafting and Legislating, Sanctioning, and Scrutinizing are unrelated to the museum's operations. However, as a national science museum, GNSM serves as a landmark science museum, and the Design column, which involves designing various policies, is highlighted based on the interview data. In terms of horizontal viewpoint, the Design column is centered, and its shape gradually decreases towards both ends. This indicates that not only policy development itself but also the areas of engaging stakeholders and advancing policies have become increasingly active.

4.2 Section A: What GNSM should put additional efforts into for sustainability transition and sustainable museum operation

This section consists of actions that most staff members emphasized GNSM should undertake. Analyzing and Forecasting are regarded as important actions for the sustainability of the science museum. Interviewee D mentioned, "I actually think this is the most important. Because, anyway, sustainability is something that needs to be pursued from a long-term perspective. ... So, there is a need to continue analyzing the current efficiency and future prospects to ensure the sustainability of such initiatives." Many interviewees noted that the museum's plans are strongly influenced by changes in government, as the museum operates under the administration of the government and implements its policies. Additionally, the director of GNSM changes every 2-3 years. As a result, museum policies and implementations often prioritize short-term achievements and may even pause when they differ from the actions of a new government. The museum staff members hope to maintain a long-term perspective on sustainability by accumulating analysis data and forecasting within the framework of GNSM.

4.3 Section B: Drive changes by cooperating with similar institutions as a landmark science museum

Section B, which is slightly broader than section A, includes several actions that fall under the soft actions of the Design and Develop columns, such as Championing, Connecting, Engaging, Partnering, and others. These actions are commonly focused on driving change through cooperation and engagement. Many staff members mentioned that GNSM actively participates in conferences with other science museums and operates traveling exhibitions with nearby smaller museums. As a landmark science museum, GNSM aims to enhance not only its own scientific research capabilities but also conducts traveling exhibitions to effectively utilize resources through cooperation with other museums. This section reflects the identity and vision of GNSM in-depth.

4.4 Borderline between section C and D: Expanding the museum's actions

Section C extends widely around section A and B, covering the left and upper parts of the entire toolkit. The actions in this zone are where GNSM is already performing adequately. Section D includes government actions unrelated to the museum, such as Running elections, Sanctioning, and Recovering. There are some actions along the borderline between section C and D, which museum staff members consider important, although they are seldom implemented.

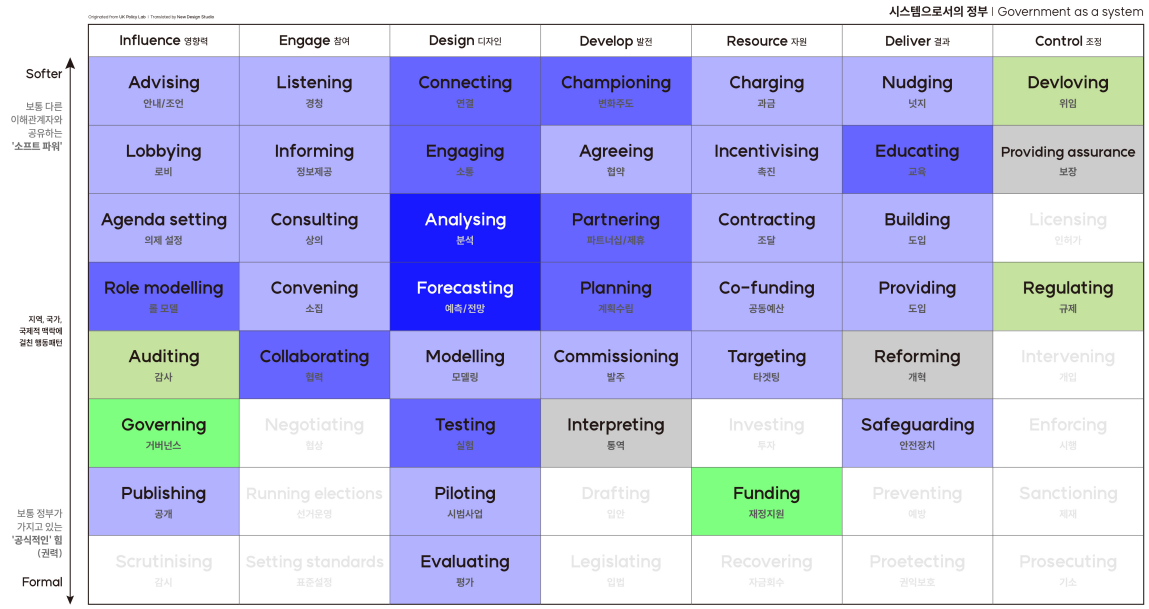

Figure 9: Tailored toolkit for GNSM with colors

V Discussion

This research attempted to derive how to tailor Government as a System toolkit in a form suitable for Gwacheon National Science Museum based on interviews, and a certain pattern was discovered in the process. It was evident that the museum already operates in a broad range when the role and actions of the science museum were examined based on the toolkit. Furthermore, beyond the fundamental role of popularizing science culture and providing cultural education opportunities, the museum aims to demonstrate excellence in sustainability and address current issues. Moreover, it was apparent that the museum is considering various actions to go beyond its previous forms.

Not only the Gwacheon Science Museum but science museums worldwide are evolving into third and fourth-generation institutions beyond the traditional forms of museums and science centers (Pedretti, Iannini, 2020) [Pedretti and Iannini, 2020]. They require activities that promote scientific discussions, engagement, and partnerships with local and similar communities, such as allyship. As we found role of GNSM push the boundaries to actions which are unrelated with the museum previously, the role of the science museum is expanding, and in order to fulfill its sustainable role, it was obvious that specific actions need to be made with greater effort.

In addition, the results of this study could be applicable to other similar science museums. Initially, the role of the science museum is not significantly different, and similar financial situations and roles are demanded. However, for other science museums that are not flagship institutions, the scope of A, B, and C may narrow down, and the focus may shift more towards the implementation rather than the planning, resulting in an overall shift towards the right. Also, it is likely that the areas classified based on the organizational structure and vision of various institutions will move accordingly, reflecting the connection with the roles of the institutions.

Lastly, all staff members agreed that analysis and forecasting are crucial for sustainability. And their specific plan and action are strongly affected by legislation and policy by higher institutions. Therefore, they emphasized the need for efforts and the role of higher-level government, as they are significantly influenced by the government.

5.1 Limitation and suggestion

Government as a System toolkit is beneficial for identifying the strengths and weaknesses of the current science museum. However, many staff members have expressed their opinions about this toolkit, despite its significant impact on real work. To enhance understanding of the toolkit, it is necessary to connect it with existing knowledge and policy decision-making processes that are already utilized in government organizations. Particularly, the horizontal axis may not be immediately relatable, so linking it to familiar processes would facilitate comprehension. By modifying and refining the toolkit to align with the functions and context of the Gwacheon National Science Museum, and improving clarity, the toolkit can be effectively utilized.

Actual validation of the tailored toolkit is essential, as the section D may still hold value for the museum, and there may be additional opportunities to push the boundaries of existing actions. Further-

more, the applicability extends beyond the collective scope of the GNSM to the internal context as well. Many actions in the toolkit can be seen as internal evaluation tools aimed at enhancing the capabilities of staff members and the organization. Lastly, the Government as a System toolkit can be expanded for commercial use, not limited to government actions. The relationship between customers and companies can also be represented and depicted using this toolkit.

References

[Chambers et al., 2021] Chambers, J. M., Wyborn, C., Ryan, M. E., Reid, R. S., Riechers, M., Serban, A., Bennett, N. J., Cvitanovic, C., Fernández-Giménez, M. E., Galvin, K. A., Goldstein, B. E., Klenk, N. L., Tengö, M., Brennan, R., Cockburn, J. J., Hill, R., Munera, C., Nel, J. L., Österblom, H., Bednarek, A. T., Bennett, E. M., Brandeis, A., Charli-Joseph, L., Chatterton, P., Curran, K., Dumrongrojwatthana, P., Durán, A. P., Fada, S. J., Gerber, J.-D., Green, J. M. H., Guerrero, A. M., Haller, T., Horcea-Milcu, A.-I., Leimona, B., Montana, J., Rondeau, R., Spierenburg, M., Steyaert, P., Zaehringer, J. G., Gruby, R., Hutton, J., and Pickering, T. (2021). Six modes of co-production for sustainability. *Nature Sustainability*, 4(11):983–996.

[England, 2023] England, A. C. (2023). Essential read: Environmental responsibility.

[Köhler et al., 2019] Köhler, J., Geels, F. W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M. S., Nykvist, B., Pel, B., Raven, R., Rohracher, H., Sandén, B., Schot, J., Sovacool, B., Turnheim, B., Welch, D., and Wells, P. (2019). An agenda for sustainability transitions research: State of the art and future directions. *Environmental Innovation and Societal Transitions*, 31:1–32.

[Markard et al., 2012] Markard, J., Raven, R., and Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6):955–967.

[MoMA, 2020] MoMA (2020). Sustainability: MoMA.

[Pedretti and Iannini, 2020] Pedretti, E. and Iannini, A. M. N. (2020). Towards Fourth-Generation Science Museums: Changing Goals, Changing Roles. *Canadian Journal of Science, Mathematics and Technology Education*, 20(4):700–714.

[Programme, 2022] Programme, C. I. (2022). New C3 million creative climate action fund launched by government.

[Rittel, 1973] Rittel, H. W. J. (1973). Dilemmas in a general theory of planning.

[Rosenbloom et al., 2020] Rosenbloom, D., Markard, J., Geels, F. W., and Fuenfschilling, L. (2020). Why carbon pricing is not sufficient to mitigate climate change—and how "sustainability transition policy" can help. *Proceedings of the National Academy of Sciences*, 117(16):8664–8668.

[Siodmok, 2020] Siodmok, A. (2020). Introducing a “government as a system” toolkit.

Acknowledgements

Although it falls short, my first-ever master thesis has finally been published. Many individuals have provided encouragement and assistance throughout the process of publishing this paper. Despite the limited space, I would like to express my deepest gratitude to as many people as possible.

First and foremost, I would like to extend my heartfelt gratitude to my advisor, Professor Seungho Park-Lee. From the initial stage of choosing the topic to completing the paper, every step of the way was new to me, and professor was an unwavering presence who provided me with immense support. Thanks to your insights and guidance, I was able to stay on track and reach the finish line. Moreover, the valuable experience gained from the MMCA project seamlessly transitioned into this research. Although I feel a tinge of regret about the paper's conclusion, given the opportunity, I would like to properly conclude this study. I sincerely thank you, professor, for believing in me throughout the preparation period, even when I was trembling with nervousness and anxiety.

Furthermore, I am grateful to the 10 interviewees from Gwacheon National Science Museum, who made it possible to successfully implement the interview methodology in this research. Despite their busy work schedules, they generously devoted nearly 100 minutes to lengthy interviews. Once again, I extend my heartfelt thanks to these interviewees. Additionally, I would like to express my deep appreciation to Deputy Director Jun-hyun Go and Research Officer Eun Ji Park from the Education and Culture Division of Gwacheon National Science Museum for their efforts in facilitating and supporting the interviews. They played a crucial role in selecting and inviting suitable interviewees, which allowed for smooth interviews without significant difficulties.

I would also like to express my gratitude to the three committee members, including my advisor, who actively participated in the entire process and provided guidance for my thesis. Firstly, Professor Hwang Kim, thank you for carefully pointing out the areas I overlooked and the logical deficiencies in my paper. Insightful questions during the greenlight meeting and defense greatly strengthened the structure of my thesis and contributed to its improvement. I sincerely appreciate your guidance.

Next, Researcher Officer Eun Ji Park, you have been attentive to every step, from the selection of interviewees to providing advice from the perspective of museum studies. Your understanding of the context and key points of Gwacheon National Science Museum ensured that the research progressed without missing crucial aspects. Moreover, your insights and perspectives provided valuable insights that helped fill the gaps in my research and bring it to a successful conclusion. Thank you once again for your support.

I would like to express my gratitude to the New Design Studio crews who have been with me and provided encouragement throughout this journey. First and foremost, I want to thank Hyori Lee, who has been my pace-setter in writing the thesis and someone I have learned so much from. Without Hyori's presence, I would not have been able to overcome difficult moments and challenges as quickly. Furthermore, thanks to Seunghoon Lee and Seongbeom Kim, who have set good academic precedents and provided guidance, I was able to refer to their thesis writing process and receive valuable advice, making the progress smooth. I also want to express my gratitude to Minju Han, Yeongjun Park, Jinyoung Chun,

Aziza Abdyrazakova, Makida Gebregiorgis, Yerslan Ababayev, Sungwon Ryoo, Taean Yoo, Gahui Yun and others who have supported and cheered me on from the sidelines.

To my beloved family, friends who have witnessed the defense process, and everyone who has supported me from afar, I want to sincerely thank you. Despite your busy schedules, you have always inquired about my well-being, encouraged me, and prayed for my successful completion of this journey, which has led me to where I am today.

Lastly, I would like to say a few words to myself and conclude. Thank you for enduring until this moment, and I hope that the experiences gained throughout this process will become nourishment for my personal growth. I wish to focus on growth rather than regrets and embrace the mindset of a person who takes action rather than succumbing to anxiety.

Thank you.

This master's thesis was made possible by the support from Ulsan National Institute of Science and Technology (Carbon Neutral Institute Research Program, 1.230044.01) and from Korea Institute for Advancement of Technology (KIAT) grant funded by the Korean Ministry of Trade, Industry and Energy (P0012725, The Competency Development Program for Industry Specialist) in 2022 and 2023.
이 논문은 2022년-2023년 울산과학기술원의 지원과 (탄소중립융합원연구사업, 1.230044.01) 산업통상자원부의 재원으로 한국산업기술진흥원(KIAT)의 지원을 받아 (P0012725, 2023년 산업혁신인재성장지원사업) 수행된 연구임.