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Towards the Sustainable Use of Digital Cultural Heritage Assets: Korea’s Source Asset Strategy and Its Challenges

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Abstract

The digitalization of cultural heritage extends beyond mere preservation, evolving into a form of public asset whose value is increasingly recognized across education, exhibitions, and the content industry. In Korea, the “Digital Cultural Heritage Source Resource Distribution Project,” led by the Korea Heritage Service, has produced a large volume of 3D assets based on traditional cultural elements. This initiative was designed to facilitate secondary use across diverse sectors and to foster a content ecosystem rooted in national heritage.
This study outlines the operational framework of the project and the characteristics of the digital resources produced, while analyzing key policy and operational challenges identified during its implementation—such as insufficient historical validation and quality inconsistencies within the broader digital heritage market. These findings highlight the need for a stronger leadership role by public institutions in areas like quality control, reuse systems, and standard setting. By doing so, this paper aims to suggest future policy and institutional directions and to provide a foundational discussion for establishing digital cultural heritage as a sustainable asset that promotes cultural equity and the expansion of public knowledge.

1. Introduction

In recent years, the digital transformation of cultural heritage has come to be recognized not only as a means of preservation but also as a critical resource with broad applications in education, exhibitions, and the content industry. National initiatives in digital cultural heritage are increasingly valued for their role as public assets that offer lasting benefits to society.

In Korea, over the past three years, the Korea Heritage Service has spearheaded the “Digital Cultural Heritage Source Resource Distribution Project,” through which an extensive collection of 3D-based cultural heritage assets has been developed. This project was designed to promote the dissemination of digital content rooted in traditional Korean culture, within a broader policy framework aimed at encouraging secondary utilization across diverse sectors.
Through market analyses conducted alongside the implementation of this project, several structural challenges have been identified, including historical inaccuracies in assets, inconsistencies in quality, and disparities in their utilization between the public and private sectors. These findings underscore the need for improvements to ensure the sustainable use of public digital cultural heritage resources.
Accordingly, this study organizes the structural framework of the project and examines the characteristics of the assets produced, while also exploring the key policy and operational issues that have emerged. Furthermore, it seeks to propose directions for enhancing the efficiency and sustainability of public digital cultural heritage utilization.
The significance of this research lies in its provision of a foundational analysis and conceptual framework for discussing the systems of utilization and public value of digital cultural heritage resources, based on actual case studies from national initiatives.

2. Digital Content Source Resources

2.1 Traditional Korean Cultural Assets

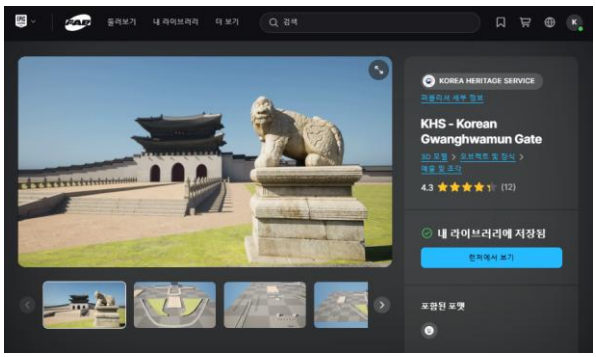

Figure 1. Overview of 3D asset packages distributed via the private platform FAB

Digital source resources are publicly available foundational assets derived from the digital documentation of cultural heritage, enabling broad applications. From 2022 to 2024, the Korea Heritage Service implemented the “Digital Cultural Heritage Source Resource Distribution Project,” through which it produced a large volume of 3D assets centered on uniquely Korean cultural elements such as traditional architecture, clothing, and everyday heritage.

These assets are released through a public portal with the intention of encouraging secondary use in education, exhibitions, and content creation. Designed with open access in mind, they are freely available for anyone to use, provided that appropriate attribution is given.

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Table 1. Number of Asset Packages and Individual Assets Produced by Year

Year	Number of Packages	Number of Assets
2022	6 packages	169 assets
2023	6 packages	3,072 assets
2024	33 packages	1,702 assets

Table 2. Types of Traditional Cultural Heritage Assets

	
Architectural Structures	Artifacts
	
Natural Heritage	Traditional Garments

Through this initiative, 45 packages of traditional architecture were developed, comprising numerous individual assets. The 3D assets created under this project span a wide range of traditional cultural themes, including buildings (traditional structures), artifacts, patterns, clothing, and natural elements. Each asset is provided in a component-based format, broken down into detailed parts, to facilitate ease of use.

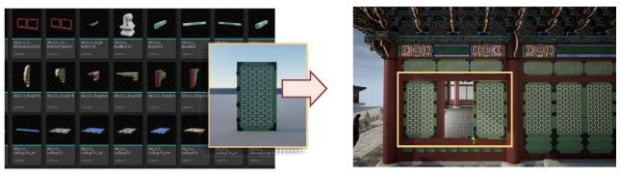

Figure 2. Example of assembling individual components into a traditional architectural structure

Especially notable is the structural characteristic of traditional Korean architecture, which is designed to interlock like modular blocks. This feature allows diverse architectural forms to be realized simply by adjusting individual assets.

2.2 Production and Operational Framework

The asset production process followed a sequential workflow: target selection, reference research, on-site investigation, 3D scanning (including both wide-area scans and detailed photography), post-processing, and final asset creation.

Priority was given to culturally significant resources with high intrinsic value, particularly those in demand within the content industry and well-suited for creative adaptation. The assets were developed based on verified resources compiled by the Korea Heritage Service, including historical validation materials, dismantling and restoration reports, measured drawings, and 3D scan data. On-site investigations were also conducted to directly observe the physical forms of cultural heritage objects, thereby minimizing distortion.

Selected targets were categorized into three stages of detail (SOD: Stage of Detail), a concept similar to LOD, reflecting historical narratives and the complexity of verification. SOD0 involved comprehensive internal and external reproduction, SOD1 focused on external reproduction, and SOD2 employed modular prefabricated components to improve production efficiency.

Each asset was subdivided into highly versatile units for assembly and further classified into standalone elements, movable components, and grouped structures. To balance physical realism with real-time performance, various technical methods were employed, including retopology, normal mapping, spatial optimization, LOD adjustments, and the application of PBR textures by material type.

The final outputs were completed through conversion into widely used formats such as OBJ and FBX, along with compatibility testing for major game engines like Unity and Unreal.

These assets are distributed simultaneously through the Korea Heritage Service’s Digital Cultural Heritage Portal and private platforms such as FAB and the Unity Asset Store. They are designed to be freely downloaded and utilized by anyone under the condition of proper attribution. The assets were structured with component-level modularity to facilitate reuse and modification. In addition, production guidelines and utilization reports were provided to enhance usability.

This integrated system of production and distribution not only promotes the dissemination of public assets within the private sector but also provides a foundation for establishing a collaborative public–private operational model within the digital cultural heritage ecosystem.

Figure 3. From individual elements to finalized objects

2.3 Policy Context and Demand for the Project

In recent years, Korea’s cultural content industry has emerged as a key driver of growth in the global market. Alongside this trend, there has been a steady rise in demand for digital content that draws upon traditional culture and national heritage. In response, Korea has been progressively strengthening its policies aimed at creating sustainable value from national heritage.

In line with this shift from mere preservation to generating long-term value, the ‘Digital Transformation Policy for National Heritage’ was established. Under this initiative, the Korea Heritage Service has set a vision for its cultural heritage digital transformation by 2030: “Creating future value through digital heritage.” Among its four core strategies, the shift toward a “digital way of working” is particularly aligned with

this project, emphasizing the simultaneous enhancement of public value and industrial utilization through the digital documentation and assetization of heritage.

In addition, a recent amendment to the Framework Act on National Heritage introduced Article 27 on “Fostering the National Heritage Industry,” providing an institutional foundation for generating new added value through national heritage and actively promoting the national heritage industry by leveraging digital content.

However, despite these policy expectations, the dissemination of Korean cultural heritage assets within the East Asian digital content market remains relatively limited.

Table 3. Number of Cultural Heritage Assets by Country (March 2022 – March 2025) Source: FAB Marketplace search data.

Country	March 2022	March 2025	Increase
Korea	115	160	+45 assets
China	580	1,100	+500 assets
Japan	105	558	+453 asset

The following table, based on a FAB search conducted in March 2025, shows the number of heritage-related assets available in the East Asian global market. During this period, China recorded approximately 450 new assets and Japan around 500, whereas Korea saw an increase of only 50 assets.

This disparity underscores how many cultural heritage assets in Korea are still managed in a closed manner by private companies, with limited public distribution systems. This project aims to address these challenges by establishing a foundation for universal access and by enhancing the openness and reusability of digital cultural heritage, ultimately supporting the growth of a content industry rooted in national heritage.

3. Types and Causes of Errors in Korean Cultural Heritage Assets

3.1 Historical Inaccuracies in Directly Produced Content

With the recent surge in demand for digital cultural heritage content, there has been a noticeable increase not only in professional production but also in the creation and distribution of traditional culture-based 3D models and visual materials by individual creators and small-scale content companies. However, in these directly produced cases, the processes of securing and thoroughly reviewing sufficient historical references are often omitted or significantly reduced.

This challenge is particularly evident in representations of Korean traditional architecture, which shares structural similarities with Chinese and Japanese wooden buildings featuring tiled roofs. Such resemblances make errors more likely. As a result, it is not uncommon to find depictions that diverge from authentic styles—for instance, inaccuracies in the curvature of traditional Korean roof tiles, the colors of dancheong (decorative patterns), or the proportions and spatial arrangements of architectural elements. Specific examples include the failure to capture the gentle curves of Korean paljak (hip-and-gable) roofs, instead applying steeper Chinese-style forms, or inadvertently incorporating gable elements characteristic of Japanese architecture.

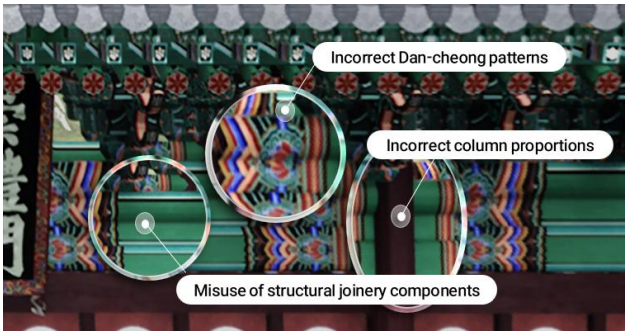

Figure 4. An example of the inaccurate reproduction of Sungnyemun in a metaverse environment

This is an example of a misrepresentation of Korean cultural heritage as a digital asset. It shows Sungnyemun, Korea’s National Treasure, inaccurately reproduced in a metaverse environment, with notable errors in the traditional dancheong painting, columns, and upper wooden structures.

Figure 5. Examples of misused architectural elements of the Joseon Dynasty

The following figure illustrates an example of Joseon-era architectural styles being misrepresented in the game Black Desert. Although the content was created using distributed assets, it was developed without a proper understanding of traditional Korean architecture. As a result, structural inaccuracies were identified, such as the inappropriate use of residential or palace-style chimy (ornamental roof ridges) and misapplied components typically found in walls.

Such historical inaccuracies go beyond mere visual flaws; when disseminated internationally, they risk spreading distorted cultural images that misrepresent Korean identity.

This risk is especially pronounced given that digital assets are widely repurposed in secondary content such as games, educational materials, and advertisements. In such an environment, inaccurately produced content may be repeatedly disseminated and reused, creating a structural vulnerability.

Therefore, it is essential to establish a robust framework grounded in verified historical sources, with standardized guidelines and rigorous quality controls, to ensure precise cultural representation in digital heritage production.

3.2 Errors in AI-Generated Assets

With recent advances in artificial intelligence (AI), automated technologies such as text-to-image generation and automatic 3D modeling have been increasingly adopted in the production of cultural heritage content. These approaches demonstrate significant potential for improving production efficiency by

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dramatically accelerating workflows and reducing repetitive tasks.

However, practical applications have revealed notable limitations of AI-driven production, as many outputs lack sufficient historical authenticity. In particular, some AI-generated content based on Korean traditional culture has been found to incorporate architectural elements, decorative techniques, and costume styles from China or Japan. Visual distortions, such as incorrect proportions and shapes in traditional architectural representations, also occur frequently.

Because these datasets often blend visually similar elements from different East Asian cultures without clear distinctions, the resulting content frequently diverges from authentic Korean styles.

This raises structural concerns, as such inaccuracies not only compromise the fidelity of individual works but also risk being perpetuated and amplified through subsequent cycles of AI learning and dissemination, thereby propagating distorted cultural representations.

source - Freepik AI tool

source – Picaso AI tool

Figure 6. Incorrect AI-generated image of a Korean traditional building.

The following image was generated using the keywords "Korean traditional building" and "3D model" with the Freepik AI tool. However, the resulting depiction fails to incorporate authentic Korean elements, instead showing roof curves, architectural features, and garden designs that respectively resemble Japanese and Chinese styles. This serves as a representative example of the frequent historical inaccuracies found in cultural heritage content produced by generative AI.

Given that cultural heritage encompasses not only visual forms but also symbolic assets imbued with identity and historical significance, it is essential to prioritize the development of refined training datasets, establish clear standards for different types of heritage, and create authoritative learning sources before further expanding the use of AI-based production methods.

By prioritizing cultural accuracy and identity safeguards, we can leverage AI technologies to establish new standards in digital heritage production.

3.3 Section Summary

Both manual and AI-based approaches carry inherent risks that extend beyond technical flaws, potentially distorting cultural representations. This underscores the urgent need for expert-driven, historically grounded systems to ensure that digital heritage assets fulfill their intended cultural and public roles.

Table 4. Comparison of Errors in Human-Created vs. AI-Generated Cultural Heritage Assets

Category	Human-Created Assets	AI-Generated Assets
Primary Creator	Individual creators, small content companies	AI algorithms and generative models
Production Method	Manual 3D modeling, reference-based creation	Text-to-image generation, automated modeling
Main Cause of Error	Lack of reference materials, omission of historical verification	Biased or undifferentiated training data
Typical Error Examples	Inaccurate proportions or forms, incorporation of Chinese/Japanese elements	Visual distortion of traditional features, unintentional adoption of foreign styles
Cultural Risk	Errors spread through SNS and content platforms	Misrepresentations may be repeatedly learned and reproduced by AI
Mitigation Approach	Expert review systems, heritage-based reference archiving	Curated training datasets, improved cultural differentiation standards

4. Social Value and Policy Sustainability of Digital Cultural Heritage

4.1 Digital Accessibility and Universal Cultural Enjoyment

Digital technologies have expanded cultural heritage beyond temporal and spatial constraints. In particular, the rise of a contactless society after the pandemic has underscored the need for online cultural content, opening new opportunities for groups that have traditionally faced barriers—such as international audiences, the elderly, youth, and people with disabilities. This broadens both the social reach and cultural value of heritage.

The digital heritage assets developed through this project are made available via publicly accessible portals, and are designed to allow relatively unrestricted use under the condition of proper attribution. This approach lays a foundation not only for preservation but also for the broader dissemination of heritage in education, exhibitions, and content industries.

Moreover, digital assets serve as gateways for global creators inspired by Korean culture and for audiences in regions with limited direct access to heritage sites, helping to convey the imagery and understanding of Korean cultural heritage. In this way, the accessibility and openness of digital heritage serve as key drivers for cultural equity and diversity.

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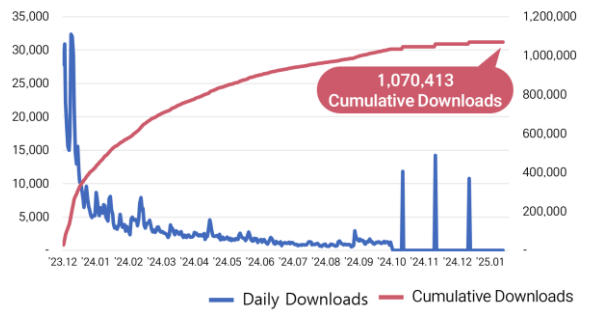

Figure 7. Cumulative Downloads of FAB Marketplace Open Asset Set (Data collected from December 26, 2023 to January 31, 2025)

In fact, since their public release in late December 2023, the digital cultural heritage assets produced and distributed through this project have surpassed a cumulative total of 1.07 million downloads within approximately one year and one month. This serves as a clear indicator of both improved content accessibility and tangible societal diffusion, supporting the potential for the universal enjoyment of digital cultural heritage.

Figure 8. Black Desert: Content created using assets from this project

These digital assets are already being utilized across various sectors, with their applications steadily expanding. Traditional architectural assets developed through this project, for example, were incorporated into the MMORPG Black Desert through collaboration with the game company Pearl Abyss. This resulted in game content featuring elements of Korean traditional culture, which was subsequently linked to the tourism industry through a joint marketing campaign with the Korea Tourism Organization, promoting the “Land of the Morning Light” tour package.

Educational institutions have also employed these digital resources. To illustrate, data on Gyeongbokgung Palace and Gwanghwamun were used to create the VR game Coexistence City Project, which reconstructs the vanished historical landscape of Seoul, providing an immersive educational experience. Additionally, a company participating in a digital content competition organized as part of this project developed new content using 2024 data of Gyeonghoeru Pavilion at Gyeongbokgung.

Figure 9. Continued industry support and partnership results

Significantly, these outcomes have not remained isolated. They have led to discussions on new collaborations with major game developer Nexon, further enhancing the potential for the industrial expansion of digital cultural heritage.

To promote such utilization, a range of outreach and marketing activities has been actively pursued, including webinars targeting small-scale developers and briefings for large corporations and regional content agencies. With the accumulation of high-quality assets each year and continued promotional efforts, even broader collaborations with enterprises are anticipated.

These examples show that digital cultural heritage functions not just as data but as a public asset integrated into the broader cultural industry ecosystem. However, despite these encouraging signs of social impact through the open use of digital heritage, institutional and practical challenges persist, particularly concerning user-centered environments and private-sector linkages.

The following section examines these issues arising within the current framework for the openness of public digital assets and discusses the tasks necessary to advance toward a more sustainable utilization ecosystem.

4.2 The Open Framework of Public Cultural Heritage Data and Its Practical Limitations

Making digital heritage publicly available advances society’s collective right to enjoy cultural heritage and helps build frameworks for preservation and use in the digital era. In practice, the 3D assets developed through the “Digital Cultural Heritage Source Resource Distribution Project” led by the Korea Heritage Service were designed to be accessible and usable by anyone under the condition of proper attribution, and their applications in education, exhibitions, and the content industry have been steadily growing.
However, a notable gap persists between this institutional framework of “publicness” and actual usage environments. In Korea, many domestically developed 3D cultural heritage assets continue to be managed in a closed manner by private companies or individual creators. These assets are often not listed on public markets or are maintained in ways that preclude external use, with proprietary copyrights imposing high costs and strict usage conditions. Moreover, the volume of privately distributed assets remains limited, and many lack adequate historical validation or structural consistency, frequently resulting in visual errors or distortions—yet they are still sold at high prices.

As a result, the pool of high-quality, publicly accessible data remains narrower than expected, limiting the wider distribution

and reuse of digital heritage content. This underscores the need for sustained public efforts to systematically build, manage, and maintain reusable assets.

Figure 10. Black Myth: Wukong, a Chinese government-supported game based on Journey to the West.

At the same time, there have been notable cases where such public data foundations have translated into industrial value. In Korea, traditional architectural assets were implemented as Korean cultural elements within the MMORPG Black Desert through collaboration with a game developer. In China, the provincial government of Shanxi supported the development of Black Myth: Wukong, a game based on the classic novel Journey to the West, as a national project. This game utilized Shanxi’s historical resources for 27 of its 36 background settings and has been recognized as a representative example that produced significant ripple effects on local tourism and the regional economy.

These cases illustrate that when a public foundation of digital cultural heritage is combined with the private content industry, it can function not merely as a source of information but as a resource for creative work and economic value generation. To further expand and deepen such utilization frameworks for publicly based digital resources, it will be essential to introduce quality certification systems, design open licensing models, and establish collaborative platforms that facilitate public–private cooperation.

4.3 Building a Sustainable Utilization Ecosystem

Digital cultural heritage is not a one-time dataset but a “living asset” that must be continuously maintained and managed to keep pace with changing times. Periodic updates in line with technological advancements, securing format interoperability, and applying long-term storage technologies are all essential requirements for these digital assets to function effectively over time.

Moreover, to enable smooth secondary use across various sectors, it is necessary to move beyond simple data provision and establish user-centered curation, developer-friendly platforms, and distribution structures grounded in public–private collaboration. This signifies a shift from merely supplying data to operating digital assets within an integrated ecosystem.

In particular, the creation of assets through 3D scanning holds significant value for preservation, as it precisely records the structural and morphological characteristics of cultural heritage, going beyond mere visual replication.

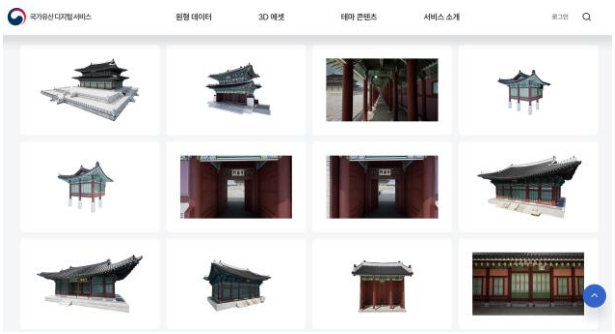

Figure 11. 3D assets provided by the National Heritage Digital Service

Korea’s national heritage digitalization efforts began in the 1990s with a primary focus on documentation and preservation, and have more recently expanded toward broader utilization. The extensive 3D data, drawings, photographs, reports, and VR content provided through the National Heritage Digital Service now form a robust foundation that can be widely leveraged by businesses, local governments, universities, research institutions, and the general public. In fact, the ability to easily search data by designation type, region, historical period, and year of production has already facilitated diverse research, educational, and content development initiatives, representing a positive outcome.

However, to build a more sustainable and expansive utilization ecosystem, it will be important to draw insights from platforms with a long history and accumulated operational expertise, such as Europe’s Europeana and Canada’s CHIN.

Europeana, for example, has developed shared metadata standards in collaboration with cultural heritage institutions across Europe and advanced its platform into a “participatory ecosystem” through user-driven curation and co-creation programs. Similarly, CHIN integrates metadata, 3D models, and educational resources via a nationwide museum network, actively operating programs in partnership with local communities, schools, and companies.

By learning from these examples, Korea can move from simply opening data to fostering a true digital cultural heritage ecosystem, supported by systematic metadata practices and expanded public–private educational programs, ensuring that heritage continues to be utilized and generates value across society.

5. Conclusion

This study examined the production and utilization framework of digital cultural heritage resources by analyzing the “Digital Cultural Heritage Source Resource Distribution Project,” led by the Korea Heritage Service from 2022 to 2024. It also identified key policy and operational challenges associated with the project.

Through this initiative, a large-scale repository of 3D assets based on traditional Korean cultural elements was created and made publicly accessible, laying a foundation for secondary use across education, exhibitions, and content industries. The assets

were intentionally developed to be open and widely usable, supported by rigorous historical validation and expert review.

However, beyond these efforts, the broader digital cultural heritage market still reveals products that lack historical verification, show inconsistent quality, contain ambiguous copyright structures, or exhibit inaccuracies inherent in AI-generated content. In privately produced materials, such shortcomings often result in visual distortions that risk misrepresenting cultural identity—an issue that goes beyond technical flaws.

Given these concerns, it is increasingly important to emphasize the role of reliable, publicly verified digital assets. Public institutions like the Korea Heritage Service should take the lead in establishing production standards, implementing data quality reviews, and designing systems that support the structured reuse of cultural resources.

From this perspective, several policy directions are needed to sustain digital cultural heritage as a societal asset:
first, enhancing design systems to improve accessibility and usability;
second, institutionalizing robust quality verification and management frameworks;
and third, fostering ecosystems that encourage collaboration with the private sector.

Ultimately, digital cultural heritage plays a vital role in advancing cultural equity and expanding the foundations of public knowledge. Achieving this requires moving beyond short-term output-focused development toward long-term technical and institutional governance.

In particular, the unchecked spread of digital assets without historical validation poses a serious risk of distorting public perceptions of cultural heritage, highlighting the essential role of public leadership. This study aimed to outline the structural and operational features of the project and serve as a foundation for further policy discussions. Future research should include more empirical analyses of utilization cases, operational models, and comparisons with international frameworks.

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