

Appendix B

Arts and Technologies in ASEAN

Interconnected Parts



ASEAN-UK Advancing
Creative Economy Initiative

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Appendix B

Country deep dives

Appendix B complements the full report, 'Arts and Technologies in ASEAN: Interconnected Parts', which is available as a separate document.

Appendix B contains the detailed findings of emerging practices and innovations across the 10 ASEAN member states and Timor-Leste. Through case studies and a dynamic mapping of socio-political contexts, policies and key stakeholder groups, we present how the arts and technologies ecosystem is evolving across the region.

Considering the wide geographic scope of the project and time and resource constraints, our research strategy focused on an "inside-out" nested case research method. It is mostly based on detailed case studies within an ASEAN country. The aim is to capture the essence of how arts and creative practices intersect with technology in localised settings.

While this approach allows us to capture rich, primary data, it inherently limits the scope to specific areas of interest, which may not fully represent the entirety of each country's ecosystem. To mitigate this, the case studies are complemented by desk research, which broadens the context and provides additional perspectives. As a result, the findings provide a deep, yet partial, understanding of the arts and technologies ecosystem across the 11 countries. This selective focus is a necessary trade-off that enables us to explore in-depth data while acknowledging that some aspects of the broader ecosystem may remain under-explored.

Data collection methods include both desk research and semi-structured interviews. Desk research involved reviewing existing literature, policy documents, and media articles related to the intersections and case studies.

In consultation with local experts and researchers, we selected case studies using criteria such as innovation and technology integration, creative and cultural impact, community and network dynamics, policy and regulatory environment, infrastructure and resources, cultural and social relevance, economic impact, and emerging trends. The case studies were further refined based on their focus on artist-led innovation and broader creative technology initiatives, considering factors such as sustainability, replicability, and inclusivity.

Semi-structured interviews were conducted with four key stakeholders per country, including artists, policymakers, technology experts, and academics. The interviews were conducted online and lasted for about an hour and a half on average. In cases where the interview was conducted in the local language, such as, Vietnamese or Indonesian, translation was provided by our local researchers to ensure transparency and comprehension across the team. We also ensured that the voices of minority groups were included and considered the gender balance of respondents. Over 60 interviews with artists, technologists, policymakers and academics were conducted.

Brunei Darussalam

Key findings

Brunei Darussalam ranks second highest in research and development (R&D) for innovation with public sector funding in government and higher education (Kim & Castillejos-Petalcorin, 2020). This is reflected in technology and AI programmes at higher education institutions. There is an opportunity to develop these sectors further and invite overseas funding.

Brunei's fashion and textile industries are at their earliest stages of technological innovation, with few hubs for creative technology or creative startup incubation. The infrastructure supporting creative technology in Brunei's fashion and textile sectors requires significant investment from the public and private sectors.

While ASEAN recommendations focus on areas like agriculture and energy development, there is government interest in fashion with the expansion of the Fashion Design programme at Universiti

Teknologi Brunei (UTB) School of Design. There have been various attempts to create a fashion hub (Seni Mode, The Collective Makerspace), but there has yet to be an initiative merging these two sectors alongside existing entrepreneurship hubs.

'Brunei has been limited by the lack of effective cultural policies, such as a national endowment for the arts and suitable cultural infrastructure' (Lopes, 2021). We find similar challenges in the fashion and textiles landscape, which are lacking in related cultural policies. As with other areas of Brunei's creative industries, fashion is not analysed or researched as its own sector.

A balance needs to be struck to ensure Brunei's national philosophy, Malay Islamic Monarchy, is retained while still fostering innovation. Policy development should create a multi-industry and intra-government environment to foster innovation. Future research should focus on understanding the long-term impacts of creative technologies on the wider Bruneian economy and society.



Digital mock-up of head scarf design with a gagtar (hairpiece traditionally worn at a Brunei Malay-Muslim wedding) as a central motif around the centre. Source: Mahkota Designs.

Country profile

Brunei Darussalam in the early 2010s witnessed the beginning of burgeoning public and private interest in creative technologies with a slow influx of infrastructure funding and higher education programmes, including intellectual property laws favourable to creativity and innovation (Lopes & Aliudin, 2019). The initial funding and programmes have reaped some rewards with youth and graduate creative entrepreneurs operating through digital platforms such as Instagram and physical settings such as creative festivals and pop-ups. Digital creative work is increasingly popular, aligning with Brunei’s increasing high social media penetration. (Mohamad, 2020; Geiger-Ho & Ho, 2016).

The broader cultural and social impact of Brunei’s creative technology sector lacks extensive academic research, with studies focusing on the cultural impact of Brunei’s film industry (Liu, 2021), the creative industry’s role in economic diversification (Lopes & Aliudin, 2019), among others.

No economic activity matching “Creative” industries is listed under Brunei’s GDP reports (quarterly or annual) published by the Ministry of Finance and Economy (MOFE). Yap (2023) points out that arts and cultural activities may fall under “Other Service Activities”, “Education” and “Wholesale and Retail Trade” based on the Brunei Darussalam Standard Industrial Classification, 2011. These relevant industries consist of nearly 25% of the working population, or 55,000. The researchers of this report would include this percentage as the population likely to engage with creative technologies.

A common barrier to Brunei’s creative economy is government restrictions in content creation or self-censorship restrictions. Individuals working in Brunei have mentioned restrictions in content creation as detrimental to growth (Mohamad, 2020; Starrs, 2017, p. 129).

Brunei Darussalam is the sixth member to join ASEAN and has the second smallest total landmass in the region. The sparsely populated country with 72% rainforest coverage has an estimated population of 450,500. The total working population over the age of 15 is 228,598 (Labour Force Survey, 2023). The latest financial indicators reveal that Brunei’s spending power and average income outperform all ASEAN countries except for Singapore (ASEAN Statistical Yearbook, 2023).

The average monthly income in 2021 was BND \$1,536 (USD 1,134) per employed person. The International Monetary Fund (IMF) reported per capita income as USD 35,110 (GDP per capita, 2024). Brunei has the second highest literacy rate in the region, after Singapore, at 97.3%.

Brunei has a nominal GDP of BND 20,318.5 million (USD 15,009.05 million) (Department of Statistics, 2023). In 2023, the oil and gas (O&G) sector contributed to around half of Brunei’s nominal GDP (CSPS, 2024). The services sector is the most significant contributor to the non-oil and gas segment.

A 2019 report on Information and Communication Technology (ICT) business integration indicated that 90% of Brunei businesses have Internet access. As of 2023, AITI recorded high country coverage of mobile and broadband internet access, with mobile penetration at 122.43%. Internet users in Brunei increased by 3,556 (+0.8%) between 2022 and 2023, with a 99% internet penetration rate, well above the regional average of 70% (Statista, 2022).

Intersections between fashion design and artificial intelligence-led product development

Brunei Darussalam’s country report explores cutting-edge Brunei fashion designers NA FORRÉR and Mahkota Designs’ use of GenAI¹ tools like Midjourney and NewArc.ai. For designers to meet the demand for customisation, they face several challenges, including restricted textile and printing options, a small local consumer base and a lack of skilled workforce, among others. High internet connectivity, mobile penetration and literacy, all of which Brunei ranks high in ASEAN, lay the groundwork for the use of GenAI. Privately run business entities lead innovation in the fashion and textile industry, modernising the process through research and development (R&D). These culturally significant industries are slow and laborious - most of the process is handmade with years to learn the craft, while design motifs are guided by Brunei’s national philosophy, Malay Islamic Monarchy (Melayu Islam Beraja). Web and app-based GenAI tools allow Brunei fashion designers to visualise and develop concepts quickly without the laborious production processes.

Policy and intellectual property overview

While no government policies exist to guide and manage the use of GenAI, there is interest in integrating it into service and by extension, the creative industries. The Ministry of Transport and Infocommunications is drafting guidelines on the responsible use of AI. The educational and technology sectors have created programmes for this growing area. An important industry hub supporting this emerging field is Brunei Innovation Lab (BIL), which aims to merge two key sectors: ICT and services. The table below outlines related policies related to the creative technologies:

Theme	Brunei IP Policy	Brunei Government Policy
Protection	Brunei’s copyright laws are governed by the Copyright Order 1999 and the Copyright (Amendment) Order 2013.	The National Youth Policy and Strategy 2020-2035 highlights efforts to achieve international recognition for Brunei’s youth in culture and art.
Innovation	Establishment of BIL, July 13 2022, a collaboration with major industry players to foster technopreneurship.	UBD Intellectual Property Policy Framework updated in 2019, to manage UBD IP rights.
Standards	Brunei is a member of the WTO, the Berne Convention and WIPO Copyright Treaty.	The Authority for Info-communications Technology Industry of Brunei Darussalam has drafted a guide for AI Governance and Ethics for Brunei Darussalam.
Frameworks	Policy framework such as the Manpower Blueprint for Brunei Darussalam and UBD/UTB (Universiti Teknologi Brunei) programmes.	Digital Economy Masterplan 2025 is a government initiative by the Digital Economy Council to drive Brunei’s socio-economic growth through digital transformation.

Songket Malaysia was added to the United Nations Educational, Scientific and Cultural Organisation (UNESCO) list of Intangible Cultural Heritage of Humanity in 2021. The traditional craft is similar in process and is as significant in Brunei. The lack of joint country nomination is an example of the lack of robust IP and cultural policy planning. The researchers also found no design guidelines for patterns or designs from the Brunei Arts and Handicraft Training Centre (BAHTC), only an emphasis on following Brunei’s national philosophy. As Siti Norkhalbi shared, there are “one thousand different motifs”, with many unknown or yet-to-be-named. There is also no central database or active policy provisions to protect the IP of motifs of tenuous (Muslim headscarf for women, also known as hijab).

1 See Glossary

International relations and bilateral agreements

Brunei and the United Kingdom have enjoyed a close and enduring relationship since Brunei gained independence in 1984. The year 2024 marks a significant milestone, commemorating the 40th anniversary of formal diplomatic relations between the two nations. This long standing partnership, rooted in shared history and mutual interests, has flourished over the past four decades, encompassing cooperation in various fields such as defence, education, and trade. In 2023, the UK emerged as the largest investor in Brunei Darussalam, contributing BND 234.5 million (USD 172.83 million) (FDI Report, 2023). Brunei operates two parallel legal systems: a Common Law system rooted in English law and a Sharia Penal Code. Additionally, Brunei is a member of the Regional Comprehensive Economic Partnership (RCEP) and, as of July 2023, a fully ratified member of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

Since 1967, the Brunei Dollar (BND) has been pegged to the Singapore Dollar through the Currency Interchangeability Agreement.

In 2022, the Brunei Innovation Lab (BIL) was established, a collaboration with major industry players to foster technopreneurship. Located in Brunei's Anggerek Desa Technology Park, along with Darussalam Enterprise (DARE) and Dynamik Technologies, near Brunei's International Airport. This effort aligns with the Brunei Darussalam Economic Blueprint (MOFE, 2020) for developing Brunei Darussalam's non-oil and gas sector and moving away from oil and gas production. This measure to encourage entrepreneurship among the youth is also led by policies by the government to create job opportunities, reducing Brunei's unemployment rate. In 2022, the rate was 7.58%, the highest in the region (ASEAN Employment Outlook, 2023).

BIL aims to increase the pipeline of tech startups to enhance Brunei's economic diversity and

competitiveness by bridging gaps between the public and private sectors, educational institutions, and funding bodies. Through their hackathons, the innovation lab focuses on solving real-world problems by working closely with industry sectors. These initiatives support startups in developing and commercialising solutions, offering startup support like innovation challenge prizes and seed funding. They aim to match the industry's needs through programmes with a focus on spin-off services from the oil and gas sector.

The innovation lab aligns with Brunei's vision of becoming a smart nation by 2025 under the Digital Economy Masterplan (DEM) 2025. The DEM 2025 is a government initiative by the Digital Economy Council to drive Brunei's socio-economic growth through digital transformation. The entities involved in establishing BIL had their own programmes promoting entrepreneurship; DST launched its InnoLab in February 2020, DARE was established in February 2016, and LiveWIRE, the longest-running initiative, launched in May 2001. BIL provides a platform for start-ups to innovate and experiment on solutions with immediate impact to companies. A total of around BND 100,000 (USD 73,800) in funding has been earmarked for startups; funding is released based on key milestones. The training programmes also aim to upskill participants and increase the quality of ideas developed into innovative solutions.

Further, the programmes also provide a bridge to the industry for those with the technical skills to take up creative entrepreneurship. One of their most attended sessions was the 101: Artificial Intelligence in Creativity by Liyana Hanif, held in 2023. Liyana is a prominent Brunei creative director and member of SEA-Up, a group that aims to bridge the GenAI skills gap in ASEAN. There have been national hackathon challenges that encourage creative solutions to solve real-world issues. An area they have yet to explore is the creative industry, since emphasis is on downstream oil and gas industries.

Gender and marginalised groups policy & initiatives

Wawasan Brunei 2035 (Brunei Vision 2035) aims to encourage equal opportunities for women in the workforce and in nation-building (Ahmad, 2019). In 2023, Brunei announced steps to create a National Plan of Action on Women for policies to address gaps in women's development. Currently, Brunei has no policy to encourage women-owned businesses. According to a 2022 ASEAN report on Strengthening Women's Entrepreneurship, women account for 43.4% of the total self-employed and 35.9% of employers. The 2021 ASEAN Gender Outlook, a joint report between ASEAN and UN Women, found that Brunei Darussalam has the highest proportion of female executives in the region.

Case study: Fashion design through AI-led product development

The manufacture of apparel and textiles contributes approximately 0.2% to Brunei's gross domestic product (GDP) annually, according to Brunei Darussalam's GDP Annual 2023. The textiles and garments industry thrived in the late 1990s, employing over 1,500 people and primarily exporting to North America (Paper 1 Brunei Darussalam, 2021).

A limiting factor in the sector's growth is that Brunei does not produce raw materials for weaving or textiles. Competitive labour markets in ASEAN also led to the sector's decline in the 2000s. Textiles are imported from Malaysia, Indonesia, and Thailand, with cloth from China and India. Locally manufactured designs typically require a longer process with more stages before production.

An example of a fabric that requires months to manufacture from scratch is *kain tenunan Brunei*. It is traditionally used as *sinjang* (short folded cloth like a sarong) for men or to carry newborns during the *Majlis Mandi Belawat* (baby shower ceremony). Typically a locally designed set of *tenunan* Brunei

for a wedding ceremony can cost up to BND 3,000 (USD 2,200). The earliest mention of the cloth, *tenunan*, in Brunei Darussalam, dates back to Sultan Bolkiah's reign in the mid-16th century. This craft is typically associated with the Muslim Malay majority and worn during important life stages (births, weddings and national events).

The craft of *tenunan* has national significance, as shown by the establishment of the government-led handicraft centre Brunei Arts and Handicraft Training Centre (BAHTC) in 1979. This traditional craft, preserved through a mother-to-daughter teaching system, remains largely unchanged, with highly skilled women using hand looms to create intricate designs. While Islam prohibits depicting human and animal images in art, floral and geometric motifs are permitted. These types of permissible patterns are typically found in motifs for *tenunan*, batik, and *tudong* (Muslim headscarf for women, also known as hijab).

The last five years have seen a renewed interest in fashion and textiles. In 2021, Universiti Teknologi Brunei (UTB), a newly opened School of Design, welcomed its first cohort of Fashion Design and Technology (The Scoop, 2021). The retail sector has shown a significant 23% year-on-year increase in fashion, textiles and ready-to-wear apparel. However, efforts to digitise the process have been limited and funding is lacking. In 2019, students from UBD launched an app called 'Reka Bentuk Kain Tenunan Kitani' (Our Woven Cloth Design). Through the app, users can browse an extensive database of traditional and new motifs and create their own design patterns. The app has not been updated since its launch.

Fashion Designers Alliance (FDAlliance) was launched in 2020. Fashion brands like NA FORRÉR, Mahkota Designs, XOIA, and Bilang, among others, were part of the pioneering non-government organisation. The FDAlliance is not affiliated with other industry players, such as manufacturing or textile imports. Rather, they see themselves as a collective to share resources and expertise.



Screenshot shows a Batik Bomber Jacket on a GenAI model designed and prompted by Farhanna Pura. Source: Na Forrér's Instagram page.

There is no creative hub or manufacturing zone allocated for textile innovation or fashion manufacturing. As NA FORRÉR shared, the fashion industry is part of the broader wedding industry. There has been a 24% increase in marriages from 2021 to 2022, indicating the growth potential for the industry, with over 2,800 marriages in 2022.

NA FORRÉR was briefly housed in the creative startup hub, The Collective Makerspace, in 2016. In 2020, NA FORRÉR moved into a permanent space alongside a piercing shop in Brunei's major commercial area. Mahkota Design was housed at Seni Mode (now rebranded as Karya Kitani), which was an initiative to create a hub for Brunei fashion designers. In 2020, Mahkota moved into its current location with another designer, Little Dayang.

Due to the limited size of the textile and general Brunei market, import costs, and the lack of other locally developed innovative technology solutions, NA FORRÉR uses AI tools for market testing. Mahkota Designs uses AI tools to improve turnaround time, reduce fabric waste and provide

further customisation. Existing methods of production are traditionally laborious and have limited raw materials and new tools provide the freedom for quick turnaround to meet market demands. While neither consider themselves technopreneurs with high-tech research and development (R&D), their explorations meet the definition of what R&D is, a process that comprises creative and systematic work undertaken to increase knowledge – including knowledge of humankind, culture and society – and to devise new applications (Bakhshi & Lomas, 2017).

NA FORRÉR, founded by Farhanna Pura in 2010, is an example of how creative practices are able to innovate new solutions amidst the current creative technology ecosystem in Brunei. Despite not having a formal fashion education, the 39-year-old has led the fashion label through an iterative approach to design. She has a marketing and change management background in Brunei's leading information technology (IT) firm, Dynamik Technologies.



'Irama' is a collection featuring digitally printed keringkam textile patterns (a traditional embroidery style type of headscarf originating from Borneo). The collection was launched in conjunction with Eid festivities and designed by Farhanna Pura in collaboration with Malaysian artist Arabyrd. Source: Na Forrér.

Farhanna's bespoke designs are known for incorporating Bruneian elements and broader Bornean cultural influences into contemporary designs. NA FORRÉR has gained recognition for its use of traditional textiles like tenunan, songket (a hand-woven textile known in Brunei, Indonesia, Malaysia, and Singapore), keringkam (a traditional Bornean headscarf), and batik (wax-drawn textile originating from Indonesia).

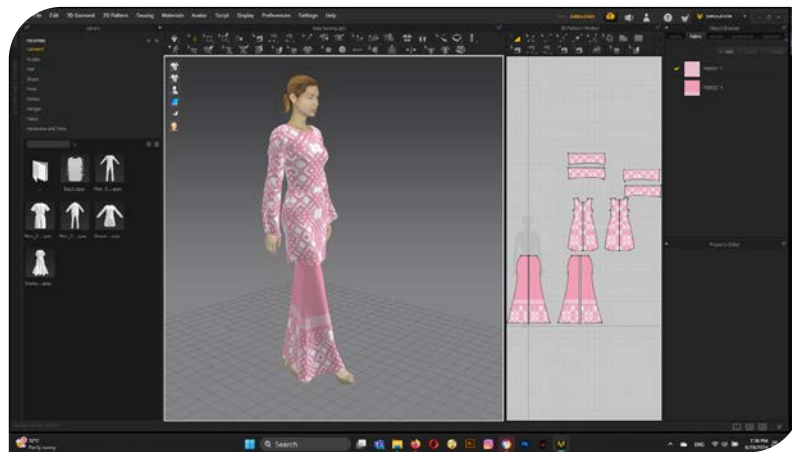
Farhanna has been leading ongoing efforts to educate the local market about the value of integrating traditional textiles into modern fashion. Her signature clothing style incorporates tenunan into everyday wear or formal occasions. This campaign to mainstream this fashion style required considerable effort, with collaborations with local celebrities and high-profile figures wearing it in overseas engagements.

Farhanna is constantly trying to streamline her creation process through digital R&D. In 2019 she had spent BND 5,000 (USD 3,690) on a bridal collection marketing campaign,¹ but now the costs related to marketing and production have been significantly reduced to yearly subscription plans for AI tools. Initially relying on sketching on paper and

traditional methods, she incorporates AI tools like Midjourney and NewArc.ai to generate design inspiration and refine sketches. She uses the AI designs as a starting point for inspiration since the GenAI outputs were Indonesian in style rather than reflecting a locally designed Brunei product. Images from GenAI lack cultural specificity and are trained on broader regional styles.

The high cost of producing seasonal collections and unsold inventory are significant obstacles that prevent Farhanna from expanding her fashion label. For her tenunan designs, it was too costly to even have a metre of woven cloth to experiment with. She mitigates these risks by sharing potential designs on Instagram and significantly reducing design time. She views AI as still in a "grey area", and she believes that AI prompts, instructions given to an artificial intelligence system to generate a specific response or output, are a form of creativity. She shared her uncertainty about the process of protecting copyright for her designs and adds that in the fashion industry designs are often copied and it is challenging to prevent others from replicating designs. Looking ahead, running the fashion business full-time, Farhanna envisions NA FORRÉR to become a "fashion-tech" company.

² While each bespoke dress was around BND 700-1,000 (USD 510 -742) each. Bringing total costs of the campaign to over BND 10,000 (USD 7,400).



(Left) Screenshot of the Marvelous Designer 3D Clothing Design Software desktop interface with a design by Adika. The software is used to create and simulate realistic clothing. (Right) Digital mock-up of head scarf design with a *gagtar* (hairpiece traditionally worn at a Brunei Malay-Muslim wedding) as a central motif around the centre. Source: Mahkota Designs.

A company that perhaps has already established itself as a “fashion-tech” company is Mahkota Designs. At the Brunei Rice Bowl Startup Awards 2019, Mahkota Designs was awarded the Best Internet of Things (IoT) Startup Award, an event hosted by the entrepreneurship body DARE. Mahkota Designs is the vice-president of the Fashion Designers Alliance and a member of the Council of ASEAN Fashion Designers (CAFD).

Established by Syahamsudin Haji Ali at Adika in 2017, the company designs and prints custom, one-off tudong, a traditional headscarf or hijab worn by Muslim women. Initially home-based, the 39-year-old designer now has a shared studio space in Jerudong. While other companies offer off-the-rack versions, Adika’s innovative approach allows customers to select motifs, colours, and designs tailored to their preferences. Turnover for designs can be as fast as two days since printing is done by Brunei-based textile printers.

Adika uses Midjourney to generate ideas after client consultation, which are then refined on a smart tablet using Procreate. The tablet offers the

flexibility to meet clients outside of the studio and share updates in real-time. While there was some hesitation in using GenAI, he understands that designers can use it as a starting point, but this requires an understanding of the cultural context of motifs and design sense.

To ensure they meet their customer’s vision, they also use Marvelous Designer 3D. The software accurately emulates fabric weight and creates accurate pattern cuttings that are ready for printing. The software enables customers to view 3D models with a 360-degree view of the garments. Initially, Mahkota Design started with three partners but now is only run by Adika. The software he uses offers less contact time with clients, less overhead costs and faster turnover. His use of a colour swatch also reduces errors and reprints of designs. His latest approach to reach customers is through the use of the popular web-based platform, Canva, for customisation. Working with a local online retailer, Miatutah Market, enables customers to select colours and motifs custom to their name, with the potential for designs to reach customers within a week.

Integrating AI into the design process

Without formal training, both fashion designers learned to use tools for textile concepts and fashion designs through AI tools such as Midjourney, Procreate, NewArci.Ai, The New Black, and Canva. The last two years have seen increased government funded educational and training programmes to understand AI and tools to use GenAI.

Around 6,000-7,000 students annually complete formal education in Brunei. In 2021, around 50% graduated in the ICT and business field (Manpower Blueprint for Brunei Darussalam, 2023). Universiti Brunei Darussalam’s (UBD) School of Digital Science, in collaboration with the learning platform Coursera, will offer a Bachelor of Digital Science in Applied

Artificial Intelligence in 2025. Course options include artificial intelligence applications, machine learning, and data analytics. This demonstrates an understanding of the importance of AI but a lag in skills development to meet current market demands.

Despite the innovative use of AI, members of the Fashion Designers Alliance have yet to work with BIL or other government entities to develop technological solutions or investigate textile production. Such network and funding opportunities from BIL were not in place when the FDAlliance was formed. However, microgrants of USD 3,000 from the United States of America Embassy and DARE, through the Academy for Women Entrepreneurs were awarded to local fashion startups, mainly for procuring machines, materials or marketing.

Cambodia

Key findings

In Cambodia, there are significant policies and resources gaps between government and private sector initiatives. Existing cultural policies need better alignment with creative sector needs. Despite big investments in the cultural heritage sector, limited access to technological infrastructure and insufficient funding remain as challenges for artistic practices. There is also a lack of social protection and tax incentives for artists and creative entrepreneurs. Fragmented community support and limited networking opportunities are also stunting opportunities for artists and technologists to collaborate and share resources. Artists also have

limited access and knowledge to advanced technologies for creative applications. Advanced technologies such as LiDAR are underutilised due to high costs and limited awareness.

The challenges created by rural-urban migration in Cambodia cannot be underestimated. The growing urban population in a few urban regions has triggered multidimensional problems in terms of housing, employment, infrastructure, crime rates and congestion (Gangopadhyay, Jain and Suwadharu, 2020). The interest of artistic practices in highlighting and exploring solutions to such problems offers potential for further development and investigation.



Rise and Fall (2012), Sound sculpture, two tracks, 4'09" & 4'48" 150 x 60 x 40 cm. Source: vuthlyno.art

Country profile

In 2018, The Diplomat wrote an article predicting “Cambodia’s Coming AI Revolution”, speaking to the specific context of the country that makes it particularly open to the potential of technology. “From a tech perspective, Cambodia is an exciting place to be right now,” shares tech strategist, Yohan Brizolier. The demographic skew means there is an unusually high proportion of ‘digital natives.’ The country’s youthful and increasingly well-educated population is passionate and energetic when it comes to technology adoption – it feels like everyday a new start-up or hackathon or incubator programme is put in motion. This analysis seems to be bearing fruit; in the last 12 months there are numerous examples of articles, events and initiatives related to AI in Cambodia, across sectors including real estate, agriculture, and education.

Cambodia’s inaugural Science, Technology, and Innovation (STI) Day, held in 2023 at the Diamond Island Convention and Exhibition Center was an immense hit with 30,000 attendees. The event gathered together scientists, researchers, innovators, entrepreneurs, and officials to highlight the most recent advances in science and technology and discuss the country’s future innovation (Khmer Times, 2023). When Cambodia hosted the 32nd SEA Games in Phnom Penh in 2023, technology was a stand-out feature of the jaw-dropping opening ceremony, which included laser light displays, projection mapping, and colourful explosions of fireworks (Kiripost, 2023).

Demographics

Cambodia’s total population in 2024 is 17.1 million and 95% are of Khmer ethnicity (UNFPA). Approximately 75% of the population live in rural areas (World Bank, 2022). Like its Mekong neighbours, Cambodia has a young population, and young people under the age of 30 currently represent two-thirds of the population in the country.

Based on a 2023 survey of more than 400 people aged 15-30, potential employment prospects seem to be a common point of concern among the youth, with ‘70% of participants consider[ing] the lack of skills as one of their most significant challenges, followed by unemployment which is rated at 57.8%, and low salaries rated at 46.3%’ (UNDP, 2024). The youth envisions Cambodian society in the next five years as ‘eager to witness robust technological development and its integration across various sectors, aiming to enhance efficiency and foster innovation.’ The transfer of knowledge and technology is also a priority area.

Socio-economic perspectives

Cambodia is still primarily an agricultural society, where the bulk of the population continues to live in rural areas. First included in the United Nations list of least developed countries (LDCs) in 1991, Cambodia, was found pre-eligible for graduation by the Committee for Development Policy (CDP) at its 2021 triennial review. Economic growth has been driven by four main sectors, agriculture, manufacturing (chiefly garments), construction and tourism. Economic growth and the inflow of foreign direct investment is largely concentrated in the capital city, Phnom Penh, the tourism hub, Siem Reap, and the port hub, Sihanouk Province.

Cambodia is aspiring to become a high-income country by 2050. To make this happen, Prime Minister, Hun Manet, released his Pentagonal Strategy, centering on the five objectives of (1) sustained economic growth, (2) more and better employment, (3) human capital development, (4) diversification of the economy and (5) increased competitiveness (East Asia Forum, 2024).

Increasing demand for productive infrastructure and a rising middle class has secured the construction and real estate sector’s position among the leading drivers of the Cambodian economy (World Bank, 2024). Economic growth is expected to improve marginally to 5.8% in 2024, up from 5.6% in 2023, and should further strengthen by 6.1% in 2025 and 6.4% in 2026 as revival in garment, travel goods, and footwear exports and tourism propel the ongoing recovery (World Bank, 2024).

Cambodia has been establishing its presence as a leader within Southeast Asia in recent years. It hosted the Asia-Europe Summit in 2021, was ASEAN Chair in 2022, and hosted the SEA Games and para-games in 2023. In 2023, Prime Minister Hun Manet took over from his father, former Prime Minister Hun Sen, now President of the Senate, who led the country and its ruling Cambodian People’s Party from 1985 until 2023.

Connectivity

There were 9.66 million internet users in Cambodia in January 2024. Cambodia’s internet penetration rate stood at 56.7% of the total population at the start of 2024 (Kemp Times, 2024). 68.4% of the population are active social media users, with Facebook, Instagram, and TikTok being the most popular platforms (DataReportal, 2024). Telegram and Messenger are both popular with respect to instant messaging. Data published in Meta’s advertising resources indicates that Facebook had 11.65 million users in Cambodia in early 2024.

In Cambodia, there are 5 mobile internet service providers and 35 fixed internet service providers. 2G mobile coverage covers 92% of the total population, 3G mobile coverage is 85% and 4G mobile coverage is 82% (Khmer Times, 2022). Local operators like Metfone, Smart Axiata and CamGSM (Cellcard) conducted 5G trials between 2018 and 2020, but the Minister of Posts and Telecommunication retracted the trial licences in 2020 – citing concerns that it would be wasteful and inefficient for everyone to build their own 5G infrastructure (Developing Telecoms, 2024)

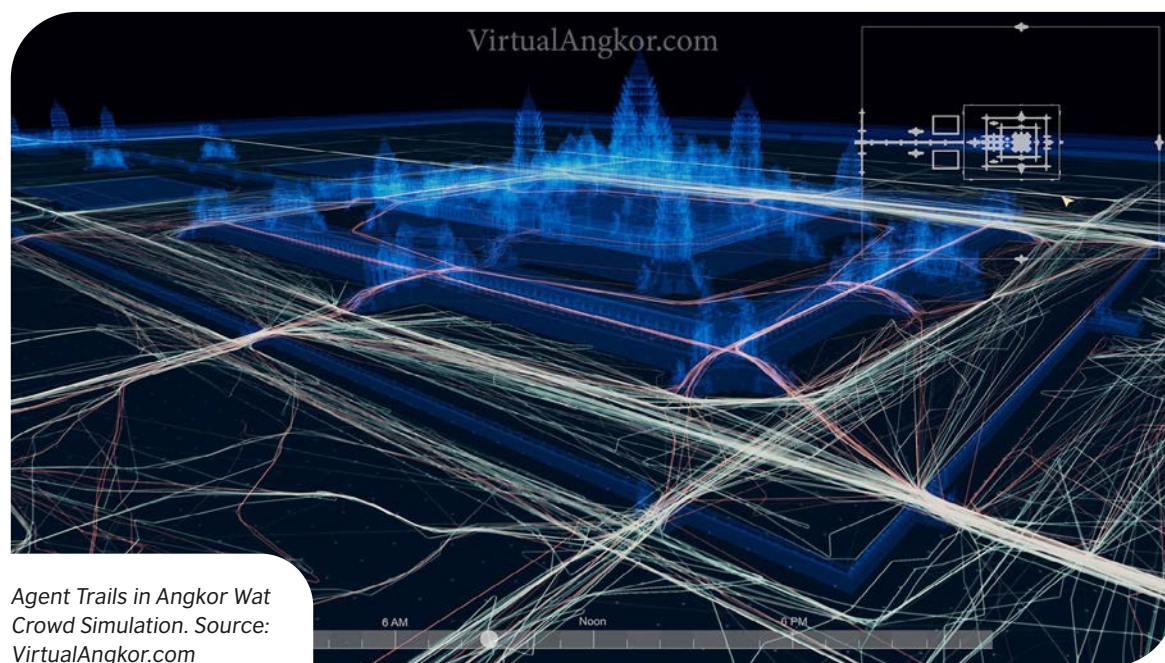
Intersections between architecture, contemporary art and new media

The case study focuses on two parallel initiatives at the intersection of architecture, contemporary art and new media in Cambodia. The Cambodian government has made significant investments in cultural heritage, which is one of the main drivers of tourism to the country. The involvement of high technology equipment in heritage research has been significant in Cambodia over the past 10 - 15 years.

This is evident in projects such as Virtual Angkor¹, which built a virtual replica of Khmer Empire at its height, and Cambodia Archaeology LiDAR Initiative (CALI), which uses LiDAR (Light Detection and

Ranging) technology, a remote sensing technology that measures distances by illuminating a target with laser light and analyzing the reflected light. It is used to create high-resolution maps and 3D models of the environment– to study ancient temples such as Angkor Wat.

Many of these projects have had significant cultural impact both locally and internationally. To date, such projects have required very large scale international funding and international teams have been involved in the process. In parallel, more emerging practices integrating technology, contemporary art and new media have had significant impacts on cities and local communities over the years. Independent creative practitioners have been finding ways to merge interdisciplinary practices despite the lack of government funding and support.



Agent Trails in Angkor Wat Crowd Simulation. Source: VirtualAngkor.com

Policy and intellectual property overview

Theme	The Royal Government of Cambodia (RGC) Policies	Other Initiatives from the RGC
Policy on Culture	The RGC passed the National Policy on Culture, a key cultural policy document, in 2014. This essential document serves as a road map for culture and development, connecting education, the environment, research, media, and health.	Youth for National Culture was the theme of the 26th National Cultural Day on March 3, 2024. The event is part of the national cultural policy and strives to preserve and enhance the Kingdom’s distinctive culture sustainably and inclusively.
IP Protection	The Law concerning Copyright and Related Rights ratified by the Senate on February, 13 2003. This law protects author rights, works, cultural products, performances, phonograms, and broadcasting organisation transmissions to ensure just and legitimate exploitation and promote culture.	The Department of Industrial Property (DIP) opened the patent and industrial design databases on April 29, 2024. These databases allow inventors, academics, corporations, and others to search for patents and industrial designs to ensure their discoveries are original and not infringing on others’ rights. It also helps identify intellectual property infringement threats for new products and services before they enter the nation.
Technology Policies	<ol style="list-style-type: none"> The Cambodia Digital Economy and Society Policy. This policy framework defines an implementation period of 15 years from 2021 to 2035. <ul style="list-style-type: none"> Phase 1: Building Digital Foundations and Digital Adoption (2021-2025) Phase 2: Digital Adoption and Digital Transformation (2026-2030) Phase 3: Digital Transformation (2031-2035) The Science, Technology & Innovation (STI) Roadmap 2030 was designed to guide the implementation of the National STI Policy. <ul style="list-style-type: none"> Enhancing the governance of the STI system. Build human capital in STI. Strengthening research capacity and quality Increasing collaboration and networking between different actors. Fostering an enabling ecosystem for building absorptive capacities in firms and attracting investments in STI. 	In 2024, the RGC launched the “TourismTech Roadmap”, a national directive document that aims to accelerate Cambodia’s tourism sector growth through harnessing innovative technologies with sustainability and inclusivity. The roadmap was developed by the Ministry of Industry, Science, Technology & Innovation (MISTI) and the National Council of Science, Technology & Innovation (NCSTI) in collaboration with the Science and Technology Policy Institute (STEPI) of South Korea.

Cultural policies

Culture is the domain of the Ministry of Culture and Fine Arts, which has a limited budget and rarely distributes financial support to the private sector. In 2021 report titled 'Backstage', the challenges facing the creative industries in Cambodia were summarised as 'hurdles to financial sustainability', including an unsupportive tax environment, lack of financial and technical support from government, and in particular "too few local people, organisations and businesses that value cultural and creative products and services sufficiently to pay for them. In 2022, Phoeurng Sackona (Minister of Culture and Fine Arts in Cambodia) noted that, 'the current socio-economic stability in Cambodia provides a favourable environment for various stakeholders in the creative economy to form mutually beneficial alliances' (ASEAN, 2022). To improve Cambodia's cultural and creative industries, there is 'an urgent need of a central agency to coordinate all aspects related to the support and promotion of Cambodia's cultural and creative industries' (Brennert, 2023).

Intellectual property

Cambodia's 2003 law on Copyright and Related Rights provides perpetual protection of moral rights, exclusive economic rights, collective management organisations for fair remuneration and easier enforcement, and legal remedies for infringement, safeguarding the integrity, reputation, financial interests, and rights of artists and cultural leaders. However, a 2022 report State of Play, by The Sound Initiative, shares that with respect to intellectual property, the government recognises that 'the ability of quality innovation and creativity is limited and the law enforcement is limited, causing copyright infringement.' Consistent with this, in its annual cultural and creative industries (CCI)

indicators survey (2023), the Cultural And Creative Industries Of Cambodia Association For Development And Advocacy (CICADA), found that artists only formally registered 9 % of their creative work in 2022, leaving them vulnerable to intellectual property violations.

UK and Cambodia bilateral agreements

The UK Minister for the Indo-Pacific and Cambodian Minister of Culture and Fine Arts Phoeurng Sackona agreed on the following initiatives during their tour at the National Museum Cambodia in Phnom Penh: investigating the possibility of signing a Memorandum of Understanding to prevent the illegal trafficking of antiquities; facilitating the dispatch of experts to assist in the preservation of gold collections and providing guidance on maintaining these collections according to technical standards to prevent corrosion and moisture damage during exhibitions; considering the opportunity to further send Cambodian professionals to undergo short or long-term training courses in the UK, particularly at SOAS University of London (Fresh News, 2024).

Gender issues

Cambodia's 2023 labour force participation rate is 69.5% for women and 82.4% for men, according to the World Bank. Growing economic sectors demanding female labourers and rising living costs have raised the opportunity cost of women staying at home in Phnom Penh. City residents have witnessed economic benefits as gender divisions of labour have become more flexible. Exposure to successful women in socially recognised jobs has advanced notions of gender. Slower changes in perceived interests, exposure, and affiliation are happening in rural Cambodia. (Evans, 2019).

Case study: Architecture, contemporary art and new media

Artist-led innovation - Urbanism and 3D mapping by Vuth Lyno

Vuth Lyno's practice as an artist centres on the interplay between history, politics, and the transformative power of technology and media. His artworks often explore themes of cultural memory, identity, and the socio-political landscape of Southeast Asia with a focus on Cambodia. He is deeply interested in how art can engage the senses and provoke critical consciousness among audiences. He uses new media, such as sound, light, the internet, video, and certain forms of machinery or mechanism to activate kinetic movements.

Since his early career experimentation with photography, Lyno has been interested in how he can present his work in a way that is impactful through different mediums and ways for the audience to engage and interact with his art. In his current practice, Lyno uses sound and light as mechanical sources to engage senses and transform spaces. Looking at the human ability to not only hear sound but also feel it through skin vibrations, he started to use the power of sound to move emotions and thoughts in his practice. Rise and Fall (2012) is his first soundwork where he built a sound sculpture as a mini shrine representing a

floating community of Kampong Phluk village. The audio told of the fishery hood in Kampong and its animistic practices in combination with Buddhism. Through this work, he wants to talk about the interconnectivity of existence and the importance of having balance in life.

Lyno also became interested in light as it is a complementary component with a different form of frequency. One of his works, Light Voice (2015), is an interactive installation using motion sensors, LED lights and sound. His idea was to create a spatial intervention in an abandoned staircase of the White Building, originally known as the Municipal Apartments, a symbol of Cambodia's modernisation constructed in the 1960s. The building fell into disrepair and became notorious during the Khmer Rouge regime when many of its residents were persecuted. With little maintenance over the decades, some staircases became a deposit of rubbish and were frequented by drug users. Together with some young residents living in the White Building, they cleaned up and repainted one staircase to its original white colour. He installed LED lights and radios that were activated through motion sensors whenever people pass by. The light and the sound permeated the architectural space, accompanying passersby and highlighting the building's beauty. The work was installed permanently in the White Building until the building was demolished in 2017.



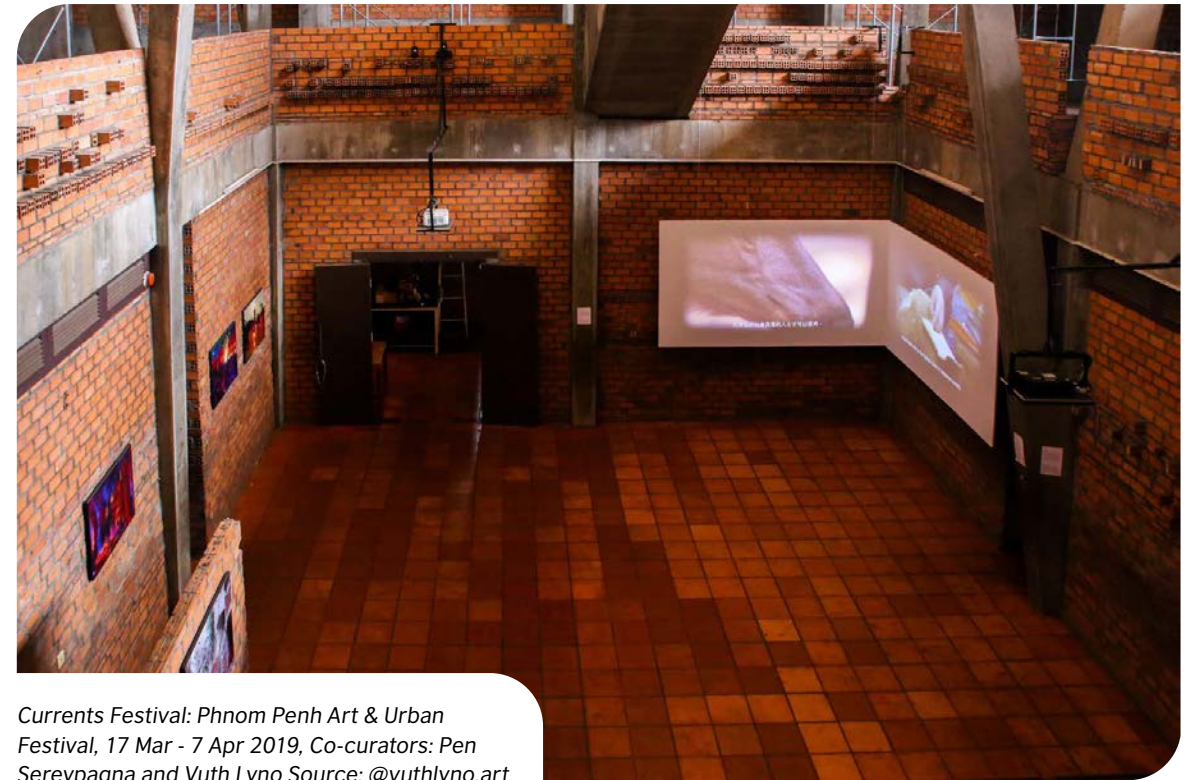
Neon light installation, H:225 x W:300 x D:200 cm,
A series of 6 paintings, 50 x 37.5cm each.
Source: Sala Samnak (2020-21)

Lyno uses digital rendering and 3D drawings to visualise and plan artworks. Due to the complexity and requirement of technical skills for his artworks, Lyno collaborates with experts in different disciplines. In his works Wave Gate, he worked with architect Loeung Sakona and Australian sound artists Madeleine Flynn and Tim Humphrey and for Open Chedi, he worked with artist and designer Kong Siden. Open Chedi was inspired by a real stupa or heap in Chiang Rai, an important form of Buddhist architecture. In the work, Lyno compares a crack on

the stupa – an exposed layer of encasing meant to preserve a fragile structure – to the layers of hidden histories and politics in Southeast Asia. He uses fluorescent paint to create visually striking lantern-like effects. His neon-light sculpture is a gesture to open and expose what's inside, creating something non-human and extra celestial that looks weightless, floating and illuminated. He wants to provoke a feeling of looking at a computer-generated 3D model or an otherworldly image in physical space.



Open Chedi (2023), 3-pieces sculpture, polystyrene foam, plywood, fluorescent paint, @vuthlyno.art, Commissioned by Thailand Biennale Chiang Rai 2023. Source: Supernormal Studio



Currents Festival: Phnom Penh Art & Urban Festival, 17 Mar - 7 Apr 2019, Co-curators: Pen Sereypagna and Vuth Lyno Source: @vuthlyno.art

As an architect, Pagna's notable contributions include co-curating the Currents Festival' with Lyno in 2019. The festival aimed to blend architecture, design, and technology with art, bringing these disciplines directly to the local community by using unconventional exhibition spaces like alleys and sidewalks. Pagna's projects, such as the Vann Molyvann Project, have also significantly influenced the creative technology sector by integrating documentation, surveying, and teaching. This project involves students in hands-on learning experiences, surveying modernist buildings and producing 2D and 3D drawings. By engaging both local and foreign students, Pagna fosters an exchange of knowledge and skills, enriching the architectural and design education in Cambodia.

Lyno met his future partners for the collective, then organisation, Sa Sa Art Projects, at a photography workshop. Sa Sa Art Projects began in 2010 and

focused on experimental work, community engagement, creating networks, and looking at different ways of teaching and engaging art with the public. Until it closed in April 2024, Sa Sa Art Projects had different kinds of training and art classes, photography, and multimedia. Through its activities, students were introduced to the possibilities of different technologies, not only new technology but also old technology such as very simple mechanical and analogue mediums.

Lyno has mixed views on technology-driven artworks. Some are very powerful and connect with him, while some fail to impact him at all. Lyno sees generative artificial intelligence (GenAI) as beneficial to generate ideas, images or text but he is yet to incorporate it into his work. He does not believe that non-technology will become irrelevant or obsolete. In his opinion, it will be even more valuable as it is perceived as natural.

Broader technology initiative - Cambodia Archaeology LiDAR Initiative (CALI)

As mentioned earlier, technology has drastically accelerated archaeological investigations. In Cambodia, LiDAR surveys completed in one week provided more information than traditional methods did in 25 years. This technology allows archaeologists to see and analyse landscapes from above, identifying structures and patterns that are not visible from the ground level. Technology experts such as Francisco Gonclaves from the Indonesian company PT Map Tiga Internasional (PTMI) has been invited to work on Cambodia Archaeology LiDAR Initiative (CALI) funded by UNESCO. He believes that technology is poised to have a significant impact on the arts, although it comes with high costs due to the need for continuous research and development. The lasers used for CALI in 2012 have since been replaced by more advanced third-generation lasers, reflecting the rapid evolution and need for investment in technology. This evolution is not without advantages. Francisco illustrated this with an example from Cambodia in 2012, where they had to

push LiDAR to acquire 20 points per square metre, a significant amount of data. Today, they would aim for 50 points per square metre, enhancing the precision and detail of the captured images.

Advanced technology like LiDAR can have a profound impact on our understanding and appreciation of cultural heritage. The combination of airborne lasers, ground lasers, still photos, handheld videos, and other tools has created impressive data sets used by research institutions, labs, and schools. Francisco believes that detailed LiDAR data, combined with overlaid images, can vividly convey the beauty and geometric intricacies of structures like the Bayon Temple. This high level of detail can be used in educational settings to instil pride in cultural heritage among students. The potential for such technology can inspire curiosity and further investigation into historical sites and artefacts. For example, creating videos and digital models of historical sites like Angkor Wat can help convey the significance of these sites to the Cambodian people. The integration of Geographic Information System (GIS) technology can also allow for detailed and accurate 3D models that can be used by artists to create visual representations that appeal to and educate the younger generation.

Francisco identified that a significant barrier to the adoption of new technologies by artists and creative professionals is a general distrust of what is new and unfamiliar. He and his team have made considerable efforts to educate their clients about the capabilities and benefits of LiDAR technology. However, due to limited resources, they cannot always provide comprehensive explanations to everyone. Similarly, convincing road engineers of LiDAR's accuracy in the initial stages was challenging. His team had to undertake several projects, often at a financial loss, to prove that LiDAR could provide the precision necessary for road design. He also noted that the integration of new technologies does not mean the abandonment of traditional methods. There will always be individuals who prefer analogue methods. For instance, some filmmakers continue to use film instead of digital technology because they believe it produces a better image for their style of movies. Similarly, some photographers are returning to analogue film and cameras, appreciating the unique qualities they offer. Therefore, new technologies coexist with traditional methods, catering to different preferences and needs without replacing them.

In 2021, Irish artist Matt Loughrey colourised and altered photographs of prisoners taken at the notorious Khmer Rouge prison, changing facial expressions to include smiles. This sparked outrage as it was seen as distorting historical truth and disrespecting the victims' suffering (Phnom Penh Post, 2021). Although AI was not used in this instance, similar incidents can easily occur with AI, making it easier to alter or retell historical narratives. This highlights the potential risks of using AI inappropriately in the arts.

Despite these challenges, arts initiatives in Cambodia effectively leverage AI while respecting cultural heritage. For instance, digital artist Kong Vollaak uses it to merge traditional Cambodian motifs with modern digital art, creating pieces that resonate with both historical and contemporary themes. These initiatives demonstrate that when used thoughtfully, AI can enhance the creative process and help preserve cultural heritage, but the importance of ethical considerations and cultural sensitivity cannot be overstated.

Emerging trends and sentiments on GenAI

Interviewees regard GenAI with a mix of optimism and caution. There are positive sentiments, particularly in enhancing visual presentations and immersive projects, as highlighted by artists who believe AI can streamline creative processes and generate new ideas. However, ethical concerns about its potential to alter the meaning of reality and the authenticity of artistic works are prevalent. A significant example is the controversy surrounding the alteration of historical photos from Tuol Sleng prison.



3D wire frame of Market; Angkor Wat West Gate, 12th Century. Source: VirtualAngkor.com

Indonesia

Key findings

The intersection of art, creative industries, and technology in Indonesia is being significantly influenced by several key trends. One notable trend is the rapid growth of digital media, which has transformed the way creative content is produced, distributed, and consumed. This includes the rise of digital art forms such as video mapping and GenAI, which are pushing the boundaries of traditional art by creating immersive and interactive experiences (HighEnd Magazine, 2023; Goethe-Institut, 2023).

Advancements in augmented reality (AR) and virtual reality (VR) are gaining traction, particularly in sectors like tourism and entertainment, offering new ways to engage audiences and enhance cultural experiences (HighEnd Magazine, 2023). Moreover, the integration of AI in creative processes, from film

production to graphic design, is revolutionising the industry by automating tasks and enabling more sophisticated content creation (Goethe-Institut, 2023)

Policies, infrastructure, and other supporting elements comprise the ecological conditions that have a significant impact on the development and sustainability of installation art in Indonesia. Government initiatives, such as those from organisations like the Ministry of Tourism and Creative Economy and Ministry of Education and Culture, are very important because they offer financial support, materials, and legal frameworks that support creativity and the arts. But the absence of clear laws governing AI and creative technologies might impede development by raising questions about intellectual property and appropriate use.



Bagus Pandega, *A Diasporic Mythology 2021*

Taishogoto, Kecapi Sijobang, Penteng Bali, Man-daliong, Penteng Lombok, LED screen, motor, Selenoids, MIDI Sprout, custom electronic and mechanic system, glass jar, vinyl paper, custom 3d printed parts, Camellia sinensis, tea, zinc plated steel, teak wood, LED, copper, acrylic, instrument stand Variable dimension

Country profile

Indonesia's creative economy continues to thrive, contributing significantly to the national GDP and exports. In 2022, the GDP value of the creative economy at current prices has reached IDR 1,280 trillion or IDR 1.28 quadrillion, breaking a new record high. The creative economy sector contributes 6.54% to the total value of national GDP. In 2022, the export value reached USD 26.11 billion, surpassing the target of USD 25.14 billion. This represents a substantial increase from USD 23.89 billion in 2021 and USD 18.89 billion in 2020 (Databoks Katadata, 2024).

Indonesia's creative economy is composed of 17 diverse sub-sectors that collectively drive significant economic growth and innovation. These sub-sectors include fashion, craft, culinary, mobile apps, game development, music, film, animation, video, photography, visual communication design, product design, interior design, architecture, advertising, television and radio, publishing, performing arts, fine arts, and digital content. Each sub-sector contributes uniquely to the economy, with fashion, culinary, and craft being the largest contributors, accounting for 75% of the sector's GDP. In this sector, government initiatives, such as those from the Ministry of Tourism and Creative Economy, have been instrumental in encouraging innovation. Additionally, the creative economy's impact was highlighted during significant events like the G20 summit in 2022, which further boosted its visibility and economic contribution (Kemlu, 2022; PwC Indonesia, 2023).

Artists utilise social media platforms like Facebook, Instagram, and X to share their work and engage with international audiences. Online galleries and marketplaces, such as Artsy, Saatchi Art, and Etsy, enable global sales and exposure. Platforms like Behance, DeviantArt, and ArtStation offer additional opportunities for artists to showcase their portfolios. Technologies like VR and AR enhance viewer experiences through immersive art and virtual exhibitions. Video conferencing tools like Zoom and Microsoft Teams facilitate global collaboration, artist talks, and participation in international fairs.

Technology has significantly boosted the development of Indonesia's creative industry by enhancing digital skills, fostering innovation, and expanding market reach. This positioned Indonesia's creative economy among the top three globally, alongside South Korea and the United States, mainly led by technology-driven sectors such as digital content, e-commerce, and online platforms for traditional industries such as cuisine, handicrafts, and fashion (British Council, 2023; The Jakarta Post, 2022). On the other hand the infrastructure for creative technologies is still being developed. To foster digital creativity throughout the nation, more extensive and easily accessible infrastructure is required, even with the existence of hubs like the Bandung Creative Hub and programmes run by organisations like Institut Teknologi Bandung (ITB).

As of 2024, the estimated population of Indonesia is approximately 279,798,049 people, reflecting a 0.82% increase from the previous year (Macrotrends. (n.d.) This growth continues the trend observed over recent years, with the population in 2023 recorded at 277,534,122, marking a 0.74% increase from 2022. Over 279 million people, the world's fourth-most populous country and the most populous Muslim-majority country with Jakarta as the world's second-most populous urban area (The World Bank. n.d.)

The geographical location of Indonesia spans between the Indian and Pacific oceans, consisting of over 17,000 islands including Sumatra, Java, Sulawesi, parts of Borneo, and New Guinea.

Indonesia has a significant urban population, with 58.6% of the population living in urban areas as of 2023 (WARC, 2023; Central Intelligence Agency, 2023). This urbanisation trend is expected to continue, with projections indicating that by 2045, approximately 70% of the population will reside in urban areas (World Bank, 2023). The urban population is concentrated primarily on the island of Java, which houses major cities like Jakarta, Surabaya, and Bandung (Wikipedia contributors, 2023). As of 2022, around 42% of Indonesians live in rural regions (WARC, 2023)

Indonesia has a relatively young population, with a median age of 30.1 years as of 2024. Approximately

68.3% of the population falls within the working-age group (15-64 years) (Central Intelligence Agency, 2023). The total dependency ratio in Indonesia is 47.6, with a youth dependency ratio of 37.6 and an elderly dependency ratio of 10 (Central Intelligence Agency, 2023).

Indonesia's GDP per capita has been steadily increasing, reflecting economic growth and rising living standards (World Bank, n.d.). Urban areas tend to have better educational facilities and higher employment rates, while rural areas often face challenges related to limited access to quality education and job opportunities (World Bank. (n.d.), WARC, 2023)

Connectivity

Urban areas generally have better access to high-speed internet and digital services, while rural areas may face connectivity challenges. Efforts to improve digital infrastructure in rural regions are essential to bridge the digital divide and enhance market potential (World Bank, n.d.)

As of early 2024, Indonesia's internet penetration rate has reached 79.5%, reflecting a consistent increase from previous years (Developing Telecoms. (2023). This translates to approximately 215.6 million people out of a total population of around 277.5 million having access to the internet (VOI, 2023). Notably, internet usage is particularly high among younger demographics, with penetration rates of 93.17% among millennials (aged 28-43) and 87.02% among Generation Z (aged 12-27). The gender gap in internet usage is also narrowing, with male and female penetration rates at 87.6% and 85.5%, respectively (Antara News, 2023).

Intersections in technology-based installation art

Technology-based installation art is becoming more and more popular in Indonesia as a result of Indonesian artists pushing the boundaries of traditional art forms and producing dynamic,

responsive installations since 1990. These artists incorporate cutting-edge technologies like sensors, robotics, and interactive systems into their creative practices. The incorporation of technology has encouraged artistic expression by enabling artists to investigate new avenues for movement and interaction. This has improved cultural production and provided viewers with immersive experiences. A thriving ecosystem of technologists, artists, and creative hubs in Indonesia is supporting the rise of technology-based installation art by encouraging innovation and collaboration.

Art collectives, tech laboratories, and academic organisations that offer forums for experimentation and knowledge sharing are important stakeholders. Offering financial incentives and infrastructure assistance, government initiatives like the National Strategy for Digital Economy growth and the Creative Economy Law have created a favourable climate for the growth of creative technology. The opportunity to experiment has been made possible by the availability of digital infrastructure, such as high-speed internet and sophisticated technological tools. These artistic mediums combine modern technology with traditional themes to produce works that are both inventive and culturally meaningful, also in line with Indonesia's rich cultural legacy.

The intersection of art and technology has opened new economic opportunities, with technology based installation art attracting interest from galleries, museums, and private collectors, thereby supporting sustainable business models for artists. Emerging trends indicate a growing interest in interactive and immersive art experiences, with potential innovation areas including augmented reality (AR) and virtual reality (VR) integrations, further expanding the possibilities for creative expression in Indonesia.

Policy and intellectual property overview

Theme	Indonesia's Government Policy	Other initiatives from Government
IP Protection	<p>Law No. 28 of 2014 on Copyright, Law No. 13 of 2016 on Patents, Law No. 20 of 2016 on Trademarks, and Law No. 31 of 2000 on Industrial Designs. These laws provide robust protection for a wide range of creative works, including literary, artistic, and scientific creations, as well as technological inventions and industrial designs. The Directorate General of Intellectual Property (DGIP) under the Ministry of Law and Human Rights is responsible for managing and enforcing these laws, ensuring that creators and innovators can secure and defend their rights.</p> <p>Government Regulation (PP) Number 56 of 2021 concerning Management of Song and/or Music Copyright Royalties. This law ensures that authors and copyright holders are appropriately compensated for their works, this rule requires the collection and distribution of royalties for the use of songs and music.</p>	<p>The introduction of Government Regulation No. 24 of 2022 on Creative Economy further enhances the IPR landscape by allowing intellectual property assets to be used as collateral for financing, thereby unlocking new opportunities for creators and innovators to access capital. Despite these advancements, challenges such as piracy and the need for greater public awareness and enforcement mechanisms persist.</p>
Cultural and Creative Sectors	<p>The Creative Economy Law No 24 year 2019, currently under consideration, aims to provide legal certainty and support for businesses in the creative sector, which includes 15 industries such as architecture, fashion, music, and digital media.</p> <p>Presidential Regulation (Perpres) Number 114 of 2022 concerning Cultural Strategy regulates the cultural strategy used as a guide for the Central Government, Regional Government and Everyone in implementing Cultural Advancement. Objects of cultural advancement include oral traditions, manuscripts, customs, rites, traditional knowledge, traditional technology, art, language, folk games and traditional sports.</p>	<p>The government's proactive policies, such as the National Strategy for Development of Indonesia's Digital Economy 2030, aim to boost digital skills and foster a robust digital ecosystem</p>

Technology Infrastructure	<p>Personal Data Protection Act to ensure data privacy and cybersecurity, fostering trust in the digital economy. The Creative Economy Law No 24 year 2019, currently under consideration, aims to provide legal certainty and support for businesses in the creative sector, which includes 15 industries such as architecture, fashion, music, and digital media</p>	<p>The "Making Indonesia 4.0" initiative is a comprehensive roadmap aimed at integrating advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), and robotics into key industrial sectors, including food and beverage, textiles, automotive, chemicals, and electronics, with the goal of positioning Indonesia among the world's top 10 economies by 2030 (Ministry of Communication and Information of the Republic of Indonesia, 2018).</p> <p>The National Strategy for Digital Economy Development focuses on fostering a robust digital economy by improving digital infrastructure, promoting digital literacy, and supporting digital startups (Tech for Good Institute, 2023).</p>
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Indonesia and UK Agreement

High-level partnerships between Indonesia and the United Kingdom in the creative economy are based on key agreements that focus on collaboration and growth in this sector. They highlight the importance both nations place on the creative economy as a driver of economic growth and cultural exchange.

The **Creative Economy Memorandum of Understanding (MoU)** between the UK Ministry of Culture, Communications, and Creative Industries and the Indonesian Ministry of Tourism and Creative Economy, signed in 2012, aimed to enhance skills and collaboration in creative industries such as film, fashion, music, and design. It included setting up a working group to implement programmes that allow Indonesia to benefit from the UK's expertise in these areas (British Council, 2012).

In 2016, President Joko Widodo and Prime Minister David Cameron signed the **Agreement on Creative Economy**, which focused on strengthening the creative sector and expanding trade and investment between the two countries, highlighting Indonesia's

growing importance as a key UK partner (The Jakarta Post, 2016). More recently, the **UK-Indonesia Partnership Roadmap 2022 to 2024** outlines strategic collaboration in the creative economy to support economic recovery and growth. It encourages investor collaboration, promotes sustainable infrastructure projects, and enhances business exchanges in digital sectors (Government of the United Kingdom, 2022).

Gender and minority issues

In Indonesia's creative economy, gender and minority issues are significant, with women facing challenges such as lower educational qualifications and persistent gender pay gaps that undervalue their contributions and limit their visibility in the sector (The Jakarta Post, 2023; Permatasari, 2021). The creative economy involves a higher percentage of women than other sectors, but they earn less than men, with women's average wages being significantly lower than men's (Permatasari, 2021). In part, this disparity can be attributed to traditional gender roles and types of jobs deemed appropriate

for women (Permatasari, 2021). Additionally, there is a lack of economic opportunity and diversity for minorities from other regions because the creative economy is predominantly concentrated in Java (The Jakarta Post, 2023; BPS, 2020). To address these issues, comprehensive policies promoting inclusivity and diversity are essential, ensuring that the creative economy's growth benefits all Indonesians, regardless of gender or ethnicity (The Jakarta Post, 2023; BPS, 2020).

Case study: Technology-based installation art in Indonesia

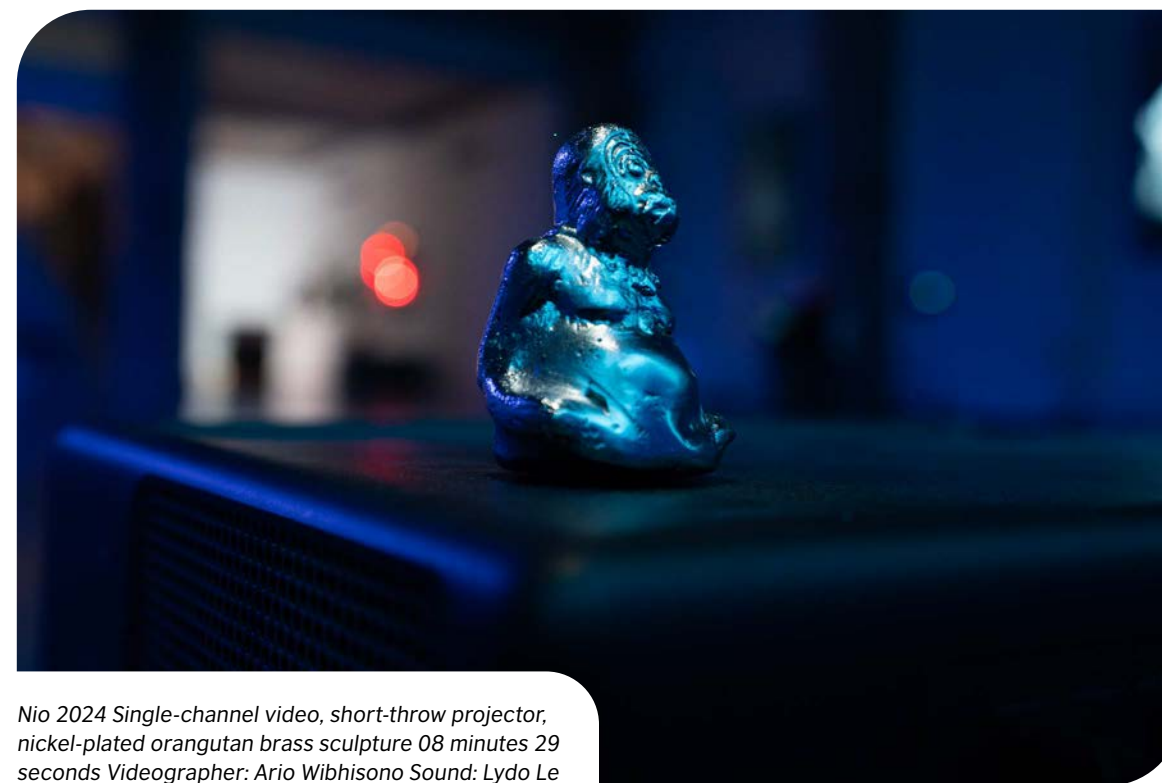
Technology-based installation art in Indonesia has evolved significantly since its emergence in the 1990s, influenced by Western trends, particularly from the U.S. This art form blends visual, aural, and interactive elements with technology, creating immersive experiences that engage audiences on multiple sensory levels. Indonesian artists like Heri Dono and Krisna Murti pioneered the integration of electronics and video art, bridging traditional cultural elements with modern technology. This fusion has led to innovative works that reflect Indonesia's rich heritage while embracing modernity, as seen in major art events like the "Jogja Biennale" and "Jakarta Biennale."

Traditional beliefs and rituals still play a role in how technology is accepted and integrated into creative practices. For example, the Cembengan ritual, performed in Java during the late 19th century, marked the integration of machinery into farming practices, particularly in the sugar industry. Originating from the Chinese tradition of Cing Bing, Cembengan evolved into a significant cultural event at the start of the sugarcane milling season. This ritual involved offerings and prayers for a successful milling season, symbolising the blending of traditional agricultural practices with modern industrial methods introduced by Dutch colonial rulers.

Over time, Indonesian artists have increasingly incorporated digital media and interactive elements into their works, with figures like Jompet Kuswidananto, Agus Suwage, and Eko Nugroho leading the charge. The use of advanced technologies such as projection mapping, augmented reality (AR), and sensor-based interactivity has become more prevalent, supported by platforms like social media that facilitate the spread and influence of these practices.

Indonesian technology-based installation art is characterised by interactivity, multisensory engagement, and the use of immersive technologies like VR and AR. These installations often involve real-time data integration and responsive features, creating dynamic and evolving experiences. Artists also employ sophisticated methods like 3D printing to produce complex and precise structures.

The extensive use of technology is represented in many works of technology based installation art. For example, Bagus Pandega experiments with materials like voice recorders, cassette and record players, lighting, and electronic circuit boards, sensors and uses these systems to put together his artworks. He utilises TouchDesigner software, Arduino, and DMX lighting technology in his practice. His work often addresses themes of memory, loss, and resilience, as seen in pieces like "Yesteryears" (2023), which explores the impact of environmental disasters. Additionally, Pandega's art frequently examines historical narratives and cultural symbols, as exemplified in "A Diasporic Mythology," which investigates the circulation of musical instruments across cultures. Through his innovative use of technology and multimedia techniques, Pandega invites viewers to reflect on their relationship with the world around them, exploring concepts of time, change, and the unexpected in our increasingly interconnected and technologically-driven society.



Nio 2024 Single-channel video, short-throw projector, nickel-plated orangutan brass sculpture 08 minutes 29 seconds Videographer: Ario Wibhisono Sound: Lydo Le

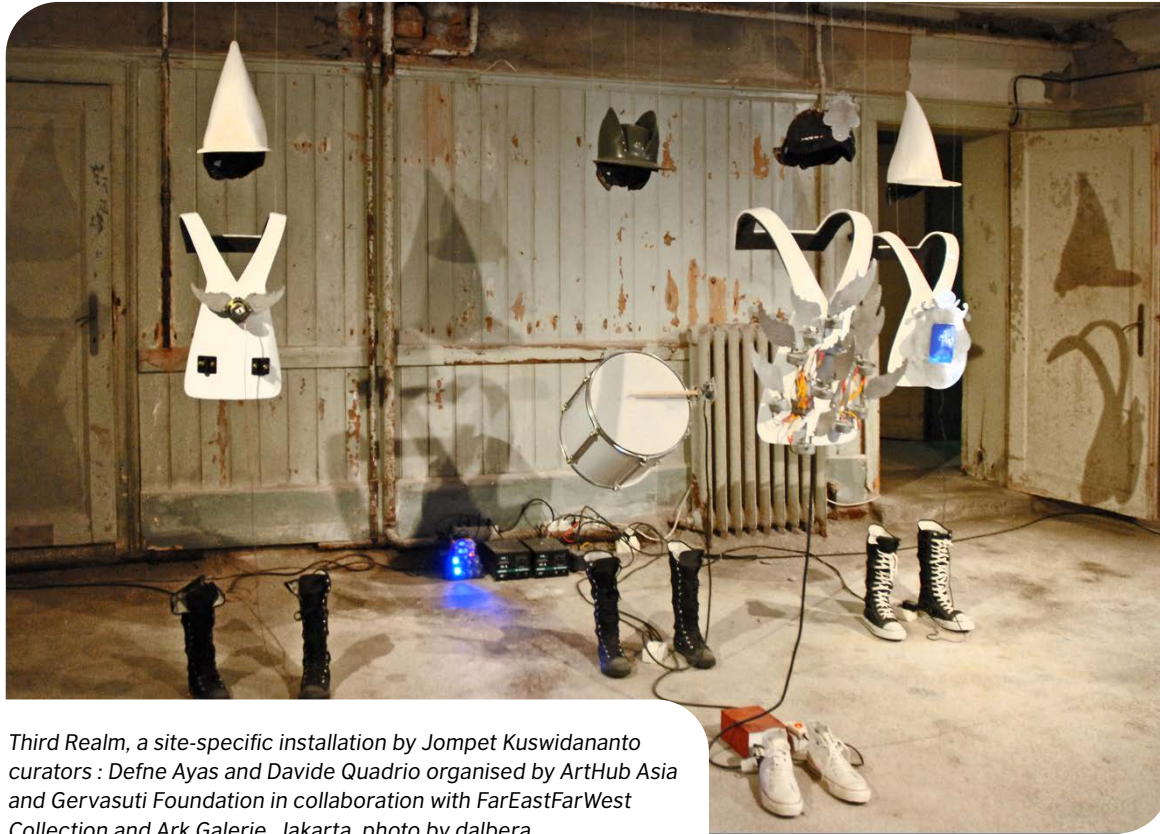
"I always want my work to be more humanistic, so it's not really all-out technology, my work. I need a human touch in my work using cutting edge technology..."

- Bagus Pandega, 2024

Tromarama is an Indonesian group of artists that uses a variety of technologies, including digital fabrication, stop motion animation, video art, interactive media, projection mapping, augmented reality (AR), and software development. Through the use of these technologies, they are able to produce complex, multi-layered pieces that challenge the conventions of traditional art forms and captivate audiences with immersive and interactive components. Digital Nativ, a prominent collective in the field of installation art, employs a range of cutting-edge technologies such as projection mapping to transform physical spaces with dynamic visuals, enhancing the sensory experience, interactive media, such as touch-sensitive surfaces and motion sensors, and augmented reality (AR). The

collective also uses advanced software programming and digital fabrication techniques, including 3D printing and CNC machining, to craft intricate components and unique digital effects, making their installations both visually striking and deeply engaging.

There is increasing interest in and support for this technology based installation art, as evidenced by the expanding number of exhibitions featuring tech-integrated art. Over the past decade, there has been a significant rise in the number of exhibitions dedicated to technology-infused art in Indonesia. Major cities like Jakarta, Bandung, and Yogyakarta host annual events such as ArtJog, Art Jakarta and Jakarta Biennale, where tech-driven artworks are prominently featured.



Third Realm, a site-specific installation by Jompet Kuswidananto curators : Defne Ayas and Davide Quadrio organised by ArtHub Asia and Gervasuti Foundation in collaboration with FarEastFarWest Collection and Ark Galerie, Jakarta, photo by dalbera

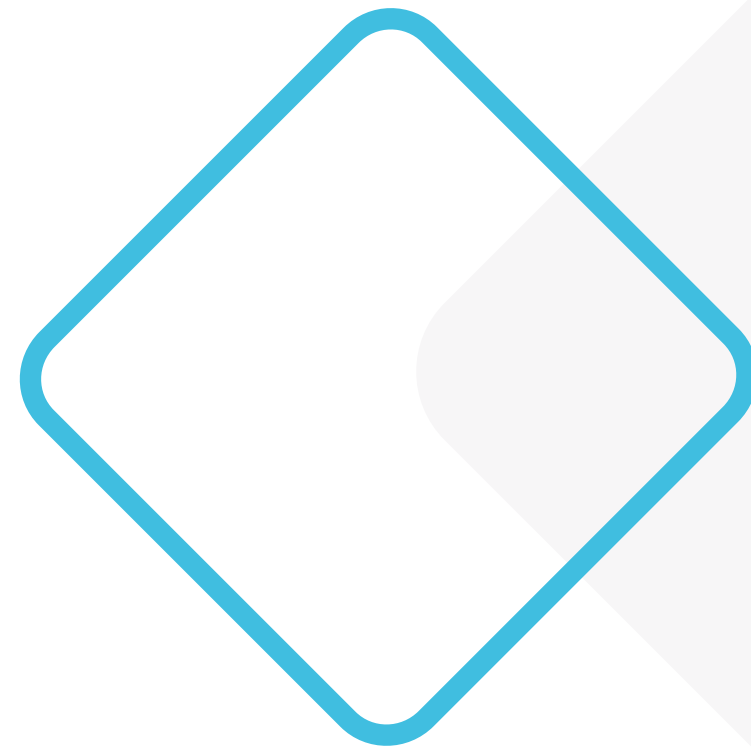
AI integration and impact

Using AI's ability to generate new ideas, patterns, and designs, artists are producing inventive and unique artworks by analysing large volumes of data and identifying artistic trends. Tools like neural networks and GANs (Generative Adversarial Networks) enable experimentation with form, colour, and composition, often resulting in intricate and surprising creations.

Indonesian perspectives on AI integration vary. Hilmar Farid highlights concerns about AI reducing human interaction and increasing individualism, emphasising the need for balanced integration without compromising ethical standards or intellectual property rights. Ignatia Nilu notes that while AI democratises art creation, it raises questions about originality and creativity, emphasising that AI should not replace critical

thinking. Wawan Rusiawan points out that while AI can reduce costs and labour, it requires significant skill and data resources, necessitating the development of data science capabilities in Indonesia.

AI is seen as a powerful tool for modelling, simulation, and planning, but there is a sense that its role should complement rather than replace the artist's creative process. AI also presents opportunities for preserving traditional practices and fostering multidisciplinary projects that blend various art forms. Ethical considerations call for transparency in AI usage and more education on its moral implications, especially concerning copyright and intellectual property. The absence of clear government policies on AI in creative technology underscores the need for well-defined protocols to prevent abuse and ensure ethical practices, while safeguarding critical works from censorship.



Lao PDR

Key findings

New infrastructure has transformed the landlocked nation of Lao PDR, enhancing opportunities and expediting the advancement of knowledge in the country. However, Laos ranks low among ASEAN countries in terms of digital access. The education sector in the country faces significant challenges, including decreasing public resources, high school dropout rates, lower university enrollment, and a lack of job opportunities for graduates. The implementation of the Law on Intellectual Property (LIP) also faces challenges due to a shortage of expertise and resources. The Ministry of Information, Culture, and Tourism regulates culture in Laos, however, the cultural sector has not seen significant investments compared to the other two sectors under the same ministry. Despite such challenges, the artists in Laos are eager to innovate by integrating technology in their practices.



Flow (2018). Photo courtesy of Souliya Phoumvong

Country profile

New infrastructure has transformed this landlocked nation. One of the most significant projects in recent years has been the high-speed China-Laos railway, part of China's Belt and Road Initiative (BRI) in Southeast Asia. The train has been operational since 2021, and has made travel between Vientiane (the capital of Lao People's Democratic Republic (hereafter "Laos")) and Luang Prabang easier, as well as cross-border travel to China. "The railway is a key piece in the Lao government's vision to see the country "graduate" from the UN's least-developed country list by 2024." (Business & Human Rights Resource Center, Feb 2021) but has come at a high cost, including USD 6 billion investment.

The State Railway of Thailand announced a new international train service connecting Bangkok and Vientiane will begin services on July 19, 2024 (Bangkok Post, 2024). The implementation of this new infrastructure will enhance opportunities and expedite the exchange and advancement of knowledge among creative individuals and institutions in Laos and Thailand.

With respect to culture, That Luang Lake special economic zone in Vientiane, which is close to the National Institute of Fine Arts (NIFA) has hosted numerous music concerts, becoming a spectacle in urban Laos. In a country where almost everything is imported, Vientiane has recently hosted music stages for Thai music groups, complete with fancy stages, LED screens, and lighting.

The challenges for creative people in Laos include a small domestic market with low demand, a lack of government support, low levels of private philanthropy, a lack of administrative skills, rising business costs, weak networks, and censorship (Janamohan, et.al, 2021). That said, creative communities in Laos manage to run independent festivals (with the government support for permission), such as the LanXang Shorts film

festival, held annually in Vientiane. LanXang Shorts features a short film competition, screenings, talks, and workshops. Local filmmakers founded it in 2020 to support young filmmakers and build community.³ This platform also helps NIFA students to present their works in film and animation.

Demographics

The population of Laos stood at 7.69 million in January 2024, with 38.6 % of Laos' population living in urban centres, and 61.4 % live in rural areas. According to UNICEF, some 59 % of Laos' population are children and young people below the age of 25. "The share of the population of working age (aged 15–64 years) in Lao PDR is projected to increase to 69% by 2050, compared with 68% in Myanmar, 65% in Cambodia and 62% in Vietnam" (Mapping Research and Innovation in Lao PDR, UNESCO, 2018). This could represent great potential for socio-economic development in the country.

Socio-economic perspective

However, today Laos is behind the rest of Southeast Asia in terms of infrastructure and services and is classified by the United Nations as a Least Developed Country (LDC). Economic growth in Laos is estimated to have been below 2019 levels in 2023 and is forecast to remain below that pace in 2024, weighed down by economic instability, low worker skills, out-migration of labour, and a challenging business environment (World Bank, 2024).

The Laos development agenda is shaped by two key visions: (i) becoming the "battery of Asia"⁴ (FPRI, 2024) and (ii) reframing landlocked as "land-linked" through connectivity investment with its neighbours. The country's economy has been driven by capital-intensive investment in natural resources, largely hydropower and mining, and more recently transport. These investments contributed to a robust average annual economic growth of 8% in

the decade to 2016, but also led to an accumulation of public debt and contingent liabilities (ADB Country Partnership Strategy: Lao People's Democratic Republic, 2024–2028). In a March 2024 CNN article Political economist Souvannaseng was quoted as saying: "Money that was loaned to the Lao government [for the railway project] through Chinese sovereign lending, has to be repaid and soon. The immediate impact of that external debt for Laos is evident in the recurrent stress and fiscal crisis, and consequences for Lao society at large is pretty evident."

Average household incomes improved in 2023, but more than a third of families saw their nominal income growth lag behind inflation, implying a loss of purchasing power. High food inflation has undermined food security, particularly for urban families. The minimum wage is currently LAK 1.6 million (approximately USD 75), a raise from LAK 1.3 million (about USD 61) previously (The Laotian Times, 17 May 2024). David Hutt, writing in The Diplomat in May 2024, predicts "much of the growing working-age population (an extra 1.6 million people between now and 2050) will probably [migrate] to Thailand, [losing...] 400,000 people from its workforce each year until 2050".

Education

At present the Laos education sector faces significant challenges, which may impact the creative and technology sectors both now and in coming decades. Public resources for education have halved as a share of GDP over the past decade, and the sector is now severely underfunded. Article 60 in the Law on Education also sets a target for at least 18 percent of total public expenditure to go towards education (International Bank for Reconstruction and Development/The World Bank, 2023) and in May 2023, at the Lao PDR Human Capital Summit, the government committed to improving the quality of basic education, enrolling all children, keeping them in school, and improving education financing.

Middle and high school students in Laos report dropping out of school because of the country's dismal economy and lack of job opportunities, while fewer young people are enrolling in universities, as surging inflation — 26% in May 2024 — has raised prices, including food and transportation, amid declining public spending on education. (Radio Free Asia, 7 June 2024).

Connectivity

Laos is one of the few remaining one-party communist nations and is one of the most closed societies in the world; scoring 6/10 on the 2023 Civicus monitor of Civic Space with only North Korea and Eritrea lower (3/100). In 2022, Laos ranked ninth out of the 10 ASEAN countries in terms of digital access, affordability and quality of internet services. In 2019, it had 90,258 km of fibre optic cable covering all districts and provinces throughout the country. The 3G mobile network was expanded to cover 82 % and 4G to cover 55 % of all villages nationwide. 5G broadband for mobile phones was tested in some areas in the capital city of Vientiane (Digital Maturity Assessment – Lao PDR Supporting Digital Government Transformation, UNDP, July 2022).

Laos' internet penetration rate at the start of 2024 was 66.2 % (Digital Laos: 2024). Among social media platforms, Facebook has the largest user base, with 3.5 million Facebook users, and 613,600 Instagram users. Social media usage has increased dramatically in the past 5 years, 26 % in 2017 to 51.5% in 2022 (Positioning the Lao PDR for a Digital Future, UNDP, June 2022). The cost of the internet in Laos is among the cheapest in the region. In 2023 average price in Laos for 1GB data cost USD 0.25, with only Cambodia cheaper in ASEAN at USD 0.12, others ranging from USD 0.28 to USD 1.92 (Cable.co.uk, 2023).

³ using hand crafted clay sculptures to create stop motion animations

⁴ Lao PDR envisions becoming the "Battery of Southeast Asia" by exporting hydropower to neighbouring countries through the regional power grid designed to reach ASEAN's goal of net-zero emissions

Intersections in animation and contemporary arts

This case study focuses on the innovative integration of technology in contemporary art practices in Laos, specifically focused on animation. The country's education system is slowly integrating creative technology into its curricula. However, progress is slow due to limited funding for better technological integration. Despite challenges, contemporary artists in Laos have made significant progress in integrating technology into their practice. This is evident in the innovative works of claymation³ by prominent contemporary artist Souliya Phoumvong. Souliya's claymation projects blend entertainment with education (edutainment) and have had significant creative and cultural impact locally. In recent years, young generations of artists with better access to the internet have also integrated technology into their practice, evident in initiatives such as Elevations Laos and Lost Jigsaw.

Policy and intellectual property overview

Theme	Lao PDR Government	Other Initiatives from the Government
Policy on Culture	The Law on National Heritage (2005) establishes the principles, regulations, and measures for the administration, use, protection, conservation, restoration, [and] rehabilitation of national heritage and the rights and duties of the State, social organisations, and individuals to preserve the value of national cultural, historical, and natural heritage to educate citizens with a conscious love for their nation and fine national traditions.	Lao PDR's Ministry of Information, Culture and Tourism (MICT) launched several smart tourism and digital initiatives with the private sector, including ticketing systems, audio tours and online tourism licence applications.
IP Protection	The Law on Intellectual Property No. 01/NA of December 20, 2011 governs the protection of copyright and related rights, patents, petty patents, industrial designs, trademarks, trade names, layout designs of integrated circuits, geographical indications, trade secrets, and plant varieties.	Laos has signed major intellectual property treaties, such as the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty, and the Convention Establishing WIPO. Laos also became part of the Berne Convention for the Protection of Literary and Artistic Works on March 14, 2012. Laos officially joined the Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks on December 7, 2015
Technology Policy	The 20 Year National Digital Economic Development Vision (2021-2040), including 10-Year National Digital Economy Strategy (2021-2030), and 5-Year National Digital Economic Development Plan (2021-2025). These initiatives define digital transformation as one of seven pillars of the national agenda and foresees the digital economy growing from 3 % to 10 % of GDP by 2040.	In 2023 the Ministry of Technology and Communications and MetaBank Singapore signed a contract to develop Lao National Blockchain Infrastructure to support digitalisation.

Cultural policy context

Culture in Laos is the domain of the Ministry of Information, Culture and Tourism. In general the Ministry has a strong focus on tourism, and in many internet searches, the official website that comes up is www.tourismlaos.org. Although the Laos government has not significantly integrated technology into the cultural sector, they have invested in developing digital applications to support the tourism sector. The focus is on creating technology that helps preserve and promote Laos cultural heritage digitally. Organisations such as Makerbox Laos use technologies to integrate the Laos alphabet and language with voice command which can help the population in Laos with low level education.

UNESCO plays an important role in the development of the creative and technology sectors in Laos. In the past decade, CCIs (cultural and creative industries) has been a focal point for cooperation between UNESCO and the Lao PDR Government. In 2012, the Ministry of Information, Culture and Tourism of Lao PDR, in collaboration with UNESCO, held the first National Consultation on Cultural Industries in Lao PDR and Validation Workshop for the 2012 Baseline Study from 14 to 15 March 2013, in Vientiane. The results of that workshop have been used as a basis for several policy-related projects since. Including until today, the third phase of the project entitled *ReShaping Policies for Creativity and Artistic Freedom*, July 2022 to December 2025, aims to 'strengthen inclusive policy dialogue and informed policy-making for the cultural and creative industries'. This project is supported by SIDA (Swedish International Development Cooperation Agency).

Technology policy context

In May 2018, UNESCO published *Mapping Research and Innovation in Lao People's Democratic Republic*, which assesses that a significant investment in human resource development will be required for Laos to be competitive within ASEAN and globally, and to achieve its goals of diversifying its economy by 'encouraging the production of higher-value goods and services.' 'The study reveals that, despite the priority given to public-private partnerships in the 8th National Socio-Economic Development Plan 2016–2020, there is no operational policy instrument in place yet to foster networking among the business, government and university sectors.' (UNESCO, May 2023). MTC, the Ministry of Education and Sports (MoES), and the Ministry of Labor and Social Welfare (MLSW) are the key institutions responsible for the development of digital skills of the workforce.

Intellectual property

Laos experiences difficulties in implementing the IP Law due to lack of expertise and resources. Consequently, they largely rely on collaborations with patent offices in other countries. The Laos' 9th Five-Year National Socio Economic Development Plan (2021–25) sets priorities to improve the ability to effectively manage Intellectual Property Rights (IPR) and educate individuals and businesses about the advantages of intellectual property. (Garcia, 2024).

Gender

The 2021 Global Gender Gap report of the World Economic Forum ranked Laos overall at 36 out of 156 countries, second in ASEAN after the Philippines. Women have a 76.8% labour force participation rate compared to 79.7% for men. Despite a small labour force participation gap, 61% of employed women and girls are unpaid family workers, compared to 26% of men and boys. One in four working women were own-account workers, compared to one in two men, indicating that women had less control over their careers (UNDP, 2022).

Case study: Animation & contemporary arts

Artist-led innovation - Claymation by Souliya Phoumivong

Souliya Phoumivong is a self-taught animator and new media artist. He uses technology as a tool to convey traditional narratives in contemporary formats. He trained as a painter and graduated in 2008 from the National Institute of Fine Art (NIFA). Before his work in animation, Souliya made a living through painting and was a part of 5 Arts, the first artistic space and commercial gallery in Laos (Tee, 2020). In Laos, general understanding and market demand of art encompasses traditional practices such as sculpture and painting. In spite of knowing that moving his practice to animation will make financial means difficult, Souliya was determined to experiment more.

Souliya saw a radical transformation in his practice during a 2010 residency in Japan, funded by the Japan Foundation. Now he is known for his innovative work with claymation. During his residency in Japan, he was determined to learn new mediums for his artistic practice. Learning animation through 2D, 3D design softwares felt foreign to him at that time. Souliya chose claymation as the process was not entirely computer generated and felt closer to his formal art training.

Souliya's studio, Clay House Studio (2012 - now), started with minimal equipment, but he managed to create high-quality work by learning new techniques during international exchanges. International residencies and working for international organisations have sustained his practice. In the early stages of his career, Souliya focused on traditional clay animation using oil clay for character creation. This approach posed challenges due to the hot climates, causing the clay to melt and making the animation process difficult. During a residency in Singapore, he discovered a lightweight, non-melting clay suitable for the Laos climate, which allowed him to create more detailed and larger-scale characters.

Technology plays a significant role in his work, with Souliya using software like Dragon Frame, Photoshop, After Effects, and Premiere Pro. Souliya uses software like Dragon Frame, which he needs to buy from the US directly. Such technology is not easily accessible to many artists due to high costs and some have to rely on pirated software. Functions such as onion skinning allow him to see the progression of motions and make precise adjustments without being afraid of losing process by moving the camera. Souliya was introduced to Artificial Intelligence (AI) in a script writing workshop in Thailand. He views AI as a complementary tool rather than a threat to creativity and uses AI in scriptwriting to generate preliminary ideas.



Behind the scenes at Clay house studio. Photos courtesy of Souliya Phoumivong

Souliya is also the chief of the Visual Communication Design Department at the National Institute of Fine Art (NIFA). He is dissatisfied with the lack of innovation in arts in his country. Traditional practices such as painting and sculpture dominate Laos' art scene. Technology plays a crucial role in fostering creative innovation, particularly in new media and digital art. However, the limited access to necessary equipment and resistance to change, particularly from older generations, pose barriers to technology adoption in art education. Souliya has been teaching animation at NIFA for eight years amidst the institute's limited equipment due to budget constraints. Despite the resource limitations, Souliya and NIFA facilitated strategic collaborations with local companies like Wuklas Design, providing students with valuable opportunities to learn beyond the school environment. Enrollment in creative technology programmes has grown steadily, highlighting the increasing interest in this field.

Souliya's students have achieved remarkable success, winning multiple awards at the Digicon 6 Asia competition. Some have secured jobs in NGOs, large companies, and various creative industries, which is viewed positively by Souliya as his students have the means to sustain their practices during the ongoing financial crisis in Laos. Souliya is currently pursuing a Ph.D. at Khon Kaen University in Thailand, he aims to broaden his knowledge and experience to further enhance the animation scene in Laos. His research focuses on storytelling and traditional art forms, employing technology as a tool.

Broader technology initiatives - The XYZ Art Center

Founded in 2017, the XYZ art centre aims to foster creative expressions in visual arts, painting, handicrafts, and design. XYZ positions itself as a bridge between artists and the government, facilitating communication and support. They emphasise developing strong relationships with government bodies, particularly the Department of Heritage under the Ministry of Information, Culture, and Tourism. Their goal is to align with UNESCO's objectives to elevate artistic expression. They advocate for the acceptance of various art forms, including those that may be considered controversial. They work with various local and international stakeholders, including other cultural associations and international NGOs such as Swiss Agency for Development and Cooperation (SDC) and the EU, who have been crucial funders for arts and cultural sector development in Laos.

XYZ focuses on securing government endorsements for their projects, which helps in obtaining funding and international support. They are working on obtaining long-term support and infrastructure to sustain their projects such as Laos Art Week, an annual event started in 2023, co-hosted with the government, showcasing contemporary art, traditional crafts, and the integration of technology in arts. It serves as a platform for artists to display their work and for the public to engage with the arts.

XYZ observes that young artists in Laos, around 18-25 years old, know technology well. They know how to use AI and are proficient with computers and software. As such, their artworks are adapting more to technology. There are also more contemporary art practices starting to appear, as artists have more access to information from overseas. Influences from neighbouring countries such as Thailand, Vietnam, and China, allow artists to follow global trends. Initiatives such as Elevations Laos (founded 2018) and Lost Jigsaw (founded 2023), aim to promote innovative art forms in the Laotian art scene. Elevations Laos is currently advocating to include contemporary art forms in the NIFA curriculum.

Although there hasn't been a direct policy impact on the use of technology in the creative industries, XYZ has plans to incorporate more technology-related aspects into their (work-in-progress) website. This will help promote local and international artists. Though their projects have not directly impacted the arts and technology sector, XYZ thorough understanding of contemporary art development in Laos and their continuing relationships with government officials can act as a bridge to create policies that can foster creative technology development in Laos.

Emerging trends and sentiments on GenAI

Trends and sentiments on GenAI in Laos reveal cautious optimism among artists and policymakers. AI is recognised for enhancing creative processes, such as scriptwriting and storyboarding, while concerns remain about its impact on traditional skills and authenticity. Writers like Souliya appreciate AI for generating ideas and streamlining workflows, using it in scriptwriting workshops and proposal writing to create captivating content. Animators use AI for character development and detailed movie storyboards, ensuring consistency and saving time. AI also enables the rapid creation of high-quality illustrative storybooks, significantly reducing production time.

However, artists acknowledge the limits of this collaboration. While AI can suggest ideas and perform certain tasks, human creativity and critical thinking are essential to ensure quality and authenticity. Ethical concerns and the risk of misinformation highlight the need for responsible use of AI in the arts. The overall sentiment from interviewees is that AI can be a valuable tool if used thoughtfully and ethically, enhancing but not replacing human creativity.



Picture 5. Laos Art Week 2023. Photos courtesy of The XYZ Art Center.

Malaysia

Key findings

The uneven distribution of internet access across Malaysia, particularly in remote areas, hampers the adoption of new technologies. This digital divide prevents many artists from fully utilising technological advancements.

Limited funding as a significant barrier. Although initiatives exist to provide grants and financial support, awareness and accessibility of these resources among non-academic artists remain low.

Interviewees mention the shortage of technical expertise and late arrival of new technologies in Malaysia as major hurdles. This gap in knowledge and skills makes it difficult for artists to integrate advanced technologies into their practices.

The ethical implications of using GenAI in art are a concern for many artists, including Khairul Hazwan Musa and Vimala Perumal. Issues such as the

commodification of art, erosion of traditional skills, and challenges to authorship and originality need clear guidelines and responsible practices.

Technology serves as a powerful catalyst for collaboration between artists, technologists, and academics, enriching Malaysia's creative ecosystem with diverse cultural influences and technological advancements. These interdisciplinary partnerships push creative boundaries, resulting in innovative works that blend traditional and contemporary elements.

Digital music production has witnessed significant growth through international collaborations and technological innovations. Collaborations with international partners have contributed to the growth and diversification of Malaysia's creative technology sector. Several international partners are interested in funding proposals focused on music technology and AI.



Khairul Hazwan Musa or Analog K, photo courtesy of the artist

Country profile

Malaysia's digital content ecosystem consists of: 1) XR and digital content's industrial application, e.g. simulation, virtual production; 2) Application of creative tech in new platforms & fields: OTT, streaming, blockchain gaming, NFT and creator-led decentralised technologies; and 3) Interactive media development for education, socio-economic and cultural preservation (British Council Malaysia, 2022).

Several creative technology sectors grow very well in Malaysia, for example animations and digital music. Local animation studios have produced more than 65 original pieces of intellectual property (IP). This translates into an export value of RM170 million and a presence in more than 120 countries (Noordin, 2020). On the other hand, the Digital Music market in Malaysia has been experiencing significant growth in recent years, driven by changing customer preferences and the increasing availability of digital music platforms. There is a strong preference for digital music creating the rise on the digital music platform users such as Spotify

One of the key trends in the Malaysian Digital Music market is the rise of streaming services which are also influenced by the diverse cultural landscape of the country. Malaysia is home to multiple ethnic groups, each with its own distinct music traditions and preferences. This diversity is reflected in the music industry, with a wide range of genres and styles being popular among different communities (Statista, 2024).

An important factor influencing Malaysia's creative technologies sector is its heritage and traditional culture, including in animation and digital music. For example: Upin and Ipin animated series produced by Les' Copaque Production featuring the daily life and adventures of Malaysian kids in traditional kampong. Another example is Alena Murang, a musician and visual artist from Sarawak, known for preserving and promoting traditional Bornean music. Many of her songs, for example Warrior Spirit, transcends the borders of traditional and contemporary art

schemes featuring digital soundscapes and contemporary beats, providing a high-tech fusion of traditional and modern sounds. She uses the Sape, a traditional lute from Borneo, and incorporates electronic elements in her music. It becomes one of the unique value propositions of Malaysia's arts compared to other countries. With the advancement of technology, these unique creative expressions could be expanded into other sectors such as tourism.

Malaysia's total population was 34.13 million (January 2023) with 78.4 % of Malaysia's population living in urban centres, indicating robust market potential for creative technologies. Malaysia's internet penetration rate stood at 96.8 % of the total population (Digital 2023 Malaysia, 2023). It implies that 1.09 million people in Malaysia did not use the internet and remained offline at the beginning of 2023 but this happens mostly in rural areas.

The working-age population (15-64 years) makes up about 69.7% of the total, highlighting a substantial demographic likely to engage with creative technologies. Economically, Malaysia experienced a GDP growth rate of 5.6% in Q1 2023, demonstrating strong economic vitality (GlobalData, 2023). The per capita income, which stands at approximately USD 10,600, reflects the purchasing power and potential for market growth in creative sectors. Fast-growing sectors include digital media and biotechnology, supported by significant government investments aimed at fostering innovation and technology adoption (S&P Global, 2023).

Despite this progress, there are notable gaps in education and infrastructure within the creative technology sector. For example, there is a lack of awareness among non-academic artists about funding opportunities and resources available for technological integration. Nowadays technology applications for creative arts are massive and rapidly changing. To keep up and make the best use of it, artists and creators need to learn at a rapid pace as well. Additionally, there is an uneven distribution of internet access across Malaysia, hindering technology adoption in remote areas.

Addressing these gaps is crucial for fostering an inclusive and thriving creative ecosystem.

Intersections in traditional and digital music production

The case study selected for Malaysia is digital music production through AI. It is selected based on two reasons. First, Malaysia's music scheme is greatly influenced by its rich culture of traditional musical instruments such as Dikir Barat, Nobat, and Mak Yong. Second, community and network dynamic. There is a great community building process through digital music production education with a high influence of Malaysian culture. This practice shows not only collaborations of creative technology in academic learning with music industry practices, but also how traditional music of various ethnic groups in Malaysia could be digitalized without losing its authenticity.

Policy and intellectual property overview

The Malaysian government's commitment in pushing forward the economic potential of creativity and innovation was manifested into an urban scale project that turned into an economic hub of the creative cluster called Cyberjaya (Manan, 2019). Located at Selangor, inside Cyberjaya, there is the Malaysian Global Innovation and Creativity Centre or MaGIC, which serves as an innovation and creativity centre. It is a concentration of infrastructures and creative organisations that aim to foster creativity and innovation at an urban scale.

Malaysia has a government agency in charge of the creative technology sector called Malaysia Digital Economy Corporation (MDEC). MDEC is under the Ministry of Communications and Digital, which released the Digital Content Ecosystem (DICE) Strategic Framework in 2019. The framework consists of Malaysia's central strategy designed to empower the digital content ecosystem by enhancing digital content skills, strengthening the

industry network, catalysing IP, and driving industry to a global standard. However, the framework needs to be translated further into policy and regulations.

Several umbrella regulatory frameworks were launched by the government a couple of years ago, for example: 1) MSC Malaysia Creative Multimedia Content Initiative (M-CMCI) and 2) The Malaysian Dasar Industri Kreatif Negara (DIKN). M-CMCI launched in April 2006, is a policy aimed at developing the creative multimedia industry in Malaysia. This initiative focuses on several key areas including: access to funding, market access, strategic alliances, talent development, and digital media zones (MAC3) supporting the growth of the creative technology sector in Malaysia. Initiatives under M-CMCI include digital content development, content localization, content distribution, and creative industry clusters. Further, Malaysia also has DIKN or the Malaysian National Creative Industry Policies, which launched in 2010 and created a list of programme focus of three sectors: Creative Multimedia, Creative Cultural Arts, and Creative Cultural Heritage.

The regulatory direction goes not only on the policy framework but also on talent development. Recently in 2020, MDEC launched the Digital Creative Content (DCC) Enterprise Development Programme, a structured training programme for new entrants to the industry focusing on animation, VFX and game development, with the objective of upskilling local talent. So far, DCC has conducted programmes such as C# programming, certified animation courses and industry marketplace pitching activities (Noordin, 2020).

Specifically related to intellectual property rights, the Intellectual Property Corporation of Malaysia (MyIPO) under the Ministry of Domestic Trade and Consumer Affairs regulates the intellectual property system in Malaysia. Key to the promotion of IP is an enabling environment for its commercial exploitation. For this purpose, the government promotes the financing of IP activities through government-backed financial instruments such as Malaysia Debt Ventures Bhd, MyCreative Ventures

and Malaysia Venture Capital (Azmi, 2018). Without such seed financing, it is doubtful whether the country's small and medium-sized enterprises (SMEs) would be able to move forward in their business ventures, particularly on IP-based business.

In the Malaysia Digital Economy Blueprint (2021), the government explicitly mentioned the National Strategy Thrust 2 called "Boost economic competitiveness through digitalisation". The programme aims to nurture a dynamic IP system for the digital economy to encourage innovations aims to Strengthen IP regulatory framework and enforcement, as well as enhance awareness to foster a dynamic and conducive environment for local innovators to increase IP ownership with the target of 50,000 IP ownerships by 2030 and 200 IP creation in digital content by 2025. Programmes will involve efforts in understanding the need for different ruling and processes of the digital economy including ruling for products and services that are digitally generated and transacted, implementing a digital IP enforcement strategy, and enhancing awareness on digital/online branding protection using a Malaysian domain, which is .MY (Malaysia Digital Economy Blueprint, 2021).

Finally, MDEC launched the IP360 Metaverse initiative to push national investment and development opportunities for Malaysia-based creators and studios in digital content creation and creative tech. The core objective is to establish Malaysia as a leading metaverse hub powered by digital content technology. Three core programs under IP360 Metaverse include: 1) Digital Asset Onboarding and 3D Asset Bundle programme, which aims to create Malaysian-themed Digital Asset/NFT posters for animated films/games, potentially with storytelling and commercial value. These posters could evolve into 3D assets for metaverse platforms; 2) Brand Metaverse Onboarding Programme, which aims to accelerate metaverse adoption and boost digital content creation with our program, designed to empower brands and content creators on Metaverse Platforms; and 3) Immersive IP Experiences Programme, to build immersive experiences with existing traditional centralised

metaverses.

To enable a strong environment, other IP activating policies were also released in the form of tax incentives. Malaysia just released Malaysia Digital (MD) Tax Incentive as of 31st May 2024. This is an outcome-based tax incentive, offered to eligible MD companies who have successfully launched programme on digital activities including Extended Reality (XR) and/or Mixed Reality (MR). The MD Tax Incentive offers a reduced tax rate based on the IP or non IP, and Investment Tax Allowance (ITA) based on qualifying capital expenditure (MDEC, 2024).

Gender and marginalised group policy and initiatives

Malaysia is conservative country where the role of women in public is less visible compared to other more democratic countries. Global Gender Gap Report shows that Malaysia is progressing but still ranks lower in gender equality compared to some other countries, ranked 106th out of 156 countries, indicating areas where gender disparities persist (World Economic Forum, 2021). Malaysia is a multi-ethnic and multi-religious society where Islam is the predominant religion. Islamic principles often influence social norms and policies regarding gender roles and rights. The interpretation of Islamic teachings can sometimes lead to conservative views on gender equality, particularly in areas such as public behaviour.

Despite its conservatism, Malaysia starts to pay attention to gender equality starting from its education sector. In Malaysian higher education, women represent approximately 37% of students enrolled in engineering, manufacturing, and construction fields, with an even higher representation of 46% in public universities. However when it comes to professional work, women are underrepresented among professional engineers, constituting only about 7% of professional engineers with practising certificates.

Malaysia may have fewer policies or initiatives towards women led creative technologies or artists. In contrast, a lot of attention was given to

marginalised and ethnic groups. Support was mostly given to showcase the traditional cultures through festivals and exhibitions. Local festivals play a significant role in promoting marginalised artists. For example, Butterworth Fringe Festival and Balik Pulau Arts Festival. These festivals provide platforms for marginalised artists to showcase their work, helping to boost local identity and culture while offering economic opportunities through tourism and public engagement.

Another support for marginalised groups is also shown in the area of talent development, for example, Khazanah Nasional and World Bank Collaboration. This programme aims particularly to attract and retain creative talents in Malaysia, including marginalised groups in Penang. This includes developing Penang as an attractive city for creative professionals and providing continuous learning opportunities (Kharaz et al., 2010). Penang is culturally diverse with a population that includes the majority of Chinese (41.3%) and Bumiputera (41.1%). Bumiputera or orang Asli is defined as people originating from Peninsular Malaysia and various indigenous peoples of East Malaysia.

Malaysia-UK collaborations

Several partnerships between Malaysia - UK in arts and technologies were dominated by education partnerships on creative technologies programmes, such as Limkokwing University of Creative Technology. Limkokwing University is a private Malaysian university that offers accredited programmes in architecture, fashion, IT, multimedia, computer gaming and animation technology, graphic, and interior design. LUCT even has LUCT London Campus and works with like Eric Way who is a top fashion designer and other well-known commercial brands like Laura Ashley, the Corus chain of hotels, Nestle and L'Oreal to provide internship and practical experiences, especially in its design programme.

For government to government level of partnership, so far there are no specific policies on creative technology that have been executed. UK-Malaysia collaborations are still executed in the area of

traditional art. For example, in 2019, the British Council formalised a working partnership with the Malaysian Handicraft Development Corporation (Kraftangan Malaysia) through Institut Kraf Negara (IKN), marking the continued commitment of all parties to Malaysian local craft and the preservation of its tradition and heritage. The programme, called Crafting Futures, aims to understand youth engagement and crafts, addressing the issues around product and design innovation, and connect IKN and its students to higher education and employability pathways.

Further, several upcoming events specific for dialogue on creative technologies have been initiated. For example, the first UK-APAC Tech Forum that invites the CEO, Malaysia Digital Economy Corporation (MDEC). There is also ongoing partnership between Malaysia Digital Economy Corporation (MDEC) and British Malaysian Chamber of Commerce (BMCC), and the British High Commission for the Malaysian trade mission in conjunction with London Tech Week 2024 aims at advancing both nations' bilateral trade relationships in the digital space.

Case study: Traditional and digital music production

The evolution of the contact between music and technology in Malaysia can be traced back to the initial adoption of digital platforms until the moment it adopted AI into the music landscape. Digital music received some resistance among several senior artists. This avoidance to incorporate digitalization into music productions is highly correlated with the low music output in Malaysia (Liang et al., 2022). On the other hand, digital music has attained significant importance due to the rise of some young and new musicians and brought the music industry to a significant stage.

In Malaysia, the Digital Music market is rapidly growing, driven by streaming services and local artist collaborations. The music industry is projected to reach 7.6 million users by 2029. Revenue in the Digital Music market in Malaysia is forecast to reach USD 52.40m in 2024 with an anticipated annual growth rate (CAGR 2024-2029) of 6.85% (Statista, 2024).

Warner Music Malaysia's Managing Director, Dinesh Ratnam, mentioned that local music industry prospects remain promising backed by the rise in digital sales. It hit historic revenue in 2023, marking the highest income ever recorded, amounting to RM 303.89 million or equivalent to USD 65 million in 2023 (New Straits Times, 2023). The shift towards digital platforms has opened up new opportunities for local artists, for example several digital music streaming apps like Spotify, Apple Music, etc. With this platform, musicians could easily reach a wider audience both locally and globally, and have access to all kinds of music. With this evidence, it is clear that digital music platforms in Malaysia have been well received and well adapted by the market, reaching the maturity stage, which normally pertains to a stable number of productions, sales, and customer base of digital music fans.

The case selected is Analog K, also known as Khairul Hazwan Musa, who stands out in the creative technology field in Malaysia as a multifaceted music producer, audio engineer, music collaborator, synthesiser, and keyboard player.

Analog K's experiments with synthesisers and modules made him more interested in designing his own signature sound and style of music, influenced by Nu-disco, French Touch, Indie Dance, House, and Electronica music. Analog K frequently uses the Malay language in his lyrics, which adds a strong cultural dimension to his music, for example in "Batas Keraguan". This use of the local language helps to connect with the Malaysian audience and promote cultural exchange.

Besides being a Music Technology lecturer at the Faculty of Music - Universiti Teknologi MARA, Analog K's focus on the independent music scene in

Malaysia drives his practice in electronic music production. He aims to bridge the gap between industry practices and academic learning by conducting workshops that demonstrate music production techniques. Digital music productions could be costly and capital intensive. However, teaching this technology at formal education could serve as a long-term investment for Malaysian creative technology development.

Analog K and other Malaysian musicians (such as Kamal Sabran) use modular synthesisers, an electronic musical instrument that consists of a multitude of different components to create electronic sounds, and effects. Digital software used is Pro Tools for sound recording, editing, and mastering processes. The integration of AI and advanced digital tools has been a pivotal development in the evolution of digital music production.

Digital music production has witnessed significant growth through international collaborations and technological innovations. Organisations like MyCreative Ventures Group, a Malaysian government-linked investment company focused on arts and culture, are proof of how international collaboration can contribute to the growth and diversification of Malaysia's creative technology sector. Several international partners are interested in working with them to fund projects focused on music technology and AI.

When it comes to distribution, Analog K and Vimala Perumal have embraced digital platforms early on, utilising them to showcase their work and engage with audiences globally. Both artists underscore the pivotal role of social media and digital platforms in amplifying artistic reach and engagement. Analog K, utilises these platforms to showcase his immersive installations and interact with his audience. His engagement spans beyond mere presentation, fostering a community around his art. Similarly, Vimala Perumal highlights how these platforms democratise artistic expression, enabling artists to share their work globally and connect with diverse audiences. The integration of social media and digital platforms serves as a nexus for artists to not

only exhibit their creations but also to cultivate dialogue and feedback, enriching the artistic process.

Technology serves as a powerful catalyst for collaboration between artists, technologists, and academics. Interdisciplinary partnerships push creative boundaries, resulting in innovative works that blend traditional and contemporary elements. By bringing together diverse talents and perspectives, technology fosters a dynamic cultural landscape where artistic expression thrives. This collaborative approach not only enhances the quality and diversity of artistic output but promotes a more inclusive and vibrant creative community. Currently, a new "matching grant" programme from the Ministry of Finance offers up to 250,000 RM (equivalent to USD 50,000) for commercially viable creative projects, potentially including music technology initiatives, such as integrating AI and music technology.



Khairul Hazwan Musa or Analog K

Analog K mentions the importance of preservation and transformation of artistic practices even after the infusion of technology. Emerging technologies such as virtual reality (VR) and augmented reality (AR) could play a crucial role. Khatriza Ahmad Saffian (Senior Lecturer at Universiti Teknologi MARA) highlights the use of virtual reality by making Malaysian cultural heritage more accessible. Moreover, the integration of these technologies encourages innovation in traditional art forms, allowing artists to explore new mediums and

methods of expression. This not only helps preserve traditional practices but ensures they continue to evolve and remain relevant in the digital age among younger audiences.

Another artist example is Mohammad Kamal bin Sabran (@kamalsabran). He is a sound artist, but also a university professor. His music is characterised by its unique blend of traditional cultural elements and contemporary digital techniques. He employs various digital tools and software to create, manipulate, and enhance his music. This includes sound synthesis, sampling, and digital processing, which he uses to explore new sound. What makes it unique is that Kamal Sabran's music often merges traditional Malaysian and Southeast Asian musical elements with modern digital sounds. This includes the use of traditional instruments, melodies, and rhythms alongside electronic and digital music technologies.

Technology can also enhance storytelling and narrative structures of artworks. Dr. Soo Wincci's research on interactive narrative systems utilising machine learning algorithms exemplifies the transformative potential of technology in the arts. By blurring traditional narrative structures, her work enhances storytelling experiences and fosters a deeper connection with audiences.



Digital music workshop with Khatriza Ahmad Saffian, Senior Lecturer at Universiti Teknologi MARA

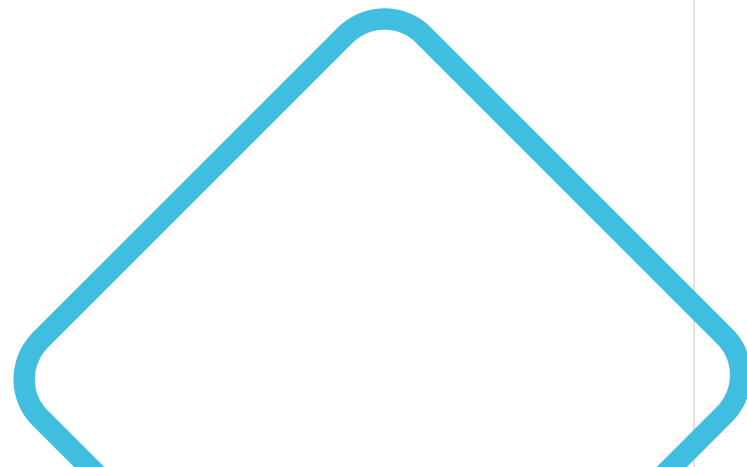
How AI leverages music

In the case of Malaysia, AI affects two different dimensions – visual storytelling and artistic expression in music production. Musicians' authenticity lies in their skills in producing music from ideation, instruments used, and combination of several melodies. With AI, some of these processes are automated and lose their sense of human touch coming from an artists' identity. Moreover, dilemmas arise regarding the ownership and authenticity of AI-generated compositions, raising questions about attribution and creative autonomy.

The integration of AI in music production has revolutionised the music community, empowering artists to explore new frontiers of sound. This AI-driven approach democratises music production and enables independent artists to realise creative visions without the constraints of traditional methods. Analog K's utilisation of GenAI exemplifies

this transformation, adding layers of complexity and interactivity to his musical compositions. By harnessing AI algorithms, he can generate unique melodies, rhythms, and harmonies, thereby expanding the realm of musical experimentation and innovation.

Despite its transformative potential, Dr. Soo Wincci raises a set of challenges and considerations when integrating AI into visual storytelling and artistic expression. These include concerns about algorithmic bias and the impact of AI on cultural representation and authenticity. Additionally, questions arise regarding the role of the artist in AI-driven creative processes, prompting reflection on issues of authorship and creative autonomy. Addressing these challenges requires a nuanced understanding of the ethical implications of AI integration and a commitment to fostering responsible and inclusive artistic practices.



Myanmar

Key findings

Arts and technology development in Myanmar is in its nascent stage, struggling to move forward due to lack of proper education infrastructure, financial support and proper connection to the outside world's advancement in technology. The military coup in 2021 significantly influenced the use of digital space and metaverse by artists as a critical space for free expression and art activism. However, the repressive political environment has led to strict regulations that reduce creative freedom and access to technological platforms. There is a significant digital divide with a substantial portion of the population in conflict-ridden and rural areas lacking internet access. The concentration of art and technology activities in metropolitan areas like Yangon further marginalises artists from other regions. Myanmar also faces substantial infrastructure deficits, including frequent electricity

cuts and limited internet access which stifle the growth of creative technology initiatives. Economic instability has made it challenging for artists to acquire new technologies as well. Despite the challenges, the art scene in Myanmar has seen innovative projects using AR/VR technologies with adoption and interest only growing in recent years.

The findings indicate that despite the challenging political and economic landscape, there is a growing creative technology scene on immersive technologies creating new spaces for artistic expression. Moving forward, there is a need for efforts from policymakers, community leaders, and international stakeholders to support the growth of a resilient and inclusive creative technology ecosystem. The potential for digital art and technology to drive cultural and economic growth in Myanmar remains significant, provided that the necessary support systems and freedoms are established.



Lotus Calling by Enchax, photo courtesy of the artist

Country profile

Out of 54.38 million population in Myanmar, 23.9 million have access to the internet and 15 million use social media platforms (We are Social and Meltwater, 2023). As per 2014 Myanmar Population and Housing Census, 67% of the population is 15-64 years of age with rural population of 70% being significantly higher than urban population of 30%. Wider range of smartphone users across the country meant that the target demographics for innovative tech solutions can be outside of metropolitan cities such as Yangon and Mandalay (Bearne, 2018).

However, the 2021 military coup has created a hostile environment for innovations to thrive. Though internet penetration in Myanmar has generally expanded in recent years, access decreased amid damage to infrastructure, internet shutdowns, and high costs imposed by the Myanmar Military since the 2021 coup. As a result of the conflicts, the Myanmar Economy is projected to weaken further. GDP growth is predicted to remain low at 1.2% in fiscal year 2024 and 2.2% in 2025. Inflation rate is also expected to remain high. On top of such challenges, no specific policies, either by government or foreign institutions, targeting to develop the intersection of art and technology sectors are found at the time of reporting, which further stunts the growth of the sector.

There is a growing population of creative technology professionals in Myanmar working across design and arts sectors. They are involved in creative fields such as visual communication design, user interface/user experience (UI/UX), three-dimensional visual effects (3D VFX) design⁵, computer-generated imagery (CGI), game design, character design, animation, and augmented reality/virtual reality (AR/VR) technology developments. The digital leapfrog in Myanmar since 2011 is due to the reduced restrictions on the internet under the quasi-civilian government. The steady flow of

foreign investments into the country allows business to thrive, and with it brings many technological advancements.

A steady interest in creative technology is evident in the emergence of institutions such as Myanmar Creative Technology College, founded in 2017, which offers International General Certificate of Secondary Education (IGCSE) and diploma programmes in Art, Design, and Game Development (Myanmar Creative Technology College, n.d.). It is also evident in the success of events such as "Ideas on the Clouds" by MM Project, which brought together many creative tech professionals in Myanmar working in creative studios, as freelance individuals, or as collectives. Such events saw partnerships between private sector businesses and local creative tech initiatives.

Moreover, there is an increasing interest in utilising AR, VR, and metaverse technologies in business, arts, and culture. The earliest and most successful examples are 360 Ed, an AR education company, and 3XVIVR, a start-up building 3D VR replicas of heritage sites in Myanmar. In business, marketing through social media AR filters on platforms such as Instagram and Facebook, interactive AR installations, and metaverse are gaining popularity. These projects see the intersection of tech and creative fields as AR/VR projects require skilled professionals from digital design and art fields as well as technology developments.

Intersections in new media art and the metaverse

The case study on Myanmar focuses on how artists, particularly with 3D design backgrounds, are using the metaverse in their creative practices and how the technological advancements have impacted their practices in recent years. The interest in metaverse was amplified in the arts sector after the double crisis of Covid-19 restrictions in 2020 and

the military coup in 2021. Digital space became a critical space of resistance and alternative space of expressions for artists. Due to its immersive nature, interconnectedness and ability to reach a wider audience through the internet, the use of metaverse for the arts becomes popular in Myanmar. This is evident in the project Spring Revolution AR Filter. NFT (Non-Fungible-Token) projects also emerged to support Myanmar's resistance movements. An example is 3 Finger Salute NFT campaign² aimed to 'raise awareness, support democracy and digital artists in Myanmar.' It aims to build a metaverse community with an interactive art gallery featuring works by Burmese digital artists. When physical actions become unsafe, digital movements continue to sustain the arts in Myanmar.

Policy and intellectual property overview

Cyberspace regulations

Myanmar Junta increased monitoring and suppression of online activities can impact the growth of creative technology sector innovations. Myanmar is the second-worst country in the world for internet freedom violations. Current laws enforced for digital space regulations are 1) Counter Terrorism Act (2014) and its by-laws (2021), 2) Telecommunication Law (2013), and 3) Electronic Transaction Law (2004). These laws grant the military authority to intercept communications and monitor online activities, criminalising media and online content deemed unacceptable by the military. Due to regulations imposed on digital space, VPN applications are required to access social media networks such as Facebook and Instagram, where the majority of AR art projects and marketing campaigns take place. Furthermore, the

military's draft Cybersecurity Law (2021) aims to criminalise VPN use and demands personal data from internet providers, enabling extensive surveillance. The possession of high tech equipment can also be ground for long term prison sentences. In January 2024, award-winning journalist and documentary filmmaker Shin Daewe was sentenced to life in prison for possession of a video drone under counter terrorism act.

Cultural policy

Myanmar cultural affairs are governed by the Ministry of Religion Affairs and Culture³. With religion and culture intertwined, policies tend to support traditional culture expressions that promote Buddhism or Burmese way of living. Policies focus on preserving Burman-buddhist way of living while 'eradicating inappropriate traditions' (Hmun, 2023). Following the coup, increasing regulations for cultural production could be introduced soon by the Junta. Myanmar film industry has already reported increased regulations on the type of content that is allowed to be produced inside the country (Soe, 2023).

In 2023, Myanmar enacted its intellectual property laws drafted in 2019, namely the Copyright and Related Rights Act, the Trademark Act, the Patent Act, and the Industrial Design Act.

⁵ Indie Film production, Yangon in action, is a good example of skilled VFX designers in Myanmar.

Intellectual property laws

Theme	Myanmar IP Policies	ASEAN Region Policy
Protection	Strengthening IP protection (Copyright and Related Rights Act, the Trademark Act, the Patent Act, and the Industrial Design Act)	Harmonisation of IP laws (ASEAN IP Rights Action Plan)
Innovation	Encouraging innovation and creativity (the Trademark Act, the Patent Act, and the Industrial Design Act)	Regional cooperation in IP enforcement (ASEAN IP Rights Action Plan)
Standards	Alignment with international standards (TRIPS, WIPO)	International treaties (TRIPS, WIPO)

The new IP laws in Myanmar significantly bolster protection for various IP categories, aligning the country more closely with international practices. These laws include the ability to take both civil and criminal actions against IP infringements, provide comprehensive protections and streamline registration processes for IP rights. This approach aims to attract foreign investment and encourage local innovation. The new laws reflect an alignment with international standards such as the TRIPS Agreement and frameworks set by WIPO. This highlights how Myanmar's recent legal reforms are positioning it closer to ASEAN and international standards, promoting better protection for IP rights and fostering an innovation-friendly environment. However, such laws alone will not suffice for creative innovations until digital space regulations and the cultural policy allow more freedom of expression.

UK - Myanmar bilateral agreements

The current bilateral agreements do not target the creative technology sector. The UK government is known for its response to humanitarian needs, particularly for vulnerable groups such as women and girls. Myanmar is a focus country for the UK's National Action Plan on Women, Peace and Security (WPS). Since the 2021 coup, the UK government has

halted all support to the military regime and implemented programmes through Myanmar civil society and international partners such as the UN agencies, the World Bank, INGOs and the private sector (Foreign Commonwealth and Development Office, 2023).

Women in tech

Policies to improve women involvement in the tech sector is necessary as gender divide is a challenge in Myanmar. Myanmar women's success in the tech sector is significantly lower than that of men despite a large number of women at computer studies universities (Staehelin, 2019) (Toe, 2015). Factors such as traditional gender roles, limited access to technology, economic constraints, educational disparities, and safety concerns collectively contribute to a significant tech sector gender divide in Myanmar, preventing women from fully participating in the digital economy and hindering their access to educational and employment opportunities (IREX, 2017). Myanmar women are at the forefront of digital resistance movements and actively participate in the art x tech sector (Perumal, 2024). Better policies to foster women participation in tech could benefit growth in the creative technology sector.

Case study: New media art and the metaverse

Artist-led innovation - ZUNE (Thoughtform)

ZUNE has worked extensively as a graphic and 3D designer for 7 years. Outside of her work in the design field, her artistic practice is unique for creating virtual reality immersive experiences.

BA Communication Design graduate and artist ZUNE (Thoughtform)'s main artistic medium is 3D art with works focused on virtual reality spaces. Growing up, she was influenced by mystery games such as Nancy Drews and ARGs (Alternate Reality Game), which is a type of interactive fiction. A great example is the 'Mr.Robot' TV series which sells collectibles and protagonist' diaries to the viewers, who can then solve puzzles to get easter eggs about the TV series' ongoing narratives. ZUNE finds this interactivity where fictional/real, digital/ physical are linked together fascinating. ZUNE's practice has themes of mythologies, spirituality and ethereal realms. In artistic works, her interest is in world-building and making new realities. ZUNE sees technology as a tool that streamlines her creation process. Technology allows her to instantly produce what she is imagining in 3 dimensions. Sketching and drawing does not produce a 3 dimensional look but with 3D modelling she can print out her concepts easier with 3D printers as well if needed. Technologies also make working alone easier. She believes technology such as AI has given more power to the individual and more possibilities to create, while AR/VR technology allows her to create in more dimensions, blending realities through technologies.

In her works, virtual reality spaces are 1) built with Blender and turned into scenes of audiovisual films via Premier Pro, evident in the works such as Rite of the Ocean 2023, Scryers 2022, 2) built as an exhibition space on open world immersive platforms, e.g :\screensaver exhibition 2021, 3) interactive experiences where visitors used VR headsets to experience, seen in the artwork Dead Man's Reverie in C a r e. exhibition (Thwe, 2023). She uses free softwares such as Blender for 3D modelling, and open world platforms such as Mozilla Hubs for more connected experiences.

The growing accessibility of technology contributes to the growth of her practice. Softwares such as Blender, compared to its senior softwares such as Maya and Cinema 4D, is free to use and has a growing community where knowledge exchange can happen. This helps ZUNE to experiment more in her practice, learn and receive support from other creators easier. However, due to inflation⁶, she faces challenges with insufficient funds to acquire new technologies and difficulties in acquiring software due to the lack of a proper international banking system in Myanmar. Constant electricity cuts are also challenging for her largely computer dependent practice.

ZUNE collaborates mostly with sound artists to turn her ideas into audiovisual films. This is evident in her works SCRYERS (2022), created in collaboration with a sound artist from the UK through British Council 'Connections Through Culture' grants. In exhibition spaces, her works are staged as installations where the 3D work is shown through projections or TVs. Her work 'And The Great Bell Tolls' is an interdisciplinary work. It is a public art AR installation, in collaboration with Enchax Creative, an AR Designer, accompanied by an audiovisual film.

⁶ The inflation rates have worsened since February 2024 after the military junta introduced conscription law, which made military service mandatory for all men aged 18-35 and women aged 18-27 for at least two years. This has resulted in a mass exodus of youths fleeing the country, effectively increasing the exchange rates (Nikkei Asia, 2024).



Rite of the Ocean 2023 by ZUNE. Image Courtesy of the Artist.

Though ZUNE is interested in creating more immersive and interconnected experiences using metaverse, her current limit in technical skills and challenges to show the metaverse based works in exhibition spaces is slowing her process. She is currently working on her own Alternate Reality Game (ARG) experience, which will involve an immersive game environment, non-fungible tokens (NFTs), and physical objects related to the NFTs. An ARG is an interactive narrative that uses the real world as a platform to tell a story, unfolding across multiple media channels. ZUNE's practice is an example of how artists skilled in both design and art fields can create innovative artistic practices.

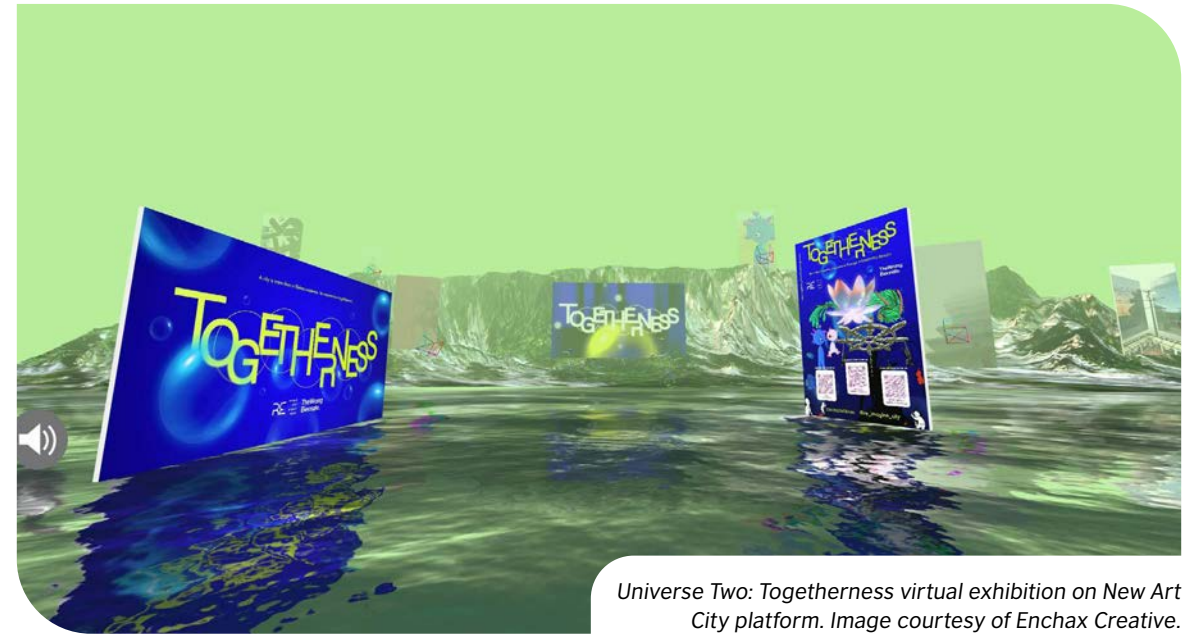
Broader technology initiatives - Enchax Creative XR Studio

Enchax is an AR designer and creative technologist who has worked in the Augmented Reality and spatial computing sector for six years. In this section, we will look at how his AR design and artistic practice has intersected with other art x tech initiatives that work with a larger ecosystem.

Enchax is a leading creative technologist in Myanmar mainly working with Augmented Reality. His interest for AR began while competing in a start-up competition, Myanmar Youth Technopreneurship Development Program 2019, collaboration between MPT and Japan Government.

Such programmes frequently occurred in Myanmar between 2014 - 2019 where start-up culture was driving the tech innovations forward. Since then, he has participated in international XR events, notably Meta Sparks Creator Connect 2022 Bangkok and MIT XR Hackathon project 2023 by Massachusetts Institute of Technology. His work spans across the business sector and the arts sector. His notable project in the business sector is Bobi: Across the Metaverse, a collaborative project in 2023 between himself, The Wanderers, a 3D VFX design collective, and Street Smarts, a youth entrepreneurship platform. Bobi is a 3D character designed to appear cross-platforms in animations, short films and as AR on social media platforms.

Enchax describes himself as a facilitator who transforms traditional art mediums into Augmented Reality (AR) to enhance its original essence while adding a new creative dimension. An example of such collaborations is seen in (Re)Imagine City/ (Re) Imagine Home projects, where Enchax helps turn artists' original concepts into AR designs. Coming from a household where his parents were involved in painting and writing, Enchax became interested in how to incorporate technology into traditional arts. Initially, AR technology was challenging for people to understand, but it has become more widely accepted and recognized as an art form in Myanmar. In his own practice, Enchax creates interactive AR face filter experiences on social media to promote Burmese culture. His work, Lotus Calling for (Re)



Universe Two: Togetherness virtual exhibition on New Art City platform. Image courtesy of Enchax Creative.

Imagine City project turns the symbol of luck, the lotus motif, into a colourful animated 3D object that the viewers can experience through AR.

The collaborative project, (Re)Imagine City/ (Re) Imagine Home, emerged in response to the dwindling art spaces in Myanmar post coup. It is designed in a way that can exist both physically and digitally. The AR artworks are made with Sparks AR software and hosted on Instagram which allows access from anywhere in the world. In physical exhibition spaces, QR codes can be generated for visitors to scan with their mobile devices and see the artworks. The project received funding from Goethe Institut RECONNECT cultural grants in 2021. Since then, the project has resulted in two exhibitions; Universe One: Portal to an Impossible City (2022) and Universe Two: Togetherness (2023). The project invites artists working in traditional and digital mediums alike to collaborate with the AR designer. When Universe One was staged as a physical exhibition in Yangon in 2022, this was the first time Augmented Reality was shown in contemporary art spaces in Myanmar. In 2023, the second exhibition, Universe Two, became a part of The Wrong Biennale, an international online arts festival. The second exhibition resulted in a virtual reality space on New Art City, a new media art focused online exhibition tool. A programme called 'Posters Around The Cities' was also initiated where viewers can access AR artworks through QR codes in different cities across the globe.

Another notable project from Enchax is The Sky I Took Yesterday For You, a collaborative AR project between Enchax and Burmese artist, curator and educator Aung Myat Htay in 2023. Keeping the rarity of new media artworks in Myanmar in mind, Aung Myat Htay, initiated School of Contemporary Arts (SOCA), which has produced education books for new media art and initiated courses to explore multidisciplinary art forms. A graduate of the National University of Art and Culture (NUAC) in Myanmar and formally trained in sculpture, Htay observed the reluctance of the general public to accept contemporary art forms. Most galleries in Myanmar tend to work with painters whose works can ensure sales.

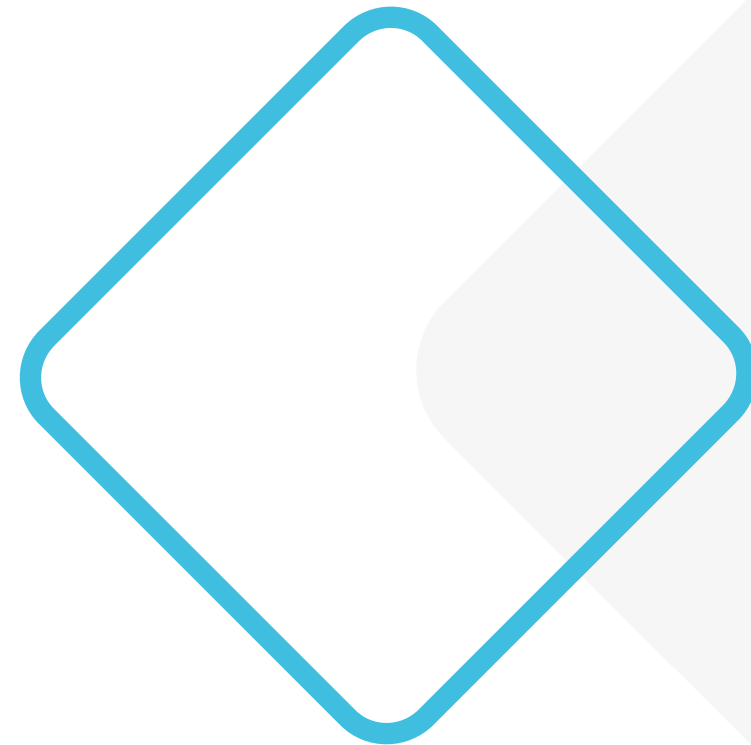
Galleries are reluctant to accept new art forms as local collectors show little interest for new art forms such as video art, even though it has been a widely used medium by artists since the early 2000s. Htay is determined to change this perception through his project SOCA. Since its inception in 2013, SOCA is committed to diversify contemporary art practices in Myanmar. This is evident in their continuing collaboration with international artists and organisations. In 2018, SOCA collaborated with an Asian Art Council grantee sound artist from Iceland, Erik Deluca, in its temporary physical space in Yangon. Young artists were invited to learn and explore with SOCA and Erik, which resulted in wider community projects.

Since Covid-19 restrictions in 2020, SOCA has found new ways to connect with a tech savvy younger generation of artists. SOCA Program #4 'What The Way We Live' explores different artistic expressions via multimedia art in social distancing. SOCA has continued its encouragement of new media art experimentation and produced documentation projects such as Silence is Golden (2019), Abstraction of Breathing (2020), and Phenomena (2023) with the support of Aura Contemporary Art project. His project ECHOES (2022) is an experimentation project that brings artists and non-artists together. These include sound artists, motion graphic designers, musicians, poets and digital artists. ZUNE was also a part of this project.

Innovators from design and tech sectors, in collaboration with curators, artists and educators, are driving innovation forward in Myanmar. They are often skilled professionals at the intersection of multidisciplinary arts and technology.

Technology plays a central role in both case studies. For example, approximately 80% of Enchax's work is done using computers. He relies heavily on software for brainstorming and experimentation. Enchax uses softwares such as Spark AR and built-in cameras on Facebook and Instagram to make AR accessible. Recent advancements in tech have made it more user-friendly for creators like Enchax. Since Covid-19 restrictions in 2020, plug-in tools⁷ for Unity and Vuforia, as well as new features from platforms like Snapchat, have streamlined the AR creation process. This has allowed for faster project completion and higher quality AR experiences. However, he feels innovation has stunted in needed areas such as AR optimisation for various mobile devices as the industry is now more focused on marketing and creating short experiences.

In the interviews, both artists mentioned the use of GenAI for ideation process; brainstorming, creating mood boards and visualising concepts. Enchax finds AI useful for enhancing workflows as AI-generated models can be swiftly incorporated into his projects. For example, 3D modelling used to be a meticulous time consuming work, but the production process in AR/VR can be sped up by 3D AI generators. The artists view AI as adding a new dimension to art and believe it enhances rather than replaces human creativity. However, they believe art and AI projects require a sophisticated artistic concept or high artistic skills to execute meaningful projects. They stressed the need for policy regulations or community guidelines for proper AI usage as it can cause copyrights issues.



⁷ Plug-ins are pieces of software added to existing operational frameworks allowing users to get the features they want.

Philippines

Key findings

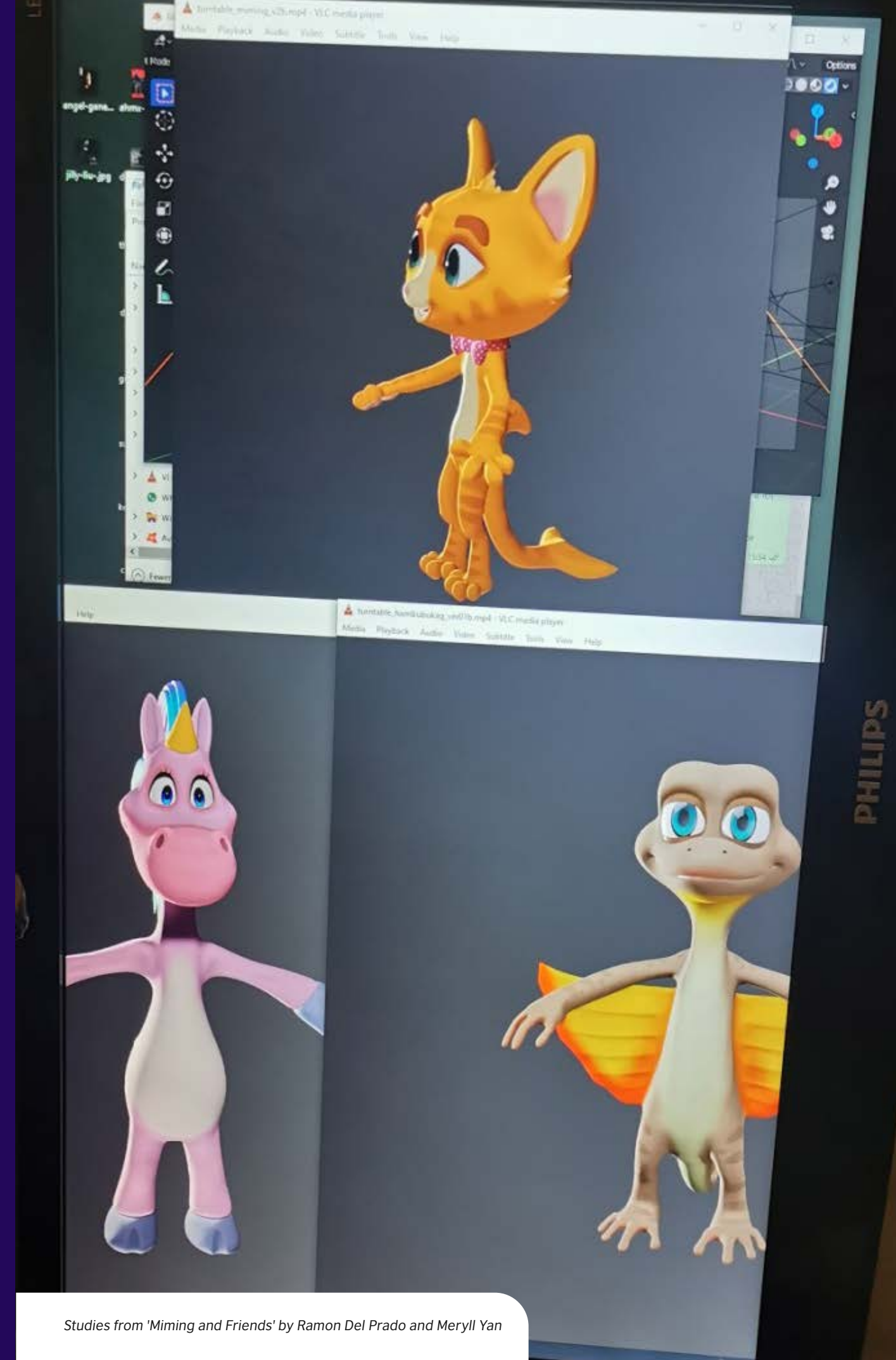
The Philippine population is mostly tech literate, with almost everyone plugged into social media. Mid-range to flagship mobile devices are abundant and relatively easy to acquire, which has led to more people exploring 3D art and design as an interest. VTubers, a type of social influencer that relies on a mix of 3D and 2D technology to have their virtual avatar movie based on the person's actual movements in real time, have also started to proliferate. Though there is access to top-line computers for 3D animation, because of cost, the majority of enthusiasts and independent creators use mid-tier or 2nd hand flagship gaming laptops and use either open-source software like Blender, or cracked versions of industry standard software like Maya, 3DS Max, and Cinema 4D. With gaming platforms like Unity and Unreal Engine now having free subscription tiers, there is a growing interest in using these platforms to integrate 3D design and animation into content like film, TV, and live events.

With over 70% of the country connected to the internet, it has created a surge in self styled content creators uploading their work to social media platforms and online video-streaming sites.

Cost is a great deterrent to industry standard hardware and software. 3D animation is an expensive pursuit. Even though there is open source 3D software available, what is being taught in educational institutions is usually industry standard software that follows subscription models.

Upskilling is essential. With new technology coming out every few months, there is a need to continually train and study to be knowledgeable of current industry applications, standards, and practices.

There is no funding or grant programme specifically for the creative technology discussed. Most funds are either generally tech-centric or creative-centric, and not for creative technologies per se. Areas outside of Metro Manila do not have visibility or information on any technology or creative centred funding or grants.

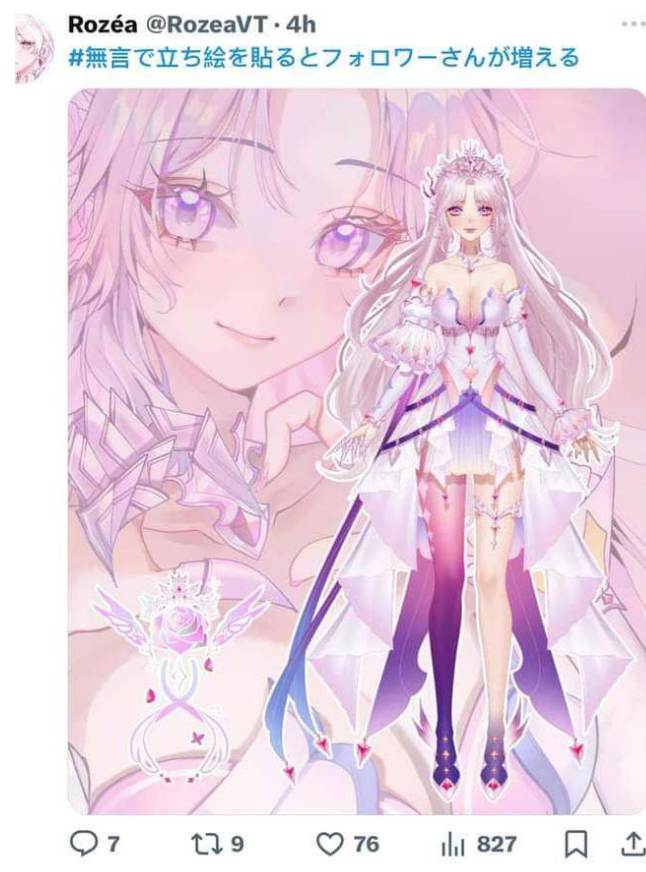


Country profile

The creative technology scene in the Philippines is dynamic, positioning the country as a regional growth hotspot for business and creative process outsourcing. The local sector is internationally recognized for its expertise in 3D game assets, character design, visualisation, and product design. The 3D technology ecosystem is a mix of large, medium, and small studios that typically run custom-built high-spec computer rigs or high-end gaming machines and use licensed industry standard software such as Maya 3D, Cinema 4D, and 3DS Max. Most independent or freelance 3D artists or animators use midrange gaming machines or custom constructed systems with a combination of midrange components and a high-end graphics card. It is not uncommon for practitioners to straddle between two worlds – one focused on proof art as a service in the morning, providing design, animation, or expertise to clients- either as part of a studio or as a freelancer – and another devoted to creating their own art or original IP content in their spare time. This approach to

creative technology is not limited to those in the animation industry, but is seen by those in game development, music, and digital design and other sectors as well.as well.

As mobile phones and tablets become increasingly computer-like, an increasing number of people have developed an interest in 3D art (Interaction Design Foundation, 2024; AWS Spatial Computing Blog, 2024). VTuber apps have helped to popularise a new type of animator/influencer hybrid, particularly through online platforms such as Gank. A VTuber, or “Virtual YouTuber,” is an online content creator who creates videos and live streams with a digital avatar, using 3D motion capture technology. This technology has now been made accessible on mobile devices. VTubers are very popular in Japan, but have gained international popularity, especially in the Philippines and Malaysia, for creating a diverse range of content such as gaming, music, and interactive live streaming (CBC, 2024; Polygon, 2024). VTubers have been appearing on other platforms outside of YouTube.



Picture of RozeaVT, a VTuber from the Philippines

Image provided by RozeaVT

The Philippine government provides no financing or grants expressly for creative technologies. The Department of Science and Technology has certain financing programmes that may include innovative initiatives, depending on the technology employed. The Intellectual Property Office of the Philippines (IPOP) runs Copyright Plus, a programme that rewards creatives who are free to utilise any creative technology they need to deliver their work in partnership with IPOP's Bureau of Copyright & Related Rights (IPOP bares 2022 copyright projects for creative economy's recovery. 2022, July 26).

As of 2024, the Philippines has an estimated population of 119.1 million people, with a population density of roughly 399 people per square kilometre. This high density shows significant urbanisation (Worldometer, 2024). The median age is about 24 years, with around 63% of the entire population within the working age group of 15 - 64 years (StatisticsTimes, 2024).

The Philippines is predicted to develop at a pace of 6.0% in 2024, with per capita growth of 4.8%, rising to 5.1% in 2025 (ADB, 2024). The average monthly pay for a worker is roughly PHP 18,423. Workers in Manila and other urbanised provincial cities earn better salaries compared to the rest of the country (ASEAN Macroeconomic Research Office, 2024). The Philippines has numerous key growth sectors, including: Digital Media and e-Commerce, Healthcare and Pharmaceuticals, and Manufacturing (McKinsey & Company, 2023)

The market size of the e-commerce sector is estimated to reach USD 29.57 billion by 2029, growing at a CAGR of 13.78% from 2024 (Research and Markets, 2024). The CREATE Act (Corporate Recovery and Tax Incentives for Enterprises Act) was enacted to reduce corporate income taxes and streamline the grant of fiscal and

non-fiscal incentives to attract more investments. This law is particularly beneficial for manufacturing firms looking to expand their operations in the Philippines (McKinsey & Company, 2023).

As of early 2024, around 73.1% of the country is connected to the internet. Most urban areas have 5G connectivity, with 5G access becoming standard in recent mobile data postpaid plans. Rural areas continue to face challenges due to poor infrastructure, high expenses, and uneven service quality, despite widespread smartphone adoption and social media usage (DataReportal, 2024; Meltwater, 2024).

Intersections in 3D animation and content development

The researchers focused on shifts in 3D technology and animated content development in the Philippines for the following reasons: The history of animation in the Philippines spans several decades, from classic cel animation to modern 3D animation. The business began commercially in the 1950s and grew significantly in the 70s and 80s, when the Philippines became a preferred outsourcing destination for international studios such as Walt Disney Television Animation and Warner Bros. Animation. The 80s and 90s are regarded as the golden age of animation, with an expansion in animation studios and a substantial flood of outsourcing projects, which boosted the industry's reputation and capabilities (Animation Council of the Philippines, 2024).

In the late 1990s and early 2000s, the industry moved away from traditional cell animation towards digital formats, embracing digital ink and paint processes and 2D animation software like Adobe Flash. By the mid-2000s, studios had

started incorporating 3D computer graphics into their production processes. Today, the Philippine animation industry is well-known for its versatility in both 2D and 3D animation, as well as an important outsourcing hub and producer of original material. The Animahenasyon festival showcases Filipino talent and promotes the local animation industry on a global scale, reflecting a blend of traditional techniques and modern technologies, with increasing government support and international collaborations (Animation Council of the Philippines, 2024).

There has been an increase in content using 3D technologies by influencers and live-streamers over

the pandemic. From integrating visual effects into their reels and edits to going all virtual by being a VTuber, the Philippines enjoys 3D art and animation in the social media content they consume. Local indie games using 3D assets and environments have started to pop up slightly, though 2D games still dominate the local scene. In the area of content development, there are local IP creators that have their eyes set on using 3D animation as their medium of storytelling, with the likes of Aurthur Mercader of Puppeteer Studios, Ramon Del Prado of Miming and Fwends Animation Studios, Marla D. Rausch of Kampilan Productions, indie animation producer Cris Dumlao, and animation director Nicole Mendoza at the forefront.

Policy and intellectual property overview

There are no known policies specifically for creative technologies in the Philippines. The researchers have identified local and regional policies that directly or indirectly impact either the creative or technology intersections, as presented in the table below:

Theme	Philippine IP Policy	Philippine Government Policy	ASEAN Region Policy
Protection	Strengthening IP protection (RA 10372, IPOPPL Circulars)	Digital infrastructure and cybersecurity (DICT initiatives)	Harmonisation of IP laws (ASEAN IP Rights Action Plan)
Innovation	Encouraging innovation and creativity (Creative Industries Development Act)	Support for creative industries (DTI initiatives)	Regional cooperation in IP enforcement (ASEAN IP Rights Action Plan)
Standards	Alignment with international standards (TRIPS, WIPO)	Promoting digital economy and blockchain (Blockchain Week)	International treaties (TRIPS, WIPO)
Enforcement	Enhancing enforcement mechanisms (IPOPPL Circulars)	Ease of doing business (RA 11032)	Regional IP infrastructure development (ASEAN IP Rights Action Plan)

Current impact on creatives in the Philippines

The existing policies have produced a more secure and friendly environment for creatives in the Philippines. The enhancement of intellectual property protections through legislative modifications and conformance with international norms creates a strong legal foundation for preserving creators' rights (Philippine E-Legal Forum, 2014; VAL Law, 2020). Government activities that focus on digital infrastructure and cybersecurity create a safer environment for digital content generation and dissemination. The development of creative industries through events and assistance programmes fosters innovation and allows Filipino creators to present their work locally and globally (Department of Trade and Industry Philippines, 2022).

These combined efforts have strengthened confidence among creators and investors, resulting in a thriving creative sector with growth in digital media, 2D & 3D animation, and game development (Department of Trade and Industry Philippines, 2022; Business Mirror, 2021).

Gender and minority group policies & programmes

The Philippines has no clearly established government policy that addresses women and minorities specifically in relation to creative technology. So far, not-for-profit SheCodes Foundation is committing to teaching 1000 women residing in the Philippines to code for free. 762 women have currently applied for this opportunity (SheCodes Foundation Program for Filipino Women, 2024). The researchers have compiled national and local policies and initiatives that include gender and/or the minority in their consideration and scope. These policies and programmes do not necessarily include creative technology, but loosely touch the local creative industry as a whole. The final column contains Industry organisation initiatives that may be both government or not-for-profit led that include the scope of the local creative industries.

Common Theme	National Government Policy/Programme	Local or Regional Government Policy/Programme	Industry Organisation Initiative
Support for Women and Minority Groups	Philippine Creative Industries Development Act (Republic Act No. 11904) aims to promote the development of the creative industries, including protections for marginalised groups (Lawphil, 2022; DTI, 2023)	Local government units (LGUs) implement various community-based programmes to support women and minority groups in creative sectors through local cultural councils.	GREAT Women Project (Gender-Responsive Economic Actions for the Transformation of Women) by the Philippine Commission on Women and DTI (DTI, 2023).
Capacity Building and Skills Development	Filipino Performers and Entertainers Accelerator – A capacity building programme for workers in film, live events, and performing arts under the Development of Creative Industries Project (DTI, 2023).	Regional cultural and arts festivals often include workshops and training programmes for women and minority artists to enhance their skills and opportunities. Industry partnerships are resourced and leveraged for these programs.	Training programmes by the Creative Economy Council of the Philippines (CECP) focus on upskilling women and minority groups in creative industries (DTI, 2023).
Inclusive Policy Framework	Inclusive Innovation Industrial Strategy (i3S) includes provisions for removing growth obstacles and promoting participation in global value chains for all segments of society (DTI, 2023).	Regional innovation hubs and incubators often have specific programmes targeting women and minority entrepreneurs in the creative industries. Many of these are grassroots initiatives that deal more with culture and heritage.	Various industry associations, such as the Animation Council of the Philippines (ACPI) Animation Fusion, offer inclusivity programmes to support diversity in creative sectors (DTI, 2023).
Access to Resources and Markets	Development of Creative Services Special Zone – This initiative focuses on creating zones with shared resources for creative professionals, particularly benefiting marginalised groups (DTI, 2023).	LGUs often provide grants and funding opportunities for women and minority-led creative projects through local economic development offices, with a focus on cultural goods from micro and small-medium enterprises.	The Creative Content Creators Association of the Philippines (SIKAP) provides platforms and networks to help minority and female creators access wider markets and resources (DTI, 2023).

Case study: 3D animation and content development

The case study focuses on the intersection of animation and 3D technology, characterised by the use of a full or partial 3D technology pipeline to produce animated content. The content may vary from motion-captured streaming avatars to rigged 3D models; from visual effects to sprawling environments. The use of 3D technology has come a long way from its initial introduction in the late 1980s by way of AutoCAD. This period saw a substantial shift in the usage of computer-aided design (CAD) tools, which were integrated into different professions in the country, including architecture, engineering, and construction. AutoCAD's debut and popularity in the Philippines matched its global spread and the broader drive towards digital design and drawing technology at that time (Scan2CAD, n.d.; Between the Lines, n.d.).

The early 2000s marked the shift of 3D technology from design to animation. The founding of the Animation Council of the Philippines, Inc. (ACPI) played a role in boosting the local animation industry by promoting and supporting 2D and 3D animation services (Animation Council of the Philippines, n.d.). In 2010, "RPG Metanoia," the first full-length 3D animated film produced in the Philippines, was released and showed the potential of Filipino 3D animators (CIIT, n.d.). Local academic institutions like the De La Salle-College of St. Benilde and the CIIT College of Arts & Technology started offering specialised courses in 3D animation, further supporting the growing pool of aspiring 3D animators (The Guidon, 2022). The use of GenAI in 3D content development has been relegated mostly to conceptual and iterative phases of the pipeline, with 3D artists drawing inspiration from that output and modelling, rigging, and animating the assets themselves. In terms of using GenAI in the actual animation process, there is little adoption or integration from local 3D practitioners.

This section presents two case studies that reflect an intersection between creativity and technology, resulting in an innovation in the use of 3D animation in content development. The researchers feel that these case studies capture the latest shift in 3D technology use in content development in the Philippine context.

Artist-led innovation: Miming and Friends

Miming & Friends is a 3D edutainment web series for preschoolers created by the husband-and-wife team, Ramon Del Prado and Meryll Yan. They each have over 20 years of experience in the creative industries, with Ramon being a multi-disciplinary artist and Meryll on the business side of the creative industries. Ramon serves as the lead artist & animator of the show, while Meryll serves as the executive producer. Both of them write the scripts and voice the different characters.

The series is a cross-cultural show for co-viewers that teaches its audience how to be better people, how to care for our environment, and introduces Filipino culture. It has been part of the official selection for Animahenasyon Philippines 2021 and Cinema Rehiyon 2021 and was a finalist at the Kre8tif Animation Pitch in Malaysia in 2021 and the ATF Animation Pitch in Singapore in 2022 (MAF Presentation Deck, 2024).

The show itself is an innovation in local original animated content. Ramon birthed Miming and Friends during the pandemic. It is intentionally designed to be a tool for parents and guardians to entertain and educate children. The content is firm in its Filipino roots, but has global reach (Manila Bulletin, 2021). The first episode was released on YouTube in August 2020. Twenty seven episodes later, the show has been featured in numerous local broadsheets and has even partnered with local and international brands and not-for-profit organisations.

The dialogue in the episodes is a mixture of English, Tagalog, and Bisaya. Ramon and Meryll want to normalise children hearing different languages, because Filipinos are usually taught to speak straight English or straight Tagalog. When a regional language, such as Bisaya, is encountered, it creates this false sense of regionalism that has long divided generations of Filipinos. By making the dialogue of the characters a mix of the three most spoken languages in the country, it opens up the child to appreciate and respect the different pronunciations and tonalities found in the different regions.



Ramon in his studio. Photo provided by Ramon Del Prado

Ramon mentioned that one of the things he would love to see is that Miming and Friends collaborate with other children's characters and shows from around ASEAN and the world, opening up different cultures, languages, and locations to those who watch the show. He would want to show that, though there are differences, there are more similarities between us. There are more things that we can love than hate.

Impressively, Ramon does the entire animation pipeline for Miming and Friends. He and Meryll write the script for the episode, and Ramon does the storyboards. He then does the modelling, sculpting, and rigging of the characters. He does the animation sequences, directs the animation, and renders the episode. He does this by fully optimising a mid-tier gaming laptop. As for his software, Ramon is a firm champion of open-source software. He uses Blender and optimises his relatively modest hardware setup in his home studio. His love for open-source software came about when he was teaching animation in a public school that had very low-spec computers, and students could not afford to buy their own laptops. He needed to find animation software that was light enough to work on old computers, but decent enough to do basic animation and 3D art.

When asked if he uses GenAI in Miming and Friends, he says no. He does use GenAI for fast conceiving for his clients. "In commercial work, clients don't care how it is done as long as it is done fast... I just use it as a part of the process for ideation and iteration," shares Ramon. At the end of the day, his love for animation was born out of watching cartoons growing up and doodling them on paper.

He loves the process of animation and how it adds an extra level to storytelling.

He does note that 3D animation is not as popular in the Philippines as in neighbouring countries like Malaysia and Vietnam. Cost is a major hindrance to those who want to get into 3D animation. Even with open-source software accessible, the cost of even a mid-range gaming machine is pricey.

Another insight he shared was that most Filipino 3D animators only like doing the fun stuff, like modelling and conceiving, and do not really study the rest of the pipeline, like rigging, retopology, and the actual animation. Ramon mentioned that this is not only apparent in the Philippines, but also across the globe, causing a big demand for riggers and animators. Lastly, the Philippines is behind its ASEAN brethren when it comes to grants and support from the government.

Being based outside of Metro Manila, Ramon has had very little engagement in terms of funding support that can allow him to focus on working on the show without having to take on clients or other work. He mentioned that there might be more opportunities in Manila, but out on the island of Dumageute, in the Visayan region, those are too few and too far in between, if any.

Industry-led case study: Robosheep Studios

The intersection of different creative technologies has opened up new possibilities for content creation, from feature films to news broadcasts and even advertising.

Robosheep Studios is a pioneering film, video, and VFX company in the studio that enables on-set virtual production and real-time rendering technology through the use of real-time 3D technologies. They are the first LED enabled virtual production stage in the Philippines, allowing 3D assets across gaming, animation, and interactive media to integrate into the film and video pipeline as a live, interactive element (RS Virtual Studio Primer, 2024). This allows complex, 3D environments to be a live part of filming, allowing the camera to track the actors against a 3D environment model, similar to the technology used in Disney's *The Mandalorian* and Matt Reeve's *"The Batman"*.

The concept of real-time production is something very new. It debuted during the *Mandalorian's* first season, when the show started filming in October 2021. The pandemic increased the demand for such technology in the creative industry. The team that brought Robosheep to life are established professionals in film, TV, print, and live event production, each with at least over a decade of experience in the creative industry. Wesley Villarica, Paolo Jaminola, Micah Fernandez, Chase Hui, and Jaime Godinez came together during the pandemic, circa 2022, to see how their respective companies could pivot together to address the restrictions and technological requirements that have now come into place for film, TV, and live events. The researchers sat down with Micah Fernandez for this research. Micah is a director, writer, producer, and creative IP developer with over 15 years in the creative industry.

It is important to note that for a film industry that is very traditional and technologically conservative in terms of business, Robosheep made a very bold and risky move. They saw the new technology needed to create and tell stories and endeavoured to make it accessible to Philippine creatives. It is something that a lot of businessmen found interesting but felt was too much of a risk. Since opening, they have done virtual stages for music videos, advertising, and promotional content. Their most recent notable achievement was their international co-production with Viva Films, Will Studios, Parallax Studios, & Ovation Productions on the PH-Korean starred movie *"The Guardian"* (Manila Bulletin, 2024).



Aside from being a studio, Robosheep also has an educational arm, where they offer training in Unreal Engine. Micah notes that there is a big need for Unreal Engine trained animators and pipeline developers, not just in the Philippines but globally. Training and expertise are one of the challenges he sees as the region starts to produce more virtual production and real-time studios. "At the moment, all of that knowledge and practical wisdom is really outside the Philippines. Either we are able to send people out to learn best practices or bring those experts in so we can have a baseline of excellence," says Micah.

Another hurdle he mentions is that locally, there is very little awareness of what is possible with this technology because of how rapid the changes are. He says, "I think that we're still really just dipping our toes in this new era as a country. There is not a lot of awareness. Creatives, technologists, or anyone who has [an] interest in media are aware of the techniques and tech[nology] out there, but from my personal interactions with people who have tried, it feels like [its] such a big leap forward. In the sense that there is a lot to learn, a lot to discover, and since we are really marrying [a] certain level of sophistication of tech to creative fields, that hasn't quite been our strength as a country."

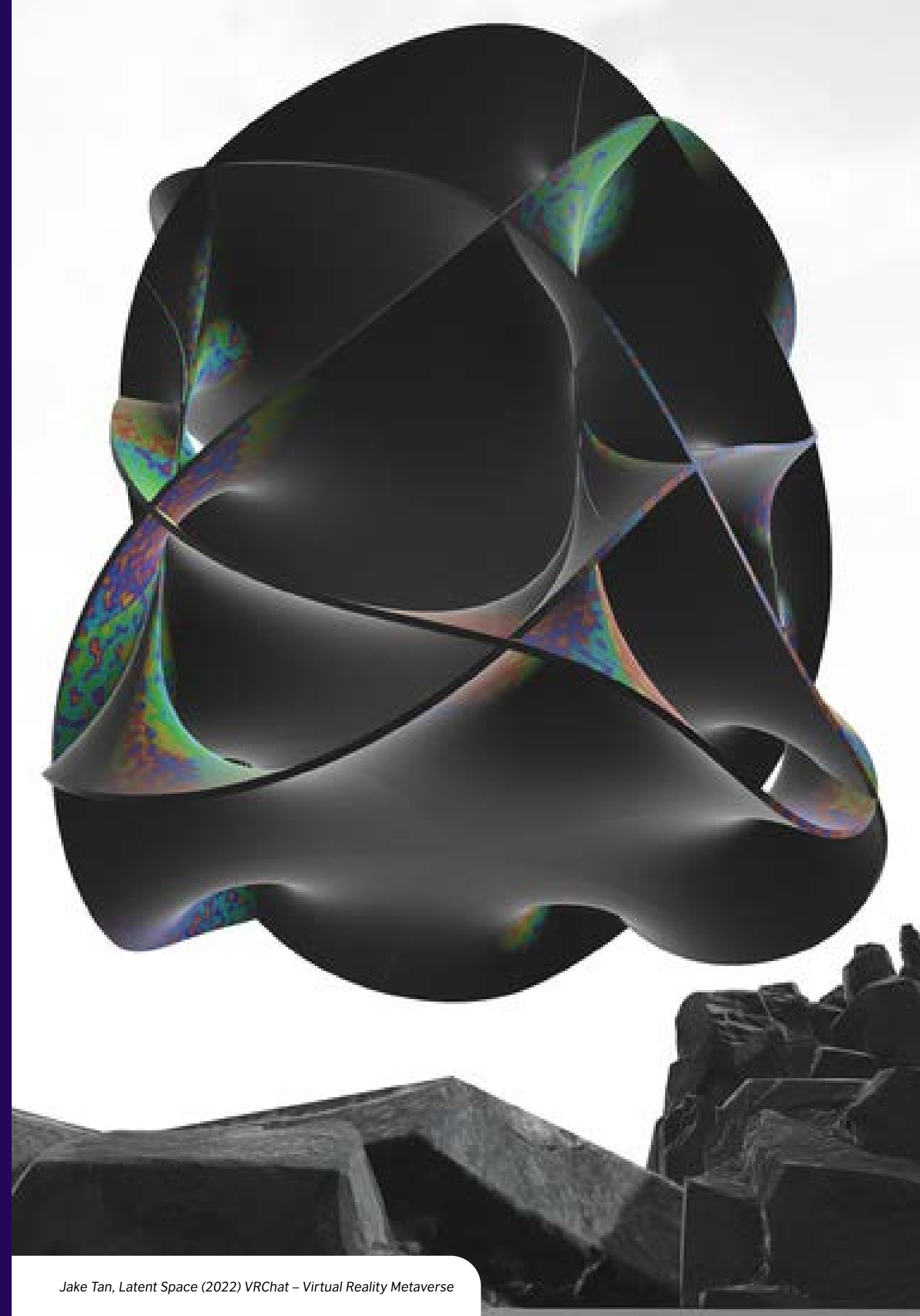
But he closes with the hope that the education hurdle will be addressed sooner rather than later since there is a push from the Department of Communication and Information Technology to make education and training for real-time technology accessible. However, there aren't any known active funding programmes that are specific to virtual-production or real-time as of the time of this writing.

Micah Fernandez, co-founder of Robosheep. Photo provided by Micah Fernandez

Singapore

Key findings

The arts and technologies ecosystem in Singapore consists of several important elements. Other than policies and infrastructures, which could be considered as one of the most developed in the region, several other distinctive ecosystem elements need to be paid attention. In Singapore, many critical stakeholders in the art and creative space are not easily identifiable as they might be several people working at the backend. Besides, the critical players are often the intermediary companies. Intermediary companies are cross-platform companies, such as gaming engine, design companies which could help create interactive art exhibitions. The other stakeholders that are sometimes perceived to be important is the government. However, the government role was perceived differently between the players vs the policy makers. The creative players think that government role is actually not major rather than their power to provide funding and incentives. Policy makers agreed that Singaporean governments have invested quite a lot of fundings.



Country profile

Singapore has a vibrant and flourishing creative economy which includes sectors such as the arts and culture, media, and design. Singapore's creative industries contribute about 1.9% of nations GDP and employ 2.2% of total workforce (Ooi, n.d), which are relatively small compared to its trade and financial industries. However, the creative industries in Singapore are intricately linked with technological advancements. Singapore has the highest digital literacy index leaving other countries in ASEAN, and maintains its top spot for digital inclusiveness among 82 countries around the world based on Roland Bergers' Digital Inclusion Index 2020 (Kusumastuti & Nuryani, 2020; Businesstimes, 2021). It enables high technology penetration, acceptance, and adoption of creative technology in the country. The creative arts industry is equally impacted by the transformative power of technology, especially artificial intelligence (AI) and digital breakthroughs. Numerous projects fuse computational design, data visualisation, and GenAI, as well as the adoption of virtual and augmented reality for immersive experiences in fashion, film, animation, and performing arts (Ocampo, 2023). One breakthrough example is the Digital Art Showcase in the Art Science Museum, dedicated to immersive art experience that combines art, science, culture, and technology into one place.

As of June 2023, the population of Singapore stands at 5,917,600 people. Domestically, Singapore is confronted by the increasing burden of ageing and slowing population growth (Bhaskaran, 2018). Singapore is a multiracial, multiethnic, and multicultural Asian society. Although Malays are recognised as the indigenous community, 75.9% of the citizens and permanent resident visa holders are ethnic Chinese, with ethnic Malay and Indians comprising 15.0% and 7.5% respectively. The heterogeneity of the population contributes to the richness of cultures and knowledge exchange among its citizens, even though in terms of the domestic market it is quite limited due to the small number of population in an island. Therefore, digital advancement has become one of the important components of creative technology in Singapore and a crucial part in increasing its scalability to reach larger markets across countries.

Singapore's GDP is one of the highest in Southeast Asia, ranked 32nd (in 2024) and GDP growth was increased by 2.1% in 2024 (IMF, 2024). Per capita income in 2022 reached USD 88,447 and it has the highest per-capita GDP in the world in terms of purchasing power parity (PPP). Singapore's economy has been consistently ranked as the most open in the world and the most pro-business, one of them is due to low tax-rates (WEF, 2012). These macroeconomic situations become a catalyst for technology investments on creative technology. This also explains why Singapore became one of the frontiers in creative technology in Southeast Asia. Further, 75.2% of GDP came from the services sector, 24.8% from industry and only 0.5% from agriculture sectors. It undoubtedly creates Singapore as one of the most important business hubs in Southeast Asia.

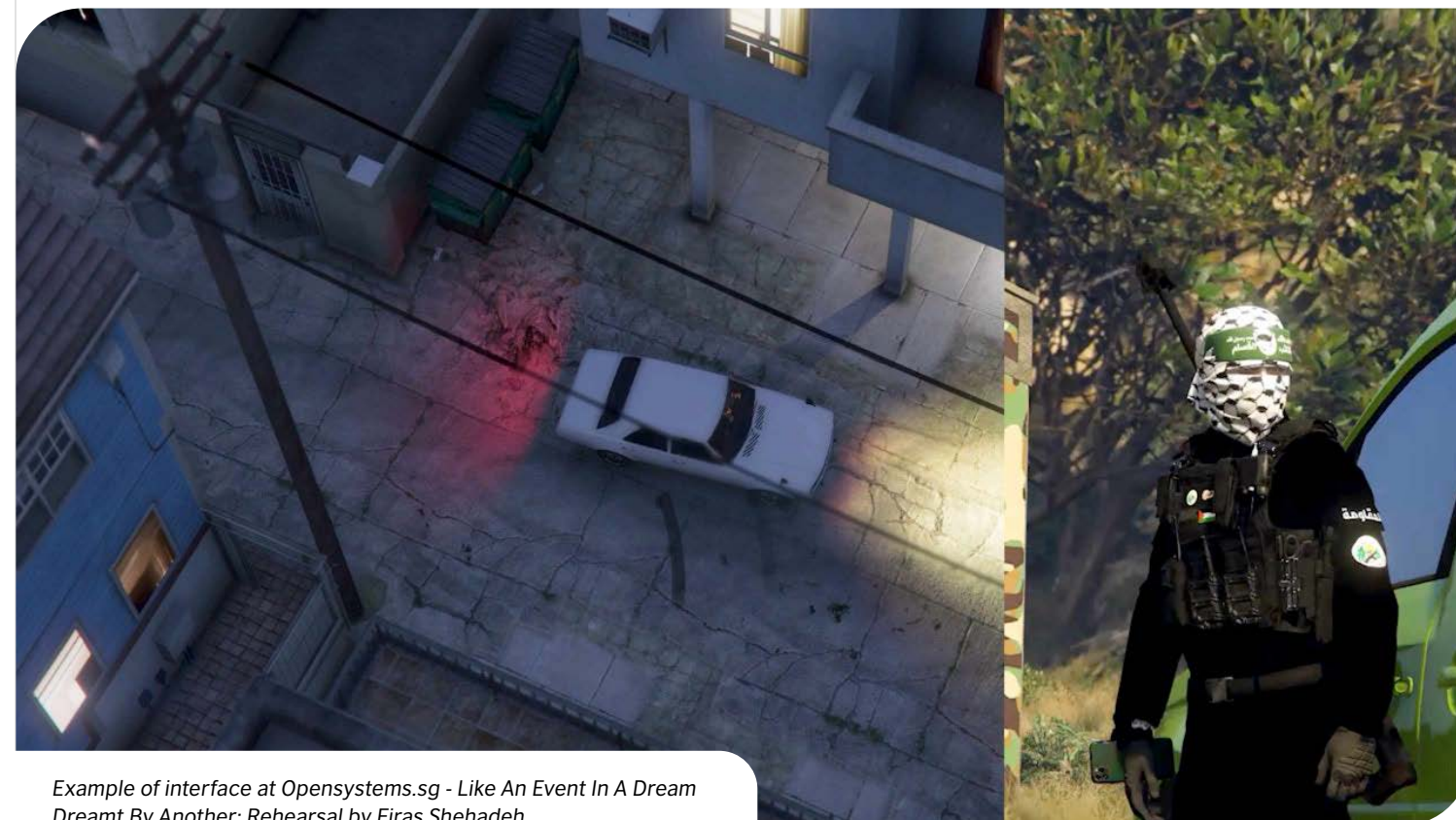
Compared to other countries in ASEAN, Singapore could be considered as one of the more mature countries in terms of providing funding and regulatory framework for creative technology. However, it does not automatically leave Singapore with no issues. Two big concerns have become a double edge sword in Singapore's creative technology sector: (1) human capital and leadership in creative tech and (2) the scalability of projects. With the massive development of creative technology, Singapore also attracts and demands skilled professionals, especially on immersive technologies and AI. On the other hand, there is a lack of local talent in the creative and arts sector, with many Singaporeans opting for careers in STEM and business fields (Singh, 2013). To attract top tech talent, the country also needs to actively strengthen their creative ecosystem, nurturing local talent into the leadership pathway of key sectors in media, museums, art councils and funding agencies. Another issue is, despite government funding, creative technology projects are seeking to become more commercially scalable. Limited resources and the need for additional support beyond financial aid effectively present significant hurdles that need to be addressed. Scalability should be also seen from the perspective of the market, not only the domestic market but also the cross-country and global market landscape.

Intersections in new media and the metaverse

The case study for Singapore focuses on the intersection between new media and the metaverse. The metaverse is defined as a digital ecosystem built on various kinds of virtual 3D technology, real-time collaboration software. It enables users to make social interactions in the digital world. In Singapore, creative technology applications were more technology-driven towards creative arts. Most of the creative arts comes from the experimentation of technology use, for example creating visual arts through generative adversarial network (GAN). It happens naturally considering that Singapore is one of the Southeast Asian countries at the frontier of technological advancement. Thus, its creative technology ecosystem is also inspired by

multidisciplinary collaboration across biology, architecture, and visual design thus creating biophilic design.

There is also strong innovation in how artists, galleries and museums are utilising the metaverse to showcase work locally and overseas. For example, audiences around the world can access opensystems.sg and interact with artworks featuring artists from different countries without having to worry about physical boundaries and limitations (Singapore Art Museum, 2023). Opensystems.sg owned by Singapore Art Museum organises online exhibitions focused on creative code, software, and digital video. The metaverse provides a platform for creators, commentators, critics, galleries and collectors to transcend and create immersive experiences. It also attracts a lot of new media artists to contribute to this platform.



Example of interface at Opensystems.sg - Like An Event In A Dream
Dreamt By Another: Rehearsal by Firas Shehadeh

Policy and intellectual property overview

Singapore is one of the countries in Southeast Asia which has established a well-designed policy for stimulating creative technology sectors. Since 2002, Singapore has launched a national policy called the Creative Industries Development Strategy that outlined a comprehensive 10-year plan spearheaded by the then Ministry of Information, Communication and the Arts (MITA) to posit Singapore as a “New Asia Creative Hub” by the year 2012 (Manan, 2019). It includes educational initiatives to connect local universities with world leading creative institutions like the Royal College of Art London and the MIT MediaLab, financial initiatives by introducing tax incentives and funds

for creative content development, and the establishment of the Design Singapore Council. Following this, the policy calls for collective efforts with other government agencies like the Singapore Tourism Board (STB), the National Arts Council (NAC), the Singapore Broadcasting Authority (SBA), the Singapore Sports Council (SSC) and the International Enterprise Singapore (IE) ensure that the creative industries strategy can generate economic spin-offs for tourism, local media, sport industry and international export. The key policies impacting creative technology in Singapore lies in the area of intellectual property, macro and umbrella masterplan of innovation, consumer and data protection, as well as funding and infrastructure.

Theme	Singapore government policy
<p>Policy on culture</p>	<p>National Arts Council (NAC) Grants</p> <p>National Arts Council (NAC) provides various grants aimed at supporting the arts sector, including those integrating technology into creative practices. These policies collectively support the development of the creative and technology sectors in Singapore by ensuring data protection, enhancing cybersecurity, fostering innovation, and providing financial incentives. These grants help artists and organisations develop innovative projects, thus promoting the fusion of arts and technology and enhancing the sector's dynamism. The National Arts Council (NAC) provides a sustainable funding infrastructure through grants and arts housing support for the arts community. The grant support for artists and arts organisations covers these broad areas of:</p> <ol style="list-style-type: none"> 1. Supporting organisational development of professional and strategic arts organisations that contribute to our arts and culture landscape 2. Producing or presenting art and/or encouraging Singaporeans' participation in the arts 3. Building audiences, patrons and supporters to complement artistic efforts at home and abroad 4. Training, research and development of artists across various fields <p>Consequently, the artists can also utilise these grants to fund their creative tech projects which are quite costly to some extent.</p>

Creative Industries Development Strategy

Since 2002, Singapore has launched a national policy called the Creative Industries Development Strategy that outlined a comprehensive 10-year plan spearheaded by the then Ministry of Information, Communication and the Arts (MITA) to posit Singapore as a “New Asia Creative Hub” by the year 2012 (Manan, 2019). It includes educational initiatives to connect local universities with world leading creative institutions like the Royal College of Art London and the MIT MediaLab, financial initiatives by introducing tax incentives and funds for creative content development, and the establishment of the Design Singapore Council. Following this, the policy calls for collective efforts with other government agencies like the Singapore Tourism Board (STB), the National Arts Council (NAC), the Singapore Broadcasting Authority (SBA), the Singapore Sports Council (SSC) and the International Enterprise Singapore (IE) ensure that the creative industries strategy can generate economic spin-offs for tourism, local media, sport industry and international export. Twenty years then, several upcoming policies listed in. The key policies impacting creative technology in Singapore lies in the area of intellectual property, macro and umbrella masterplan of innovations, consumer and data protections, as well as funding and infrastructures.

Design 2025 Masterplan (DesignSingapore Council, 2016)

Developed by Design Singapore Council, this master plan outlines strategies to make Singapore an innovation-driven economy and a loveable city through design. It emphasises integrating design into business strategies, fostering design innovation, and developing a skilled design workforce. This policy supports the creative sector by promoting design thinking and innovation, crucial for developing cutting-edge tech solutions and creative content. Even though this masterplan was specifically created for design, it also highlights the importance of technology-driven design such as considering the advancement of internet of things (IoT) in the design and technology utilisation for better functionality.

IP Protection

Intellectual Property Hub Master Plan (Ministry of Law Singapore, 2013)

This plan released in 2013 aimed to develop Singapore as a global IP hub in Asia. It includes measures to enhance IP registration processes, strengthen IP protection, and foster IP transactions and management. For the creative technology sector, robust IP protection is crucial for encouraging innovation and creativity. This policy helps ensure that creators and tech developers can safeguard their inventions and creative works, providing a secure environment for innovation.

Technology Infrastructure

Personal Data Protection Act (Singapore Statutes Online, 2012)

The Personal Data Protection Act (PDPA) provides a baseline standard of protection for personal data in Singapore. Even though it applies into general business applications, it greatly affects the arts and creative technology ecosystem. Enacted in 2012 (with several amendments over time from 2013, 2014, 2020, and latest at 2021), it positively affects both creators and customers. For creators, it requires companies to implement strict data protection measures, impacting how creative tech companies handle user data. Compliance ensures trust and credibility but also imposes additional operational responsibilities. Meanwhile for customers, the implications protect customer data privacy, ensuring that personal information is handled with care and security, which is crucial in building trust in digital platforms and services.

Data Protection Trustmark (DPTM) Certification

Launched in 2019, it encourages companies to adopt sound data protection practices through a voluntary certification scheme. Achieving Data Protection Trustmark (DPTM) certification can enhance a company's reputation and provide a competitive advantage. Meanwhile it also provides assurance that certified organisations have robust data protection policies, giving customers confidence in how their personal data is managed.

DPTM increases trustworthiness in the AI and advanced technology era especially nowadays where customers are involved with digital platforms to access creative works, such as through metaverses, digital music platforms, virtual exhibitions, etc. With a strong DPTM certification, it provides a guarantee for the customers and thus increases the adoptions of the creative tech use massively.

Gender issues

Gender parity in Singapore's tech industry is moving towards balanced directions. In 2020, women comprised 32.4% of STEM graduates in Singapore, while they make up 41% of the tech workforce (Nur, 2023). This indicates a higher proportion of women in STEM fields compared to the global average of 28%. To promote further female contribution to the tech industry, The Singapore Computer Society (SCS) launched the SG100 WIT list to recognize and celebrate women who have made significant contributions to the field. This initiative aims to raise awareness about the importance of women in tech and drive the conversation around gender equality.

Singapore-UK collaboration

Bilateral agreement between the UK and Singapore is one of the strongest in the region. The UK and Singapore ever signed a UK-Singapore Digital Economy Agreement (UKSDEA) building on the UK-Singapore Free Trade Agreement (FTA) signed in 2020. UKSDEA is Singapore's third DEA and entered into force on 14 June 2022 following the UK and Singapore's completion of their respective domestic ratification processes. The UKSDEA includes binding disciplines on cornerstones of the digital economy. Specifically on the creative technology sector, special sections on the cooperative elements including Artificial Intelligence. It discusses protection of algorithms and source code, cryptography, AI and emerging technologies.

Case study: New media and the metaverse

Jake Tan and Serial co started his work eight years ago since augmented reality being the hottest thing. He built the entire company around creating augmented reality and cross-reality experiences, then moved into virtual production. Currently, Serial Co focuses on immersive experiences and creating digital sensors. These sensors are physical in nature but translate data into a digital setting, allowing artists to create digital media sculptures. Serial Co is also slowly moving to AI, however it seems that AI is becoming a big leap and not in the market yet for creative technology. Jake mentions: "We can talk about AI—corporations are still very afraid of pursuing it. That's what we've noticed in Singapore. We developed these projects thinking AI is hot and everyone would want to jump on the bandwagon. However, Singaporeans seem to have a "wait and see" approach to things. We've seen some really cool AI campaigns in America and Europe, but we haven't seen any that have taken Asia, especially Singapore, by storm. I really don't think there are any AI campaigns here at all"

The evolution of the intersection of arts and technology in Singapore can be traced through several key phases, each marked by distinct trends and technological advancements. Over the past eight years, this field has experienced significant shifts, beginning with the rise of augmented reality (AR). AR became a central focus for many creative technology companies, particularly influenced by the popularity of platforms like Instagram. However, as social media trends evolved, the prominence of AR shifted towards other applications such as TikTok.

Following the AR wave, virtual production gained traction, largely inspired by high-profile projects like "The Mandalorian". The Mandalorian, Disney's smash Star Wars show, exhibits the beauty of virtual production that rely on real-time graphics, just like metaverse. This period saw a surge in interest in creating immersive and cross-reality experiences,

driving innovation in digital media and interactive installations. Concurrently, the blockchain technology boom brought about a brief but intense focus on decentralised applications and NFTs. Despite its potential, the blockchain hype did not sustain, leading to a pivot towards more stable and scalable technologies.

As the global focus shifted towards artificial intelligence (AI), Singapore's creative technology ecosystem also began exploring AI's potential. Companies started developing AI tools for various applications, from augmented reality agents to digital sensors. However, the adoption of AI faced significant hurdles, with local agencies exhibiting a cautious approach. Despite active government promotion, AI campaigns in Singapore remained scarce, contrasting with the more adventurous implementations seen in America and Europe.

The evolution of creative technology in Singapore has also been influenced by broader technological trends. Artists often struggle with the steep learning curves associated with new technologies, such as transitioning from blockchain to AI. Additionally, there is a persistent need to shift cultural perceptions of art from mere aesthetics to a deeper appreciation of its complexities and functionalities.

Metaverse and immersive art: Serial Co

Metaverse has been adopted quite massively in different sectors. Several examples of companies in Singapore who have utilised it are: UOB SkyArtVerse, Changi Verse, OCBC Metaverse, Xctualyfe's NDP World. One of the examples is providing virtual consultations with financial advisors, allowing customers to explore different investment options in a simulated environment. The fast adoptions of it show how Metaverse are widely accepted into Singapore markets and its intersections with art creates high tractions.

Most metaverse in creative art in Singapore started from galleries. In May 2023, Singapore Art Museum started their online exhibition utilising Metaverse.

Local companies are also actively exploring the utilisation of this digital space for their brands, including gaming, finance, and even retail. We took the case studies of Serial Communication, founded by Jake Tan (New Media Artist, Adjunct Lecturer at Nanyang Technological University, and Co-Founder of Serial Co). Serial Co is a creative technology studio based in Singapore that blends the digital and the analogue to curate immersive experiences.

Serial Co is an inter-media, polymorphous studio that blends the digital and the analogue. The space was launched together with a physical exhibition where people can get on the metaverse via VR headsets and send themselves into the virtual world.

Singapore is one of the countries in Southeast Asia which experienced the dynamics of creative

technologies in Singapore, how fast paced it is in the country and how it impacts business. Jake Tan in the interview mentioned, “we started from augmented reality being the hottest thing till now, it has probably shifted to TikTok or something else. Previously, Instagram AR was very hot. We essentially built our entire company around creating augmented reality and cross-reality experiences. Then we moved into virtual production, which became really hot because of *The Mandalorian*. At the same time, Blockchain was becoming a big thing and then not being a big thing. Now, we’re focusing on immersive experiences, building IP, and creating digital sensors and things like that. These sensors are physical in nature but translate data into a digital setting, allowing us to create digital media sculptures. These are the areas we’re exploring.”

The intersection of arts and technology in Singapore is marked by a collaborative ecosystem where contributions from diverse fields such as engineering, biology, and visual arts are highly valued. This collaborative approach fosters innovative projects and interdisciplinary engagement, creating a space where creative technology can truly thrive. As Jake Tan aptly describes, the community operates like a DAO system (i.e. decentralised autonomous organisation or bottom-up entity structure with no central authority), emphasising intersectionality and welcoming engineers and scientists who wish to explore creative applications alongside artists. This synergy allows for a rich exchange of ideas and practices, feeding back into visual arts and pushing the boundaries of traditional creative processes.

Educational institutions in Singapore play a pivotal role in integrating technology into their curricula to prepare students for industry demands. Programmes such as the Computation and Design component at LASALLE College of the Arts, spearheaded by Andreas Schlegel, cover areas like creative coding, physical computing, projection mapping, AI, and AR. These initiatives aim to bridge traditional design practices with new technological concepts, ensuring that students are well-equipped to engage with contemporary creative technology. This educational integration is crucial in cultivating the next generation of artists and designers who can navigate and innovate within this evolving ecosystem.

Technology is more than just a tool for arts

In terms of technological and creative innovations, Singapore experienced an increasingly important aspect to see technology as more than just a tool for creative expressions. From a technology expert point of view, Clement Zheng views technology not merely as a tool but as a material akin to clay. This perspective fosters collaboration with technology, allowing for creativity within its constraints. He draws a parallel to the craft of ceramics, where understanding and respecting the material can lead to unexpected and beautiful outcomes. Zheng

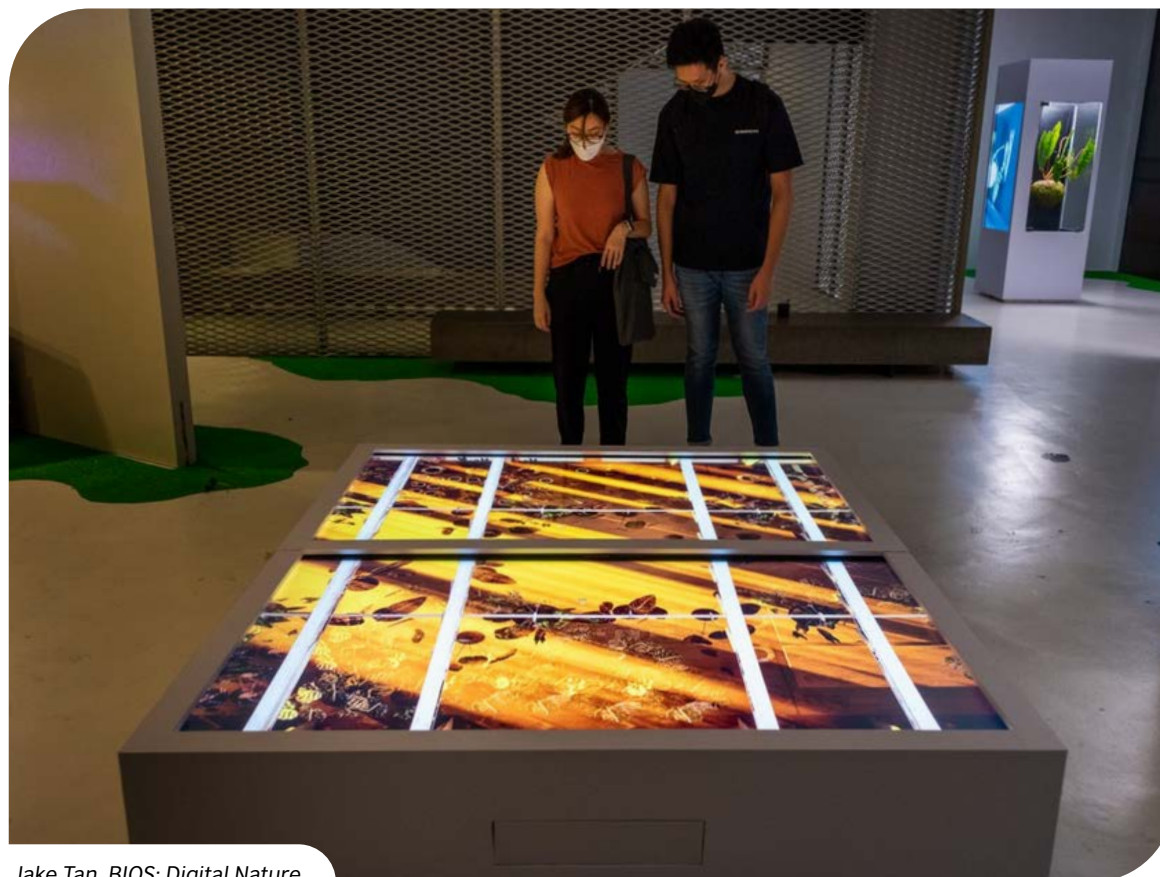
mentioned: “I have two technologies that come to mind, and I wouldn’t even say they are emerging because many artists are already using them. However, they are not as commonplace as traditional methods like oil on canvas. One technology that I think will have a huge impact on art is robotics. Robotics can affect art in many different ways. First, if you think about robotics as fabrication tools or machines, they can augment or even replace the human hand at times. A 3D printer is a type of robot that can produce three-dimensional forms in various materials. While many people use 3D printers to create objects out of cheap plastic for prototyping or hobbies, advanced 3D printing involves materials like biological materials, ceramics, and concrete. Printing human organs or other bio-materials, for instance, has significant implications for critical art-making practices.”

Challenges and look ahead

The cultural and economic impacts of integrating arts and technology in Singapore illustrate the challenges and opportunities in redefining art, engaging audiences, and leveraging institutional support to foster a vibrant and innovative arts scene.

At the heart of this evolution is the drive to create a sustainable business model that supports both local and global talents in the arts. The traditional ecosystem of galleries and museums, funded by donors and private collectors, is being reimaged for digital art, where artists can market their works directly, bypassing the traditional middleman. This shift raises questions about the role of galleries in the digital age and how they fit into this new model. Artists and creative technologists in Singapore are navigating this transition, aiming to balance artistic integrity with financial sustainability.

Jake Tan discusses the evolving ecosystem of digital art and its economic implications. He highlights the shift from traditional gallery-centric models to self-marketing by artists, questioning the future role of galleries. He emphasises the importance of audience development in Singapore, aiming to elevate local appreciation for both traditional and



Jake Tan, *BIOS: Digital Nature*

digital arts. This is crucial in a culture that heavily relies on imports, underscoring the need to foster a deeper local engagement with the arts.

Andreas Schlegel, Senior Lecturer and Head of Media Lab at LASALLE College of Arts, highlighted the role of major institutions like the ArtScience Museum and the Singapore Art Museum in promoting the integration of art and technology. He notes how exhibitions like TeamLab's 'Future World' help inspire young artists and broaden public acceptance. These institutions play a crucial role in expanding the cultural understanding of art, incorporating technological elements and moving beyond traditional mediums.

The set of challenges and opportunities in the intersection of arts and technology in Singapore highlights the need for adaptability, collaboration, and a willingness to embrace new technologies while addressing the associated risks and ethical considerations.

AI integration is a prominent feature in this ecosystem. Utilising tools like the OpenAI pipeline and exploring Meta's LLaMA models, artists and technologists in Singapore incorporate AI into various aspects of their work. From generating social media content to automating administrative tasks, AI serves as a facilitative tool rather than a replacement for human creativity. The potential of AI to enhance artistic processes is widely recognized, yet its role remains supportive, enabling artists to focus on higher-level creative tasks.

Challenges remain, particularly in the perception and ethical considerations of AI. While AI offers exciting possibilities, concerns about intellectual property, ethical usage, and the potential for AI-generated 'hallucinations' highlight the need for careful consideration and control. Artists are encouraged to critically engage with these technologies, using them to push ethical boundaries and provoke thought, thus contributing to broader conversations about AI and its impact on society.

Regarding this issue, Clement Zheng mentioned the importance of the traceability of artwork: "One challenge is related to AI. With computational technology, it's more difficult to trace, and with AI, it's even more complicated due to debates about

copyright and biases. In Singapore, we're grappling with the fact that AI models available for use are not trained on Southeast Asian data. To support art-making using technology, we need to develop local AI models that reflect our cultural origins, which requires a significant investment and collaboration across multiple countries. Developing these AI models is very expensive and involves complex policy considerations".

Clement Zheng highlights the complexities associated with integrating AI into the arts, particularly around issues of copyright and bias. He notes the challenge of developing AI models that are culturally relevant to Southeast Asia, which requires substantial investment and international collaboration. Despite these hurdles, Clement sees the potential for AI to support art-making if these local models can be developed, emphasising the need for policies that address these concerns. Further, he also challenges the definition of art and design within the context of creative technology. He underscores the fluidity of these definitions and the obstacles posed by strict categorisations. Clement's perspective reflects the complex interplay between different disciplines, suggesting that rigid definitions may hinder the support and development of innovative art forms.

AI could become a double-edged sword. From the perspective of Gallery Management, Bridget Tracy Tan (Director of Art Gallery at Nanyang Academy of Fine Arts) mentioned the importance of supporting artists and enhance their freedom of expression: "There's a fear that artists may lose control over their intellectual property due to AI advancements, like GenAI, adversarial networks, and variational autoencoders. While these technologies are supposed to aid the creative arts, they are sometimes seen as a threat. In the arts, if you give artists the opportunity and the necessary funding, they will surprise you. That's what we've been doing with the Institute of Southeast Asian Arts, partnering with artists from around the region. We reach out to regional artists who are ready to demonstrate their work with technology." She noted both the opportunities and threats posed by technologies like GenAI. As long as policy makers give artists a chance and funding to explore new technologies, the outcome could be unlimited.

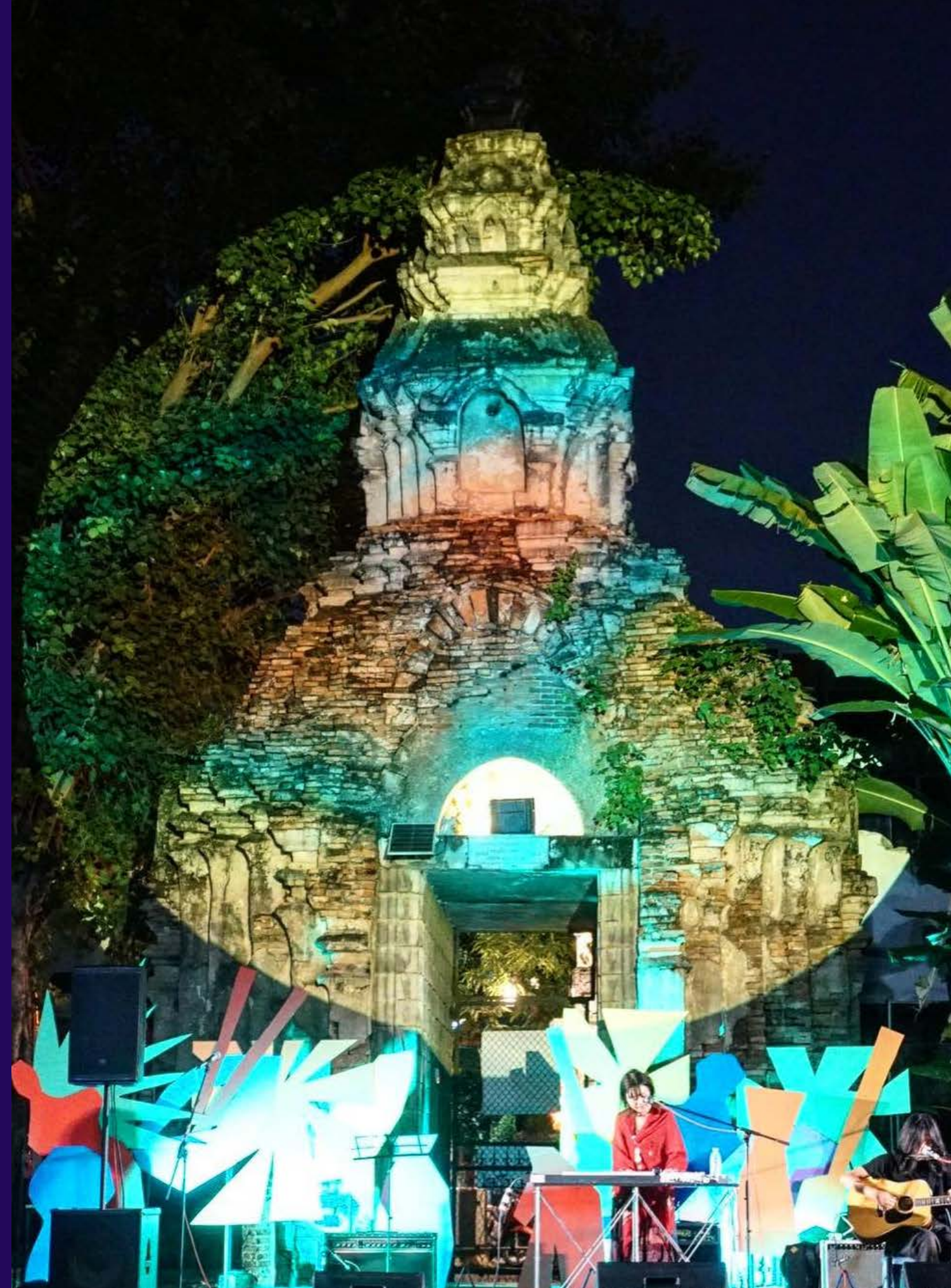


Thailand

Key findings

Thailand's integration of art, science, and technology holds an important role in critically challenging emerging life science applications, stimulating scientific thinking, and contributing to new research questions and new technologies. Artists like Henry Tan and Wave Pongruengkiat, in collaboration with scientists like Pakpoom Subsoontorn, are pushing the boundaries of traditional art forms by integrating technology, science, art, and community engagement.

Our interviews revealed that the intersection of bioart and technology has played a significant role in addressing social and environmental challenges in Thailand and enhancing local community involvement



Midnight Rice Fest, 24-25-26 November 2023, Wat Chomphu, Chiang Mai, @<https://rhiannonhopley.com/midnightrice-festival>

Country profile

Digital technology is changing Thai life. Creative industries, especially software, have more opportunities due to this phenomenon. The pandemic has accelerated digital platform and tool adoption, but not all industries have benefited. Production suffered in the entertainment industry during Covid-19 and had to find new revenue streams. Creatives in performing arts, film, and broadcasting had to adapt to this massive disruption, which brings opportunities and risks (Punpeng, 2021). The 2024 Bangkok Design Week sparked a heated controversy after an AI-created work was used by one of the participants to promote the event. The incident provoked debates around the authenticity of AI art versus the creativity of artists (Thaiger, 2024).

Demographics

The total population of Thailand was 66.05 million in 2023, with a median age of 41 years. Thailand's birth rate has been declining since 2013, "which could negatively impact the country's economy in the near future." (Anamwathana, 2024). In April 2024, the total labour force was 39.79 million, with the majority of the workforce under 35 years of age. The minimum wage in Thailand is currently 330 baht or USD 10 per day (The Board of Investment of Thailand, 2024). Approximately 50% of Thailand's population lives in urban areas, having increased from 36% ten years ago. The main urban areas by population are Bangkok 5.47 million, Nakhon Ratchasima 2.63 million, and Chiang Mai 1.3 million.

Socio-economic perspective

"After decades of solid growth, Thailand is displaying all of the hallmarks of the middle-income trap, analysts say, where a combination of low productivity and poor education leaves much of the workforce stuck in low-paid, low-skilled work" (Aljazeera, 2024).

As the above quote indicates, the overall outlook for Thailand is challenging. The economy was hit badly by Covid-19 due to its strong economic reliance on international tourism and international trade, sectors which were both heavily impacted by the

pandemic. The economy is growing, but not as fast as its neighbours in Southeast Asia, and factors including the declining birth rate described above, along with inequality that affects the workforce and productivity, in addition to vulnerability to climate change, require significant policy action (Thailand Systematic Country Diagnostic Update 2024, World Bank, March 2024).

One way in which the Thai Government is tackling these issues is through economic policy. Since 1961, the Government has implemented a series of economic policies, with the most recent being "Thailand 4.0 (2017-2036)." The plan is a national strategy focused on transforming Thailand into a high-income, innovation-driven economy by fostering technology, creativity, and sustainability. It also promotes soft power through Thai culture, creative industries, and tourism to enhance the country's global influence and attract investment. It builds on the earlier economic development plans in agriculture (Thailand 1.0), light industry (Thailand 2.0), and heavy industry (Thailand 3.0) (Ibid).

The World Bank recommends, "that to become a more innovative and inclusive economy, Thailand must improve learning outcomes and close skills gaps by increasing education spending, optimising resource allocation, and aligning education with labour market needs. Thailand must also enhance tech competitiveness, strengthen competition regulations, attract skilled professionals, and empower small and medium-sized enterprises through increased access to finance for innovation."

Thailand's "soft power" is being utilised as a significant selling point by the government to revitalise the economy, promote meaningful travel, produce income for local communities, and improve the country's tourism industry to achieve sustainable and balanced growth. Thailand's tourism sector was contributing approximately 12% to GDP before being severely affected by the Covid-19 pandemic; Thailand lost 1.45 million tourism-related jobs in 2021, 400,000 of which were the first quarter. A December 2023 World Bank report noted that while tourism will be a major driver of economic growth, arrivals in 2024 were predicted to be just 90% of pre-pandemic levels in 2019 and overall growth for 2024 and 2025 was projected to be mild, at 3.1 and 3.2% (World Bank, 2023).

Connectivity

Thailand's internet landscape is characterised by a high penetration rate (88% at the start of 2024) and advanced infrastructure. "Data published in the ad planning tools of top social media platforms indicates that there were 49.00 million users aged 18 and above using social media in Thailand at the start of 2024, which was equivalent to 83.7 % of the total population aged 18 and above at that time." (Digital 2024: Thailand, Data Reportal, Feb 2024).

Thai network operator AIS (Advanced Info Service) has announced plans to develop and expand internet connectivity through its 5G smart network, aiming for comprehensive coverage - widest, farthest, highest, and deepest - in every area of the country. In this endeavour, AIS showcased its Sea Coverage initiative on the coastal areas of the Gulf of Thailand and the Andaman Sea (Telecomtalk, 2023).

Intersections in bioart and technology

This country report focuses on bioart and technology based on the work of FREAK Lab¹ or Futuristic Research on Enigmatic and Aesthetic Knowledge), particularly experimental work by FREAK Lab members, Henry Tan in Bangkok and Wave Pongruengkiat in Chiang Mai. FREAK Lab is an anti-disciplinary research cluster that converges arts, science, and technology for thinking beyond and exploring the symbiotic relationship between humans and the emerging technologies. Founded by a group of JSTP (Junior Science Talent Project)² alumni and mentors in 2017 inside King Mongkut's University of Technology Thonburi (KMUTT), FREAK Lab uses a variety of methods and mediums: prototypes, research, arts, and new media installation to reimagine the possibility of realities.



@Freak Lab website and social media

Policy and intellectual property overview

Theme	Thailand Government	Other Initiatives from the Government
Policy on Culture	The Thai national cultural policy was formulated and proclaimed in 1981 in accordance with the spirit of Article LXIV of the Constitution of the Royal Thai Kingdom B.E. 2521	<p>In 2000 a Ministry of Culture (MOC) was established. In 2018 Thailand established the Creative Economy Agency (CEA) with the mission to promote the Creative Economy</p> <p>In September 2023, Thailand established a National Soft Power Committee, which operates to implement the 'One Family, One Soft Power' policy that aims to upgrade the skills of 20 million Thais from 20 million families into high-skilled creative workers. One of its early actions was to establish the Thailand Creative Content Agency (THACCA) as a new organisation that encompasses all creative and cultural sectors, to strengthen the country's global competitiveness.</p>
IP Protection	The prevailing copyright legislation in Thailand is the Copyright Act B.E. 2537 (1994), implemented from March 1995. In August 2015, a new amendment was implemented aiming to modernise the legislation for the digital era. Another change came into effect in March 2019 to align with the Marrakesh Treaty. The purpose of this amendment was to grant exceptions to copyright infringement for those with disabilities.	Thailand is a member of the World Trade Organization (WTO) and World Intellectual Property Organization (WIPO). In 2022, the Customs Department launched the Thai Customs IPR Recordation System (TCIRs). The Department of Intellectual Property (DIP) has been developing its trademark system, leveraging artificial intelligence (AI) technology to assist in the Image Search system. This enhances service efficiency of the DIP and facilitates the public and entrepreneurs who wish to check/clear prior device marks before registering their marks.
Technology Policy	<p>13th National Economic and Social Development Plan (2023-2027) Milestone 6: "Thailand is ASEAN's hub for digital and smart electronics industry", with the strategies:</p> <ol style="list-style-type: none"> 1. Bringing forth Thailand's digitally driven society and economy 2. Further developing the existing electrical and electronics industry 	In 2004, the Thai government established a plan to stimulate economic activity in peripheral areas by combining the National Science, Technology and Innovation (STI) with local knowledge. Initially, there were three science parks in major universities (Prince of Songkla, Chiang Mai, and Khonkaen University) ⁸ , providing soft services to local firms. In 2011, the plan resumed with a large budget for new infrastructure, resulting in 16 science parks across Thailand.

<ol style="list-style-type: none"> 3. Advocating for the local digital industry with competitiveness 4. Creating an ecosystem to support the development of smart electronics and digital industry and services <p>National Science, Research and Innovation National Policy (2023-2027) by NXP (National Higher Education, Science, Research, and Innovation Policy Council).</p> <ol style="list-style-type: none"> 1. Developing the Thai economy through a value-based and creative economy to achieve sustainable competitiveness and self-reliance while preparing for the future by utilizing science, research, and innovation. 2. Elevating society and the environment for sustainable development to address challenges and adapt promptly to the dynamics of global change through science, research, and innovation. 3. Advancing cutting-edge science, technology, research, and innovation to create new opportunities and ensure the country's readiness for the future. 4. Developing human resources and institutions in science, technology, research, and innovation to serve as a foundation for leapfrogging economic and social development in a sustainable manner through science, research, and innovation 	<p>These science parks have significant opportunities to facilitate the collaboration of science, technology, and arts in local communities, but for now they are more as a start-up incubator, focused on science, technology, and agriculture.</p>
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⁸ Songkhla, Chiangmai and Khonkaen are the major secondary provinces in Thailand after the Bangkok metropolitan area. These provinces' function as regional hubs for transportation, education and business (Bangkok Post, 2020).

Cultural policy context

Today the Office of the National Economic and Social Development Council (NESDC) is responsible for national policy development and is one of the key actors, along with MOC and the Creative Economy Agency, at a strategic level in the development of the creative economy and the creative industries. At an operational level, in 2018 Thailand established the Creative Economy Agency (CEA) with the mission to promote the Creative Economy as the driving force to a balanced and sustainable economy. Thailand Creative Content Agency (THACCA), as a new organisation established by National Soft Power Committee, which operates to implement the 'One Family, One Soft Power' policy, organised "THACCA SPLASH - Soft Power Forum 2024," an international soft power forum to "showcase the power of culture, promoting Thailand on the global stage", from June 28-30 2024.

Thailand-UK collaboration

Thailand and the UK have recently declared an enhanced partnership in the fields of science, research, and innovation, aiming to create and disseminate sustainable scientific knowledge for future advantages. The International Science Partnerships Fund (ISPF) facilitates this initiative by providing support for research and innovation collaborations with Thailand. The ISPF cooperates with delivery partners in both the UK and Thailand (The Nation, 2024). The British Council is signing a memorandum of understanding with the Ministry of Culture in 2024.

Technology policy context

In its 13th National Economic and Social Development Plan (2023-2027), the National Economic and Social Development Council focuses on technology within Milestone 6: Thailand is ASEAN's Hub for Digital and Smart Electronics Industry. The policy articulates that, "A delay in overall digital development is a result of a low level of technological and innovation readiness and a lack of advanced digital skills among the Thai population, together with outdated laws and regulations which are uncondusive for foreign investment from global tech leaders as well as for startups". And within strategies for achieving Milestone 6 it references the arts sector: Sub-strategy 3.4 Promoting the development of e-commerce software and the creation of digital content that creatively incorporate Thai culture, lifestyles and tourist destinations etc. to generate economic value add in all aspects, such as virtual museums, virtual cultural performance stages, virtual concerts and virtual movie characters.

Gender & skills

The first large-scale assessment of adult skills in Thailand (ASAT) conducted in 2022, focused on six demographic groups to evaluate digital and other skills necessary for success in the labour market. The findings highlight shortfalls concentrated among individuals over 40, those lacking higher education, residents of rural areas, and inhabitants of the Northern and Southern regions of Thailand. The report identified four subgroups particularly lacking in skills, leading to suboptimal labour market outcomes: young women and men without tertiary education, and older women and men (World Bank, 2022).

Case study: Intersections in bioart and technology

Artist-led innovation - Bioart by Henry Tan and Wave Pongruengkiat

The term bioart describes artists who use biological materials in their practice. They use living plants and animals as a part of their expressions. In their practice, they also merge technologies that are of industry standard and used by scientists. Henry Tan's artistic practice encompasses the use of biological materials and living organisms. His practice in bio-art began in 2018 at BioArt Camp in Tokyo and continued in 2019 when he was invited to metaPhorest (biological art/ bioaesthetics platform) in Japan founded by Hideo Iwasaki. Henry explores how different technologies, such as EV batteries, solar cells, robotics, big data, AI, and biotech, influence life and society.

Henry observes that biotechnologies are becoming more accessible and affordable; technologies like lab-grown meat have evolved from requiring cow embryo serum to using synthesised alternatives, making them more cost-effective and sustainable. Henry views these changes positively, believing that they enhance quality of life and open up new possibilities for human longevity and well-being.

While neighbours like Singapore are supportive of innovation and provide funding for bioart, countries like Thailand and Indonesia are just starting to integrate these technologies into the arts. Henry emphasises the need for collaboration and knowledge in biotech, highlighting that today artists must navigate significant challenges to incorporate these technologies into their practice.

Henry uses diverse technologies in his projects; 'Dancing Brain' uses technologies like EEG (Electroencephalogram), used for sensing electrical activity in brainwaves. Henry uses consumer grade EEG devices which only let him see the frontal brain activity. However, it's still useful for him to detect different states of mind and corresponding brain activity. He examined themes of memory and dreams, exploring how simulations could evoke specific memories and trigger dreams. In his performance, he experimented with the concept of a "dream engineer"—an entity capable of shaping people's dreams. For instance, he considered whether the scent of a friend's childhood could prompt that friend to dream about past experiences, and questioned why such dreams occurred. Henry also explored the possibility of extracting and interpreting brainwaves to understand and perhaps influence dreams, delving into the complexities of human memory and perception.



Short Circuit Hamamatsu, Bangkok 2020 @whenryandpartners.com



Dancing Brain, 2022 @henryandpartners.com

'The Pillar of Creations,' blends ancient Hindu symbolism with cutting-edge science and technology, exploring modern biotechnologies such as genetic modification and DIY bioreactors to synthesise proteins and other substances. 'Lunartic Dream' simulates life on the moon by creating terrariums out of lunar soil replicas from a research lab and trying to propagate life forms on it. Henry used Augmented Reality (AR) and Virtual Reality (VR) to create immersive experiences where users can interact with terraforming—the process of modifying the environment of a planet or moon—in a simulated lunar environment (pressure and temperatures). The VR component allows participants to perform a gravity-defying dance inspired by the movements of microscopic organisms. The project, 'robotic chicken blanket', is a robotic mechanism designed to crawl up the user and hug the body as it detects the user's sleep rhythms. Robot chicken blanket is one project out of many Henry is currently working on with Wave Pongruengkiat from Chiang Mai.

Similar to Henry, Wave is involved in a multidisciplinary artistic practice that integrates technology, science, and community engagement. His work focuses on bioart, DIY electronics, and digital media. He explores how emerging technologies like DNA manipulation, brainwave analysis, and GenAI can be used creatively to push the boundaries of traditional art forms. Wave emphasises the importance of open-source tools and the DIY ethos, promoting accessibility and innovation in art. His projects often aim to reinterpret cultural practices, especially in conservative contexts, using technology to create new meanings and community engagement.

Wave collaborates with a diverse range of communities and institutions. He has connections with DIY and open-source communities, such as Hackteria, which focus on bioart and technology. He also works with universities, such as Chiang Mai University, to gain access to scientific resources and expertise. Wave is involved with local and international artists, including those in Thailand and from other regions. His collaborations often involve creating events and installations that combine traditional cultural elements with cutting-edge technology. For example, in his project with his science and art collective, tomorrow.lab, Midnight Rice Festival,⁹ Wave used video mapping and lighting for decorative purposes in traditional settings, temples. He emphasised the importance of reinterpreting cultural practices through technology to engage communities and reflect modern perspectives. Midnight Rice Festival has not gathered government support, but Wave is slowly trying to work with a larger community and bring in

more technology and science based art into the festival programme.

Henry and Wave both use AI in their practice. Henry uses it for customised coding and generating 3D models. Wave uses it for brainstorming and writing. For Wave, he feels that AI has become too humanised. The gap between machine and human is now blurred. Moreover, AI creates both advantages and problems. Scamming, hacking data and political propaganda using AI has become common in Thailand. In arts, Henry suggests artists to question what they can do more now that everyone can create images. In Wave's experience, AI art is more than just generating images. There have been AI art exhibitions in Thailand, which turn AI generated works into video or installation. The 'artists' genius' is still necessary in the process. The initial reactions to GenAI technologies like Chat GPT were of scepticism, but people have gradually recognised their usefulness. Henry and Wave want to continue bringing bioart to the public, embrace innovation and experimentation, and impact society through formal and informal relationships with scientific labs.

Broader technology initiatives - Biotechnology

Due to their heavily technology and science dependent projects, Henry and Wave collaborate frequently with experts in biotechnology, a diverse field which involves either working with living cells or using molecules derived from them for applications oriented toward human welfare using varied types of tools and technologies (Gupta, 2016).

One of their partners, Pakpoom Subsoontorn (Assistant Professor, Department of Biochemistry, Naresuan University), was trained in bioengineering, particularly in synthetic biology, which involves manipulating the DNA of living organisms to create new characteristics. His research extends from bacteria to plants and human cells, aiming to develop practical applications like biocontrol agents in agriculture or therapeutic molecules for diseases. He draws parallels between synthetic biology and

engineering, noting that both transform one-dimensional data into multidimensional phenomena, which can be inspirational for creating new mediums in art.

Together with Henry and Wave, Pakpoom has hosted bioart camps and residency programmes where artists are exposed to biotechnological tools like bacteria that produce colour or analyse molecules in perfumes. These events, held at his university, Naresuan University in Thailand, and in Singapore, serve as platforms for artists to learn about and apply scientific techniques in their work. Although no new technologies were developed during these short programmes, they facilitated the exploration of existing tools for artistic purposes. Pakpoom points out that artists' interpretations of scientific concepts can drive technological advancements by inspiring new directions for research and development.

In discussing the evolution of technology and its impact on the arts, Pakpoom envisions a future where biotechnology follows the path of information technology, becoming more accessible and less costly, allowing more artists and designers to engage with these tools, leading to broader creative possibilities and innovations. Biotechnology has traditionally been focused on medical applications, such as developing vaccines and antibiotics. Today, it is beginning to be used for creating molecules with unique tastes and smells, signalling a shift towards broader applications. He identifies artificial intelligence (AI) as another key area that will significantly impact the arts.

AI's ability to process vast amounts of data and generate new combinations is paralleled by biotechnology's potential to create diverse molecules that affect our senses. By manipulating sensory organs and understanding sensory information, these technologies will enhance how art interacts with and is appreciated by people. However, achieving a sustainable economic model that supports artistic endeavours remains a critical issue.

⁹ Midnight Rice Festival in Thailand is a traditional celebration that marks the end of the rice harvest. In Chiang Mai, the festival features rituals, cultural performances, and communal feasting, highlighting the agricultural and spiritual significance of rice. It brings communities together to celebrate their heritage while integrating modern elements like digital art to engage newer generations.



Lunartic Dream, 2022 JWD ART SPACE, Installation, Lunarium, Mycelium, Lunar rock, 8mins 2 channel Videos

Timor-Leste

Key findings

Timor-Leste's creative community is a strong independent movement that follows a DIY attitude (do it yourself), which has helped them overcome challenges through the years. There are promising signs of growth, such as successful ticketed festivals, indicating public support for local artists. The potential market for Timor-Leste's creative industries is substantial, especially in Portuguese-speaking countries, highlighting the need for investment and infrastructure. International collaborations introduce new technologies, while efforts to document and conserve traditional culture strengthen national identity.

Timor-Leste's music industry includes social media and digital platforms like YouTube, Spotify, and SoundCloud, which allow artists to share music and

connect globally. Virtual instruments and digital effects offer endless creative possibilities, enabling musicians to produce unique music efficiently and affordably. Streaming platforms expand distribution reach and revenue potential, while AI reduces the cost and time of music video production. However, there's a decline in traditional musical proficiency as new producers often lack formal training. Technology's role in cultural preservation is critical for national identity building, with calls from stakeholders to establish cultural centres.

And yet, challenges remain, including gaps in government support, slow internet and infrastructural challenges, and the lack of specific arts policies and educational programmes. Despite this, technology has enabled independent musicians to produce and share their work.



KLAMAR performance at Festival Kultura Rezistencia Popular, 2023. Photo courtesy Amin Baretto.

Country profile

Timor-Leste's traditional music, which has its roots in the Portuguese and Indonesian occupation periods, includes traditional music and dance forms such as cansaun, dansa, tebe, and tebedai. These genres are essential to the region's cultural expression and social gatherings (Ibid). Efforts to incorporate innovation and technology into the creative industry have been launched recently, with a focus on young people. Students have been exposed to interdisciplinary skills in technology and innovation through programmes like the UNDP Timor-Leste Accelerator Lab's collaboration with the Technical Vocational School of Don Bosco Fatumaca. These skills are essential for contemporary creative industries and include digital literacy, coding, and 3D design (UNDP, 2022). Inspired by history and technological breakthroughs, these projects seek to enable young Timorese to become change-makers and contribute to the creative and technological growth of their country.

The music sector is one of these expanding industries in Timor-Leste. The Strategic Development Plan 2011-2030 outlines plans to create Regional Cultural Centers in each district, which will showcase Timorese music, art, and dance. In addition to that, the government plans to establish a National Academy of Arts and Creative Industries, which will include a School of Music to promote artistic creation in the music sector (Government of Timor-Leste, 2011). By means of music creation platforms, online distribution channels, and AI generator tools for promotional products and campaigns, Timor-Leste's artists have enhanced the standard and scope of their work.

A number of noteworthy patterns are influencing the fields and technologies that are combining in Timor-Leste to create digital media and music. One significant trend is the increased use of content creation and sharing platforms like YouTube, which allows filmmakers and artists to interact with a worldwide audience and take part in digital activism

(Sari & Wibowo 2023). In addition, the idea of aesthetic experiences is changing as a result of the use of tools and technologies in music production and performance such as Pro Tools and Logic Pro, opening up new and varied avenues for artistic expression (Pratama & Nugroho, 2021). These trends are being supported in large part by government programmes to enhance literacy and infrastructure, which are establishing the fundamental foundation for the development of Timor-Leste's creative technology sector.

Access to finance is a major obstacle to innovative technological projects. Due to the nation's low level of investment in the creative industries, it is challenging for new businesses and independent artists to obtain the funding they need to develop and expand their ideas (Heinrich Böll Stiftung, 2023). The legal system of Timor-Leste is not sufficiently advanced to assist the creative technology industry. The requirements of the digital and creative sectors, such as those pertaining to intellectual property rights, digital transactions, and the application of cutting-edge technology like artificial intelligence, are not adequately covered by particular laws or regulations. This can stifle creativity and produce legal ambiguities. The nation is still developing its infrastructure to support creative technologies. Insufficient availability of high-speed internet, sophisticated technological instruments, and cooperative work areas impedes the capacity of producers to generate and disseminate digital content efficiently (World Bank, 2021).

Population insight

At the start of 2024, Timor-Leste is believed to have around 1,428,911 residents. According to the Timor-Leste Labour Force Survey 2021, the total household population was estimated to be 1.3 million, with 61.7% residing in rural areas (794.4 thousand) and 38.3% in urban areas (492.3 thousand) (International Labour Organization, 2023). Timor-Leste has a predominantly young population. The Population and Housing Census 2022 indicates

that about 65% of the population is under 35 years old (Heinrich Böll Stiftung, 2023).

The Labour Force Survey 2021 reveals that more than one-third (38.2%) of the population did not have formal education or had less than primary education, while 25.4% completed primary education, 19.1% completed secondary education, and only 5.1% received tertiary education (International Labour Organization, 2023). This indicates a need for educational and vocational training programmes to enhance market potential.

The labour force participation rate in Timor-Leste is relatively low at 30.5%, with youth facing even greater challenges. The youth labour force participation rate is merely 9.2%, and 30% of youth between 15-24 are not in employment, education, or training (Heinrich Böll Stiftung, 2023).

Dependence on Government Spending: Timor-Leste's economy heavily relies on government spending to stimulate domestic economic activities, with most formal employment concentrated in the public sector (about 80%) (Heinrich Böll Stiftung, 2023).

In terms of infrastructure and connectivity, significant strides have been made since the introduction of a competitive telecoms market in 2012. Mobile service coverage has expanded to 96% of population areas, and 3G and 4G data services are now available in all municipalities. The government is also working on implementing a reliable fibre optic submarine cable system to improve internet connectivity and support the digital economy.

Economic indicators

Timor-Leste declared independence from Portuguese rule in 1975, but soon after, it experienced a period of political struggle with Indonesia (Leach, 2017; Silva, 2019). Timor-Leste achieved full sovereignty in 2002, becoming the first new nation of the 21st century (CAVR, 2005).

According to the World Bank's Timor-Leste Economic Report, the country's GDP growth rate is forecast to pick up pace, averaging 4.1% in 2024 and 2025. This projected acceleration in economic growth comes after a slowdown in 2023, where the growth rate tapered to 2.3% due to a deceleration in economic activity associated with pauses in government spending during the political transition period. Timor-Leste's economic growth has been slower compared to other ASEAN countries.

The Gross Domestic Product (GDP) per capita in Timor-Leste was approximately USD 1,497 (nominal) and USD 3,747 (Purchasing Power Parity - PPP) in 2023. This relatively low per capita income indicates that while there is potential for growth, the market for creative tech products may currently be limited by the overall purchasing power of the population.

The e-commerce sector in Timor-Leste is on a rapid growth trajectory. The eCommerce market is predicted to reach US\$48.7 million in revenue by 2024, reflecting an estimated growth rate of 12% compared to 2023. The market is expected to show a compound annual growth rate (CAGR) of 9.6% from 2024 to 2028, resulting in a projected market volume of USD 70.2 million by 2028.

The government of Timor-Leste is actively supporting the fast-growing sectors through various initiatives and investments. For instance, the launch of the Timor-Leste Trade Information Portal aims to improve cross-border trade and create a conducive business environment, facilitating easier and less costly import and export activities (World Bank, 2024)

Technology penetration

According to the "Digital 2024: Timor-Leste" report, there were 742.4 thousand internet users in Timor-Leste at the start of 2024, with an internet penetration rate of 54.2%. Additionally, there were 578.5 thousand social media users, equating to 42.2% of the total population. This growth in digital connectivity is fostering a vibrant digital media

landscape, providing new opportunities for content creation, digital marketing, and online engagement (Datareportal, 2024). In 2023, around 71% of adults in Timor-Leste had a smartphone, making it the common digital device available (UNCP, 2024). The prevalence of smartphones in Timor-Leste is especially noticeable among adults with 85% of those aged 15 to 24 and 81% of those aged 25 to 34 owning a smartphone (UNCDF, 2023). On the other hand, access to tablets, computers, smart TVs, internet routers or modems is much lower. About 28% of adults in Timor-Leste have tablets or computers while fewer own smart watches or speakers (10%) and smart TVs (6%) (UNCP 2024). The widespread use of smartphones is further emphasised by the fact that most internet connections and digital transactions are done through these devices since 15% of the population has an internet router or modem at home (UNCDF, 2023).

Intersections in traditional and digital music production and distribution

The Timor-Leste report focuses on the intersection between traditional music and digital music production and distribution. Due to political conflicts between 1975 and 1999, much of the country's traditional musical culture has either vanished or remains deeply obscured. While most young Timorese are attuned to Western popular music, this has often come at the cost of their own cultural heritage, leading to the disappearance of traditional music in many areas (Dunlop, 2012).

Before the internet era, Timor-Leste's music industry was largely community-based and non-commercial, with musicians and performers playing important social roles in villages and towns, preserving cultural heritage through their art rather than through recorded media or formal distribution channels.

The use of digital music production and streaming platforms have emerged as significant factors in Timor-Leste's music ecosystem due to their ability to expand the creativity of musicians and help them reach a broader audience. One example is the band, KLAMAR, celebrated for blending traditional Timorese music with modern genres, garnering international acclaim. They utilise advanced digital audio workstations for high-quality music production and actively promote their work through social media and streaming services.

Policy and intellectual property overview

Timor-Leste has been developing its intellectual property (IP) framework to support and protect creative technologies and content creation, recognizing the importance of IP rights in fostering innovation and cultural preservation. The Code of Copyright and Related Rights, approved in 2022, marks a significant milestone by providing legal protection for various forms of creative works, including literary, scientific, and artistic creations. This law ensures that creators can benefit economically from their work, thereby encouraging more investment in creative endeavours. Additionally, the Constitution of the Democratic Republic of Timor-Leste guarantees the protection of intellectual property, emphasising the state's responsibility to safeguard and promote the creation, production, and commercialization of creative works. The ongoing development of the Industrial Property Code aims to further regulate patents, industrial designs, and trademarks, providing a comprehensive framework for protecting industrial property rights. These IP arrangements are crucial for building a robust creative economy, as they provide the necessary legal foundation to protect creators' rights, incentivize innovation, and attract both local and international investments in the creative and technology sectors.

Theme	Timor-Leste's Government Policy	Other initiatives from Government
IP Protection	<ul style="list-style-type: none"> On November 29, 2022, the Parliament of East Timor approved the country's first Code of Copyright and Related Rights. This law is set to come into force 180 days after its publication and aims to protect the creation, production, and commercialization of literary, scientific, and artistic works The Council of Ministers has approved a Draft Law Proposal regarding the Industrial Property Code, which, once enacted, will provide protection for inventions, industrial designs, and trademarks, among others 	International Agreements: Timor-Leste has joined some international agreements related to IP, including becoming a member of the World Intellectual Property Organization (WIPO) in 2017
Cultural and Creative Sectors	<p>The government has implemented several laws and policies since 2011 to support dynamic cultural and creative sectors, including:</p> <ul style="list-style-type: none"> Government Resolution No. 25/2011 on the protection of cultural heritage Government Resolution No. 30/2014 on the establishment of a National Cultural Day Decree Law No. 33/2017 on the legal framework for cultural heritage (UNESCO, 2020) 	The Timor-Leste Strategic Development Plan 2011–2030 outlines a vision to develop a vibrant creative industries sector, with initiatives such as establishing regional cultural centres and a national culture database to promote and preserve Timorese culture (Asian Development Bank, 2011).
Technology Infrastructure	<ul style="list-style-type: none"> The National ICT Policy (2017–2019) and the Digital Strategy 2032 aim to enhance digital infrastructure, promote e-government, and support the digital economy (Government of Timor-Leste, 2024). The recent Decree-Law No. 12/2024 establishes a legal framework for e-commerce and electronic signatures, aligning with international standards to facilitate digital transactions and boost economic innovation. 	The Programme of the Eighth Constitutional Government emphasises the importance of ICTs as vital tools for economic diversification and sustainable development, setting targets for broadband expansion and digital skills development.

The National Strategic Development Plan 2011-2030 aims to develop Timor-Leste's creative industries to promote cultural heritage and identity. Key strategies include developing industries in weaving, carving, music, film, and writing to generate income, jobs, and exports, and establishing cultural institutions like museums, libraries, and archives. The plan envisions a National Academy of Arts and Creative Industries and targets employing over 5% of the labour force in creative industries by 2030. It also includes setting up Community Multimedia Centers to aid technology adoption and ensure access to diverse knowledge and artistic expressions. Additionally, the plan emphasises international cooperation, cultural tourism, cross-sectoral coordination, vocational training, and implementing the Copyright and Related Rights Code.

The IX Constitution of Timor-Leste emphasises the importance of technology and outlines actions to promote and facilitate women's access to ICTs, enhance scientific research and innovation through ICTs, and create partnerships with the private sector for knowledge dissemination. It includes providing free training in computer skills, graphic design, and new information technologies for research and business creation. The plan also aims to improve existing Youth Centres and construct Multifunctional Youth Centres in all municipalities to offer training in languages, technologies, art, music, sports, and civic education.

Gender and minority issues in Timor-Leste

In order to advance gender equality and assist marginalised communities, Timor-Leste has built a strong legislative and constitutional framework that includes political representation, economic empowerment, and cultural preservation. Significant implementation issues still exist in spite of these efforts, especially in rural regions where customs frequently supersede formal legislation. The nation keeps tackling important problems like gender-based violence and works to close the gap between progressive policies and the conditions that women

and minorities must live in on a daily basis. Below are some summary of related policy or regulation in Timor-Leste's gender and minority.

1. **Constitutional Framework:** Timor-Leste's constitution guarantees equal rights and duties for women and men, reflecting a commitment to gender equality in line with international standards (Grameen Foundation, n.d.).
2. **National Action Plans:** The government adopted the National Action Plan on UN Security Council Resolution 1325 on Women, Peace and Security in 2016, focusing on women's participation, prevention of violence, protection, and peacebuilding (PeaceWomen, n.d.).
3. **Gender Mainstreaming:** The National Development Plan recognizes gender mainstreaming and women's empowerment as critical aspects of Timor-Leste's development strategy (Asian Development Bank, 2005).
4. **Political Representation:** Timor-Leste has one of the highest proportions of women parliamentarians globally, with 38% of seats held by women. The Village (Suco) Law mandates that at least one woman per Suco stands for election as Suco Chief (UN Women, 2023).
5. **Economic Empowerment:** The government has implemented a Women's Economic Empowerment Strategy to increase economic opportunities for women, particularly in rural areas (UN Women, 2023).
6. **Minority Groups:** The country recognizes the rights of minority groups, including linguistic minorities. The Basic Education Act of 2008 emphasises mother tongue education (Minority Rights Group International, 2007).
7. **Violence Against Women:** The government has approved a National Action Plan on Gender-based Violence to address the high prevalence of domestic violence (UN Women, 2023).

Timor-Leste- UK collaboration

The UK is supporting Timor-Leste's efforts to join the ASEAN Economic Community (AEC) by providing technical assistance, including a workshop on developing preferential rules of origin legislation. This initiative aims to help Timor-Leste implement an origin certification scheme for "Made in Timor-Leste" products, enhancing their access to trade preferences. This support underscores the UK's commitment to fostering Timor-Leste's economic integration and development within the ASEAN framework.

Moreover, some collaboration initiatives have already been carried out by Timor-Leste band, KLAMAR with a sound engineer and DJ from the UK. This collaboration involved both performance and recording, which helped in enhancing the quality of their music production. These global partnerships are crucial as they bring in new ideas, technologies, and creative approaches, helping us innovate and expand their artistic horizons.

Case study: Traditional music and digital production and distribution

Artist-led innovation - KLAMAR

The case study focuses on KLAMAR ('soul' in the local Tetun language), a band known in Timor-Leste for blending traditional Timorese music with contemporary sounds. Formed in Dili City in 2009, the band comprises core members Otopsy (vocals), Danny (guitar, backing vocals), Dede (guitar, backing vocals), Adi (drums, percussion), Olde (bass), Kouso (drums, percussion), and Bonny (bass, backing vocals). Their music is a fusion of rock, ska, funk, reggae, and folk, with heavy island influences, including sounds specifically from Timor and Lospalos, reflecting the origins of the band

members. Managed by Titiso Kour-Ara, who also serves as their spokesperson, KLAMAR's music addresses social and political themes relevant to Timor-Leste, and is celebrated for its cultural and artistic significance.

KLAMAR's success is marked by their ability to merge traditional music with modern influences, resonating with both local and international audiences. They incorporate instruments like the guitar, mandolin, and drums, infused with Portuguese and Indonesian influences. Their work is deeply rooted in the cultural and historical narratives of Timor-Leste, reflecting the struggles and triumphs of its people, and has significantly influenced the preservation and modernisation of Timorese music.

One of KLAMAR's albums, "Hakmatek," captures the essence of Timor-Leste's journey, focusing on themes of resistance against occupation, national identity, and the quest for peace and reconciliation in a post-independence era. The album blends traditional Timorese sounds with contemporary music, delivering poignant lyrics that speak to the collective memory and hopes of the Timorese people.

The band also actively utilises technology to enhance their music production, using advanced recording software such as Pro Tools and collaborating with international sound engineers and artists to improve the quality of their music. Despite challenges like high internet costs and limited connectivity in Timor-Leste, they have maintained an active and engaging presence. Titiso Kour-Ara, the band's manager, attributes his passion for working in the music sector to his upbringing and early experiences with music, which were further nurtured during Timor-Leste's independence period and developed during his studies in the United States. Upon returning to Timor-Leste, he reconnected with the members of KLAMAR, helping to propel their influence in the music scene.

'Growing up, we used to listen to the radio to hear Timorese songs and also to traditional ceremonies where elders chanted songs, which we didn't have the recording of. It sparked the love of music and influenced the sound of our music. We can now record our own songs and put them on a digital platform for people to access,' shares Danny Lopes, a band member.

Since 2018, KLAMAR have been showcasing their works to connect and promote their music to a wider audience through platforms like Tiktok, Instagram, Facebook and YouTube. Through these social media platforms, KLAMAR are not only sharing their work but building an online community that celebrates the diverse talents of Timor-Leste.

Broader creative technology initiatives

The scene in Timor-Leste is marked by a DIY (do it yourself) ethos, where artists often rely on their resources and networks to produce and promote their work. Despite lacking formal infrastructure and industry support, this grassroots approach fosters a strong sense of community and shared creativity. This collaborative spirit not only enriches artistic production but helps build a supportive and innovative community.

Technology adoption has expanded access to artistic content, allowing a broader audience to engage with local music, art and culture. One of the cases is that of Ego Lemos, who is a prominent figure in Timor-Leste's music scene, known for his contributions as a permaculturist and singer-songwriter. His work, particularly the song "Balibo," has received significant recognition, including awards for best original song composed for the



KLAMAR acoustic live session. Courtesy Titiso Kour-Ara.



Titiso Kour-Ara organising an event, 2023.

screen at the 2009 Screen Music Awards and a 2009 APRA Award (Australasian Performing Right Association) for best song in a film Lemos's music. He performs in his native Tetum language and helps preserve and promote Timorese culture. His involvement in the band Cinco do Oriente further highlights his influence in the local music scene.

Other musicians like Cleopatra are increasingly using technology like Pro Tools and AI tools like Kaiber.ai to produce and promote their music. They utilise social media platforms such as TikTok, Instagram, Facebook, and YouTube to share their art and connect with wider audiences, showcasing their cultural heritage and contemporary art scene. In Timor-Leste, musicians like these are unique and could inspire the entire sector.

As an educator, Nurima Ribeiro Alkatiri emphasises the value of integrating technology into the arts, also proposing educational policies that promote this integration. Despite limited financial support, the younger generation, particularly DJs, actively engage with technology in their artistic pursuits, showcasing their innovation potential. Cooperation between organisations, local artists, and government agencies all contribute to the development of innovative technology within this ecosystem. These initiatives empower artistic

expression and strengthen social unity. From this perspective, the merging of artistry with technology introduces business models and revenue streams like digital music sales and virtual performances that contribute to the expansion of the creative economy.

Musicians in Timor-Leste are also utilising streaming platforms like Spotify, YouTube, and SoundCloud to distribute their music, reaching a global audience. Social media platforms like Facebook, TikTok, Instagram, and X are crucial to connecting with their audience, sharing updates, and promoting their music. During the Covid-19 pandemic, many Timor-Leste's musicians adapted to the restrictions on live performances by hosting virtual concerts through platforms like Youtube and Facebook live.

Economically, the creative sector's contribution to the national GDP is negligible due to the absence of necessary data, public policies, educational frameworks in creative technology, and supporting industry infrastructure. However, the creative industries in Timor-Leste have untapped potential. Rodriguez highlights this potential: "There is a significant potential market in Portuguese-speaking countries, but investment and infrastructure are needed to tap into it."

Expert perspectives underscore the transformative role of digital technology in revolutionising the creative sector. Technology has made creative processes more accessible, allowing many young, talented individuals to engage in music production and other artistic endeavours. Policymaker Nurima Alkatiri highlights technology's role in cultural preservation through document digitisation and music production. Preserving and documenting traditional culture is critical for national identity, with calls to establish cultural centres. Concerns exist about technology diluting traditional arts, but a balanced approach can enhance and preserve cultural heritage while embracing innovation.

Various stakeholders, including government organisations like the Secretary of State for Art and Culture, regional creative entrepreneurs, educational institutions, NGOs, and international organisations like The Asia Foundation, HIVOS, and AusAID, play crucial roles in Timor-Leste's creative sector ecosystem. Community organisations and cultural centres like Arte Moris, Timor-Leste Cultural Center, Community Multimedia Centres, and Gembel Art Collective promote local participation and cultural heritage preservation, while tech hubs and digital platforms facilitate innovation and market access.

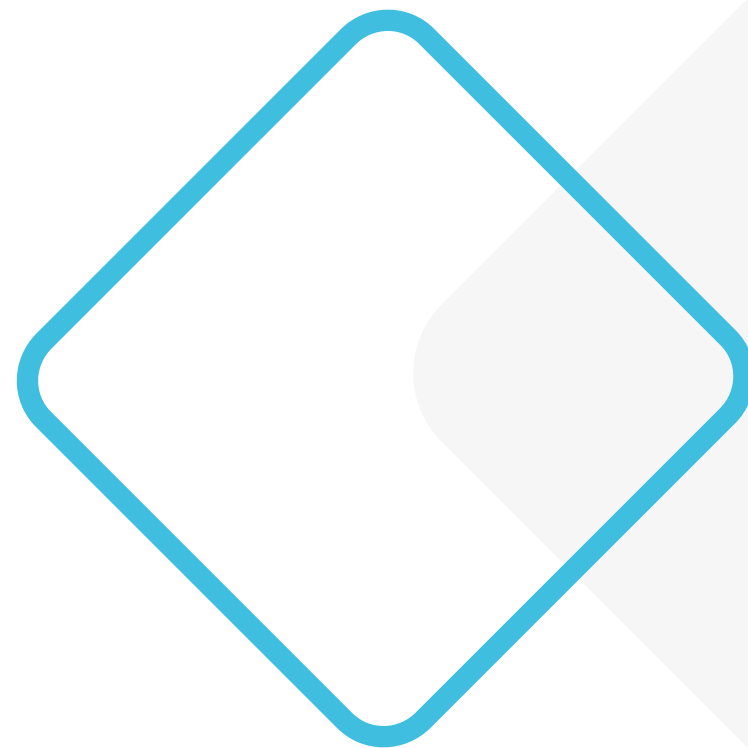
AI integration and impact

AI tools generate album covers, descriptions, beats, and mix tracks, allowing artists to focus on creativity while maintaining quality. "AI helps us manage time constraints while maintaining high-quality outputs," said Titiso Kour-Ara. In addition to Titiso, musician-teacher Kay Limak highlights how emerging technologies, particularly AI, have revolutionised music production by automating beat creation, mixing, and mastering tasks. This accessibility allows artists to produce high-quality music from home studios, significantly lowering barriers to entry.

By incorporating AI into music production local musicians can explore sounds and methods pushing the limits of music and crafting innovative compositions. The rising awareness and utilisation of AI among artists in Timor-Leste indicate a change in the music sector. AI makes music production more accessible, enabling high-quality home studio creations and opening new economic opportunities.

AI-generated modifications create futuristic aesthetics in music videos, showcasing innovative applications of AI in visual storytelling. Titiso Kour-Ara mentioned, "A hip-hop crew utilised AI-generated modifications to create a futuristic aesthetic in their music video. Titiso also mentions collaborating with AI-generated paintings for one of KLAMAR's singles, demonstrating a willingness to experiment with technology and explore new artistic avenues. Titiso emphasises how GenAI makes artistic expression more accessible and empowers artists to engage in creative endeavours.

On the other hand, there is a rising concern about AI products lacking emotional depth and cultural context. Some artists also raise questions about originality and value. Intellectual property rights and copyright issues also need addressing.



Vietnam

Key findings

In Vietnam, policies and resources that could enable growth at the intersection of arts and creative technologies are already in place, but there are systemic issues that isolate the arts sector from these resources and opportunities. 3D animation and virtual production are flourishing because of people from a cross-sector background with a commercial sense who are able to navigate different structures and sustain themselves through income outside of the arts. Businesses are willing to invest in arts and technology projects, but only if it aligns with their marketing strategy. Artists are not looking to the government to make their projects possible.

Existing policies are not effectively supporting the arts sector. Funding for tech-based art projects is scarce and inconsistent, often requiring private sponsorship. The arts and technology community lacks organisation and support, relying heavily on individual efforts. Comprehensive training and development programmes are limited, hindering the growth of skilled professionals in the sector. Cultural policies focus more on ideological control than on fostering creativity though recent IP law amendments show progress.



Country profile

Both the creative industries and technology sector in Vietnam are considered to have high potential for development and growth. Despite having a relatively low urban population (39,8% in 2023), Vietnam has the fourth highest internet penetration rate in Southeast Asia (70.3%), and its young population drives a faster technology adoption rate than the global average (Le Thu, 2022). The 8th edition of e-Economy SEA by Google, Temasek, Bain stated that Vietnam's thriving digital media scene is supported by strong local demand and many local players. Gaming, especially mobile gaming, is growing particularly quickly, with some local developers finding international success. Local music-on-demand streaming providers also continue to be prominent, even as piracy poses challenges to subscriptions (Google, 2023). However, challenges facing the creative technology sector include a lag in education and training, needed to provide a skilled workforce, and a lack of funding, particularly to the independent creative sector.

Demographics & socio-economic information

The national average population in 2023 reached 100.3 million persons. 38,11 % of Vietnam's population live in urban centres, while 61,9 % live in rural areas (General Statistics Office Vietnam, 2023). Vietnam Gross Domestic Product (GDP) growth ranked 6th in the ASEAN region as per 2024 statistics (Rao & Lu, 2024). GDP in the first quarter of 2024 was estimated to increase by 5.66% over the same period last year. The country's labour force aged 15 and over in the first quarter of 2024 is estimated to be 52.4 million people (General Statistics Office Vietnam, 2024).

Connectivity

There were 78.44 million internet users in Vietnam at the start of 2024, when internet penetration stood at 79.1 %. A total of 168.5 million cellular mobile connections were active in Vietnam in early 2024, with this figure equivalent to 169.8 % of the total population and the Information and Communications Ministry of Vietnam has selected the year 2024 as the designated time for the

nationwide implementation of 5G services. The Vietnam's Ministry of Information and Communications has declared its intention to implement 6G technology, making the country one of the first 10 nations globally to establish a specialised 6G Steering Committee (Việt Nam News, 17 May 2024).

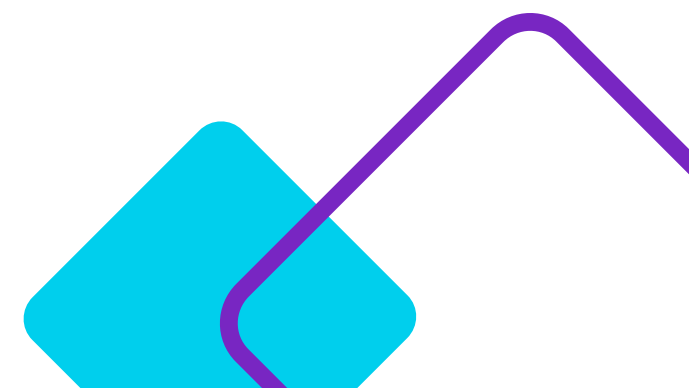
Vietnam was home to 72.70 million social media users in January 2024, equating to 73.3 % of the total population. Facebook and a local messaging app called Zalo are equally popular in Vietnam as digital touchpoints (Vietnam Digital Landscape, 2023). Interestingly, although Zalo is not officially categorised as a social network platform, it is widely acknowledged by users as a prominent social network.

Intersections in new media art and immersive technology

The Vietnam case study focuses on immersive art experiences, emerging from the trend of Visual Jockey or VJing, a new terminology used to describe creating visuals, such as real-time graphics animation, generative graphics and animations built by algorithms, live to audios. The popularity of EDM (electronic dance music) festivals in Vietnam presented an opportunity for artists to blend traditional artistic heritage with cutting-edge digital innovations. This fusion can be seen in the works of artists such as Le Thanh Tung (Crazy Monkey), whose projects integrate real-time graphics, augmented reality, and immersive multimedia into music events. Such initiatives resonate with local audiences and bridge the gap between past and present through technology. The success of events such as the Neo Nirvana multimedia exhibition by Le Thanh Tung, funded by corporate sponsorships and spread to the masses through social media outreach, highlights the growing influence of creative technology in the Vietnamese art scene. Despite the challenges, such as limited government funding to the arts, a fragmented community, and the need for substantial investment in training and development, this offers potential for contemporary Vietnamese art on global platforms and signifies the importance of cross-sectoral collaborations where artists, technologists, and corporations can jointly contribute to cultural and economic growth.

Policy and intellectual property overview

Theme	Vietnam Government	Other Initiatives from the government
Policy on Culture	The National Strategy for the Development of Vietnamese Cultural Industries until 2020, with a vision to 2030 was established in 2016. It is the first national plan aimed at addressing the need for the growth of cultural creative industries.	In 2023, two more Vietnamese cities joined UNESCO's Global Creative Cities Network: Da Lat (in the central highlands province of Lam Dong) for music and Hoi An (in the central province of Quang Nam) for handcrafts and folk arts
IP Protection	The Law on amendments and supplements to several articles of the Intellectual Property Law was officially approved by the 15th National Assembly on June 16, 2022, effective as of January 1, 2023. This is considered the most comprehensive amendment ever with 102 articles being amended and supplemented to further promote the use and protection of IP rights. The law is expected not only to contribute to promoting innovation and application of breakthrough results of the 4.0 industrial revolution but also to help this activity be closer to international practice.	Tasks and solutions to implement the IP Strategy to 2030 continue to be focused on implementation, which focuses on increasing the new intellectual property of Vietnamese individuals and organisations in both quantity and quality, improving Vietnam's IP indexes in the global innovation index (IP Annual Report, 2022).
Technology Policy	The Information and Communication Infrastructure Master Plan for the Period 2021-2030, with a Vision to 2050. This extensive plan lays the foundation for Vietnam's transformation into a leading force in the high-tech industry. The plan focuses on establishing a strong broadband communication infrastructure, investing in international telecommunications cable lines, transitioning to IPv6 technology, establishing green data centres, and establishing dedicated IT parks.	Decree 10/2024/ND-CP, which takes effect on March 25, 2024, intends to expedite processes and improve support for investors in Vietnam's high-tech parks and economic operations.



CCIs & the potential of the creative economy

Since the 2010s, the concepts of Cultural and Creative Industries (CCIs) have started to gain traction in Vietnam. In 2016, the Vietnamese government approved the 1755 Decision on a National Strategy for the development of cultural industries to 2020, with a vision for 2030 (National Strategy). In 2020, Vietnam joined the top ten exporters of creative goods worldwide (UNCTAD, 2022). With the potential for rapid development towards high technology, the Vietnamese government's goal is for cultural industries to contribute 7% to GDP by 2030.

The report "Creative Economy Development: Trends, International Experiences, and Policy Recommendations for Vietnam" by Central Institute for Economic Management (CIEM) in 2024 analysed strengths, weaknesses, opportunities, and challenges for creative economy development in Vietnam. Strengths include: rich and diverse cultural heritage; young, dynamic and technologically proficient population; positive policy changes towards new economic models¹. Weaknesses include inherent funding constraints, particularly in traditional creative sectors; a lack of many creative economy skills in many creative groups (particularly middle-aged and elderly people, women, and localities with difficult socio-economic conditions, among others); and inadequacies in "hard" and "soft" infrastructure for creative economy development.

Vietnam offers significant prospects for creative economy development due to digital revolution, a robust recovery and rise in the tourist industry, a relatively big local market, and international collaboration. Vietnam must also deal with issues such as worldwide market competitiveness, adaptation to fast technological development.²

The UK has actively promoted and supported Vietnam's cultural industries strategy through the British Council. The "Vietnam Cultural and Creative Hubs" project, the "Heritage of Future Past" project, and the "Strengthening Intellectual Property Practices in Vietnam" project are successfully implemented by the Vietnam National Institute of Culture and Arts Studies (VICAS), protecting and promoting traditional cultural values and boosting sustainable development. To improve cooperation, the Vietnamese Ministry of Culture, Sports, and Tourism and the British Council in Vietnam signed an MoU in June 2023 (Hanoi Times, 2023).

Cultural policy perspectives

Throughout Vietnamese modern history, culture, and art have been recognized as an ideological front thus being managed by the state party, which includes not only government agencies like the Ministry of Culture Sports & Tourism (MCST), but also ideological institutions associated with the Communist Party (CPV), most notably propaganda departments. According to Thuy Tran (2023), the translation of CCIs into Vietnamese cultural policy has become a coordination tool both globally and locally, in the hands of politicians, international organisations, and creative practitioners, and from the censors to the censored, all at once.

Vietnam is a socialist republic and a single-party state where the CPV holds authority over both the government and society. Freedom of expression, religious freedom, and civil society activism are tightly restricted. The authorities have increasingly cracked down on citizens' use of social media and the internet to voice dissent and share uncensored information (Freedom House, 2024).³ In relation to intellectual property laws, the CPV acknowledged copyright as a private entitlement, while also highlighting its significance within the socialist system. This emphasis was reinforced by a rule regarding censorship.

Technology and innovation policy context

While MCST has been known for its role in culture, the Ministry of Science and Technology (MST) has been leading on policies for innovation. The pivotal stakeholders with regard to creative technologies are the Ministry of Education & Ministry of Science, large technology companies, gaming companies, media, and units under the Ministry of Science and Technology, Ministry of Industry and Trade, and government funds for creative start-ups.

Vietnam is undertaking a significant endeavour to transform its digital landscape, driven by the introduction of the Information and Communication Infrastructure Master Plan for the Period 2021-2030, with a Vision to 2050. Led by Prime Minister, Phạm Minh Chính, and formalised as Decision 36/QĐ-TTg on January 11, 2024, this extensive plan lays the foundation for Vietnam's transformation into a leading force in the high-tech industry. By 2025, all high-tech parks, concentrated information technology parks, and R&D centres will have 1Gb/s Internet and deploy and invest in 2-4 international telecommunications cable lines (Viet Nam News, 19 January 2024).

Gender & skills

Vietnam is among few countries demonstrating gender parity in digital skills and the use of the internet. Girls and boys aged 7-14 are acquiring foundational reading skills at similar rates, and adolescent girls and boys, as well as young men and women aged 15-24, are acquiring basic digital skills at comparable rates (UNICEF, 2023).

Case study: New media art and immersive technology

Artist-led innovations - Le Thanh Tung (a.k.a Crazy Monkey)

Visual artist Le Thanh Tung, started integrating technology into his practice when he started working as a Visual Jockey or VJ-ing. In the same year, the boom of EDM (electronic dance music) in Vietnam allowed him to work on a festival scale. EDM/Dance is the 4th most popular music genre in Vietnam, Vpop (Vietnam Pop) has the highest level of popularity, followed by bolero and ballad (Vietnam Digital Music Landscape, 2024).



Echo Zen, Live Vjing, Audio Visual Performance
@creative material Co.ltd and Le Thanh Tung

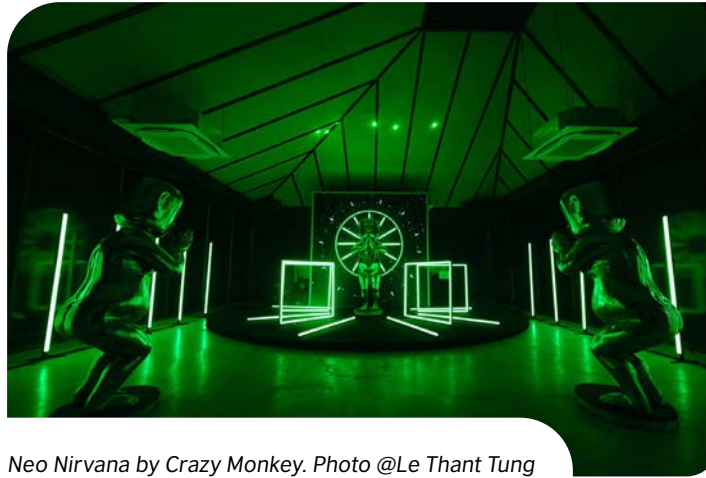
In 2015, Tung collaborated with Tri Minh - an electronic music and experimental sound artist to create Echo Zen. Tung created a lot of Buddha images in 2D and 3D to transform his performance stage into a religious milieu. He fused computer graphics with Vietnamese artistic heritage and religion and experimented with real-time graphics. In 2017, when people started talking about immersive technologies such as AR (Augmented Reality), MR (Mixed Reality), and VR (Virtual Reality), Tung easily adapted to this trend because he and his team already had skills and knowledge with real-time graphics.

During the pandemic, Tung saw new possibilities from collaborations between different industries in Vietnam. For example, the film industry merged with the game industry to create virtual production and the marketing industry merged with the game industry to create a kind of metaverse.

In 2022, Tung shared his initial public project, the Fragmented City, an attempt to recreate and preserve pieces of memories in digital space. He used LiDAR technology to scan layers of images to reconstruct his family home in Hanoi in 3D format. In April 2024, Tung curated an eight-day multimedia exhibition at De La Sól—a mixed-concept venue in Ho Chi Minh City—called Neo Nirvana. More than 6,000 people came during the eight-days, most of whom were young audiences who discovered the event via social media.

Broader technology initiative - Neo Nirvana

Neo Nirvana was an immersive, multi-sensory exhibition inspired by Tung's memories, experiences and reflections on Buddhism and in particular based on the concept of Nirvana, and the three states he understands humans need in order to achieve rebirth. In creating the exhibition, Tung integrated various technologies, including laser systems, smoke machines, visual graphics, and RGB LED lighting (Red, Green, and Blue light-emitting diodes that produce colours). All of these elements were synchronised using timecode to coordinate their timing. Neo Nirvana also used augmented reality (AR), with each AR graphic produced adding another



Neo Nirvana by Crazy Monkey. Photo @Le Thant Tung

layer of narrative for the artwork about rebirth. He partnered with collaborators including INA Nguyen Studio for design and FOMALIA * POLARIS ARTHUB for AR content.

The success of Neo Nirvana can at least in part be attributed to it being created at the right moment, with the right people, at the right time. The exhibition was financially supported and presented by De La Sol, which is a flagship venue and sub-brand of Sun Life Vietnam Insurance Company Limited, located in the heart of Ho Chi Minh City. De La Sol was created to bolster the presence of Sun Life in the Vietnamese market, and also to encourage community engagement and artistic growth. It was established in 2022, and is a mixed-use space targeting young audiences, including cafe, bar and exhibition spaces, with a signature spiral staircase.

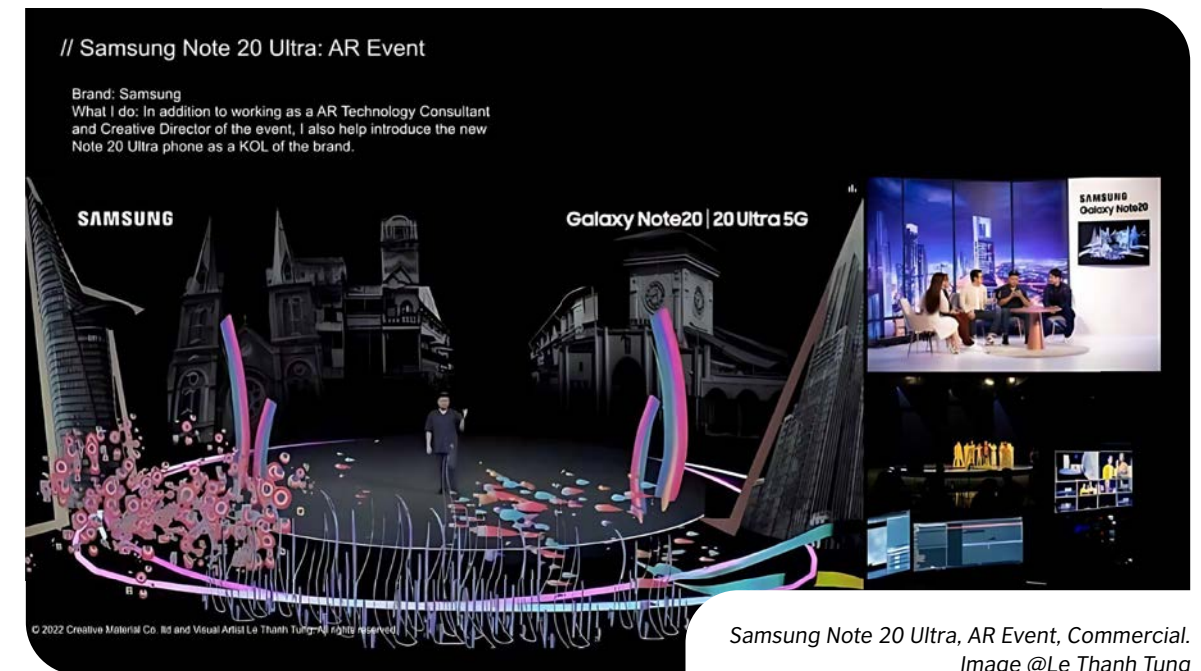
Neo Nirvana was exclusively funded by De La Sol, with a USD 30,000 sponsorship in addition to providing the space. Within the context of Southeast Asia and Vietnam, this is a 'dream budget' and enabled Tung to fully realise his creative vision. For a creative practitioner like Tung who identifies both as an artist and a Creative Director undertaking commercial projects, it can be a challenge to meet the criteria of arts organisations in Vietnam. In the past, the only way he was able to get sponsors to do art-technology exhibitions was to apply to art galleries/art organisations, which was very hard for self-taught artists like Tung, who may not fit a

certain definition or expectation of what an artist is, to access. The corporate support for this project was therefore significant in its happening.

A major factor in the exhibition's successful outreach, attracting 6,000 audience members in 8-days, was its promotion on TikTok: "Neo Nirvana never gets that number of people to come to the exhibition if I don't post it on TikTok. Neo Nirvana has more than 6,000 people visiting the exhibition, estimated around 500 to 700 people go to the exhibition per day. It's because of social media, people come and share what they love about Neo Nirvana on TikTok, and people keep sharing it and attract other people to come to the exhibition. That

type of communication never happened five years ago. Now, we can use different tools to promote our work. That also drives me as a creative person to think of more opportunities to create art and sell my art." (Tung, 2024)

With Neo Nirvana, Tung and his collaborators raised standards for immersive events in Vietnam. Tung is excited about new possibilities available thanks to AI visualisation tools. He believes that technology drives not only him but also other people in the creative industries. His friends in the creative agency share an interest in arts x technology with him, such as immersive exhibitions. For them it's not only an artistic trend but also a financial interest.



Samsung Note 20 Ultra, AR Event, Commercial. Image @Le Thanh Tung

Analysis of case studies

In Vietnam, there are cultural and economic differences between the North and the South of the country, which are also reflected in the arts scenes. Nguyen Hoang Giang describes: "Hanoi has a tradition of philosophical arts and contemporary arts. I appreciate Hanoi has this kind of intellect. Saigon is more relaxed, it's more designer-based. Here in Saigon, we all have a day job as graphic designers, and at night we throw an event that combines music and technology. This type of work, creative studio doesn't exist in Hanoi, because the advertisement industry is in Saigon. That's why it's very hard for this kind of art x technology to grow in Hanoi."

This is further reflected in the case study where we hear of Tung's previous challenges accessing support from the arts sector for his earlier projects. Neo Nirvana was in large part facilitated because it was positioned in a cross-sectoral space, outside of what would typically be considered the 'arts community'. There are perhaps also different attitudes in Ho Chi Minh City; Giang also observes that artists in Hanoi tend to focus more on sculpture and painting, which is considered 'real art' and is sellable; in opposition to internet art, which is not taken seriously.

As noted in the case study, the funding support that Tung received was critical to the success of the project. Both Giang and Hoang Anh spoke to the funding ecosystem for arts and technology projects and the ways that it limits artists. Predominantly, funding to artists comes from international funds (British Council, Korea and Japan were specifically mentioned), and sometimes private companies.

Little to none comes from the government, and this is made more challenging by the regulatory environment where to get government funding, an individual must have a representative company or his or her own company. This is a difficult requirement for individual artists, so a practitioner like Tung who is both an artist and a Creative Director may be better positioned to seek funds. That said, there are start-up funds available from the government for the technology, but not for the 'creative technology' sector. It's also typical that artists need to have multiple income sources. Giang describes the situation: "To make it sustainable (because of lack of funding), you need people who are passionate about it and also can support themselves. Some artists did one or two works, and then they quit. Well, we have a small community of VJ, but at the same time, it's only us, the old generation because I consider myself not a young artist anymore, I'm 35, and other members are 37 and in their forties."

Tung was successful in being funded by a corporate company that has already identified culture and creativity as a branding strategy, meaning they are willing to invest in this type of project. As noted, it was unusual that the budget from one sponsor was sufficient to cover the costs of what he wanted to do. In general, Hoang Anh tells us that if an artist wants to use 3D scanning or a tracking image chip experience for the audience, "a huge budget is needed for that. I need to have another investment, the fund is not enough. I've worked with independent/small companies (SMEs) to sponsor the artwork, such as the Fly On Dust and N21. The big technology companies are not interested in art."

It is also valuable to understand Tung's own creative journey. Interestingly both Tung and Hoang Anh graduated from the same university FPT Arena, which is a university run by Vietnam's biggest technology company, FPT (Financing and Promoting Technology) where many creative workers studied. There are also other technology companies who run technology education. However there are not many graduates working in art and creative technology. Giang teaches in the Digital Media Department of RMIT (Royal Melbourne Institute of Technology Vietnam) University and is teaching emerging visual culture theory, a theory course about posthumanism, cyborgs, and societal impacts of technologies. Through his university he administers RMIT Vietnam Digital Design & Art Grants, which is in its second year and provides a grant of up to USD 3000, along with mentorship and access to the school's resources.

A major gap identified by the interviewees was the absence of stakeholders working to develop the ecosystem around the practice of art and technology. There needs to be time and investment in training, development, archiving and networking. Giang is currently trying to initiate something, inspired by Hanoi DOCLAB, an independent organisation that served the film sector successfully for many years, but was unable to sustain itself due to the challenging funding environment.

Emerging trends and sentiments on GenAI

In Vietnam, the integration of AI in artistic practice is sparking significant discussions about the very definition of art. Artists and academics are exploring

how AI's capabilities challenge traditional notions of creativity and artistic authorship. Le Thanh Tung emphasises that while AI can rapidly generate new concepts and visualisations, it cannot replace the unique personal narrative and identity that each artist brings to their work.

The "Voice Gems" project by Reeps100 (Harry Yeff) and Trung Bao illustrates how AI can blend technology with cultural expression. This project uses AI to transform voice recordings into unique visual art pieces. By analysing voice recordings for characteristics like pitch, tone, and rhythm, the AI generates digital gemstones that visually represent these audio features. The project aims to preserve and celebrate individual voices and ecological phenomena, creating a digital archive that captures the essence of both human and natural sounds.

This sentiment is echoed by university lecturer Nguyễn Hoàng Giang, who notes that although AI can assist in creative processes, the final artwork still requires a human touch to maintain authenticity and originality. Giang also mentions how AI is changing the way we perceive creativity and the human role in artistic production. He points out that AI's ability to generate images and text, previously thought to be exclusive to human creativity, forces a reevaluation of what constitutes art. This redefinition extends to the role of artists, who now collaborate with AI as co-creators, integrating AI-generated elements into their work while preserving their personal artistic vision. Giang highlights that this collaboration between humans and AI could lead to a future where AI is not seen as a competitor but as a partner in the creative process.

Glossary

Art and creative practices. These terms refer to various forms of artistic expression and the integration of technology in traditional and modern art forms

Name	Definition
Animation	Art form of creating motion graphics, includes 2D, 3D, and claymation techniques.
Audiovisual Films	Content that combines visual elements with sound, often created using digital tools.
Bioart	An artistic practice that combines living organisms, biological processes, and other artistic expressions to explore intersections in art, science, and life.
Claymation	Animation technique using clay figures that are manipulated and filmed frame by frame.
Digital Art	Art created using digital technology as an essential part of the creative process.
Electronic Music	Music that employs electronic musical instruments, synthesisers, and digital audio processing.
Fashion Design	The art of applying design, aesthetics, and natural beauty to clothing and accessories.
Film	Medium used for motion pictures, involving the capture and projection of images.
Interactive Art	Art that involves the spectator in a way that allows the art to achieve its purpose.
Interactive Installation	Art installations that involve the audience's interaction as part of the artwork.
Inter-media Art	Art that combines multiple media forms, including digital and analogue elements.
Kinetic Art	Art form that contains moving parts or depends on motion for its effect.
Light Installation	Art installations that use light as the primary medium to create visual experiences.
Music Collaboration	The practice of working with other artists and technologists to create music.
New Media Art	Art that uses digital technologies as a medium, including video art, computer graphics, and interactive installations.
Painting	Traditional art medium involving applying pigment to a surface such as canvas.
Photography	Art or practice of taking and processing photographs.
Sculpture	Traditional art form involving the creation of three-dimensional works by carving or modeling materials.
Sound Sculpture	A form of art where sound is used as a medium to create three-dimensional spaces or experiences.
Stop-motion Animation	Animation technique that physically manipulates an object so it appears to move on its own.
Textile Innovation	The use of new technologies and methods to develop and enhance textile production and design.
Traditional Music Digitalisation	The process of converting traditional music forms into digital formats without losing their authenticity.
Virtual Performances	Live music performances streamed over the internet.
Visual Communication Design	Art and practice of communicating ideas visually, includes graphic design, advertising, and more.
World-building	Artistic practice of creating detailed, immersive environments and narratives.

Creative technology. Creative technology integrates technological tools and methods into the creative process, enhancing the creation, dissemination, and experience of art and cultural products.

Name	Definition
Alternate Reality Game (ARG)	An interactive narrative that uses the real world as a platform to tell a story, unfolding across multiple media channels, and engages participants in a game-like experience.
Digital Music Production	The process of creating music using digital tools and software.
Edutainment	Combination of entertainment and education to engage and teach.
Fashion-tech	The integration of technology and digital tools in fashion design and production.
Immersive Installations	Art installations that use technologies like VR, AR, and GenAI to create interactive and engaging experiences.
Interactive Narrative Systems	Systems that use AI and machine learning to create dynamic and engaging storytelling experiences.
NFTs (Non-Fungible Tokens)	A Non-Fungible Token is a unique digital identifier that is attached (typically) to a digital or digitised object. These are then built onto a blockchain network, which ensures that each token is distinct and verifiable. As NFTs can be traded, they offer monetisation opportunities that can generate revenue.
VTuber	Virtual YouTuber, a content creator who uses a virtual avatar generated using computer graphics.

Digital tools. Digital tools encompass software and applications used in the creation, modification, and presentation of digital content.

Name	Definition
After Effects	Adobe software used for creating motion graphics and visual effects.
Blender	Free and open-source 3D creation software used for modelling, animation, and rendering.
Canva	A web-based graphic design tool used for creating customizable digital designs.
Dragon Frame	Software used for stop-motion animation that includes features like onion skinning for precise adjustments.
Kaiber.ai	Artificial intelligence tools used to generate content such as album covers and music videos.
Marvelous Designer 3D	A software tool that emulates fabric weight and creates accurate pattern cuttings for fashion design.
Midjourney	A GenAI tool used for creating design inspiration and refining sketches.
Mozilla Hubs	Open-source platform for creating virtual spaces and immersive experiences.

NewArc.ai	A GenAI tool for developing and visualising fashion designs.
Photoshop	Adobe software used for image editing and graphic design.
Premiere Pro	Adobe software for video editing and post-production.
Procreate	A digital illustration app used on iPads for creating and refining design concepts.
Social Media AR Filters	Augmented reality effects that users can apply to their photos and videos on social media platforms.
Spark AR	A platform developed by Meta company that allows users to create, share, and explore augmented reality (AR) effects for Instagram and Facebook using custom animations, interactions, and 3D objects.
TouchDesigner	Software for creating interactive digital art and multimedia installations.
Unreal Engine	Advanced real-time 3D creation tool used for game development, virtual production, and real-time rendering.

Hardware. Hardware refers to physical devices and tools used in the creation and display of digital art and technology-based installations.

Name	Definition
3D Printers	Machines that create physical objects from digital 3D models, used to bring digital art into the physical world.
3D Scanners	Devices used to capture the shape and appearance of real-world objects.
Consumer-grade EEG Devices	Affordable EEG devices that allow artists to detect frontal brain activity for various artistic applications.
Handheld Lasers	Portable laser devices used in archaeological surveys and 3D scanning.
iPad	A tablet device used for digital illustration and design with apps like Procreate.
LED Lights	Lighting devices that use light-emitting diodes to produce light.
Mid-tier Gaming Laptop	A moderately powerful laptop used for gaming and music production work.
Still Cameras	Traditional cameras used for capturing high-resolution images.
VR Headsets	Devices that provide immersive virtual reality experiences by displaying 3D environments.

Platforms. Platforms are digital environments and services that support the creation, sharing, and consumption of digital content.

Name	Definition
New Art City	Online platform for creating and viewing new media art exhibitions in virtual reality spaces.
Social Media	Platforms like Facebook, Instagram, and X used for sharing visual material and engaging with a global audience.
Streaming Platforms	Services like Spotify, YouTube, and SoundCloud used for distributing music to a global audience.
Video conferencing	Platforms like Zoom and Microsoft Teams used for virtual collaboration and events.

Software. Software encompasses programmes and applications used in the creation, modification, and presentation of digital content.

Name	Definition
Ableton Live	Software used for music production, known for its flexibility and live performance capabilities.
Adobe Flash	Software used for creating 2D animations, formerly widely used for web animations.
Cinema 4D	Professional 3D modelling, animation, and rendering software.
Maya	High-end 3D modelling and animation software.
Plug-ins	Pieces of software added to existing operational frameworks allowing users to get the features they want.
Premiere Pro	Adobe software for video editing and post-production.
TouchDesigner	Software for creating interactive digital art and multimedia installations.
Unreal Engine	Advanced real-time 3D creation tool used for game development, virtual production, and real-time rendering.
VRChat	Social VR platform for creating and exploring virtual reality worlds.

Technologies. Technologies refer to advanced systems and methodologies that enhance the capabilities and applications of digital tools more generally.

Name	Definition
Artificial Intelligence	An umbrella term for different kinds of data and technologies that learn to analyse large amounts of data, recognise patterns, and make predictions or decisions based on that data, continuously improving its performance over time. These include machine learning, deep learning, natural language processing, and GenAI.
Artificial Intelligence Tools	Various software and tools developed to incorporate AI into digital art and creative processes.
AR (Augmented Reality)	Augmented Reality overlays physical environments with a virtual layer of information to create a virtual-material co-presence
Blockchain	Blockchain is a digital ledger where transactions are logged and stored across multiple computers in a decentralised network. The network uses complex cryptography to ensure security and integrity and once logged, the ledger cannot be changed retroactively. Blockchains vary by degrees of transparency, cost, and energy efficiency.
DMX	Digital Multiplex, a standard for digital communication networks used to control stage lighting and effects.
EEG (Electroencephalogram)	Technology for sensing the electrical activities in brainwaves, used to study different states of mind and corresponding brain activity.
Generative Artificial Intelligence	Built on large-language models and foundation models, GenAI can create outputs including text, images, or media from input data. It involves a practice whereby the artist uses GenAI to create a process (such as a prompt, a set of rules, or code to develop such outputs)
GIS	Geographic Information System mapping (GIS) combines spatial data (geographic locations) with attribute data (info about said locations) to create maps
IoT (Internet of Things)	Network of physical objects embedded with sensors, software, and other technologies to connect and exchange data.
Machine Learning Algorithms	Algorithms that use pattern detection through historical data and experience to recommend content to users based on their interests and past behaviour. The uses of ML are wide-ranging, from product recommendations on Amazon, voice assistants like Siri, spam filters on email, and targeted content on social media.
Metaverse	Digital ecosystem built on various kinds of virtual 3D technology, real-time collaboration software, enabling social interactions in a digital world.
MR (Mixed Reality)	Mixed Reality can describe: an aspirational seamless blending of virtual and physical elements, AR which uses goggles, and/or a blend of AR and VR.
Real-time Graphics	Graphics that are generated and displayed instantaneously, often used in live performances.
VR (Virtual Reality)	Virtual Reality is a virtual space which alters a user's perceptive experiences across multiple sensory modalities. Users can interact using special equipment such as a virtual reality headset, gloves fitted with sensors, or a full body haptic suit.
XR (Extended Reality)	Immersive technologies, encompassing Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), holograms, among others.

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