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ASSESSMENT OF THE IMPACT OF TECHNOLOGICAL TOOLS ON THE WORK OF ARTISTIC ORGANIZATIONS IN SERBIA THROUGH THE APPLICATION OF THE FUZZY-DELPHI METHOD

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Abstract

This research paper aims to investigate the impact of technological innovations on the management of artistic organizations in Serbia. In today's contemporary digital environment, these organizations face numerous challenges. This study focuses on enhancing the management processes of these organizations, as well as increasing their efficiency and productivity. Special emphasis is placed on the importance of technological innovations in improving business operations and strengthening connections with the audience. The goal is to further explore the role of technological innovations in the Serbian artistic sector and to find the most effective ways to implement them. Plan is to develop a methodological framework for identifying crucial decision-making factors utilizing the Fuzzy-Delphi method (FDM). Additionally, an analysis of the impact of technological tools on the long-term sustainability of artistic organizations is planned, with a particular focus on the application of digital platforms, artificial intelligence, and blockchain technology. Through the analysis of expert opinions, a better understanding of the impact of technological innovations on the artistic sector and the identification of key success factors is expected.

Keywords: *art, technological tools, organizations of visual artists, FDM*

1. INTRODUCTION

This paper delves into the role and importance of arts management in contemporary literature. It explores the essence and objectives of arts management theory and practice, focusing on understanding and navigating the complexities of managing artistic organizations and their impact on culture. The aim is to provide deeper insight into arts management's dynamics in today's society through analyzing relevant literature, theoretical frameworks, and empirical research.

Technological innovations of the 20th and 21st centuries aim to enhance processes, improve productivity, and ensure safety across various aspects of life. Technology pervades every sphere of human activity in today's digital age, with rapid advancements constantly emerging. It significantly influences industrial development, facilitates communication,

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and enables the creation of new business models and products/services of higher quality (Štrbac, 2007). Technology permeates every aspect of human activity, from agriculture to healthcare, education, and even art. While it offers numerous advantages, it also presents challenges like data privacy concerns, identity theft, and digital security risks. Nevertheless, technology has become indispensable in our daily lives, driving innovation and shaping our future. In the artistic sector, technology poses both challenges and opportunities. The rapid digitization of cultural resources and shifts in consumer behavior demand innovative solutions from artistic organizations. Traditional funding and distribution models are inadequate in this evolving landscape. Therefore, integrating technological innovations into arts management is essential for enhancing efficiency, sustainability, and creativity. Online platforms enable artists and organizations to reach wider audiences, while artificial intelligence facilitates data analysis, personalization, and process optimization. These advancements streamline resource management and decision-making, fostering growth and adaptability in the artistic realm.

This paper explores how technological innovations impact organizations supporting visual artists in Serbia using the Fuzzy-Delphi method (FDM). In today's digital landscape, these organizations continually seek innovative technologies to enhance creativity and reach a broader audience. The FDM offers a structured approach to assess the impact of these technologies, gathering expert opinions to understand their potential benefits. This deeper understanding can improve efficiency, foster creativity, and contribute to overall success in the art industry. Through careful evaluation, organizations can make informed decisions about technology adoption, staying competitive in a demanding market.

2. LITERATURE REVIEW

The rapid advancement of technology profoundly influences various aspects of artistic creation, distribution, and organizational management. However, there's a dearth of empirical research on how technology affects organizations supporting visual artists. This gap underscores the need for further investigation in this area.

The European Parliamentary Research Service (EPRS) report, "*The relationship between artistic activities and digital technology development*" delves into the impact of digital technology on artistic processes and its role in driving innovation, particularly within the European Union. It examines trends and potential collaborations between artistic and technological domains (Davies et Dyer, 2019). One study specifically explores the challenges and opportunities of integrating digital art within Serbia's institutional framework. Many cultural institutions in Serbia are grappling with digitalization, preservation of digital art, and other related challenges. Through case studies like the Museum of Contemporary Art of Vojvodina, this research analyzes the integration of digital art practices into Serbia's cultural landscape, both at institutional and local levels (Mevorah, 2013). In the article "*The Role of Arts Management in the Modern World*" by Tamar Tavkhelidze, new methods in arts management and influential factors shaping arts organizations are explored. Additionally, the article examines why arts management has become a distinct discipline, defines the key role of arts management in the contemporary

art world, and discusses the skills that arts managers must apply in their daily work. Information sources that can help arts managers acquire knowledge are also analyzed (Tavkhelidze, 2016).

The literature review on "*Assessment of the Impact of Technological Tools on the work of Artistic Organizations through the Application of the Fuzzy-Delphi Method in Serbia*" revealed a scarcity of scientific research on this subject. One study focused on fostering youth creativity through innovative technologies in arts management, particularly within educational institutions. It explored the intersection of art and management, highlighting the potential of innovative arts management technologies to stimulate cultural and creative initiatives among students, especially through artistic project methods. The study emphasized an interdisciplinary approach and integration of structural and aesthetic elements in technology implementation. Notably, none of the reviewed papers utilized the Fuzzy-Delphi method to analyze technological trends or predict their impact on organizations supporting visual artists in Serbia. This underscores the necessity for further research to address the gaps in understanding and explore new technological advancements in enhancing artistic organizational management processes (Komandyshko, 2016).

2.1. Art Management

The introductory paragraph from the "Arts Management" entry in the 1998 edition of the International Encyclopedia of Public Policy and Administration offers a foundational framework for understanding the concept. It outlines the five fundamental management functions - planning, organizing, staffing, leading, and controlling they relate to the creation and presentation of performing or visual arts to audiences. This encompassing administration and support of the creative process extend to both public, nonprofit arts organizations (such as theaters, symphony orchestras, operas, dance troupes, museums, and performing arts centers) and private, commercial, for-profit artistic entities (Chong, 2010). Creative individuals are actively involved in the field of arts management. Art managers are precisely involved in this domain to enable art to reach a certain level. This area of management brings together various aspects of management, as already mentioned, and also encompasses a wide range of tasks, including leadership, distribution, marketing of cultural services, products, etc (Tavkhelidze, 2016). To grasp management in culture, we examine it through two lenses. Firstly, we identify key actors in this realm. The primary figure is the artist or cultural practitioner (actors, painters, sculptors, directors, etc.), pivotal in crafting works that enrich cultural development. These creations typically form part of cultural production presented to audiences. Cultural significance and creativity are fostered and endorsed by governmental bodies at national, regional, and local levels. Apart from governmental support, culture often receives backing from donors and sponsors, who also serve as co-financiers and audience members. Cultural experts monitor and analyze individual artistic works and creative trends, assessing their importance. In contemporary society, the media serves as a vital communication conduit, linking artists with audiences and shaping cultural supply and demand (Antolović, 2009).Top of Form Managing creative and cultural organizations demands managers to undertake various essential tasks,

including project management, financial planning, strategic decision-making, and human resource management. Managers in artistic institutions require specific skills tailored to the demands of creative and cultural industries. Effective project management is often emphasized in these organizations due to their frequent focus on specific projectsTop of Form (Raduški, 2016).

2.2. The role of technological innovations in the artistic sector

Daily, companies and their managers confront inevitable changes. Managers can resist, react to, or predict these changes. Depending on their scale and speed, changes can present challenges or opportunities. Managerial attitudes towards change are pivotal for an organization's future success or potential downfall. Creativity is increasingly crucial for organizational change and competitiveness, especially in cultural institutions and artistic organizations. These entities balance traditional values with the imperative for innovation and must adapt to remain relevant and vital. Openness to innovation, flexibility, and adaptability are essential for success, particularly for cultural and artistic organizations navigating specific challenges in a dynamic society (Stevanović, 2016). Technology and art have shared roots and are closely linked with societal trends. In the book "*Art and Technics*" historian Lewis Mumford delves into this connection, examining how both realms mirror human nature. Art delves into the inner world of humanity, expressing profound emotional and symbolic layers of life, while technology addresses the need to control external conditions and improve practical human action (Rajčetić, 2012). In today's digital age, contemporary art museums worldwide face specific high-tech demands, aiming to attract audiences amid abundant online information. However, complete digitization of operations remains a challenge. The rise of digital technology has disrupted traditional exhibition models and the relationship between artists and art institutions. Internet art, pioneered by a group of artists experimenting with computer and web aesthetics in the 1990s (net.art), utilizes the internet as its primary medium. This practice has evolved and gained acceptance, offering artists new avenues for expression, communication, promotion, and collaboration outside traditional institutional frameworks. This trend challenges conventional exhibition models, fostering exploration of innovative artistic forms Top of Form (Mevorah, 2013).

3. DATA AND METHODOLOGY

The research section involves conducting email surveys to facilitate communication with panelists. Before applying the Fuzzy-Delphi method, it's crucial to form an expert group, ideally comprising 10 to 50 members (Pua et al., 2017). 10 respondents with diverse backgrounds participated in the study, considered adequate for its objectives. The research aims to assess visual artists' attitudes, opinions, and perspectives on innovative technologies in art, including their experiences and perceptions. It also evaluates the impact of innovative technologies on the art market, such as changes in artists' sales, promotion, and distribution methods. A Fuzzy scale with seven degrees is used to gauge respondents' subjective feelings or opinions on these parameters.

3.1. Fuzzy-Delphi Method (FDM)

Proposed in 1960 by Dalkey and Helmer, the Delphi method offers a systematic approach to forming group opinions or making decisions through expert surveys. In 1985, Murray, Pipino, and Gigch introduced the Fuzzy-Delphi Method (FDM), integrating Fuzzy theory into the Delphi method for factor analysis. FDM provides several advantages over traditional Delphi methods, including allowing experts to express opinions in greater detail, utilizing expert knowledge more rationally, and being more time and cost-efficient (Yao et al., 2022). The Fuzzy Delphi method integrates Fuzzy theory into the Delphi method, serving as a predictive tool based on expert opinion and research conducted through expert meetings. It features several key aspects (Suzianti et al., 2021):

Anonymity: Experts remain anonymous to ensure objectivity and minimize influence.

Feedback: Participants receive feedback on group ideas, prompting reassessment and resubmission.

Statistical analysis: Statistical processes and graphs depict the majority opinion (50% of experts) as the team's prediction, while upper and lower quartiles indicate deviations.

Convergence: Multiple rounds of feedback lead to final predicted results.

Procedure for applying the Fuzzy-Delphi method, according to all authors, consists of several basic steps outlined below:

Step 1: Selection of Experts. This step involves the selection and engagement of experts. It is important to choose appropriate experts who will provide relevant opinions within the research framework. Authors' recommendations suggest that the optimal number of experts should be between 10 and 15, provided there is a high degree of consensus among them. This approach ensures diversity in insights and a quality contribution to the research team (Abdullah & Mohd Yusof, 2018).

Step 2: Determining the Linguistic Scale. After experts complete the survey and express their opinions, data collection follows, translating linguistic variables into a numerical system or fuzzy scale. In this master's thesis, a seven-point fuzzy scale was used (Table 1) ranging from (1) - Completely unimportant; (2) - Very weak / Very low; (3) - Weak / Low; (4) - Neutral; (5) - High; (6) - Extremely high / Extremely significant; (7) - Completely important / Completely significant.

Table 1. Seven-point Fuzzy Scale

Linguistic Variables	Ratings	Fuzzy Scale
Extremely important	7	0.9 ; 1 ; 1
Important	6	0.7 ; 0.9 ; 1
Moderately important	5	0.5 ; 0.7 ; 0.9
Neutral	4	0.3 ; 0.5 ; 0.7
Moderately unimportant	3	0.1 ; 0.3 ; 0.5
Unimportant	2	0.0 ; 0.1 ; 0.3
Completely unimportant	1	0.0 ; 0.0 ; 0.1

Step 3: Calculation of the Threshold Value (d). This is a crucial step or condition for determining consensus among experts. As authors Pua et al. state in their work: "Identifying Mental Health Elements among Technical University Students Using Fuzzy Delphi Method" the threshold value (d) should be less than or equal to 0.2 ($d \leq 0.2$). This value is calculated using the following formula:

$$d = \sqrt{1/3[(m1 - n1)^2 + (m2 - n2)^2 + (m3 - n3)^2]} \quad (1)$$

Triangular Fuzzy Numbers represent m1, m2, and m3, which are actually the ratings assigned by experts according to the seven-point fuzzy scale.

Step 4: Assessment of the Percentage Agreement Value of Experts. The next condition for determining whether consensus has been reached is a percentage value that should be greater than or equal to 75% to be considered consensus (Abdullah & Mohd Yusof, 2018).

Step 5: Defuzzification. This process involves determining the rank and rating of each criterion using one of three formulas as shown below (Pua et al., 2017):

$$A = 1/3 * (m1 + m2 + m3) \quad (2)$$

$$A = 1/4 * (m1 + m2 + m3) \quad (3)$$

$$A = 1/6 * (m1 + m2 + m3) \quad (4)$$

Specifically in this study, the first formula will be applied. The value of the defuzzification process or the Fuzzy Score (A) should be greater than or equal to 0.5 to be considered that consensus has been reached: α – cut value ≥ 0.5

4. RESULTS AND DISCUSSION

The Table 2 shows the criteria and letter designation of sub-criteria, i.e. technological tools and innovations, which the respondents evaluated.

Table 2. Digital Tools in the Art Sector Based on Criteria and Subcriteria (K1-K19)

Digital marketing	Online sales platforms	Virtual tools for exhibitions	Technologies for the authentication of works of art	Art inventory management systems
K1	K5	K9	K13	K16
K2	K6	K10	K14	K17
K3	K7	K11	K15	K18
K4	K8	K12		K19

Where:

K1 - Using social media campaigns through specific art platforms.
K2 - Focusing on email campaigns that directly engage the targeted artistic audience.
K3 - Organization of interactive webinars and workshops for the audience.
K4 - Creation of digital portfolios and online galleries.
K5 - Presence on e-commerce platforms specialized in works of art.
K6 - Using online auctions and marketplaces for works of art.
K7 - Cooperation with digital art galleries and distributors.

K8 - Developing your own online store for the direct sale of works of art.
K9 - Implementation of virtual exhibitions in reality for global audience accessibility.
K10 - Using AR technologies for more interactive exhibition experiences.
K11 - Creation of online art tours and virtual galleries.
K12 - Organization of digital artistic performances and interactive events.
K13 - Applying blockchain technology for secure authentication of works of art.
K14 - Using digital watermarks to track the authenticity of works of art.
K15 - Implementation of fingerprint recognition technology for artwork authentication.
K16 - Implementation of a cloud system for better availability of artwork inventory data.
K17 - Integration of RFID technology for accurate inventory tracking.
K18 - Development of mobile applications for inventorying works of art.
K19 - Using AI technologies to automate inventory management.

In todays art world, it's essential to examine the demographic traits, backgrounds, and inclinations of artists to grasp the impact of technological advancements on their creative methods. Scrutinizing the information offers valuable glimpses into the varied profiles and viewpoints present within the artistic sphere. The Table 3 shows the demographic statistics of the respondents.

Table 3. Analysis of demographic characteristics

Gender	
Male	Female
60%	40%
Age	
26-30 years old	30%
31-35 years old	20%
36-40 years old	30%
Over 41 years old	20%
Self-taught artist	20%
Employees in the museum	10%
Academic Artist	30%
Art association member	10%
Employees at a higher education institution in the field of art	20%
Curator	10%
Experience in using innovative technologies in artistic work	
No experience	0%
Slightly experienced	0%
Partially experienced	30%
Very experienced	70%
Painting	50%
Graphic design	10%
Photography	30%
Digital art	30%
Other (Design, Film...)	20%

Table 4 provides the final results after the FIRST round.

Table 4. Final table - FIRST round

Eligibility criteria	Threshold Consensus Value, d ≤ 0.2	% of Experts Group Consensus ≥75%	Fuzzy Score (A), α – cut value ≥ 0.5	Experts Threshold Consensus	Rank
K1	0.168	80.00%	0.75333	Accepted	10
K2	0.162	**70.00%**	0.68667	**Rejected**	17
K3	0.118	90.00%	0.83667	Accepted	4
K4	0.165	90.00%	0.87333	Accepted	1
K5	**0.201**	**70.00%**	0.66000	**Rejected**	18
K6	0.192	**70.00%**	0.64333	**Rejected**	19
K7	0.144	90.00%	0.82667	Accepted	5
K8	**0.202**	80.00%	0.69000	**Rejected**	16
K9	0.154	**70.00%**	0.75000	**Rejected**	11
K10	0.146	80.00%	0.72000	Accepted	13
K11	0.119	80.00%	0.74333	Accepted	12
K12	0.152	80.00%	0.77000	Accepted	9
K13	0.168	90.00%	0.84667	Accepted	2
K14	0.155	100.00%	0.84667	Accepted	2
K15	0.160	**70.00%**	0.78333	**Rejected**	7
K16	0.162	90.00%	0.72000	Accepted	14
K17	0.179	80.00%	0.78333	Accepted	8
K18	0.159	90.00%	0.80333	Accepted	6
K19	0.166	**70.00%**	0.70667	**Rejected**	15

Analyzing the obtained results in the first round, together with the criteria used to evaluate the acceptance or rejection of each individual criterion, we can conclude the following: Criteria: K1, K3, K4, K7, K10, K11, K12, K13, K14, K16, K17, and K18 have met all the specified conditions ($d \leq 0.2$; ≥75%; $A \geq 0.5$), thus passing the consensus, meaning that a second round is not required for them. Criteria: K2, K5, K6, K8, K9, K15, and K19 did not pass the consensus because not all conditions were met, therefore a second round is recommended for these criteria. Specifically, K2, K6, K9, K15, and K19 do not meet the second condition because the percentage of expert agreement is less than 75%, i.e., it is 70% for all criteria. While criteria K5 and K8 do not meet the first and second conditions, with a Threshold Value of 0.201 for K5 and 0.202 for K8. Additionally, the percentage value for criterion K5 is lower than the specified and is 70%. According to the results of the first round of analysis, the criteria are ranked based on the defuzzification process (Fuzzy Score - A), and accordingly, the most significant criteria after the first round are: K4 - Creation of digital portfolios and online galleries: It has the highest rank (1) and a high Fuzzy Score - A (0.87333), indicating high expert consensus and relevance. Other significant criteria: K13 - Applying blockchain technology for secure authentication of works of art: It has a high rank (2) and a high Fuzzy Score - A (0.84667), making it also very relevant. K14 - Using digital watermarks to track the authenticity of works of art: Also has a high rank (2) and a high Fuzzy Score - A (0.84667), making it also a significant

criterion. K3 - Organization of interactive webinars and workshops for the audience: It has a high rank (4) and a high Fuzzy Score - A (0.83667), placing it among the significant criteria. K7 - Cooperation with digital art galleries and distributors: It has a solid rank (5) and a high Fuzzy Score - A (0.82667), making it relevant. For more precise results, as already mentioned, a second round of the Fuzzy-Delphi method is required. Only those criteria for which consensus was not reached in the first round enter the second round. The criteria recommended for the second round are as follows: K2 – Focusing on email campaigns that directly engage the targeted artistic audience; K5 – Presence on e-commerce platforms specialized in works of art; K6 – Using online auctions and marketplaces for works of art; K8 – Developing your own online store for the direct sale of works of art; K9 – Implementation of virtual exhibitions in reality for global audience accessibility; K15 – Implementation of fingerprint recognition technology for artwork authentication; K19 – Using AI technologies to automate inventory management. Table 5 provides the final results after the SECOND round.

Table 5. Final table - SECOND round

Eligibility criteria	Threshold Consensus Value, d ≤ 0.2	Percentage of Experts Group Consensus, ≥75%	Fuzzy Score (A), α – cut value ≥ 0.5	Experts Threshold Consensus	Rank
K1	0.168	80.00%	0.753	Accepted	13
K2	0.096	90.00%	0.747	Accepted	15
K3	0.118	90.00%	0.837	Accepted	5
K4	0.165	90.00%	0.873	Accepted	1
K5	0.093	80.00%	0.773	Accepted	10
K6	0.116	80.00%	0.757	Accepted	12
K7	0.144	90.00%	0.827	Accepted	6
K8	0.168	80.00%	0.690	Accepted	19
K9	0.108	80.00%	0.750	Accepted	14
K10	0.146	80.00%	0.720	Accepted	17
K11	0.119	80.00%	0.743	Accepted	16
K12	0.152	80.00%	0.770	Accepted	11
K13	0.168	90.00%	0.847	Accepted	2
K14	0.155	100.00%	0.847	Accepted	2
K15	0.174	90.00%	0.837	Accepted	4
K16	0.162	90.00%	0.720	Accepted	18
K17	0.179	80.00%	0.783	Accepted	8
K18	0.159	90.00%	0.803	Accepted	7
K19	0.164	80.00%	0.783	Accepted	8

Analyzing the results obtained after the second round, along with the criteria used for assessing the acceptance or rejection of each individual criterion, we can conclude the following: Threshold values (d) range from 0.093 to 0.179. Most criteria have values below 0.2, indicating that all results are within the defined range. All criteria after the second round have expert consensus percentages greater than 75%, indicating a high level of agreement between experts and results. The defuzzification process (Fuzzy Score - A) varies from 0.69 to 0.847. Most criteria have high Fuzzy Score - A values, indicating that

the results are highly rated and relevant. Criteria K4, K13, and K14 are again among the most significant, with ranks (1, 2, and 2) and the highest Fuzzy Score - A values. These results indicate a high level of quality and relevance of criteria in the analysis. Specifically, K4, K13, and K14 in the second round of analysis suggest that these criteria are crucial and of primary importance for research or analysis in the given context. As for criteria with very low ranks, such as K8 - Developing your own online store for direct sale of artwork, ranked (19); K16 - Implementation of a cloud system for better availability of artwork inventory data, ranked (18); and K10 - Using AR technologies for more interactive exhibition experiences, ranked (17), the reasons why these and some other criteria received such low scores may include: lack of training, information, or understanding about certain technological tools, but there may also be resistance to new changes, which can hinder understanding and later adoption and implementation of these technological tools in practice. Strategies to overcome these challenges may include: enhancing education for skill improvement, investing in technological and human resources, tailoring criteria to specific goals, and involving stakeholders in decision-making for technology adoption and implementation to address issues effectively.

5. CONCLUSION

After a thorough analysis, it's evident that technological advancements are pivotal in shaping the art sector's future. The research highlights the critical need for embracing technology to stay competitive. High ratings for criteria like K4 (Creation of digital portfolios and online galleries), K13 (Applying blockchain technology for secure authentication of works of art), and K14 (Using digital watermarks) underscore technology's importance. Leveraging blockchain or digital watermarks enhances artwork authentication, necessitating organizations to integrate technology for authentication, distribution, and audience engagement. Overcoming challenges associated with technology adoption, such as staff training and resource alignment, demands focused efforts. Remaining adaptable and monitoring technological trends enable continuous innovation. Anticipating technological impacts aids in strategic decision-making, fostering long-term growth and competitiveness. Organizations embracing these strategies stand to expand influence, attract new audiences, and secure lasting success, recognizing technology's role in shaping the art sector's future.

PROCENA UTICAJA TEHNOLOŠKIH ALATA NA RAD UMETNIČKIH ORGANIZACIJA U SRBIJI PRIMENOM FAZI-DELFI METODE

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Izvod

Ovaj istraživački rad ima za cilj da istraži uticaj tehnoloških inovacija na upravljanje umetničkim organizacijama u Srbiji. U današnjem savremenom digitalnom okruženju, ove organizacije se suočavaju sa brojnim izazovima. Ova studija se fokusira na unapređenje procesa upravljanja ovim organizacijama, kao i na povećanje njihove efikasnosti i produktivnosti. Poseban akcenat je stavljen na značaj tehnoloških inovacija u unapređenju poslovanja i jačanju veza sa publikom. Cilj je dalje istraživanje uloge tehnoloških inovacija u srpskom umetničkom sektoru i pronalaženje najefikasnijih načina za njihovo sprovođenje. Plan je da se razvije metodološki okvir za identifikaciju ključnih faktora donošenja odluka koristeći Fazi-Delfi metodu (FDM). Pored toga, planirana je analiza uticaja tehnoloških alata na dugoročnu održivost umetničkih organizacija, sa posebnim fokusom na primenu digitalnih platformi, veštačke inteligencije i blokčejn tehnologije. Kroz analizu stručnih mišljenja očekuje se bolje razumevanje uticaja tehnoloških inovacija na umetnički sektor i identifikacija ključnih faktora uspeha.

Ključne reči: *umetnost, tehnološki alati, organizacije vizuelnih umetnika, FDM*

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