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New Media Display Technology and Exhibition Experience

A Case Study from the National Palace Museum

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Abstract

As the inheritor of Chinese civilization, the National Palace Museum (hereafter referred to as the NPM), houses a world-class collection of cultural art and artifacts. Since the NPM began promoting the National Digital Archives Project in 2002, its efforts have expanded to develop a digital museum and various e-learning programs. Extending the use of digital archives to its educational and cultural industrial endeavors, the NPM has maximized the value of its exhibitions, publications, and educational programs. In 2013, the NPM integrated creative thinking and interdisciplinary technologies, such as floating projection, augmented reality, and other sensory interactive media, to recreate the historical circumstance of 19th century East Asian maritime cultures in "Rebuilding the Tong-an Ships—New Media Art Exhibition," which opened at Huashan 1914 Creative Park and later won the Gold Award at the 2014 Digital Education Innovation Competition. Through a thorough exploration of the factors contributing to the success of "Rebuilding the Tong-an Ships," this study has isolated the two main factors of the exhibition's popularity, namely, the compactness of the metadata and the atmosphere created by the interactive display technology.

Keywords: *National Palace Museum; New Media Arts; Interactive; Exhibition*

1. Background and Motivation

1.1 Museum Function in the Age of Information

Exhibition is a very important part of museum operations. After all, all museum exhibitions are made for the public's education and the transmission of human knowledge. Mirroring our time and reflecting our current aesthetic tastes, exhibition is an altruistic cause done for public welfare. [1]

As times evolve, museum operation patterns have also reached a point of transition. A museum's value and function are both expanding. In recent years, the NPM has been promoting a "museum without walls" project by which it hopes to allow those who cannot visit the museum in person to become familiar with the collection. The concept of a "museum without walls" is enabled by the proliferation of photography and printing, which allow for the mass replication of collection images and change people's habits of appreciating art. In the present age, digitization, the internet, and multimedia technologies add to the trend of limitless exchange and transmission. Items in a museum's collection are no longer trapped beneath the dust in a museum's physical archives. From still life displays to dynamic interactive media, exhibition materials seek to shake up art and artifacts with new technology and new media. The digital archive is believed to be the foundation on which the NPM will develop into a world-class museum. The far-reaching effects of the internet will allow the essence of Chinese civilization to spread across the world and attract more visitors to the museum.

1.2 NPM Digital Archive Applications and Results

The NPM's digital archive started officially in 2001. In the following year, the NPM took part in the National Digital Archives Project. With as many as 650,000 items in its collection, preservation and management was extremely tasking prior to digitization. Thanks to the development of technology, the NPM now has cutting-edge methods to organize its collection. Seven departments--Antiquities, Painting and Calligraphy, Rare Books and Historical Documents, Publishing, Registration, Technology, and Information Center--initiated the NPM's Digital Archive Plan in 2001 with the aim of establishing a complete collection database for public appreciation and use.

The brunt of the plan lies in digitizing all the art and artifacts in the collection, a process which begins with

photographing, scanning, color correcting, watermarking, printing, composing item descriptions and extends to developing metadata, knowledge base, and applications. In other words, photographing or scanning art and artifacts to create digital files enables more efficient organization, research, and application. Digital files can be copied or edited to create useful backup images that will not suffer the ravages of time and can be easily preserved.

Digitizing the collection offers advantages not only in assisting the museum's exhibition planning, publishing, archival, educational, and research efforts but also in opening up the treasures of Chinese civilization to people all over the world. Image licensing services could also be offered in the future, allowing the digitized materials to achieve the goals of educational promotion, to stimulate the development of value-added applications and creative products, and to contribute to the knowledge based economy. [2]

After several years of implementing the 2002 National Digital Archives Project, the NPM advanced to establish a digital museum and other digital learning programs. Applying its digital archives to educational and cultural industrial endeavors, the NPM has not only maximized the value of its exhibitions, publications, and educational programs but also catalyzed the government's endeavors in the cultural and creative industries by injecting a new wave of inspiration and resources.

1.3 New Media Interactive Displays and the Museum Experience

Explorations of relevant fields in new media art, from early creative media discussions to recent speculative studies of aesthetics and museum industry archival mechanisms, have seen a considerable growth in the amount of data accumulated, demonstrating that this field is indeed developing vigorously. Concurrently, the government proposed the Digital Art Creation Project when implementing the 2008 National Development Challenge. This project gave rise to the international exhibition "Wanderer," curated by Junjie Wang and "Pleasure," curated by Shuming Lin for the 2005 Ars Electronica 25 Year Anniversary. Both exhibitions were held at the National Museum of Fine Arts and soon after ignited a wave in new media art. As a result, new media art became the mainstream in the Taiwanese art scene. [3]

In Pine II and Gilmore's concept of the experience economy (1998), they noted that enterprises should be thinking of how to enhance service to create a more attractive consumer experience. Pine II and Gilmore proposed to consider experience from two levels: (a) degree of participation--active versus passive--and (b) the relationship between experience and environment, which can be subdivided into two types: absorption, the method of manipulating experience to attract consumer attention, versus immersion, the method of including audience as part of the physical experience. There are four types of experiences: (1) Entertainment; (2) Education; (3) Escapist; and (4) Esthetic. So, applying Pine II and Gilmore concept of the experience economy, in order for museums to truly achieve long term competitive advantage, museum curators need to create an immersive, stimulating, and memorable experience.

In the past, exhibitions mostly relied on textual, auditory, and especially visual content to explain art and artifacts; therefore, audience members are traditionally the most familiar with looking. But, as the direction of museum exhibition and educational ideals shift, more and more emphasis is being placed upon audience participation, audience immersion, guided observation and reflection, and development of participant insight. Taking into account the ever-changing nature of the technology used in exhibitions, how then do we achieve an exhibition's original intention and faithfully apply new media art to exhibition content? We must transform the NPM's collection into a wellspring for the museum's creative industry by generating creative content from the research derived from the collection. Adhering to the core concept of using science and technology as a platform for marketing NPM's world-class collection to the world, the exhibition combines ancient artifacts with new technology to show the fruits of NPM's latest digitization efforts. [4]

Focusing on "Rebuilding the Tong-an Ships—New Media Art Exhibition" as the object of study, this paper explores the extent to which the new media installations interact with and generate feedback from the audience while showcasing the fruits of NPM's digitization overhaul and its application of new media art for the purpose of providing a point of reference for future exhibitions related to history.

2. "Rebuilding the Tong-an Ships" New Media Art Exhibition

2.1 Tong-an Ship History

Tong-an ships refer to the large sized ancient sailing vessels that saw rise during the middle of the Qing Dynasty. The ships were so named because they originated in Fujian Province, in the municipality of Tong-an. These ships were not only widely common for civil use, but they were also immensely popular with the pirates. Since the Age of Discovery ushered in a surge of maritime activities in the East Asian seas, the region, under the combined influences of harsh weather conditions and the demands of the imperial Chinese tributary system, experienced a new maritime era made possible by extensive economic contact. The comings

and goings of trading vessels, adventurers and navigators from various countries created business opportunities and promoted political and economic contact between China and other Asian countries, even with Western European countries. Situated on the western hub of the Pacific Ocean, Taiwan experienced a steady improvement in its political, military, and economic status as well.

Beginning in the early 19th century, increasing maritime activities led the Qing Empire to strengthen its military forces in an effort to preserve order and stability on the seas. But conflicts between the Vietnamese regimes caused the pirates, whose military might ran supreme in those times, to be courted for their prowess. The Tây Sơn dynasty granted the pirates many titles and favors, creating a hotbed for the rise of piracy. After repeated restoration efforts by the Ming loyalists in Taiwan, the Qing Empire kept a vigilant effort along the Southern Coast, building a naval fleet in Taiwan and Penghu to regulate the seas and stabilize relations in South East Asia.

Tong-an ships do not merely act as methods of transportation, but enable connections to form in the region's political, military, economic, and cultural activities. At last, they became the main naval force off coast and are the most representative of ancient Chinese ships before the appearance of steamboats. "Rebuilding the Tong-an Ships--New Media Art Exhibition," organized by the NPM, is the first exhibition with the combined theme of maritime history and Taiwanese history. The exhibition is based on two rare warship diagrams from the Qing Dynasty in the National Palace Museum collection, *Diagram of the Tong-an Ship Ji* and *Diagram of Tong-an Ship No. 1*,which were reckoned to be attachments to a memorandum. However, the original memorandum in question remained long hidden in the archives of NPM until a researcher discovered its appendix out of nearly 200,000 military official records in the digital archive and finally was able to reconstruct the conflict between two major players in Chinese naval history, Li Changgeng and Cai Qian.

2.2 Exhibition Overview

Devoting itself fully to incorporating new media into its exhibitions, the NPM, after planning *NPM Digital* and other special new media exhibitions, cooperated with Huashan 1914 Creative Park and launched *Rebuilding the Tong-an Ships--New Media Art Exhibition* as part of the museum without walls series. The Department of Education, Exhibition, and Information Services and the Department of Rare Books and Historical Documents are the central members of this exhibition's curatorial team. Using interactive installations to fulfill the exhibition's educational goals, The Department of Education, Exhibition, and Information Services developed new forms of display techniques to present the findings of researchers from the Department of Rare Books and Historical Documents.

This exhibition space is organized into three main sections--period background, main characters, and ship structure. Within these sections are seven main new media art pieces: *The "Bon Voyage!" Projection Wall*, *Cross-over dialogue: Holographic Projection*, *Cloud Gallery*, *Deconstructing the Tong-an Ship*, *Looking Through the Tong-an Ship*, *The Augmented Reality Clothes Changing System*, *Breaking Waves: Tongan Ship Interactive Game*, *Nautical Chart Interactive Tabletop*, *Rebuilding the Tong-an Ship: Theater.*

2.3 New Media Art in "Rebuilding the Tong-an Ships"

The exhibition uses holographic projection, naked-eye 3D, augmented reality, kinect sensory interactive devices, and other new media technologies to stimulate the five senses. Each piece reproduces an aspect of the prosperous 19th century East Asian maritime culture to help audiences understand the military, cultural and other historical background information related to the Tongan ship. The metaphorical use of *chao*, meaning tide, in the Chinese exhibition title originated in connection with the ocean tide, emigration tide, and economic tide brought in by the Tong-an ships. First, the actual ocean tide brought unlimited possibilities by opening up China to external contact; immigration brought about abundant manpower, leading to the development of Taiwan; the ensuing economic tide created a rich and diverse maritime culture, from which sprung figures such as the Great Seafarer Cai Qian. Finally, using new media technologies to reinterpret and present the museum collection is a new trend, or tide, in contemporary exhibition. Manifesting the different meanings of "tide," therefore, is one of the exhibition objectives. [5]

The seven installations integrate interactive technology with woodworking equipment, lighting, and fragrances to create an appropriate atmosphere for each piece. The documentary *Rebuilding the Tong-an Ships* provides a supporting overview of the ship's cultural and naval history and some insights into the historical documents left behind.

The themes of the exhibition are the Tong-an ship and the ocean, both of which are closely linked to the main visual design concept. Manifested in the typeface of *Rebuilding the Tong-an Ships* documentary, the overlapping red and blue in *chao* from the Chinese title represent the use of 3D and other new media technology. The blue-green and yellow gradients in the base layer symbolize youth, the ocean, and the ocean tides. The floor covering the exhibition entrance uses light brown tones to mimic a

ship's brown wooden color. Surrounding interactive installations and fences are also created in the same colors as those painted upon the Tong-an ships' hulls.

In the exhibition's audio design, the curatorial team installed sounds of seagulls and ocean sprays at the entrance to create a soothing ocean atmosphere. Music of Chinese string instruments play in the background. The hope is that audio settings can not only help relax the audience but also bring them into the exhibition environment.

Scent, which can have a direct impact on mood, is also an important factor in the creation of experience. This exhibition especially designed a fragrance exclusive to the Tongan ships. Inspired from blue amber, the exhibition fragrance is supposed to symbolize the ship's adventurous, resolute spirit, capable of forging ahead in the face of adverse sea weather. The reason for the emphasis on scent is that scent has the power to strengthen human memory and emotional experience. Olfactory information passes more easily to the limbic system in the brain and can be registered more firmly in human memory. Scent can facilitate the diffusion of information and allow audience members to have a more varied experience. Exhibition facilities use wood for the deck and side gate fixtures, improving tactile sensations. Combined with the virtual interaction system, these construction material choices enable audiences to have an entirely new tactile experience when visiting "Rebuilding the Tong-an Ships--New Media Art Exhibition."

3. Visitor Experience

Held in the Boiler Room at Huashan 1914 Creative Park, the exhibition ran from July 20 to September 22, 2013. The Park closes on Mondays. Weekends and holidays crowds peak (Table 1). Total attendance reached 54,067 visitors. The highest percentage visiting group falls in the 20-29 age range (Table 2), with more female than male visitors (Table 3); sex and age factor little into overall satisfaction, but familiarity with electronic equipment has a significant difference on visitor response (Table 4), indicating that this exhibition is immensely suitable for the internet generation and corresponds to curatorial objectives.

The overall satisfaction rating for this exhibition is 99.4% (Table 10). The most popular exhibition piece is *Breaking Waves: Tongan Ship Interactive Game*, with 35.1% average satisfaction rating (Table 11); The satisfaction rating for the hardware equipment is 87.9% （Table 12). A few visitors complained of devices freezing or that there were too many visitors and insufficient time to experiment with the devices.

Out of all the exhibition pieces, the *Cloud Gallery* is the extension of the National Palace Museum's Cloud ICT Platform Development Project. Since the execution of the Digital Archive Plan, the NPM gathered an enormous quantity of digital content not only for the purpose of developing its creative cultural industry but also for the integration and application of more effective business models. Particularly, now with the substantial improvements in screen resolution and network bandwidth, cloud galleries are bound to become the new mainstream. Due to budget constraints, certain exhibitions offer only a uni-directional presentation; however, starting in 2012, in "Four Seasons of the NPM," installations have managed to fulfill interactive goals in their designs. Compared to two-directional, interactive presentations, uni-directional media have a satisfaction rating of only 4.1%. From comparing this data, audience preference for interactive installations is evident.

The satisfaction rating for interactive installations is 95% (Table 13). 89.3% of audiences think that the installations adequately convey the exhibition theme. These results are enough to demonstrate audience recognition of this exhibition's curatorial efforts.

On the scheme of the exhibition, 96.2% (Table 15) agree that using games to help people understand the artifacts is an effective method, but there are some who think that not all artifacts are suited to this method. 89.2% (Table 16) agree that the spatial design creates the right atmosphere for a museum. These numbers demonstrate that, overall, the design of the exhibition space was a success.

On the level of education, audience interest rose from 58.9% to 81.6% after viewing the exhibition, demonstrating that this exhibition achieved its educational goals by a large margin (Table 17 and 18).

To sum up the statistical results, this exhibition takes advantage of the ambiance at Huashan 1914 Creative Park's and new media display methods to attract successfully more than fifty thousand visitors. The highest frequency visiting age group is ages 20-29. There were more female than male visitors. The display methods and new media interactive technologies cater to the younger generation's curiosity for new things. The familiarity of electronic equipment acquired by those living in the Information Age makes the exhibition installations easily accessible. The high satisfaction ratings gathered from the data are the best supporting evidence for proving that the NPM has fulfilled its purpose to create memorable and enjoyable educational experiences.

4. Tables

Table 1: Exhibition visitors by days of the week

		Frequency	*Percentage*	*Effective Percentage*	*Cumulative Percentage*
Efficient	Tuesday	207	12.9	13	13
	Wednesday	198	12.4	12.4	25.3
	Thursday	232	14.5	14.5	39.9
	Friday	284	17.8	17.8	57.6
	Saturday	381	23.8	23.8	81.5
	Sunday	296	18.5	18.5	100
	Total	1598	99.9	100	
Missing Values	System-Missing Values	2	0.1		
Total		1600	100		

Table 2: Exhibition visitors distributed by age

Age		*Frequency*	*Percentage*	*Effective Percentage*	*Cumulative Percentage*
Efficient	< 20	342	21.4	21.4	21.4
	20~29	572	35.8	35.9	57.3
	30~39	288	18	18.1	75.4
	40~49	298	18.6	18.7	94
	>50	95	5.9	6	100
	Total	1595	99.7	100	
Missing Values	System Missing Values	5	0.3		
Total		1600	100		

Table 3: Exhibition visitors distributed by gender

		Frequency	*Percentage*	*Effective Percentage*	*Cumulative Percentage*
Efficient	Female	1100	68.8	68.8	68.8
	Male	498	31.1	31.2	100
	Total	1598	99.9	100	
Missing Values	System Missing Values	2	0.1		
Total		1600	100		

Table 4: The effect of gender on overall satisfaction data

Group Statistics

	Gender	*Frequency*	*Mean*	*Standard Deviation*	*Standard Error of the Mean*
Total	Female	1078	4.1313	0.42458	0.01293
	Male	487	4.1471	0.41111	0.01863

Table 5: The effect of gender on overall satisfaction test

Independent Sample Test

		Equal mean t test				
		t	Degree of Freedom	Significant (two-tailed)	Mean Deviation	Standard Error Difference
Total	Equal Variances Assumed	-0.688	1563	0.492	-0.01579	0.02296
	Equal Variances Not Assumed	-0.696	965.99	0.486	-0.01579	0.02268

Table 6: The effect of age on overall satisfaction data

Descriptive Statistics

Total						
Age	Frequency	Mean	Standard Deviation	Standard Error	95% confidence interval of the mean	
					Min.	Max.
<20	341	4.1666	0.42105	0.0228	4.1218	4.2115
20~29	559	4.1171	0.40708	0.01722	4.0833	4.1509
30~39	279	4.1049	0.46221	0.02767	4.0504	4.1594
40~49	293	4.1666	0.38337	0.0224	4.1225	4.2107
>50	90	4.1465	0.47025	0.04957	4.048	4.245
Total	1562	4.1367	0.42034	0.01064	4.1159	4.1576

Table 7: The effect of age on overall satisfaction test

ANOVA

Total					
	Sum of Sqaures	Degrees of Freedom	Average Sum of Squares	F	Sig.
Between Groups	1.073	4	0.268	1.52	0.194
Within Groups	274.733	1557	0.176		
Total	275.806	1561			

Table 8: The effect of familiarity with electronic equipment on overall satisfaction data

Group Statistics

	Familiarity with Electronic Equipment	Frequency	Mean	Standard Deviation	Standard Error of the Mean
Total	No	310	4.0842	0.42594	0.02419
	Yes	1251	4.1472	0.41672	0.01178

Table 9: The effect of familiarity with electronic equipment on overall satisfaction test

Independent Sample t Test

		Equal mean of t test				
		t	Degrees of Freedom	Significant (two-tailed)	Mean Deviation	Standard Error Difference
Total	Equal Variances Assumed	-2.372	1559	0.018	-0.06299	0.02656
	Equal Variances Not Assumed	-2.341	466.478	0.02	-0.06299	0.02691

Table 10: Overall satisfaction

		Frequency	*Percentage*	*Effective Percentage*	*Cumulative Percentage*
Efficient	Very Satisfied	383	23.9	24.1	24.1
	Satisfied	1045	65.3	65.7	89.8
	Neutral	163	10.2	10.2	100
	Total	1591	99.4	100	
Missing Values	System Missing Values	9	0.6		
Total		1600	100		

Table 11: Favorite exhibition item

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	The "Bon Voyage" Projection Wall	225	14.1	14.1	14.1
	Cross-over Dialogue:	228	14.3	14.3	28.4
	Cloud Gallery	65	4.1	4.1	32.5
	Deconstructing the Tongan Ship	140	8.8	8.8	41.2
	Looking Through the Tongan Ship	65	4.1	4.1	45.3
	The AR Clothes Changing System	124	7.8	7.8	53.1
	Breaking Waves	561	35.1	35.2	88.2
	The Nautical Chart Interactive Tabletop	51	3.2	3.2	91.4
	Rebuilding the Tongan Ships: Theater	137	8.6	8.6	100
	Total	1596	99.8	100	
Missing Values	System Missing Values	4	0.3		
Total		1600	100		

Table 12: Satisfaction with hardware equipment

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	Very Satisfied	433	27.1	27.2	27.2
	Satisfied	964	60.3	60.6	87.9
	Neutral	193	12.1	12.1	100
	Total	1590	99.4	100	
Missing Values	System Missing Values	10	0.6		
Total		1600	100		

Table 13: Satisfaction with interactive installation

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	Very satisfied	413	25.8	25.9	25.9
	Satisfied	1030	64.4	64.6	90.5
	Neutral	146	9.1	9.2	99.6
	Not Satisfied	6	0.4	0.4	100
	Total	1595	99.7	100	
Missing Values	System Missing Values	5	0.3		
Total		1600	100		

Table 14: The interactive Installation adequately conveys the theme of Tong-an ships

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	Strongly agree	403	25.2	25.2	25.2
	Agree	1024	64	64.1	89.3
	Neutral	164	10.3	10.3	99.6
	Disagree	7	0.4	0.4	100
	Total	1598	99.9	100	
Missing Values	System Missing Values	2	0.1		
Total		1600	100		

Table 15: The design of the interactive game allows for a understanding of the art work

		Frequency	Percentage	Effective Percentage	Cumulative
Efficient	Strongly Agree	742	46.4	46.4	46.4
	Agree	795	49.7	49.7	96.2
	Neutral	58	3.6	3.6	99.8
	Disagree	3	0.2	0.2	100
	Total	1598	99.9	100	
Missing Values	System Missing Values	2	0.1		
Total		1600	100		

Table 16: The spatial design has the ambiance of a cultural exhibition from a museum

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Strongly Agree	407	25.4	25.5	25.5	
Agree	918	57.4	57.4	82.9	
Neutral	242	15.1	15.1	98.1	
Disagree	31	1.9	1.9	100	
Total	1598	99.9	100		
System Missing Values	2	0.1			
Total		1600	100		

Table 17: Interest towards Tong-an Ships prior to visiting the exhibition

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	Strongly Agree	248	15.5	15.5	15.5
	Agree	693	43.3	43.4	58.9
	Neutral	522	32.6	32.7	91.6
	Disagree	118	7.4	7.4	98.9
	Strongly Disagree	17	1.1	1.1	100
	Total	1598	99.9	100	
Missing Values	System Missing Values	2	0.1		
Total		1600	100		

Table 18: Interest towards Tong-an Ships after visiting the exhibition

		Frequency	Percentage	Effective Percentage	Cumulative Percentage
Efficient	Strongly Agree	291	18.2	18.2	18.2
	Agree	1013	63.3	63.4	81.6
	Neutral	266	16.6	16.6	98.2
	Disagree	28	1.8	1.8	100
	Total	1598	99.9	100	
Missing Values	System Missing Values	2	0.1		
Total		1600	100		

5. Conclusions

Due to the lack of visual supporting materials, previous exhibitions based on documents had trouble relaying to the audience their historical significance, making the task of educational dissemination difficult. By bringing ancient artifacts to life with new technology and conveying knowledge of their historical background through new media, museums can maximize their educational potential. Documents, memoranda, and other historical artifacts related to the Tong-an ships can all be reproduced in the physical or virtual space of the exhibition area.

"Rebuilding the Tong-an Ships--New Media Art Exhibition," the NPM's first digital interactive art exhibition with the combined theme of maritime history and Taiwanese history, is seminal to the fields of historical education, art and artifact research, and digital display technology. The exhibition focuses on the Tong-an ship theme as the main historical axis, from which the story of a period unfurls in simple terms. As technology advances, cultural art and artifacts, after undergoing digitization, mediatization, and interactivity in accordance with national technological advancement plans for a digital archive, have utterly transformed audiences from passive recipients to active participants. This new aesthetic experience creates deeper feelings and memories, shatters the limitations of traditional display methods, and utilizes the newest technology. In so creating this new aesthetic, we can say that the NPM as the inheritor of Chinese civilization has fully demonstrated its value as the key player of Asian art and culture and fulfilled its function of knowledge transmission.

Having provided an overview and visitor experience analysis of the exhibition, it is evident that this exhibition has much creative potential in the field of new media displays. The exhibition communicated to audiences the possibilities of future exhibitions and established the creation of memorable experiences as the new museum focus.

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