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Environmental and Health Impacts of Increased Municipal Solid Waste: A Sustainable Management Practice

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doi:10.63593/AS.2709-9830.2025.06.001

Abstract

The municipal solid wastes (MSWs) are generated by the household, institutional and commercial, street, demolition, and industrial sources of the municipality. These wastes are identified as biodegradables, non-biodegradables, recyclables, and inert materials. These are increasing rapidly due to rapid urbanization, increased industrialization, improvement of living standards, rapid economic growth and development, population growth that result in environmental contamination, and the increase of numbers of landfills. At present MSW is the most alarming issue for safety, health, and environment that poses a significant threat to both the global economy and ecosystems. Proper management of MSW is economically and environmentally crucial for the sustainable development. On the other hand, improper management of MSW can have a significant impact on human health and the environment. At present the proper MSW technologies are developed that not only reducing the waste significantly, but also generating substantial quantity of decentralized energy. This study examines the techniques of MSW management and the consequence on the health of the city dwellers.

Keywords: municipal waste, recovery, recycling, landfill, incineration

1. Introduction

Various anthropogenic activities actively produce various kinds of waste that have existed since the start of human civilization. Waste is the most often defined by its source, such as household waste, industrial waste, construction and demolition waste, and electronic or medical waste (Wilson et al., 2012; Mohajan, 2015). In recent years, the municipal solid waste (MSW) creates a great problem due to the increase in population as a result of industrial development in major towns and cities of the world that have necessitated rapid growth of urbanization (Adejobi & Olorunnimbe, 2012). These wastes are categories as, food waste, paper, plastics, wood residue, textiles, glass, aluminum can, sludge, and steels and other metal scraps (Mohajan, 2020). Most cities of the world are facing waste problems due to the rapid increase of MSW amount and the limitations of the MSW management system (Phu et al., 2021). It is estimated that global waste generation in low, lower-middle, upper-middle, and high-income countries are about 5%, 29%, 32%, and 34%, respectively (Maalouf & Mavropoulos, 2023). The cost of MSW management activities in developed countries with advanced waste treatment systems is about \$350 per ton, and the corresponding figures are \$20 and \$100 per ton in low and middle-income countries, respectively (Kumar et al., 2016).

About 2.01 billion tons of municipal solid wastes (MSWs) from residential, commercial, and institutional sources are generated globally, and it is estimated that this figure will develop to 4 billion tons by 2050 (Mohajan, 2018). These result in diseases, explosive gases, air pollution, landfill gas and liquid migration, and water and marine pollution (WHO, 2024). In the USA, the MSW is known as trash or garbage, and rubbish in Britain. Rapid urbanization and population growth are mainly responsible for very high increasing rate of MSW generation in the urban areas that possess a social, environmental and professional threat for city dwellers, urban

planners, development authorities, and other concerned stakeholders (Alamgir & Ahsan, 2007).

Management of MSW is one of the most important functions in city administrations. It is a key service on which public health, the maintenance of safe public spaces, the implementation of environmental policies, and the external image of the city depend (Luz et al., 2021). All the municipalities worldwide are under heavy pressure to implement more efficient technologies and policies to manage MSW, and to reduce environmental threats. At present MSW management practicing are waste recycling, biological treatment, and energy recovery (Young, 2010).

2. Literature Review

A literature review is an overview of previously published works on a particular topic that is included for the preparation of a dissertation, research proposal, prospectus, and a journal article (Baglione, 2012). It deals with the secondary sources and does not report new or original experimental work (Galvan, 2015). A good literature review has a proper research question, a proper theoretical framework, and a chosen research methodology (Cooper, 1998). Chris Zurbrugg and Roland Schertenleib have identified five major problems of SWM in developing countries and have provided the probable solutions for improving the situation through the emphasis on the problem of inadequate landfill disposal (Zurbrugg & Schertenleib, 1998). Muhammed Alamgir and Amimul Ahsan have aimed to evaluate the per capita generation, total daily generation, percent composition and the potential for waste recovery and reduction through the different waste generation sources, such as residential, commercial, institutional and open areas at six major cities, namely, Dhaka, Chittagong, Khulna, Rajshahi, Barisal and Sylhet of Bangladesh (Alamgir & Ahsan, 2007).

Seshibe S. Makgato has wanted to quantify and analyze the composition of MSWs by type, evaluate proximate and ultimate analysis, and assess the potential effectiveness of energy generation. His study findings try to select and design the thermal waste-to-energy process for the composition of the studied waste, thereby expediting the transition to a circular economy in urban regions and reducing pollution (Makgato, 2024). Ityona Amber and his coworkers have studied the generation, characteristics, and energy potential of MSW for power generation in Nigeria where waste is managed poorly, such as direct burning that elevates temperatures liberates heat energy, inert gases and ash, which can be conveniently used for power generation and other applications (Amber et al., 2012).

Omotayo Sarafadeen Amuda and his coworkers have provided an overview of the state of MSW management by local authorities in Nigeria. They have realized that the unplanned urbanization growth will definitely lead to huge problems on governments, especially for meeting the increasing demand for proper and healthy municipal services (Amuda et al., 2014). Mohammad Rasel Kabir has shown that generation of MSW is threateningly increasing due to the rapid growth of population, urbanization, industrialization, and improved living standards with the increasing scale of economic activity. He has tried to evaluate the capacity of Dhaka City Corporations in handling waste against the mounting generation of MSW (Kabir, 2015). Anees Ahmad and his coworkers have wanted to examine the advanced environmental and techno-economic performances of sustainable bio-fertilizer production from mixed MSW using a life cycle assessment (LCA) approach (Ahmad et al., 2025).

3. Research Methodology of the Study

Research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue. It is a systematic investigation and study of a specific topic to discover new knowledge (Creswell, 2008). It involves the collection, organization, and analysis of evidence to increase understanding of a topic, characterized by a particular attentiveness for controlling sources of bias and error (Kara, 2012). Methodology is the systematic method to resolve a research problem through data gathering using various techniques, providing an interpretation of data gathered, and drawing conclusions about the research data (Murthy & Bhojanna, 2009).

Research methodology is a structured and scientific approach used to collect, analyze, and interpret quantitative or qualitative data to answer research questions or test hypotheses. It refers to both the specific procedures used in research and the broader philosophical discussions about the underlying assumptions and values that guide these procedures (Groh, 2018). It includes all the important aspects of research, such as research design, data collection methods, data analysis methods, and the overall framework within which the research is conducted. It describes the techniques and procedures used to identify and analyze information regarding a specific research topic. There are three types of research methodology, such as quantitative, qualitative, and mixed-method (Cohen & Arieli, 2011).

4. Objective of the Study

The volume of MSW is generated in a city due to human activities, such as population growth, urbanization and social development, resources exploitation, and unchecked technological advancement (Amuda et al., 2014). When the population is increased in the cities, the concentration of industrial, commercial, infrastructural, administration, and government activities are also increased (Mohajan, 2021a). Main objective of this article is

to increase the efficiency of MSW management and establish a sustainable way to generate energy, and reduce the dependency on fossil fuels that causes harm to environment, eco-system, and human beings (Henry et al., 2005). Other minor objectives of the study are as follows:

- 1) to highlight on mechanisms and effects of MSW,
- 2) to focus on MSW management policy, and
- 3) to discuss health and safety of MSW management workers.

5. Mechanisms of MSW

Raw materials from natural resources are limited, financial resources are often insufficient, and securing land for final disposal is getting more difficult (Mohajan, 2025h). All the cities of the world should provide a clean, healthy and pleasant living environment to its citizens for current and future generations (Mohajan, 2021b). There are three types of MSWs: i) degradable wastes, such as paper, textiles, food waste, straw and yard waste, ii) partially degradable wastes, such as wood, disposable napkins and sludge, sanitary residues, and iii) non-degradable wastes, such as leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, and dust and electronic waste (Herat, 2009).

Rapid growth of population in cities is increasing the rate of waste generation that increase air pollution during burning wastes, and is increasing concentration of greenhouse gases that cause global warming (Amuda et al., 2014). Usually, the developing countries face five types of problems during MSW management, such as i) inadequate service coverage, ii) operational inefficiencies of services, iii) limited utilization of recycling activities, iv) inadequate management of non-industrial hazardous waste, and v) inadequate landfill disposal (Zurbrugg & Schertenleib, 1998). The MSW industry has four mechanisms, such as source reduction and reuse, recycling, incineration, and disposal. All of these are necessary for the proper management of MSW (Goodarzian et al., 2022).

6. Effects of MSW

Environment is the sum of all social, biological, physical, and chemical factors that compose the surrounding of human being (Iqbal et al., 2015). MSW created many negative effects on environment, such as air pollution, land pollution, groundwater contamination, and social conflict in the waste disposal area that attributes negative impact on real estate values, loss of available resources, such as loss of cultivated land, and environmental degradation, such as traffic congestion generated by waste disposal vehicles, and facilities unpleasant odor, pests, dust, noise, etc. (Hasnat et al., 2019). Infectious chemicals and radioactive hazards can be created by medical wastes on handling and disposal due to improper dumping that may cause various fatal diseases, such as cancer (Mohajan, 2025g). Bad odor can be created by degraded waste materials while transporting, handling, and dumping into landfills. Blockage of drainage and river system by MSW may cause flood in rainy seasons (Iqbal et al., 2015). These also increase the risk of human health that leads to the disruption of normal life. For example, methane gas emissions from landfills contribute to 4% of global greenhouse gas emissions, while the uncontrolled disposal of waste in oceans poses a grave threat to marine life (Lu et al., 2017). The MSW produces enormous amounts of methane that can be used in industry and household matters (Hoy et al., 2023).

7. MSW Management Policy

Operating system of MSWs management is a complex chain of interdependent logistical processes that includes waste prevention, generation, storage, collection, transportation, processing, resource recovery, recycling and reuse, treatment, and disposal (Kumari et al., 2019). MSW directly generates carbon dioxide, methane, nitrous oxide, and other harmful substances that can damage the environment. Effective MSW management has an important preventive impact that contributes to public safety, and the prevention of environmental damage and contamination (Okedere et al., 2019).

Usually MSWs are needed to handle, store, collect, and disposal, but the whole process can pose risks to the environment and to public health (Mohajan, 2025f). If these are not properly managed, insects are developed in wastes, pollute water resources and air, and various diseases are spread by the vectors, and the greenhouse gas emissions can impact on climate change (Zurbrugg & Schertenleib, 1998).

Modern MSW management policy is to provide top priority on reduction and then follow by utilization, incineration, burying, and landfill of the municipal waste (Sandhi & Rosenlund, 2024). It plays an essential role in maintaining the environment as well as the hygiene of the inhabitants, and that has been considered as one of the major contemporary concerns for urban management (Bassi et al., 2017).

7.1 Recycling

Recycling is a critical component of the circular economy, as it involves processing used materials to create new products, thereby conserving natural resources and reducing energy consumption associated with raw material

extraction. It can enhance resource efficiency, minimize environmental impacts, and promote sustainable urban development (Indriawati et al., 2024). The MSW is a raw material and energy source that can be recovered (Mohajan, 2021c). More than 50% of the waste collected worldwide is often disposed through uncontrolled landfilling and about 30% is processed through unsafe and informal recycling and the remaining 20% is incinerated (Chandak, 2010). Therefore, about 70% of MSW is not recycled that represents a significant loss of valuable supplies, placing a substantial strain on primary resources that exert detrimental effects on both the environment and socio-economic structures (Lu et al., 2017).

Recycling has environmental benefits at every stage in the life cycle of MSW, such as significant economic, job creation, and reduction of global warming (Edet & Maduabuchi, 2019). Potential recycling is necessary to improve MSW management activities and reduce waste generation. The ultimate benefits from recycling of MSW are cleaner land, air, and water; overall better health; and a more sustainable economy (Mohajan, 2025e).

7.2 Disposal

The disposal of MSW by land filling is the ultimate fate of all solid wastes. The aim of solid waste disposal is to immediately remove solid waste from urban community and reduce its volume in hygienic ways (Kamaruddin et al., 2017). Cost effective environmentally acceptable disposal methods of MSW is necessary to reduce pollution and global warming, keep the human habitats ranging from small towns to big cities clean and green, recover 'resources' which can be recycled into useful products for reuse, and process of wastes into useful clean energy, such as heat and electric power (Reddy, 2011). Therefore, it is important to take into account the type, form, composition of wastes, location of landfill site, regional, hydrological, and climatic condition before disposal of MSW (Johari et al., 2014).

8. Health and Safety of MSW Management Workers

The MSW management service is one of the most dangerous professions, and waste workers are particularly exposed to potentially severe occupational health and safety risks (Mohajan, 2025d). The most common forms of injuries the MSW workers often face are respiratory illnesses, back and joint injuries, infections, puncture wounds, various injuries, headaches, nausea, and heavy metal poisoning (Philips & Thorne, 2013). Some of the major problems the MSW workers face are, cut and wound by broken glasses, blades, syringes, nails, and thorns; poisoning from hazardous substances and heavy metals, such as lead, mercury, cadmium, pesticides, paint, e-waste, etc. (Mohajan, 2025c); injuries from dogs, rats, snakes and poisonous insect bites; stress due to heavy workload and tight shifts; traffic accidents at points of collection, waste transfer points, and final disposal; back pain and repetitive strain injury due to over workload; and biological contamination from medical wastes (Sandu et al., 2017).

The MSW workers are vulnerable to diseases that are carried by vectors, such as rats, mosquitos, flies, cockroaches, pigs, and birds (Mohajan, 2025a). Workers can be exposed to toxic substances which can affect the vital organs of the body and cause major health conditions, such as immune problems; cancers; damage to the reproductive system and birth defects; respiratory and lung diseases; liver problems; neurological and kidney problems (Philips & Thorne, 2013). They can be infected with HIV/AIDS due to handling of hospital waste, tetanus due to handling of jagged metals, respiratory problems due to exposure to smoke, and neural damage due to exposure of lead (Mohajan, 2025b). The life expectancy may reduce if they workers are not properly trained, no protection materials are equipped, and proper treatment is not provided to recover from ill-health and injuries (Samson, 2015).

9. Conclusions

MSW management is one of the major challenges for every municipal authority worldwide and is considered as an obvious result of human activities. This is the most alarming issue for safety, health, and environment. At present it has become both local and global phenomenon. Rapid urbanization, poor waste management system, lack of technical experiences and financial resources, and lack of coordination among proper plans, skilled manpower, and public awareness are the major challenges for managing the MSW. MSW is increasing very rapidly, therefore, it is needed to improve the efficiency of resource use, and organize the processing of MSW to maximize the use of their material and energy potential. Development of reduce, reuse, recycling activities are necessary and increase the level of environmental awareness among common people should be encouraged that will result in a smaller waste stream to landfill. All nations should be come forward that the waste materials can be turned into wealth that will reduce the need for increasing extraction of raw materials and fossil fuels.

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How Informal Employment Affects the Career Trajectories of Vocational Youth in Urban Vietnam

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doi:10.63593/AS.2709-9830.2025.06.002

Abstract

This paper explores how informal employment shapes the career trajectories of vocationally trained youth in urban Vietnam. Despite ongoing reforms in technical and vocational education and training (TVET), a substantial number of vocational graduates are absorbed into the informal labor market, where employment is characterized by precarious conditions, lack of social protection, and minimal opportunities for advancement. Drawing on a conceptual framework of career path divergence, the paper compares the long-term developmental implications of formal versus informal employment pathways. It argues that informal work—while providing short-term income and flexibility—often leads to stalled skill development, income volatility, blocked upward mobility, and social marginalization. At the same time, vocational youth exhibit adaptive strategies, including informal apprenticeships, portfolio livelihoods, micro-entrepreneurship, and reliance on social and family networks. These strategies offer resilience but do not fully compensate for institutional deficiencies. The study concludes that to bridge the gap between vocational training and sustainable employment, policy must recognize informality as a structural feature of Vietnam's urban labor market and design inclusive interventions that support recognition, mobility, and protection for youth at the margins.

Keywords: vocational youth, informal employment, career trajectories, social networks, skill development, Vietnam, precarity

1. Introduction

Vietnam's economic transformation over the past three decades—driven by Đổi Mới (Renovation) reforms, industrialization, and global integration—has led to impressive GDP growth, urban expansion, and a diversification of employment structures. Yet, this rapid development has also deepened labor market segmentation, especially in urban areas where formal job creation has lagged behind the influx of new labor force entrants. One particularly vulnerable group within this evolving labor landscape is vocational youth: young individuals, often aged between 15 and 24, who have completed technical or skills-based training in hopes of securing stable employment.

Vocational education in Vietnam has been promoted as a strategic solution to bridge the skill gap and meet the demands of the modern economy. Technical and vocational education and training (TVET) institutions aim to produce a workforce that can adapt to industrial and service-sector needs. However, in practice, a significant proportion of vocational graduates—especially in urban settings—find themselves unable to secure formal sector jobs and instead enter the informal economy. This disconnect raises critical questions about the efficacy of vocational training systems, the quality of job opportunities available, and the broader structural constraints of Vietnam's labor market.

Informal employment, defined by the absence of legal contracts, social insurance, and employment benefits, is both pervasive and persistent. In urban Vietnam, it includes jobs in street vending, informal construction, retail

sales, personal services, and gig economy platforms like ride-hailing. For vocational youth, entering the informal economy is often not a matter of choice but necessity—driven by limited job openings, employer preference for experienced workers, or the mismatch between training and market demand.

The implications of informal employment for vocational youth are profound. Without access to formal job protections, structured skill progression, or income stability, their career trajectories are often characterized by stagnation, precarity, and a lack of upward mobility. The informal sector offers limited scope for professional identity formation or long-term planning, elements essential for sustainable career development. Youth who begin their careers in such conditions may find it difficult to transition to formal employment later, creating a cycle of vulnerability and marginalization.

This essay critically examines how informal employment affects the long-term career development of vocational youth in urban Vietnam. It explores not only the economic dimensions of informality but also its social and psychological effects, the coping strategies employed by youth, and the role of family, migration, and skill networks. Through a conceptual framework and synthesized evidence, this analysis aims to highlight the gap between policy aspirations for vocational training and the labor market realities that young people navigate daily.

2. Overview of Informal Employment in Urban Vietnam

Informal employment is a structural mainstay of Vietnam's urban labor market, rather than a residual or transitional phenomenon. According to the General Statistics Office (GSO), more than half of the urban workforce is engaged in informal activities, with many sectors exhibiting deep-rooted informality that spans decades. These jobs typically lack formal contracts, social insurance coverage, and compliance with labor law protections. This absence of regulation renders informal employment precarious, yet it remains a vital income source for millions, particularly among youth entering the workforce.

In Vietnam's urban economy, informal jobs are distributed across a variety of sectors. Construction and day labor, for instance, remain heavily reliant on informal hiring practices, often mediated by intermediaries or labor brokers, and provide unstable, short-term income without any employment guarantees. Meanwhile, informal retail trade and street vending flourish in cities like Hanoi and Ho Chi Minh City, offering low-barrier entry points for rural migrants and youth with limited capital. Hospitality and domestic work also absorb a significant number of young laborers—particularly women—who are paid under the table and exposed to long hours and poor working conditions. In small-scale manufacturing and service sectors such as tailoring, food preparation, or motorbike repair, informal apprenticeship structures persist, providing skill development outside formal educational channels but without recognized certification. More recently, platform-based gig work, including app-based ride-hailing, delivery services, and online reselling, has expanded rapidly. While digital in interface, such work typically replicates the informality of traditional sectors, with workers classified as independent contractors and denied access to basic labor rights.

The expansion of informal employment is rooted in a combination of institutional and economic forces. The shift to a market economy following the *Đổi Mới* reforms created vibrant private sectors, but these have remained fragmented and under-regulated, particularly among micro and small enterprises. Formalization poses a significant compliance burden for many employers, including taxes, paperwork, and legal obligations, disincentivizing official registration. At the same time, vocational training institutions often do not produce graduates with skills fully aligned to the urban labor market's evolving needs, further pushing youth into informal pathways.

Vocational youth in particular are structurally disadvantaged in this landscape. Many migrate from rural areas with aspirations of social mobility, only to confront a lack of formal job opportunities upon arrival in cities. With limited social networks and few mechanisms to translate their training into recognized employment, they accept roles in the informal sector out of necessity rather than choice. Their position is further undermined by hiring biases favoring experienced or older workers and by opaque recruitment processes that rely more on personal referrals than meritocratic assessment.

The outcomes of informal employment for these young workers are often deeply unequal and stagnant. Entry-level roles do not lead to predictable career advancement, wages are low and volatile, and there is little opportunity for skill certification or lateral movement into the formal economy. Gender and ethnic disparities persist. Young women are overrepresented in care work and hospitality—sectors known for their exploitative conditions—while ethnic minority youth often face discrimination and language barriers that confine them to the most insecure and invisible forms of labor.

In short, informal employment in urban Vietnam is both a coping mechanism for economic insufficiencies and a systemically embedded structure shaped by national development patterns, institutional gaps, and mismatches in vocational training. For vocational youth, it is not just a phase, but often a starting point that profoundly influences their long-term career possibilities.

3. How Informal Employment Shapes Vocational Youth Careers

Informal employment plays a determining role in shaping the early and long-term career paths of vocationally trained youth in urban Vietnam. While often considered a pragmatic entry point into the labor market, the realities of informal work present serious challenges to the development of a sustainable and upward-moving career trajectory. This section explores these effects across five interrelated dimensions.

3.1 Stalled Skill Development and Occupational Entrapment

Vocational youth enter the labor force equipped with practical competencies intended to meet industry needs. However, once in informal employment, many find their skills underutilized or mismatched with the tasks at hand. Informal jobs are typically repetitive, low-skill, and focused on immediate productivity rather than long-term worker development. Opportunities for acquiring new skills, gaining formal recognition, or receiving mentorship are rare. As a result, many young workers experience occupational entrapment—remaining in the same job role or sector for years without progression. This undermines not only their personal aspirations but also the national objective of developing a skilled workforce through vocational training.

3.2 Income Volatility and Economic Insecurity

One of the most tangible consequences of informal employment is irregular and often inadequate income. Workers are usually paid by the day, by output, or informally negotiated monthly sums, without written contracts or wage protections. For youth, this makes budgeting, saving, or planning for the future extremely difficult.

In times of crisis—such as during the COVID-19 pandemic—informally employed youth are among the most affected. Lacking access to unemployment benefits or furlough schemes, many are left without any source of income for extended periods. Even in stable periods, they face the constant risk of job loss, wage theft, or sudden changes in working conditions.

3.3 Blocked Upward Mobility and Labor Market Segmentation

Informal employment is often disconnected from formal labor market channels. Youth who begin in informal jobs accumulate work experience that is rarely recognized by formal employers. Without documented contracts, verifiable job references, or accredited skill upgrades, vocational youth struggle to transition into stable, formal employment. This contributes to a segmented labor market, where the informal and formal sectors operate in parallel but disconnected ecosystems.

Consequently, the starting point of informal work may define an individual's long-term career ceiling. Many youth remain stuck in lateral moves across similar informal roles, unable to access the benefits or opportunities available in formal employment pathways.

3.4 Social Marginalization and Institutional Exclusion

The absence of formal employment status has far-reaching consequences beyond the workplace. Informally employed youth are typically excluded from key pillars of social protection: health insurance, pension schemes, paid leave, and access to financial services. Without formal proof of income, they often cannot apply for housing leases, business loans, or even phone contracts.

This exclusion reinforces their marginal position in urban society, where formal employment is often associated with citizenship, stability, and social legitimacy. It also makes them more vulnerable to labor rights violations, including excessive work hours, gender-based discrimination, and lack of safety measures.

3.5 Long-Term Scarring Effects and Intergenerational Inequality

The impacts of informal employment are not limited to the short term. Numerous studies across developing economies suggest that informal labor market entry can have “scarring” effects, reducing lifetime earnings potential and delaying critical life transitions such as marriage, parenthood, or homeownership.

In Vietnam, many vocational youth from low-income or rural backgrounds remain informally employed well into adulthood, limiting their capacity to accumulate assets, invest in further education, or support younger family members. This perpetuates cycles of economic inequality and undermines efforts to promote upward social mobility through vocational education.

In conclusion, while informal employment may offer immediate income and flexibility, it carries long-term risks that fundamentally reshape the career potential of vocational youth. Understanding these dynamics is essential for policymakers, educators, and development practitioners seeking to improve youth labor outcomes and reduce structural inequality in Vietnam's rapidly urbanizing economy.

4. Analysis

To better understand how informal employment shapes the career trajectories of vocational youth, it is crucial to contrast it directly with the developmental pathways available in formal employment. The following analysis

draws upon a conceptual model of “career path divergence,” mapping the evolution of professional status over a 10-year period. This is complemented by a comparative table examining structural features across both sectors.

4.1 Career Divergence Over Time

The chart below outlines a typical trajectory comparison between vocational youth who enter formal employment versus those who remain in informal work for a decade. While idealized, this figure highlights cumulative disparities that emerge early and widen over time.

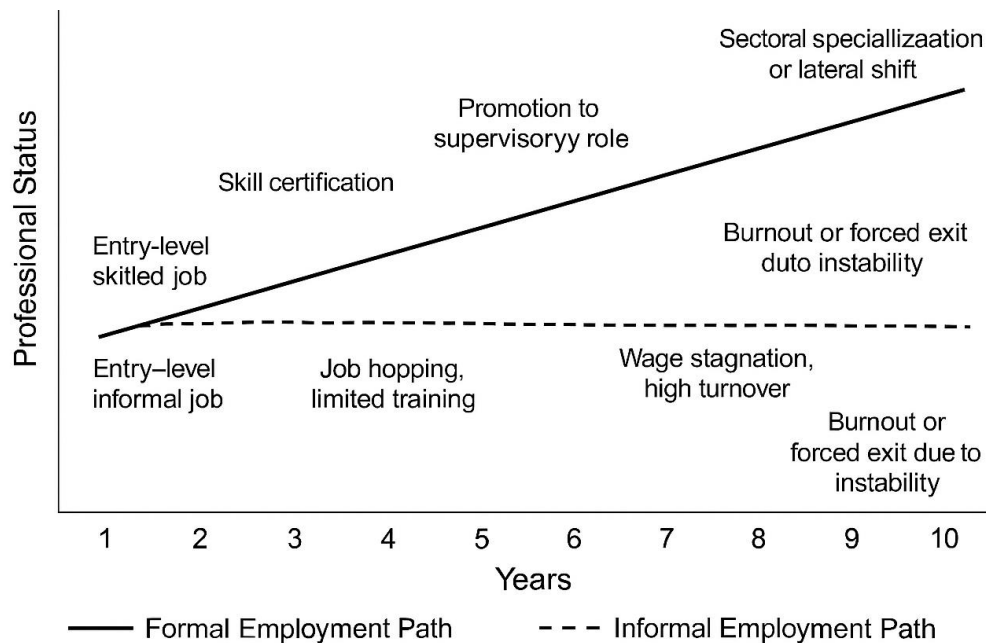


Figure 1. Career Path Divergence – Formal vs. Informal Trajectories Over 10 Years

In formal employment, the progression is marked by predictable stages: integration into the workplace, recognition through credentials, promotion, and eventual upward or lateral mobility. Vocational training aligns well with this pathway, providing foundational skills that are recognized and developed further in the workplace.

In contrast, the informal pathway is nonlinear and fragmented. Workers frequently change jobs or sectors, rarely accumulate experience that is certifiable, and face instability that prevents long-term planning. Skill development is often experiential and unrecognized by formal institutions. The lack of regulation also exposes them to physical and mental health risks due to long hours, hazardous conditions, and absence of labor protections.

4.2 Structural Inequities in Employment Conditions

The following table presents a side-by-side comparison of five structural dimensions that shape the working lives and prospects of vocational youth.

Table 1. Comparative Impacts of Informal vs. Formal Employment on Vocational Youth

Factor	Formal Employment	Informal Employment
Wage Growth	Moderate to high, often indexed to tenure or performance	Low and stagnant, susceptible to exploitation
Job Security	Protected by labor contracts and tenure policies	Highly insecure, at-will employment or gig-based
Access to Benefits	Health insurance, social insurance, paid leave	Lacks legal benefits or entitlements
Skill Development	Structured training, internal promotion ladders	Learning-by-doing, no credential recognition
Career Advancement	Predictable pathways based on merit/performance	Uncertain, often network- or survival-driven

This comparative framework illustrates how formal employment embeds individuals within systems of legal protection and institutional support. These mechanisms—ranging from standardized contracts to formal grievance procedures—enable workers to anticipate risks, make long-term investments in their careers, and enjoy social mobility. Informal employment, by contrast, externalizes risk to the worker and offers little long-term payoff. Even when informal work is entrepreneurial or flexible, it lacks scaling potential for most youth, especially those without capital or social leverage.

4.3 Hidden Costs and Cumulative Disadvantages

While informal employment may seem flexible or even empowering to some youth at the outset—especially when it offers immediate income or avoids bureaucratic rigidity—its hidden costs are substantial. These include: Skill obsolescence: Without continuous training, vocational competencies may become outdated, especially in fields like electronics or IT support. Health deterioration: Long hours, poor working conditions, and lack of medical support often lead to chronic fatigue or physical injury. Social isolation: Exclusion from workplace communities or unions reduces the potential for collective voice or mutual aid.

These hidden costs are cumulative. A youth who starts informally and remains there may find by age 30 that their income, employability, and social capital are significantly lower than peers who began in formal positions—even if they had the same initial training.

4.4 Intersections with Gender and Class

Not all youth experience informal employment in the same way. Gender plays a major role: young women in informal domestic or hospitality work often face greater risks of harassment and are typically paid less than men in manual labor. Likewise, youth from low-income or ethnic minority backgrounds are less likely to leverage social networks to access better-paying informal niches or transition into formal roles. Thus, the disadvantages of informal employment are often compounded by pre-existing social hierarchies.

This analysis demonstrates that informal employment is not just a precarious starting point—it is a structural trap that constrains long-term development across multiple dimensions. The divergence between formal and informal career paths becomes more pronounced over time, reinforcing inequality and limiting the transformative potential of vocational training in urban Vietnam.

4.5 Can Informal Work Become a Stepping Stone?

Although informal employment is generally associated with stagnation, some vocational youth demonstrate agency and adaptability in turning short-term, informal experiences into longer-term opportunities. This usually occurs in three scenarios:

Youth with strong social networks—especially family members or friends who own small businesses—may begin informally but eventually gain trust, experience, or capital to enter semi-formal or formal roles. Second, some entrepreneurial youth use informal gigs to accumulate initial capital or market knowledge and later launch registered micro-enterprises, such as phone repair shops, online retail, or food services. Finally, youth in gig-based digital platforms sometimes use informal work as a temporary bridge while pursuing formal opportunities, including higher education or certification programs. However, such upward transitions are rare and contingent. They depend heavily on individual agency, urban location, family background, and timing. For the majority, informal work does not lead to mobility but rather replicates existing disadvantage. The few who do succeed tend to be exceptions, not evidence of systemic permeability between informal and formal labor markets.

4.6 Spatial and Temporal Dimensions of Career Divergence

Career trajectories in informal employment are also shaped by where youth work and how long they remain in the sector. Spatially, vocational youth in mega-cities like Ho Chi Minh City may have access to denser labor markets, more frequent job turnover, and emerging platform-based work (e.g., ride-hailing or delivery services). These contexts offer more diverse—but not necessarily more secure—employment options.

In contrast, those in smaller urban centers or peri-urban zones often find fewer opportunities and face local economic stagnation. This limits not only employment choices but also the visibility of youth to potential employers or support programs. Over time, this geographic marginalization compounds their economic precarity.

Temporally, the first few years of post-training employment are critical. Youth who remain informally employed for more than three years face a sharp decline in probability of entering the formal sector. This reinforces the importance of “career path dependency”, where early informal experiences shape the logic and feasibility of future employment moves.

Time and place matter. Informality becomes most damaging when it is prolonged and when it unfolds in areas with weak economic dynamism or social infrastructure.

5. How Vocational Youth Navigate Informal Employment

While much of the literature emphasizes the structural vulnerabilities faced by vocational youth in informal labor markets, it is equally important to consider the agency and resilience many of these individuals display in navigating instability. Rather than passive victims of informality, many youth actively develop creative strategies—both individual and collective—to survive, adapt, and even find opportunity within constraint. These coping mechanisms are shaped by personal initiative, social networks, geographic mobility, and embedded cultural norms.

5.1 *Learning-by-Doing: Informal Apprenticeship and Experiential Growth*

In the absence of formal pathways for skill advancement, many vocational youth turn to informal modes of knowledge acquisition. This includes learning-by-doing in small-scale repair shops, beauty salons, tailoring stalls, or on construction sites, where mentorship is often transmitted through observation, imitation, and gradual trust-building rather than structured curricula. While such arrangements lack official certification or pedagogical oversight, they provide critical technical exposure and socialization into workplace routines. Youth involved in these environments often report developing practical competencies that surpass what they acquired in vocational school, albeit without formal recognition in the job market.

However, these experiences are highly variable in quality and duration. Much depends on the willingness of employers to train and the youth's own ability to negotiate favorable conditions in unregulated environments. As such, these informal apprenticeships are both opportunity and risk—a space of learning but also of potential exploitation.

5.2 *Managing Fragmentation through Portfolio Livelihoods*

In an environment where stable, full-time employment is rare, many young people have adopted a portfolio approach to earning. Rather than depending on a single job, they cobble together multiple income sources—such as combining part-time motorbike taxi driving with weekend electronics repair or operating a home-based online shop while assisting in family businesses. This diversification is not only a survival tactic but also a form of income smoothing, allowing youth to mitigate risk in volatile sectors.

While this multi-activity livelihood model offers short-term resilience, it often comes at the cost of exhaustion, time poverty, and a lack of focus on long-term development. The absence of career consolidation also means these youth may continue to hover at the margins of multiple sectors without gaining seniority, recognition, or social benefits in any of them.

5.3 *Grassroots Entrepreneurship and Micro-Enterprise Creation*

Some vocational youth leverage the low entry barriers of the informal sector to initiate small entrepreneurial ventures. In sectors such as food vending, phone repair, or mobile grooming services, they use modest capital—often borrowed from family—to gain autonomy over their income. Entrepreneurship, in this sense, becomes not just a coping strategy but a means of reclaiming agency and control over one's labor. However, this entrepreneurial energy is frequently constrained by structural limitations: lack of access to credit, absence of legal registration, competition from larger players, and vulnerability to regulatory crackdowns. Many youth entrepreneurs remain in a precarious zone—earning just enough to survive but not enough to scale up or formalize their businesses. Entrepreneurship, while often celebrated in policy discourse, therefore functions more as “necessity-driven self-employment” than as a pathway to upward mobility.

5.4 *Strategic Mobility and Spatial Adaptation*

Geographic movement is another significant strategy employed by youth to manage the uncertainties of informal employment. Many engage in circular migration—moving between urban centers and their rural hometowns in response to employment fluctuations, housing costs, or family obligations. Others shift across cities to pursue better job conditions or tap into different social networks. Such spatial adaptability allows youth to temporarily escape high-cost urban life or seek seasonal opportunities. However, frequent movement can also disrupt social ties, reduce continuity in skill development, and limit accumulation of work history. For those without strong urban roots or support systems, the city becomes a place of opportunity but also of transient belonging and deepening precarity.

Vocational youth in urban Vietnam display a range of coping strategies that reflect both structural constraints and individual agency. These tactics are adaptive, often ingenious, and crucial for survival in an exclusionary labor market. Their long-term effectiveness remains limited unless embedded within supportive ecosystems—such as access to credit, skill recognition systems, youth employment services, and social protection. Without such institutional scaffolding, these strategies may help youth “get by” but not necessarily “get ahead,” reinforcing the very inequalities they seek to escape.

6. The Role of Social and Family Networks

In the context of Vietnam's post-reform urban economy, where labor market institutions remain fragmented and social protection systems are limited in scope, social and family networks function as informal but powerful infrastructures for vocational youth. These networks mediate access to jobs, provide emotional and financial support, and often shape the contours of youth aspirations and decisions regarding work. Yet, while they help youth "get by" in the absence of institutional guarantees, they also risk reinforcing patterns of dependence, low mobility, and intergenerational informality.

6.1 Embeddedness in a Collectivist Culture

Vietnam's collectivist cultural foundations emphasize familial obligation, community cohesion, and reciprocal support. These values are especially pronounced in the context of youth employment. Young people entering the urban labor force often rely on extended kinship ties for basic subsistence—including housing, introductions to employers, and moral guidance. In many cases, parents or relatives not only influence but co-determine job decisions, reflecting a deeply relational model of career development. For first-generation vocational graduates from rural areas, this relational scaffolding is often the only bridge connecting them to opportunity in cities. This embeddedness provides resilience in the face of urban precarity. When formal institutions fail to guarantee secure jobs or affordable services, family members fill the gap. Youth who lose informal jobs can temporarily return to their hometowns, work in family-run enterprises, or live rent-free with relatives, easing the harshness of labor market volatility. Such safety nets reduce the risks of destitution or homelessness, but they are not always empowering.

6.2 Social Capital and Informal Recruitment Channels

Word-of-mouth hiring remains a dominant mode of job acquisition in Vietnam's informal economy. Friends, neighbors, and distant kin act as referral agents, connecting youth to work opportunities in small shops, restaurants, factories, and construction crews. These interactions generate what sociologists term bonding social capital—dense, trust-based relationships that provide access to resources within one's immediate social group. For vocational youth without formal networks or institutional placements, such bonding capital can be vital for employment entry.

However, this form of job acquisition also limits exposure to more diverse or formal labor markets. Youth become embedded in occupational niches defined by family or community precedent. For example, sons of construction workers may join the same informal teams; daughters of street vendors may inherit market stalls or informal trade routes. Over time, these patterns reinforce occupational segmentation and perpetuate low-income work cycles across generations.

6.3 Financial Cushioning and Risk Sharing within the Household

Families in Vietnam function as economic units that pool resources and redistribute risk. In many cases, parents finance vocational training, provide housing in urban centers, or contribute start-up capital for self-employment ventures. This "financial cushioning" enables youth to accept low-paying jobs initially, experiment with small-scale entrepreneurship, or survive job loss without falling into destitution. For youth who work informally, such support often makes the difference between economic survival and exclusion.

This interdependence has trade-offs. Youth may feel pressured to conform to parental expectations about which jobs are acceptable or where to work. In low-income families, youth income may be diverted to support younger siblings or repay family debts, constraining their ability to invest in their own skill development or mobility. In this way, family support can become both a source of empowerment and a mechanism of constraint.

6.4 Emotional Support and the Maintenance of Subjective Well-being

Informal employment often entails psychological stress—unpredictable hours, lack of respect, fear of job loss, and social stigma. In such conditions, the family often becomes the emotional bedrock. Parents and siblings offer moral encouragement, normalize the struggles of informal labor, and help maintain a sense of dignity. Emotional support from home is particularly important for rural migrant youth who may experience isolation or discrimination in urban settings.

Strong emotional bonds may also delay necessary transitions. Some youth remain in low-paying or exploitative jobs simply to stay close to their family or avoid social shame associated with failure or withdrawal. Others may suppress dissatisfaction to maintain harmony, a dynamic shaped by Confucian ideals of filial piety and relational responsibility. These cultural norms, while stabilizing, can discourage risk-taking or non-conforming career moves.

6.5 Intergenerational Continuity and the Reproduction of Informality

Perhaps the most long-term implication of social and family networks is the way they reproduce informal employment across generations. In the absence of structural reforms, youth often follow employment trajectories shaped by their parents' labor histories. For instance, a parent who runs an informal garment workshop may train

their child to assist and eventually take over the operation. Over time, what appears to be intergenerational support can become the mechanism for reproducing economic marginality.

When social networks substitute for state institutions, they mask deeper systemic failures—such as the inadequacy of public job placement services or the exclusion of vocational youth from formal sector recruitment. In this sense, family networks not only support youth survival but also inadvertently perpetuate the structural invisibility of informal labor in policy discourse.

Social and family networks are double-edged: they provide indispensable buffers against labor market volatility, but they also constrain youth agency, reinforce informal labor practices, and blur the boundaries between support and control. For policy interventions to be effective, they must recognize these dynamics—not by replacing family roles, but by complementing them with inclusive labor institutions, equitable access to employment services, and formal recognition of vocational competencies. Only then can vocational youth rely on networks by choice, rather than by necessity.

7. Conclusion

The expansion and persistence of informal employment in urban Vietnam has created a deeply unequal and segmented labor landscape in which vocational youth—despite their technical training and ambitions—often find themselves structurally marginalized. While the country's economic growth and urban transformation have opened new employment avenues, the quality and stability of these opportunities remain uneven. Vocational youth, trained with the promise of integration into a modern, skill-based economy, are instead frequently absorbed into informal sectors where their capacities are underutilized, their rights are unprotected, and their careers lack sustainable trajectories. This paper has demonstrated that informal employment not only limits economic mobility but also reshapes the very logic of career development for vocational youth. The early years of working life, meant to serve as a foundation for long-term professional growth, instead become sites of fragmentation, precarity, and stalled potential. Without structured skill advancement, formal recognition, or institutional pathways for mobility, these youth are often trapped in cycles of low pay, high insecurity, and limited upward progression. The divergence between formal and informal employment becomes more pronounced over time, not only in terms of material outcomes but in subjective experiences of dignity, stability, and hope.

Within this constrained environment, vocational youth exhibit remarkable forms of adaptation and agency. They cultivate experiential learning in informal apprenticeships, adopt hybrid livelihood strategies to diversify income sources, and initiate entrepreneurial ventures with limited capital and state support. Social and family networks act as essential scaffolds—providing job referrals, financial cushioning, emotional support, and sometimes even informal business platforms. These adaptive behaviors reveal not only the creativity of youth but also the inadequacy of the current institutional framework to absorb and nurture their potential. However, these coping strategies, while critical for short-term survival, are not a substitute for structural solutions. Reliance on informal networks and piecemeal employment strategies often leads to the reproduction of informality and intergenerational disadvantage. Such strategies disproportionately benefit youth with stronger social capital or urban familiarity, deepening inequalities among vocational graduates based on class, gender, and rural-urban origin.

The analysis thus calls for a shift in how policymakers, educators, and labor institutions conceptualize both vocational training and informal work. Rather than treating informality as a temporary or residual phenomenon, it must be recognized as a central feature of the labor market that actively shapes life trajectories. Policy responses must go beyond technical training reforms or employment quotas; they must address the systemic barriers that prevent informal workers from gaining legal recognition, skill certification, and social protection. This includes designing mechanisms to formalize experiential learning, expanding youth access to inclusive financial services, and building state-backed job matching platforms that extend beyond elite networks. The career trajectories of vocational youth in urban Vietnam are not simply a function of individual effort or educational attainment, but are deeply shaped by the institutional and informal structures that define the urban labor market. Addressing the challenges they face requires both a recognition of their ingenuity and a commitment to transforming the systems that continue to constrain them. Only by bridging the gap between vocational promise and labor market reality can Vietnam fully realize the potential of its next generation.

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Visual Cultural Penetration: A Study on the Cultural Expression of Graphic Design in Contemporary Chinese Weddings

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doi:10.63593/AS.2709-9830.2025.06.003

Abstract

In contemporary China, where the process of globalization continues to advance, traditional wedding customs are undergoing profound visual transformation and cultural reconstruction. This paper takes graphic design as a starting point to explore its media role in the integration of Chinese and Western wedding cultures. Through the analysis of cultural penetration theory, semiotics and typical image cases, it reveals how images in contemporary weddings reflect the influence and reshaping of Western culture on traditional Chinese rituals. The study found that graphic design not only records cultural changes, but also participates in the process of cultural negotiation, becoming an important means of modern identity construction, value translation and emotional identification. The article believes that as a reorganizer of the cultural symbol system, designers should maintain critical thinking and cultural sensitivity in visual integration, explore local contemporary expressions, and promote the innovative dissemination of Chinese wedding customs and culture at the visual level.

Keywords: cultural penetration, graphic design, wedding, visual culture, integration of Chinese and Western cultures, semiotics, globalization

1. Introduction

With the rapid development of information technology and the high degree of integration of global communication media, images have become the most intuitive, emotionally penetrating and ideologically influential core media in contemporary cultural communication. Especially in the highly ritualized cultural field of weddings, images not only bear the functions of emotional expression and social expectations, but also constitute an important mechanism for the construction of cultural identity. The visual language it presents often implies the reproduction and reconstruction of identity, value and tradition.

As a social behavior of collective participation, weddings condense the cultural logic and social structure in a specific historical context in their ritual process, visual symbol system and media reproduction. Graphic design plays an intermediary role in connecting individual aesthetics and collective consciousness in this process. Through the design intervention of color configuration, image generation, symbol translation and communication style, graphic design not only shapes the visual form of the wedding, but also participates in the generation and dissemination of cultural meaning at a deeper level.

Based on this, this paper aims to explore how Western culture penetrates the visual expression system of contemporary Chinese weddings through images, and further analyzes the role of visual translation and cultural negotiation played by graphic design. Through theoretical review and case analysis, it reveals how visual culture has become a key channel for interaction between Chinese and Western cultures, and the issues of identity construction and cultural awareness it has triggered in the context of contemporary Chinese society.

2. Theoretical Basis: Cultural Penetration and Visual Communication

Before analyzing the cultural transformation reflected in the graphic design of contemporary Chinese weddings,

it is necessary to clarify the theoretical background of the two core concepts of “cultural penetration” and “visual communication”. How culture spreads in different social contexts and influences ideas, aesthetics and identity through the non-verbal medium of images is the key issue behind understanding the visual transformation of weddings.

2.1 Concept and Mechanism of Cultural Penetration

“Cultural infiltration” usually refers to the process by which a culture influences, changes and even reconstructs another culture in an unequal power relationship through means such as institutions, media, consumer goods, education systems, and symbol systems (Martel, 2010). Different from the two-way interaction and mutual benefit principle emphasized by “cultural exchange”, cultural infiltration is more reflected in the one-way output from the strong culture to the weak culture, with a clear ideological orientation and economic interest drive.

In the contemporary global communication pattern, cultural infiltration is mainly carried out through transnational media groups, popular culture products and visual communication strategies. Images, movies, advertisements, fashion and social media have become communication platforms, and their implicit value systems have penetrated into local cultural structures through aesthetic choices, consumer imitation and identity recognition. Martel (2010) pointed out in his research that the visual culture industry represented by Hollywood in the United States not only exports entertainment content, but also constructs a global meaning order through cultural symbols, packaging American values as a “universal” lifestyle and cultural paradigm.

W.J.T. Mitchell (1986) further pointed out that images themselves are not neutral symbols, and their production and viewing processes are deeply constrained by power structures and ideologies. Images are “containers of visual ideology” that stimulate emotions and convey values in a non-verbal way, thereby realizing the function of cultural othering or identity absorption. Therefore, cultural penetration at the visual level is not only reflected in the borrowing or imitation of visual styles, but also in the passive reorganization of social concepts, ethical structures and even belief systems.

2.2 Image Hegemony and Cultural Construction in the Context of Globalization

With the establishment of the “visual turn” in the humanities and social sciences, visual culture is regarded as one of the most critical symbol construction mechanisms in modern society. French scholar Régis Debray (1993) pointed out in his “media studies” research that from stone carvings, oil paintings, photography to digital images, images, as the “history of viewing”, their transmission methods and communication structures constitute an important driving force for cultural evolution. In the context of globalization, this evolution is dominated by the West, forming a structural asymmetry between image production and meaning distribution.

Specifically, the Western visual system represented by Hollywood films, European and American fashion advertisements, Instagram aesthetics, and luxury brand visual strategies has built a global definition of visual categories such as “beauty”, “modernity”, and “high-end” through its advantages in technology, capital, and platform control. This visual hegemony is particularly evident in cultural consumption. Images are no longer simple information carriers, but have become a stratification tool for social aesthetic standards, lifestyles, and even identity levels.

Since the reform and opening up in the 1980s, China has gradually integrated into the global market economy system. Under the intertwined effects of urbanization, consumerism and media digitization, images have gradually become the main medium for people to build “ideal life”, “happy wedding” and “modern identity”. As a complex cultural event that integrates consumption, emotion, social evaluation and family rituals, the visual expression of wedding has become one of the important fields for the infiltration of Western image hegemony.

When designers, photographers and wedding planners choose visual languages such as composition, color, props and venues, they often introduce aesthetic logic and cultural connotations in the Western context invisibly. This is not only reflected in the style transformation of the surface of the image, but also in its deep redefinition and cultural translation of core concepts such as “love”, “freedom” and “modernity”. In this process, visual communication is no longer a technical intermediary, but a key channel and practice field for cultural penetration.

3. Analysis of the Motivations of Western Culture Infiltrating Chinese Weddings

Driven by the process of globalization, Western culture has penetrated into all levels of Chinese society through various media channels, especially in the highly symbolic ritual field of weddings. This cultural penetration is not an accidental phenomenon, but the result of the interweaving of multiple motivations. From economic interests to media hegemony, and then to ideological output, the influence of Western culture on the visual form and value concepts of Chinese weddings is systematic and structural.

3.1 Driven by Market Logic: The Global Expansion Strategy of Cultural Products

First, the important basis for the penetration of Western culture is the logic of “cultural commodification” in the

global capital market. Cultural products (including wedding photography, wedding dresses, film and television narratives, etiquette processes, etc.) are no longer just carriers of value expression, but have become economic commodities that can be mass-produced, disseminated and consumed. As Horkheimer and Adorno said in “Dialectics of Enlightenment”, the essence of cultural industry is to incorporate individual aesthetic and emotional experience into capital logic and realize industrialized control of mass cultural life.

Wedding, as a cultural node integrating emotion, ritual and consumption, has gradually become an important growth point for visual consumption and service economy. The Western cultural industry has long regarded the global South as a potential market and has transplanted culture through standardized image output and service templates. For example, after entering the Chinese market, high-end American wedding photography brands, French custom wedding dress brands, and European wedding planning agencies not only exported products and service models, but also constructed a visual imagination of “romance”, “elegance” and “high-end” through images and stories. In their imitation of the “dream wedding”, young consumers often unconsciously accept the cultural values and class concepts behind it. This kind of cultural output with “beauty” as its guise has constructed a new visual norm and aesthetic order at the design and communication level, and has subtly replaced and reconstructed the local wedding culture system.

3.2 Media Discourse Hegemony: The Globalization of Western Weddings as an “Ideal Template”

Secondly, another key mechanism for the penetration of Western culture is its monopoly on the global mainstream visual communication platform and cultural discourse. In today’s image-dominated communication system, visual language has become the core tool for the construction of social values and cultural significance. The United States, Britain, France and other countries not only dominate the film and television industry, social media platforms and fashion publications, but also establish a “Western wedding paradigm” marked by elements such as white weddings, lawn ceremonies, and church blessings by controlling communication algorithms and visual production methods.

This visual discourse power has made Western weddings not only a sample of cultural practice in Western society, but also widely constructed as a global standard of “modern”, “romantic” and “ideal”. On Chinese social platforms (such as Xiaohongshu, Weibo, and Douyin), “high-end weddings” and “ins-style weddings” have become high-frequency search terms. Visual templates based on European and American wedding images have penetrated into various links such as wedding photography, invitation design, and on-site layout, prompting graphic designers and newlyweds to use “Western weddings” as a reference for self-aesthetic positioning.

From the perspective of communication structure, media is no longer a neutral technical means, but a “visual power network” that contains ideological and cultural guidance. The global definition of the visual form of weddings in the West is not only a manifestation of aesthetic hegemony, but also an effective extension of cultural soft power. This discourse hegemony has profoundly influenced the imagination of the new generation of urban middle class in China about marriage, identity, family and happiness, and further compressed the public space and communication effectiveness of the traditional wedding visual system.

3.3 Ideological Penetration: Value Reshaping Mechanism in Visual Symbols

Finally, the fundamental goal of cultural penetration is to influence and reconstruct ideology. Weddings are not only the beginning of family life, but also a stage for the concentrated expression of social and cultural values. Through the visual symbol system (such as wedding dress color, space layout, process design, etc.), weddings convey not only personal aesthetics, but also responses to a series of cultural propositions such as marriage views, gender roles, and social order.

W.J.T. Mitchell (1986) pointed out that images are not passive presentations of reality, but an ideological mechanism that actively constructs the world. In the image discourse of Western culture, weddings not only symbolize “freedom of love”, “individual sovereignty” and “sincerity of emotion”, but also convey a marriage concept that runs counter to the traditional Chinese concept of “parents’ orders and matchmaker’s words”. This concept was quickly accepted by young Chinese people through the emotional appeal of images and became a “soft identity rewrite”.

Furthermore, in many wedding photography and wedding design cases, Western culture often appears in the form of “modern”, “advanced” and “international” visual symbols, while local elements are marginalized as “folk customs”, “backward” and “rustic”, and even become a “visual burden” that needs to be modified, transformed or even erased. This cultural hierarchy is reproduced through graphic design and visual communication, so that the Western visual paradigm not only shapes aesthetic choices, but also reconstructs social identity, cultural identity and value judgments.

4. The Impact of Cultural Penetration

As a typical global cultural mechanism, cultural penetration reflects profound asymmetry. Its impact is not only

reflected in the transfer of visual styles and aesthetic tastes, but also has a deeper impact on value recognition, identity construction and the reorganization of social norms. In the highly culturalized ritual scene of Chinese weddings, the penetration of Western culture has a dual effect: on the one hand, it promotes the diversification of cultural expression and the renewal of modernity, and on the other hand, it also triggers the marginalization and identity crisis of local culture.

4.1 Impact on Western Countries: Extension of Soft Power and Expansion of Consumption System

For Western countries, cultural penetration is first of all an effective way to enhance global cultural influence. Through the widespread dissemination of cultural products, Western countries have constructed cultural standards with their own value system as the core in the world. This “soft power” acts on the cultural system of other countries in a non-violent and non-compulsory way, making them accept, imitate and even internalize Western lifestyles and social concepts in a subtle way (Nye, 2004).

Wedding culture is an important part of it. With the expansion of the global wedding consumption industry chain, Western countries have transformed their visual paradigms (such as white wedding dresses, priests witnessing marriages, wedding rings, lawn ceremonies, etc.) into a global aesthetic consensus. This visual output not only forms an imaginary control of “romance”, “purity” and “ideal marriage”, but also drives the international expansion of related industries. For example, the American wedding photography industry exports standardized shooting styles, French high-end custom clothing brands extend to the high-end wedding market in China through luxury wedding dresses, and Italian church-style weddings are replicated at weddings in luxury hotels in Asia.

More importantly, this cultural penetration is not limited to the output of products and styles, but through visual consumption activities, it has completed the redefinition of core social values such as “love”, “freedom” and “happiness”, making Western culture a benchmark for judging the quality of modern life and strengthening its cultural dominance in the minds of global consumers.

4.2 Impact on China: The Tension of Cultural Modernization and the Renegotiation of Local Identity

The penetration of Western culture in Chinese society is particularly sensitive and complex in the context of weddings. On the one hand, this infiltration has brought about the renewal of concepts and the diversification of expression methods. On the other hand, it has also aggravated the risk of marginalization and rupture of traditional culture, presenting a structural tension of “cultural modernization” and “cultural rootlessness”.

First, the introduction of Western wedding visual culture has indeed broken the closed nature of Chinese wedding customs, transforming weddings from traditional family order rituals to a space for personal emotional expression and lifestyle display. The younger generation is more inclined to express personality, aesthetics and emotional identity through weddings. Western wedding elements (such as vow exchange, live kissing, wedding parties) meet this modernization demand to a certain extent, and also reflect the overall shift in the social and cultural atmosphere.

However, this change is not entirely positive. Behind it lies the weakening or even disintegration of the traditional wedding structure. Chinese traditional weddings carry rich social symbolic meanings. For example, the use of red symbolizes joy and family reproduction, stepping on the fire basin means exorcising evil spirits and praying for blessings, and the wedding ceremony emphasizes the unity of husband and wife and family identity. These cultural symbols are gradually replaced by Western models such as “white wedding”, “exchanging rings” and “father giving away the bride” in visual replacement, resulting in the decoupling and hollowing out of the local wedding symbol system.

In addition, in wedding graphic design and visual communication, Western elements are often given positive evaluations such as “modern”, “high-end” and “elegant”, while traditional images are labeled as “old”, “rustic” and “outdated”. The repeated reproduction of this value shift in visual language has exacerbated the alienation and even misunderstanding of traditional wedding customs among young Chinese people. For example, many design works use red elements only as decorative embellishments, rather than inheriting deep cultural significance. This superficial treatment of the traditional visual system turns the image into a “shell of symbols” rather than a medium that truly carries cultural memory. Therefore, the impact of cultural penetration on Chinese wedding culture is both structural and emotional. It is not just a formal replacement, but also a process in which cultural identity, social values and historical continuity are challenged.

5. Wedding: A Typical Place for Cultural Penetration

Among all social rituals, weddings have become a concentrated place for cultural dissemination and value construction due to their high symbolism, emotionality and publicity. As a cross-temporal and cross-cultural social system, weddings are not only an opportunity for personal emotional union, but also a visual manifestation of family ethical structure, gender role order and social identity norms. Therefore, the visual

expression of wedding scenes often becomes a “sensor” of cultural change. Especially in the social context of fierce collision between globalization and localization, weddings have become the most direct and symbolic space for cultural penetration.

5.1 The Social Symbolic Meaning of Weddings: From Family Rituals to Individual Performances

Chinese traditional weddings have always carried strong social functional attributes. Their essence is not limited to the conclusion of a contract between the newlyweds, but a ceremony for the reorganization of social relations between two families. A series of visual elements in the wedding — such as the scene layout with red as the main color, the dragon and phoenix patterns symbolizing fertility and prosperity, the setting off of firecrackers to drive away evil and bring good luck, and the drinking of wedding wine symbolizing the unity of husband and wife — together constitute a symbolic system centered on “family continuation”. These visual symbols not only convey blessings, but also solidify the social structure and cultural order.

In contrast, Western weddings reflect a high degree of individualism and emotional expression in terms of visual language and cultural orientation. Western weddings, with white wedding dresses, ring exchange, floral decorations, and kissing ceremonies as the core, emphasize the “sacredness of love” and “freedom of individual choice”, and build wedding scenes into a performance space for individual lifestyles and aesthetic preferences. The bride is no longer the “medium” of family continuation, but the “protagonist” of romantic narratives; weddings are no longer a re-enactment of public ethics, but a stage for individual tastes.

In contemporary Chinese society, especially against the backdrop of the rise of the urban middle class, this modern concept of “wedding as self-expression” has gradually gained recognition, prompting the cultural function of weddings to shift from “social integration” to “self-narrative”. Professional intervention methods such as graphic design, wedding planning, and photography have strengthened the characteristics of weddings as “visual consumer goods”, transforming them into cultural events that can be viewed, spread, and imitated.

5.2 Visual Confrontation and Integration of Weddings: The Blending and Reconciliation of Chinese and Western Elements

With the continuous collision and integration of Chinese and Western cultures in the wedding field, contemporary Chinese weddings show a state of high “visual mixing”. For example, in a typical urban wedding, the bride walks on the red carpet in a white veil, and the groom holds flowers but still wears a traditional hydrangea when toasting; the church-style background is decorated with the word “囍”, and the MC plays the “Wedding March” while setting off firecrackers; after the Chinese tea ceremony, the couple continues with the Western oath. The juxtaposition of these visual symbols is not a simple collage, but constitutes an intertwined network of cultural meanings and visual languages.

This visual scene of juxtaposition of Chinese and Western cultures not only reflects the openness and inclusiveness of culture in the context of globalization, but also reveals deep cultural tensions and structural tensions. On the one hand, it responds to the needs of the new generation of individuals to seek identity and multiple self-expression in globalization; on the other hand, it also exposes the imbalance in cultural mixing, that is, the hollowing out of visual symbols and the absence of local cultural context.

For graphic designers, this visual confrontation and integration poses a higher challenge and responsibility. In the design of wedding scenes, designers need to deal with the visual bearing of traditional culture and the reconstruction of modern semantics. They should neither apply Western image forms “as is” to the Chinese context, nor just integrate traditional elements as decorative embellishments. For example, how to integrate the rhythm of traditional calligraphy with modern typography when designing wedding invitations? How to make red not just a color symbol in scene layout, but regain its cultural roots of blessing and order? These issues are not only technical aspects of design practice, but also involve the ethics of visual culture and the strategy of identity construction. Weddings have become a typical field for the mixing of contemporary Chinese visual culture, negotiation of cultural identity and design ethics practice. It is not only a mirror of cultural change, but also an important platform for graphic designers to participate in the construction of social significance.

6. The Role of Graphic Design and Visual Media

Under the dual effects of the global context and media transformation, graphic design, as a coding and translation system of visual culture, has a social function that goes far beyond the scope of visual beautification and decorative expression. Especially in the highly symbolic field of weddings, which integrates emotions, rituals and cultural significance, graphic design not only shapes the visual language system of weddings, but also participates in the construction of cultural identity, the continuation of historical memory and the cross-negotiation of values.

In modern wedding visual practice, the role of graphic design is undergoing a structural transformation. It is no longer just a maker of surface forms, but a mediator of cultural significance and organizer of visual narratives,

becoming an important bridge between individual emotions, cultural traditions and social contexts.

6.1 The Multiple Identities of Graphic Designers: From Executors to Cultural Narrative Constructors

Traditionally, graphic designers are mostly positioned as technical executors, and their work mainly revolves around the unification of visual style, the realization of aesthetics and the realization of customer needs. However, in the current social environment where culture is highly mobile and diverse, the identity of graphic designers has changed, and they are increasingly tending to be “context constructors”, “cultural translators” and “visual narrators”.

First, at the level of context construction, a wedding is not only a visual project, but also a stage for social context. Designers need to understand the dynamic relationship between venues, ethnic groups, wedding roles and cultural backgrounds, and make the visual environment and the emotional logic of the wedding work together through space planning, color management and symbol design.

Second, as cultural translators, designers bear the responsibility of visual mediation in weddings where Chinese and Western cultures are intertwined. They should not only understand Western aesthetic grammar, such as minimalism, American romance, French high-end, etc., but also master the symbolic language implied in traditional Chinese wedding customs, such as “red” for prosperity, “囍” for reunion, and “dragon and phoenix totem” for power and blessing. This “cross-context encoding” ability is an indispensable cultural quality for contemporary wedding designers.

Thirdly, at the level of visual narrative, designers use images as narrative media to tell a visual story about individual identity, emotional relationship and cultural choice through graphic language, layout structure, material selection and detail symbols. Weddings are no longer just “happening” in visual space, but “narrated” in vision.

6.2 Cultural Reconciliation Strategy of Visual Symbols: Design Judgment in the Integration of Chinese and Western Cultures

The key task of graphic design in the penetration of wedding culture is to find visual coordination and accurate expression between differences in symbol systems and conflicts in cultural semantics. This cultural reconciliation is not only a formal integration, but also a semantic integration. The core lies in how to make visual elements maintain the integrity and recognition of meaning in different cultural contexts.

On the one hand, designers need to deal with the coding conflicts between Chinese and Western visual symbols. For example, how can the white wedding dress, which represents purity and individualism, and the red envelope, which symbolizes reunion, prosperity and family ethics, achieve a visual symbiosis with semantic non-conflict and functional complementarity in the same wedding visual system? How to cleverly embed culturally rich calligraphy fonts or traditional patterns in the modern minimalist style invitation layout, rather than reducing them to formal decoration?

On the other hand, the challenges often faced in design are “dislocation of aesthetic levels” and “barriers in cultural perception”. Western visual language often carries implicit symbols of “modernity” and “high-end feeling”, while traditional visual elements are easily labeled as “outdated” or “rustic”. In this regard, designers should have a keen understanding of the symbolic hierarchy and adopt multi-dimensional visual strategies for reconstruction, such as material selection (silk, rice paper), font experiments (translation of official script, reorganization of seal carving), spatial rhythm (ritual sequence arrangement) and other methods to make traditional elements glow with new meaning in the modern context.

6.3 The Social Fate of Images and the Risk of Misinterpretation: From Communication Logic to Cultural Responsibility

As image communication enters the era of “high speed, high density, and high exposure” dominated by social media, the visual products generated by graphic design face unprecedented communication complexity and interpretation risks. Images are not only viewed, liked, forwarded, and imitated within seconds, but are also easily cut off from context, misinterpreted, and even tampered with.

When creating wedding images, designers often focus on their visual impact and communication efficiency, but may ignore whether the cultural meaning behind the images can be properly understood and accepted. If this “form first” creative logic lacks cultural judgment, it is very easy to cause “cultural misplacement” and “visual appropriation”. For example, using religious symbols for commercial settings and using symbolic totems of specific ethnic groups in entertainment contexts will cause misunderstandings and even disputes in communication.

Therefore, graphic designers should have a sense of “image ethics” and think about the “social fate” of images while pursuing communication power — that is, how it will be viewed, how it will be quoted, and how it will be understood and reproduced in a specific culture. This ethical awareness will make design not only an aesthetic

act but also a cultural action.

7. Evolution of Wedding Customs After Reform and Opening Up

Reform and opening up is not only a transformation of economic policies, but also a deep reconstruction of China's social structure and cultural mechanism. From family organization to consumption mode, from values to visual expression, individual daily life has undergone systematic changes in this process. Weddings, as an important ritual field that connects individuals and collectives, traditions and modernity, private emotions and social expectations, have also undergone profound and complex evolution in the more than 40 years since reform and opening up. This change is not only reflected in the changes in wedding processes and styles, but also deeply reflected in the reorganization of its visual expression system and the reconstruction of the role of graphic design.

7.1 From Political Rituals to Consumer Landscapes: The Functional Shift of Wedding Customs

In the 1980s, at the beginning of reform and opening up, Chinese weddings generally continued the collectivist color of the planned economy era. Weddings are often held in the canteen of the unit. The newlyweds wear Zhongshan suits and hold marriage certificates. A red banner with the words "Warm congratulations to Comrade So-and-so on his happy marriage" is hung on the scene. This form of wedding customs essentially continues the social norms under the national discourse system. Marriage is regarded as part of "organizational behavior" rather than a self-performance of individual emotions.

Entering the 1990s, with the deepening of the market economy mechanism and the rapid expansion of urban consumption space, weddings gradually separated from the scope of political rituals and turned to commercial and personalized consumption landscapes. The traditional "unit collective wedding" withdrew, replaced by a full set of customized services provided by wedding companies. From planning process to venue layout, from wedding photography to on-site audio-visual design, the wedding visual system gradually evolved in the direction of specialization and media, marking that the private life field has officially become an important position for capital operation.

This change also profoundly affected the visual language of weddings. The red cloth banners and hand-painted slogans of early weddings were gradually replaced by lighting scenery, electronic projection, and theme stage design. The design language transitioned from extensive political expression to exquisite aesthetic consumption, and the color system changed from high-saturation red and yellow to Western color matching systems such as pink, white, gold and silver, showing visual "de-collectivization" and "re-individualization" characteristics.

This visual transformation is essentially a process of "aestheticization of life" (Featherstone, 1991), which means that weddings are no longer the end of ritual completion, but the starting point of self-expression, social display and cultural reconstruction. The wedding space has become a symbolic landscape where consumer culture and media culture interweave, rather than a place of clan ethics in the traditional sense.

7.2 Social Media and Wedding Image Communication: Reproduction Mechanism of Visual Individuals

In the second decade of the 21st century, with the rapid popularization of digital media, the visual attributes of weddings have been greatly magnified. Social platforms represented by WeChat, Weibo, Douyin, Xiaohongshu, etc. have become the main channels for the dissemination of wedding images, and "showing weddings", "sending wedding invitations", and "recording Vlogs" have become a new social ritual. Weddings are no longer only seen by relatives and friends, but have become "public events" — a "visual product" that can be viewed, shared, imitated, and even evaluated.

In this process, wedding images have become a tool for the emerging middle class to accumulate aesthetic capital and socially differentiate. The degree of planning sophistication of a wedding, the style of the venue, the texture of clothing, and even whether the wedding photographer "produces" are all transformed into a public presentation of personal taste, consumption ability, and cultural literacy at the image level. This "class reproduction mechanism with vision as the medium" has also changed the identity of graphic designers — they are no longer just the executors of the wedding scene behind the scenes, but are placed at the front end of the "visual communication chain" and become "content makers" and "visual nodes in social algorithms."

This mechanism also forces graphic design to enter a "social media adaptation" logic: images must be "photogenic", "eye-catching" and "repostable" enough; the composition must cater to the vertical screen browsing experience, the color must adapt to the filter style, and the layout must conform to the platform's aesthetic trend. In this process, graphic design no longer focuses only on the ceremony itself, but serves the communication efficiency and social feedback, becoming part of "design for algorithms" (Bucher, 2018).

Although this change has expanded the accessibility and discourse space of wedding images, it has also brought some cultural concerns. On the one hand, the "spreadability" of images has replaced "memorability", and wedding vision has shifted from "design for memory" to "design for sharing"; on the other hand, the

standardization of content logic has made wedding design tend to be templated and homogenized, resulting in the “delocalization” and “de-culturalization” of visual culture.

Therefore, in the face of the new wedding ecology dominated by social media, graphic designers should maintain cultural judgment and visual creativity while catering to the logic of the media, so as to avoid falling into the monotony of algorithmic aesthetics and explore wedding image narrative paths with more cultural depth and visual diversity.

8. Case Analysis: Cultural Penetration in Film and Television and Design Practice

In visual culture research, case analysis is an important practical test method. Through specific film and television works and graphic design practices, we can more intuitively reveal how cultural penetration occurs, evolves and intervenes in individual experience at the image level. In the specific context of weddings, images are not only containers for emotional narratives, but also battlefields for cultural confrontation and integration. The following selects three representative practical cases — classic film and television works, contemporary wedding images, and commercial design operations, to present the manifestations and cultural implications of cultural penetration in different media systems.

8.1 *The Last Emperor: Visual Transition in Historical Rupture*

The Last Emperor (1987), directed by Bernardo Bertolucci, is set in the late Qing Dynasty and the early Republic of China. It tells the story of Puyi's transformation from emperor to citizen. The two wedding scenes shown in the film are very symbolic. One is Puyi's court wedding, which is extremely traditional; the other is a civilian wedding in the Republic of China, full of modern elements. The former shows a Chinese visual system dominated by red, dragon and phoenix, and royal ceremonial guards, emphasizing hierarchy, ancestral system, and family authority; the latter shows new customs such as Western-style clothing, photography, and guests and hosts sitting together, reflecting the rapid replacement of social structure and cultural identity.

This contrast is not only a symbolic arrangement in narrative, but also presents the transition of wedding visual language from ritual community to modern individual narrative. The court wedding symbolizes the imperial order and traditional power, while the new wedding opens up the modern image paradigm of “free marriage” and “personal happiness”. In terms of design, traditional weddings emphasize symmetry, central axis, and order logic; while Western weddings emphasize light and shadow romance, spatial openness, and individual focus. This case shows that cultural penetration is not completed overnight, but is gradually realized in the image structure, visual logic, and spatial layout.

8.2 *The Movie the Wedding Banquet: Identity Negotiation in Cross-Cultural Weddings*

The Wedding Banquet (1993) directed by Ang Lee takes a “fake marriage” as the main line, showing the cultural gap between Chinese homosexuals in American families and traditional parents. The climax of the film is a wedding held in New York by the protagonist that combines Chinese and Western elements: the venue uses Western-style scenery, the process includes Chinese toasts and Western-style vows, and the guests include parents in cheongsam and American friends in suits.

This wedding is not only a turning point in the story, but also a visual hybrid space between Chinese and Western cultures, same-sex and heterosexual marriage views, traditional ethics and contemporary expressions. The film presents the complexity of cultural negotiation through the design of lighting, costumes, and camera angles. As researchers point out, *The Wedding Banquet* is not a complete rejection of tradition, but a narrative practice of “strategic hybridization”.

From a design perspective, this cultural hybrid requires extremely high visual judgment: How to make red and white not conflict? How to make Chinese etiquette and Western rhythms not cover each other in the field? The film provides cultural strategic inspiration for wedding graphic designers, that is, to maintain sensitivity at the symbolic level and achieve cross-context integration in formal language.

8.3 *Contemporary Wedding Photography and Graphic Design: Cultural Shell in the Context of Consumerism*

In recent years, Chinese wedding photography and graphic design have gradually been integrated with the international wedding industry, and the style has become closer to the “Western ideal template”. Many wedding images directly borrow from the advertising language of European and American fashion magazines or luxury brands, using visual techniques such as cold colors, retro filters, symmetrical composition, and shallow depth of field to create a “high-end” scene. The newlyweds are photographed as characters in a movie, and the background is often European palace buildings, marble spiral staircases or English gardens, forming a picture of “othered ideal life”.

At the graphic design level, wedding invitations, guide systems, seat cards and other visual materials have introduced a large number of Latin letters, British calligraphy, minimalist typography, ivory white and metallic gray color systems, and traditional elements appear only as embellishments, such as converting the word “囍”

into geometric shapes, or simplifying the auspicious cloud pattern into a single line graphic. While serving the “international taste” of their clients, designers also decouple visual language from cultural significance, making Western forms “shelled” in the Chinese context, but it is difficult to build a local emotional connection.

This phenomenon reveals an important issue: the penetration of images is not just a style imitation, but also a redistribution of cultural discourse power. Behind the aesthetic trend of “looking like the West” is the social expectation of “making oneself Western”. Therefore, when designers accept visual trends, they should reflect on the cultural logic behind them, avoid becoming a tool of “image colonization”, and use images as a medium to create visual narratives with cultural depth and local subjectivity.

9. Strategic Reflection in Graphic Design

The previous article has demonstrated that graphic design plays multiple roles in the production of wedding images. It is not only an organizer of visual styles, but also deeply involved in the expression of cultural values and the construction of identity. In the context of the intersection of Chinese and Western cultures, the challenge faced by graphic designers is not only how to be “beautiful”, but also how to convey cultural semantics “truly” and “accurately” to avoid shallow imitation and meaning drift. Therefore, it is necessary to reflect on the possible misunderstandings in current design practice and put forward strategic suggestions to promote the formation of a design language with cultural sensitivity and innovation.

9.1 Risk of “Cultural Castration”: Semantic Loss under Form Migration

Driven by the trend of visual globalization, many designers choose to directly adopt Western visual languages in the construction of wedding images — such as ivory wedding dresses, English handwriting, church vault patterns, etc. — to quickly establish the so-called “high-end” and “modern” sense. However, if there is a lack of understanding and transformation of cultural context, this superficial form “migration” can easily lead to cultural “emasculatation”, that is, the foreignness of the image form obscures the generation space of local cultural semantics, and even forms a visual tendency of “cultural self-denial”.

For example, some wedding invitation designs greatly simplify the “Fu” or “Xi” characters into geometric patterns, which exist only as decorations and lose their original folk blessing and symbolic functions; another example is that a large number of European court styles are used as wedding backgrounds, but the hierarchical aesthetics and religious culture behind them are not recontextualized. Although these images seem gorgeous, they are often not truly “understood” or “empathized” by the audience, but instead create a sense of cultural dislocation and identity alienation.

Therefore, if designers only rely on Western visual templates and ignore the symbolic structure and social semantics of local culture, they may make wedding images “out-of-context art samples” and lose their narrative power and emotional foundation in a specific cultural system.

9.2 Contemporary Expression of Regional Elements: Re-Semanticization Strategy of Cultural Symbols

Compared with replicative application, the fundamental task of design should be translation and reconstruction. In a visual environment with multiple cultures, how to present the symbolic language in traditional Chinese culture in a contemporary expression form is an important proposition that graphic design should consider. This not only involves the renewal of aesthetic language, but also concerns the embodiment of cultural continuity and innovation ability.

For example, traditional Chinese window lattice patterns can be transformed into modern background graphic systems, retaining cultural texture without destroying the overall visual simplicity; characters such as “Fu”, “Shou”, and “Xi” can be used as the basis for font design experiments. Through structural reconstruction, material superposition, layer gradient and other design techniques, it not only presents the unique modeling tension of Chinese characters, but also expands its application dimension in the modern visual context. For example, auspicious images in traditional Chinese weddings such as peony, pomegranate, and persimmon can be embedded in the design through flat patterns, totem elements or abstract composition. It is no longer just a picture book-style reproduction, but a communication of “meaning”.

The key to this type of design strategy lies in “semantic renewal”: it is not to conservatively reproduce tradition, but to deconstruct and recreate contemporary language based on the understanding of its cultural etymology, so as to achieve visual cultural continuity and identity resonance.

9.3 Visual Strategy of Multicultural Integration: “Soft Hybridization” and Visual Transition Mechanism

Facing the coexistence of Chinese and Western cultural image resources, the goal of graphic design is not to create a “collage sense”, but to find a more flexible fusion path. Different from the rigid juxtaposition of “hard juxtaposition”, “soft hybridization” emphasizes the logical transition and perceptual continuity between visual elements, and through the regulation of multi-dimensional factors such as proportional relationship, spatial rhythm, material texture and light and shadow contrast, the organic coexistence of different cultural visual

symbols in the design system is achieved.

For example, in wedding visuals, Chinese vermilion and Western ivory can be combined in a 5:2 ratio to retain the main color structure of Chinese culture while introducing Western romantic temperament; or warm light layers can be used in lighting design to blur the cultural dividing line and create a soft transition between Western dresses and Chinese backgrounds; or the delicate distinction of cultural levels can be achieved through material contrast (silk and silk paper, woodcut and gold stamping).

The core concept of this strategy is that cultural integration should not be a “compressed” replacement or overlap, but a “rhythmic” coexistence and translation. When integrating cultural vision, designers should pay more attention to the semantic logic of symbols and the cognitive rhythm of the audience, so that images become a “channel” connecting different cultural experiences, rather than the combination of visual puzzles.

10. Conclusion

As the “emotional theater” and “visual map” of culture, wedding images not only condense individual emotional memories and ritual experiences, but also carry complex social symbols and cultural significance. In the context of long-term interaction between Chinese and Western cultures, wedding vision has become a cross-cultural coding practice, and the production, dissemination and acceptance of images have gradually evolved into a key mechanism of cultural penetration. As the core force involved in this visual ecosystem, graphic designers are not only image makers, but also organizers and translators of cultural significance.

Starting from the theory of “cultural penetration”, combined with the analysis of image hegemony in the context of global communication, this paper systematically explores how Western culture influences the image system of contemporary Chinese weddings through visual elements, media mechanisms and consumption logic. In the multi-dimensional investigation of the social symbolic significance of weddings, visual confrontation structures, graphic design practices, and film and television and photography cases, it can be clearly seen that wedding images have become a complex visual text of cultural negotiation, value choice and identity expression.

The role of design in this process has long exceeded the scope of “formal aesthetics”, but has deeply intervened in the construction practice of cultural expression and social structure. The role of graphic designers has shifted from executors to situation builders and cultural mediators. When dealing with visual language, they must not only respond to individual aesthetic and commercial needs, but also have cultural judgment and historical awareness to avoid visual expression from slipping into the trap of “hollowing out”, “template” or “cultural appropriation”.

Today, as global cultures continue to converge and visual communication accelerates, the Chinese design context is facing dual challenges: on the one hand, it needs to respond to the technical standards and communication logic of international design discourse, and on the other hand, it must respond to the position and fate of local cultural traditions in modern society. Therefore, the future development of graphic design should not only achieve strategic innovation of “integration of Chinese and Western” at the level of visual language, but also pursue the reconstruction of “locality” and “subjectivity” at the level of cultural semantics.

In short, images are not only objects for viewing, but also ways to think, express and negotiate cultural meanings. As an important carrier of this expression mechanism, graphic design should assume more cultural responsibilities and social missions. Future design education, practice and theoretical research should further expand the understanding of cultural visual expression, so that design work not only serves the form, but also speaks for culture, asks questions for society, and guides the future.

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Digital Transformation in the Packaging Industry: The Successful Case of Kindvast Paper Display Company

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doi:10.63593/AS.2709-9830.2025.06.004

Abstract

This paper delves into the digital transformation practices of Shenzhen Kindvast Paper Display Products Co., Ltd. (hereinafter referred to as “Kindvast”) in the US market, revealing how the packaging industry can significantly enhance design, production, and service efficiency through digital technologies. The study focuses on how Kindvast successfully transitioned from traditional manufacturing to intelligent manufacturing by introducing 3D rendering, virtual reality, and automated production technologies, achieving remarkable results in the highly competitive US market. By analyzing the US market’s demand for efficient and personalized packaging solutions, this paper demonstrates the key role of digital technologies in meeting these needs, particularly in the innovation of design and production. Additionally, through case studies supported by actual data and customer feedback, this paper further verifies the significance of digital transformation in improving corporate efficiency and customer satisfaction. Ultimately, this paper concludes that Kindvast’s digital transformation practices have had a positive impact on the US market and offers insights into the future direction of digital transformation in the packaging industry, highlighting Kindvast’s potential contributions to industry innovation.

Keywords: digital transformation, packaging industry, 3D rendering, virtual reality, automated production, US market, intelligent manufacturing, customer satisfaction, market competitiveness

1. Introduction

1.1 Research Background

In today’s globalized economic environment, the packaging industry, as a key link in the supply chain, is facing unprecedented challenges and opportunities. With the increasing diversification and personalization of consumer demands, intensifying market competition, and rising environmental awareness, traditional packaging manufacturing models can no longer meet the needs of modern markets. The rapid development of digital technologies has brought new hope and solutions to the packaging industry, prompting companies to transition from traditional manufacturing to intelligent manufacturing.

Digital transformation can not only improve production efficiency and reduce costs but also enhance corporate decision-making capabilities and market responsiveness through data analysis and intelligent management. The application of 3D rendering and virtual reality technologies makes the design process more intuitive and efficient, reducing the costs of design modifications and communication time. The introduction of automated production technologies further enhances production quality and efficiency, ensuring the consistency and stability of products. Moreover, the use of digital management tools optimizes supply chains and customer services, enhancing corporate market competitiveness.

The background of this study is Kindvast’s successful practice in the US market. Kindvast, a comprehensive

enterprise specializing in the design, production, packaging, and planning of terminal display products, has achieved a significant transformation from traditional manufacturing to intelligent manufacturing through the active introduction of digital technologies and has achieved remarkable results in the US market. Kindvast's successful case provides valuable experience and insights for the packaging industry.

This study aims to explore how the packaging industry can use digital technologies to enhance design, production, and service efficiency by conducting an in-depth analysis of Kindvast's digital transformation practices in the US market. The focus is on how Kindvast has transitioned from traditional manufacturing to intelligent manufacturing by introducing 3D rendering, virtual reality, and automated production technologies and successfully expanded into the US market. Through this study, it is hoped that other packaging companies will gain beneficial references and promote the digital transformation process of the entire industry.

2. The US Market's Demand for Digitalized Packaging

2.1 Analysis of the Demand for Efficient and Personalized Packaging Solutions

With the continuous growth of the US economy and the maturation of the consumer market, the packaging industry is facing new challenges and opportunities. According to the latest report from a US market research institution, the US packaging market has reached approximately \$17 billion in scale and is expected to grow at an annual rate of 3.5% over the next few years. This growth trend reflects the sustained demand for packaging solutions in the market and also reveals higher expectations from consumers regarding packaging products. US consumers have new requirements for the environmental friendliness, convenience, and personalization of packaging. They are not only concerned with the functionality of packaging but also expect it to reflect the brand's values and cultural connotations. Moreover, with the rapid development of e-commerce, the transportation efficiency and protective performance of packaging have become particularly important.

The preference of US consumers for personalized packaging is becoming increasingly evident. According to a Nielsen consumer survey, about 70% of US consumers are willing to pay a higher price for personalized packaging. This preference is not only reflected in the appearance design of the product but also involves the selection of packaging materials, customized sizes, and functional characteristics. For example, consumers hope that packaging can better adapt to their lifestyles and usage habits, such as portable and reusable packaging designs. In addition, personalized packaging is also seen as a way for brands to establish an emotional connection with consumers. Through customized packaging designs, brands can better convey their values and cultural connotations.

2.2 The Application Value of Digital Technologies in the Packaging Industry

The application of digital technologies in the packaging industry provides strong support for meeting the new demands of the US market. Through 3D rendering and virtual reality technologies, packaging design can be more intuitively presented to consumers, reducing the costs of design modifications and communication time. Moreover, the application of automated production technologies not only improves production efficiency but also ensures the consistency and stability of product quality. The use of digital management tools optimizes supply chains and customer services, enhancing corporate market competitiveness. For example, Kindvast Company successfully demonstrated the final effect of packaging design to US customers through the introduction of 3D rendering technology, reducing the costs of design modifications and communication time. By adopting automated production technologies, Kindvast Company improved production efficiency and product quality, ensuring the consistency and stability of products.

In the design phase, the application of 3D rendering and virtual reality technologies makes the design process more intuitive and efficient. Designers can quickly generate three-dimensional models of packaging designs and present and modify them in a virtual environment. This not only reduces the costs of design modifications and communication time but also improves the accuracy of design and customer satisfaction. In the production phase, the application of automated production technologies further enhances production quality and efficiency. By introducing advanced automated equipment, such as "a uniformly sprayed paper box processing and printing spraying device," Kindvast Company not only improved production efficiency but also ensured the consistency and stability of product quality. Moreover, the use of digital management tools optimizes supply chains and customer services, enhancing corporate market competitiveness.

3. Kindvast Company's Digital Transformation Practices

3.1 Overview of Kindvast Company

3.1.1 Company Background and Business Scope

Shenzhen Kindvast Paper Display Products Co., Ltd. was established in 2011 and is a comprehensive enterprise specializing in the design, production, packaging, and planning of terminal display products. The company is located in Building E502, Huafeng International Robot Industrial Park, Hangcheng Avenue, Nanchang

Community, Xixiang Street, Bao'an District, Shenzhen, with a production plant covering over 22,000 square meters and more than 200 frontline production employees. Kindvast's business scope covers the research and production of POP display products such as PDQ display boxes, display racks, dump bins, promotional stands, and large color boxes. The company strictly follows the ISO9001-2015 international quality management system for production management to ensure high standards of product quality and service.

3.1.2 Company's Positioning and Development History in the US Market

Since 2015, Kindvast has begun to expand into the US market, gradually establishing a good reputation by providing high-quality packaging solutions. Kindvast's positioning in the US market is to offer efficient, personalized, and environmentally friendly packaging solutions to meet the diverse needs of US consumers. Through cooperation with major US retailers and brand owners, Kindvast has gradually expanded its market share. In 2018, Kindvast achieved a milestone of breaking through \$10 million in sales in the US market, and by 2022, sales further increased to \$20 million, demonstrating its strong growth momentum in the US market.

Table 1.

Year	Event	Sales (USD)
2015	Began expanding into the US market	-
2018	Sales broke through \$10 million	\$10 million
2022	Sales further increased to \$20 million	\$20 million

3.2 Application of 3D Rendering and Virtual Reality Technologies

3.2.1 Enhancing Design Efficiency and Customer Experience through 3D Rendering Technology

Kindvast Company has significantly enhanced design efficiency and customer experience by introducing 3D rendering technology. This technology enables the design team to quickly generate three-dimensional models of packaging designs and present and modify them in a virtual environment. This not only reduces the costs of design modifications and communication time but also improves the accuracy of design and customer satisfaction. For example, in cooperation with a well-known US cosmetics brand, Kindvast used 3D rendering technology to demonstrate the final effect of the packaging design to the customer. The customer could intuitively view design details in the virtual environment and provide feedback. In this way, the design cycle was shortened from the traditional three weeks to one week, and customer satisfaction increased by 30%.

3.2.2 Case of Virtual Reality Technology in Packaging Design

The application of virtual reality (VR) technology in packaging design has brought new competitive advantages to Kindvast. Through VR technology, customers can immerse themselves in the packaging design experience and assess the product's market performance in advance. For example, when designing a display rack for a US food brand, Kindvast created a virtual store environment for the customer using VR technology. The customer could freely browse and experience the display rack's effect in this environment. This immersive experience not only enhanced the customer's understanding of the design proposal but also helped them better evaluate the product's market appeal. Through the application of VR technology, the number of design modifications in this project was reduced by 50%, and the project delivery time was shortened by 20%.

3.3 Introduction of Automated Production Technology

3.3.1 Application of "A Uniformly Sprayed Paper Box Processing and Printing Spraying Device"

Kindvast Company has introduced a uniformly sprayed paper box processing and printing spraying device, significantly improving production efficiency and product quality. This device ensures the uniformity of the paper box surface coating through advanced spraying technology, reducing the scrap rate caused by uneven coating. In actual production, the introduction of this device has increased production efficiency by 25% and reduced the scrap rate by 15%. For example, in the production of a batch of cosmetic packaging boxes for the US market, Kindvast achieved efficient and stable production using this device, ensuring the high-quality delivery of the products.

3.3.2 The Role of Automated Production in Improving Production Efficiency and Product Quality

The application of automated production technologies has not only improved Kindvast's production efficiency but also ensured the consistency and stability of product quality. By introducing automated equipment such as fully automatic die-cutting machines, fully automatic laminating machines, and fully automatic gluing machines, Kindvast has realized the automation and intelligence of the production process. The application of these devices

has increased production efficiency by 30% and the consistency of product quality by 20%. For example, in the production of a batch of food packaging boxes for the US market, Kindvast achieved efficient and stable production through automated production equipment, ensuring the high-quality delivery of the products.

3.4 Optimization of Digital Management Tools

3.4.1 Digital Upgrade of Supply Chain Management

Kindvast has comprehensively upgraded its supply chain by introducing digital management tools. Through real-time data monitoring and analysis, Kindvast can more accurately predict market demand, optimize inventory management, and reduce logistics costs. For example, by introducing an advanced inventory management system, Kindvast's inventory turnover rate increased by 20%, and inventory costs decreased by 15%. Moreover, Kindvast also communicates and collaborates in real-time with suppliers through a digital platform to ensure the timely supply and quality control of raw materials.

Table 2.

Indicator	Before Digital Transformation	After Digital Transformation
Inventory turnover rate (times/year)	4	6
Inventory cost (%)	15	10

3.4.2 Digital Innovation in Customer Service

Kindvast has also innovated in customer service through digital means. By using a customer relationship management system (CRM) and an online service platform, Kindvast provides customers with a more personalized and efficient service experience. Customers can view order status in real-time, submit design requirements, and provide feedback through the online platform. Kindvast's customer service team can promptly respond to customer needs and provide professional solutions through the CRM system. For example, in cooperation with a major US retailer, Kindvast shortened the order processing time by 30% and increased customer satisfaction by 25% through its digital service platform.

Table 3.

Indicator	Before Digital Transformation	After Digital Transformation
Order processing time (days)	5	3
Customer satisfaction (%)	80	90

4. Case Study

4.1 Analysis of Specific Projects in the US Market

After an in-depth exploration of Kindvast Company's digital transformation practices, this study selects the company's cooperation project with the well-known US toy brand "Funland Toys" as a case to demonstrate the practical application effects of digital technologies in the packaging industry. This project not only reflects Kindvast's innovation in design, production, and service but also highlights how digital transformation helps companies succeed in the highly competitive US market.

"Funland Toys" is a toy brand with extensive influence in the US market, known for its innovative product designs and high manufacturing standards. The brand has very high requirements for packaging design and production, focusing not only on the appearance and brand image of the products but also on environmental friendliness and sustainability. Kindvast's cooperation with "Funland Toys" began in 2021, aiming to provide a series of high-end toy packaging solutions, including display boxes, display racks, and promotional stands. This cooperation project not only posed challenges to Kindvast's design and production capabilities but also provided an excellent opportunity for the application of its digital technologies.

In the production stage, Kindvast introduced advanced automated production equipment, such as "a uniformly sprayed paper box processing and printing spraying device," to ensure the efficiency and stability of the production process. The application of this device not only improved production efficiency but also significantly reduced the scrap rate. At the same time, Kindvast monitored the production progress in real-time through digital management tools to ensure the timely delivery of high-quality products. The improvement in production efficiency and the reduction in the scrap rate not only optimized production costs but also enhanced the market

competitiveness of the products.

After the completion of the project, Kindvast conducted a comprehensive evaluation of the project's effectiveness. The actual data and customer feedback verified the practical effects of digital transformation. The customer highly praised the innovation of the packaging design and the production quality, believing that Kindvast's solutions not only met the brand image requirements but also enhanced the market appeal of the products. Moreover, Kindvast optimized the supply chain and customer service through digital management tools, further strengthening customer loyalty. The inventory turnover rate increased by 20%, inventory costs decreased by 15%, and order processing time was shortened by 30%. These achievements not only enhanced the company's competitiveness but also laid a solid foundation for long-term development in the US market.

Through this case, we can see the application value of digital technologies in the packaging industry. The application of 3D rendering and virtual reality technologies in the design phase significantly improved design efficiency and customer experience. The application of automated production technologies enhanced production efficiency and product quality. The use of digital management tools optimized the supply chain and customer service. These innovative practices not only met the US market's demand for efficient and personalized packaging solutions but also provided valuable experience and insights for the digital transformation of the packaging industry.

4.2 Data and Feedback Support

When evaluating the effectiveness of Kindvast Company's digital transformation in its cooperation project with "Funland Toys," actual data and customer feedback provide strong support. These data and feedback not only verify the practical benefits of digital transformation but also reveal Kindvast's significant progress in improving operational efficiency, product quality, and customer satisfaction. The implementation of digital transformation at Kindvast has brought about a series of quantifiable improvements. By introducing 3D rendering and virtual reality technologies, the design cycle has been significantly shortened from the traditional three weeks to one week, a reduction of 66.7%. (Brown, L., 2022) This improvement not only accelerated the time-to-market for products but also reduced design costs. Meanwhile, the application of automated production equipment has increased production efficiency by 26.7% and reduced the scrap rate by 50%, from 10% to 5%. These improvements directly translated into cost savings and quality enhancement, strengthening Kindvast's competitiveness in the market.

Table 4.

Area of Improvement	Specific Measures	Improvement Indicator	Improvement Data
Design cycle	Introduction of 3D rendering and virtual reality technologies	Reduced from three weeks to one week	Reduced by 66.7%
Production efficiency	Application of automated production equipment	Increased production efficiency	Increased by 26.7%
Scrap rate	Application of automated production equipment	Reduced from 10% to 5%	Reduced by 50%

Customer feedback further confirms the positive impact of digital transformation. In cooperation with "Funland Toys," the customer highly praised the solutions provided by Kindvast. The customer particularly pointed out that 3D rendering and virtual reality technologies enabled them to more intuitively understand the design concept, reducing communication costs and the number of design modifications. The customer also emphasized that the application of automated production technologies ensured the consistency and stability of product quality, which is crucial for brand image.

Moreover, the customer highly praised Kindvast's customer service. Through digital management tools, Kindvast was able to provide faster and more personalized services, enhancing the customer experience. Customer feedback indicates that Kindvast's digital transformation not only improved operational efficiency but also increased customer satisfaction, enabling "Funland Toys" to more effectively manage its supply chain and market promotion activities.

Overall, Kindvast's digital transformation has shown significant improvements in data and received positive evaluations in customer feedback. These data and feedback demonstrate that digital transformation is the key factor for Kindvast's success in the US market, laying a solid foundation for the company's future sustainable development.

5. Conclusion

5.1 Market Significance of Kindvast's Digital Transformation

Kindvast Company's digital transformation has not only brought about significant improvements in operational efficiency and cost savings for the company itself but also had a profound positive impact on the US market. By introducing 3D rendering, virtual reality, and automated production technologies, Kindvast has successfully transitioned from a traditional manufacturing model to an intelligent manufacturing model. This transition not only meets the US market's demand for efficient and personalized packaging solutions but also provides a valuable transformation example for other packaging companies.

In the US market, Kindvast's digital transformation practices have significantly enhanced customer satisfaction and market responsiveness. Through 3D rendering and virtual reality technologies, Kindvast can quickly demonstrate design concepts, reduce the number of design modifications and thus shortening the time-to-market for products. The application of automated production technologies has improved production efficiency and the consistency of product quality, reducing the scrap rate. These improvements not only strengthened Kindvast's market competitiveness but also provided higher quality and more innovative packaging solutions for US customers, thereby enhancing the efficiency and value of the entire supply chain.

Moreover, Kindvast's digital transformation has provided an important demonstration effect for the packaging industry. By optimizing supply chain management and customer service, Kindvast has shown the great potential of digital tools in improving corporate operational efficiency and customer experience. This transformation not only helps companies better adapt to market changes but also provides other companies in the industry with valuable experience and models to follow, promoting the development of the entire packaging industry towards digitalization and intelligence.

5.2 Future Outlook

With the continuous progress of technology and the ongoing changes in market demand, the digital transformation of the packaging industry is developing towards deeper levels and broader fields. In the future, packaging companies will place greater emphasis on data-driven decision-making, the application of artificial intelligence and machine learning, and the integration of sustainable development technologies. The application of these technologies will further enhance corporate operational efficiency, product quality, and market competitiveness while meeting consumers' demands for environmentally friendly and sustainable packaging.

Kindvast Company has already achieved significant success in digital transformation, but there is still room for further development. In the future, Kindvast can continue to deepen the application of digital technologies, such as optimizing production processes through big data analysis, improving the automation level of design and production with artificial intelligence, and exploring new sustainable materials and technologies. Moreover, Kindvast can also collaborate with leading companies in other industries to jointly promote innovation and practice in digital transformation, further enhancing its influence and competitiveness in the global market.

In summary, Kindvast's digital transformation has not only laid the foundation for its success in the US market but also provided important insights and direction for the future development of the packaging industry. By continuously innovating in technology and strategic planning, Kindvast is expected to maintain its leading position in the future and make greater contributions to the development of the industry.

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Research on the Application of Digital Modeling in Inheriting Traditional Chinese Architectural Art — Taking the Design of the Lei Family Architecture as an Example

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doi:10.63593/AS.2709-9830.2025.06.005

Abstract

With the progress of science and technology, digital modeling technology plays an increasingly important role in the protection and restoration of traditional architectural heritage. This paper discusses the application of digital modeling technology in the inheritance of Chinese traditional architectural art, especially taking the architectural design of style Lei family as an example, and analyzes how technology supports the preservation and revival of traditional architectural art. By using modern design software such as 3DMAX, Maya, rhinoceros and SketchUp, this study discussed in detail the specific application and effect of these tools in the digital modeling, restoration and display of style ray family buildings. The paper also examines the contribution of digital modeling technology to the restoration of architectural details, the reconstruction of historical data, public display and education promotion.

Keywords: digital modeling, traditional architectural art, style mine building, restoration and inheritance

1. Introduction

As an important representative of traditional Chinese architectural art in the long history of Chinese architectural art, the architectural art of the Shiyilei family carries a rich cultural and historical heritage. However, with the passage of time, precious architectural heritage such as the architectural art of the Shiyilei family faces challenges such as natural aging, environmental changes, and human destruction. This makes the protection, inheritance, and innovation of traditional architectural art an urgent issue that needs to be addressed. In recent years, the protection and restoration of traditional architectural heritage, as well as the rapid advancement of digital modeling technology, have provided many new solutions. These technologies can not only efficiently record and restore the details of buildings but also enhance public awareness and support for cultural heritage. At the same time, they can strengthen interactive experiences with the public through virtual displays (Wang Gang, Li Hao, Lei Xin & Cheng Shiyu, 2018).

This paper will delve into the application of digital modeling technology in the inheritance of traditional Chinese architectural art, taking the architecture of the Shiyilei family as an example, and analyze how to achieve this through modern design software such as 3DMAX, MAYA, Rhinoceros, and SketchUp.

2. Basic Application and Advantages of Digital Modeling Technology

In recent years, digital modeling has developed relatively well and has been widely applied. The mainstream two-dimensional drawing software packages include CAD (Computer Aided Design), which stands for computer-aided design. People can engage in traditional architectural plane restoration work through computer programs and hardware devices. Based on CAD, there are many secondary developments such as Tianzheng CAD (Cui Xiao, 2017) and so on. In terms of three-dimensional modeling, there are 3DMAX, MAYA,

Rhinoceros, Sketchup, and so on.

3DMAX is a powerful 3D modeling and rendering software developed by Autodesk, which is widely used in architectural visualization, industrial design and other fields. It can build a complete architectural scene, including the surrounding environment, landscape elements and urban background, so as to improve the overall visual effect. The software is helpful to understand the spatial relationship of traditional buildings and their surrounding environment.

Maya is usually famous for its powerful animation and special effects production ability, but it is also unique in construction. Combined with virtual reality (VR) technology, Maya creates complex animation and interactive scenes to provide an immersive architectural experience. At the same time, the display of complex structure and construction details of the process details and construction difficulties of traditional buildings can help understand the artistic difficulties of traditional buildings.

RHINOCEROS (RHINO) is a high-precision modeling software widely used in the architectural field for its accurate surface modeling capabilities and flexible plugin ecosystem. Its Chinese name is also translated as “犀牛”. It primarily works in conjunction with digital fabrication techniques, such as 3D printing and CNC machining, to prepare precise architectural models through collaborative efforts, and enables the visualization of complex traditional architecture through 3D printing.

SketchUp is famous for its intuitive, easy-to-use and rapid modeling capabilities, especially suitable for building visualization and the restoration of early traditional buildings.

Table 1.

Software name	Main application fields	Core advantages
3DMAX	High quality building visualization and building roaming	Powerful rendering ability, animation roaming production
MAYA	Advanced animation and virtual reality, complex surface modeling	Parametric modeling
RHINO	Precise parametric modeling, integration with BIM system, and joint work with 3D printing technology	High precision modeling, multi technology cooperation application
SKETCHUP	Sketch modeling, rapid modeling	Intuitive and easy to operate

The adoption of Computer-Aided Design (CAD), 3D scanning, and modeling software has significantly enhanced the efficiency and precision of traditional architectural art restoration. Traditional buildings often feature complex structures and intricate decorations, making manual restoration both time-consuming and labor-intensive, and prone to errors during construction. Digital modeling, on the other hand, can rapidly generate high-precision 3D models that accurately capture architectural details and proportions, reducing human errors. Furthermore, digital data can be easily stored, modified, and shared, enabling more efficient collaborative restoration efforts among multiple parties. Designers and restoration experts can evaluate restoration plans in advance through virtual simulation and optimize the restoration path before implementation, thereby improving the overall quality of the restoration.

3. Application of Digital Modeling in Inheriting Traditional Architectural Art

3.1 Application of Digital Protection Technology

Digital preservation aims to comprehensively and accurately record and archive the existing architectural heritage through digital technology, so as to facilitate future research, display and protection.

Digital preservation technology involves the use of high-precision 3D scanning and modeling to produce detailed digital models. For instance, laser scanning (such as LIDAR) and photogrammetry techniques are employed to conduct high-precision 3D scanning of buildings, generating comprehensive architectural models that encompass geometric architectural information and simultaneously document architectural details such as texture, color, and material. The comprehensive digitization of large-scale architectural sites can be facilitated through aerial photography using drones, combined with laser scanning. In complex environments, LIDAR technology can provide depth information, which is difficult to obtain through conventional manual measurements, while photogrammetry complements the detailed surface texture. The integration of these two techniques significantly enhances the overall means of architectural art preservation.

Establish a unified digital archive to store all digital building data. These archives are not only convenient for information retrieval and sharing, but also can be used as long-term digital records to prevent physical damage

caused by natural disasters, wars or other reasons.

3.2 Application of Heritage Restoration Technology

Design software such as 3DMAX, MAYA, Rhinoceros (Rhinoceros), and Sketchup (SketchUp) have played a significant role in the restoration of traditional architectural heritage. By providing efficient 3D modeling, visualization, and animation capabilities, these software programs preserve and perpetuate architectural art. Each of these software programs possesses unique features, greatly enhancing the precision and efficiency of restoration work.

Through 3DMAX, designers can create a detailed three-dimensional model based on simulating real building materials and lighting effects, thereby producing vivid renderings. This is of great significance for formulating restoration plans, conducting subsequent restoration design evaluations, and presenting the restoration results to relevant personnel. In addition, the animation function of 3DMAX can be used to simulate changes in buildings over different time periods, helping the restoration team better understand and plan the restoration process.

Restoration experts can utilize MAYA to create virtual roaming animations of buildings, allowing for a comparison between the historical evolution of the buildings and their condition before and after restoration. This, in turn, aids in the optimization of restoration plans. Furthermore, this interactive display method enhances public awareness and support for cultural heritage conservation. The excellent compatibility of MAYA with other design software also facilitates smoother collaboration among multiple departments. Consequently, MAYA plays a pivotal role in the field of cultural heritage conservation.

Rhinoceros supports a highly customized modeling process and can accurately copy the complex curves and decorative details of traditional buildings. At the same time, with the help of its plug-in grasshopper, designers can realize parametric design and automatic modeling, and improve work efficiency and model accuracy. In addition, the high-precision 3D model generated by rhinoceros can be used for the design and sales of architectural and cultural peripheral products (such as memorial models, decorations and educational materials), and further promote the dissemination and commercialization of cultural heritage. More importantly, rhinoceros can seamlessly integrate with 3D printing technology. Designers can directly convert digital models into solid models for display, research or repair work. For example, through 3D printing, complex architectural details and decorations can be accurately copied to ensure the degree of detail restoration in the repair process. Through joint work with 3D printing technology, it can also be used to make physical models of buildings to help the repair team more intuitively understand and plan the repair scheme.

SketchUp is suitable for the initial repair and concept stages. Designers can quickly create the basic structural model of the building, and compare and adjust the schemes. Its intuitive operation mode reduces the technical threshold, enabling team members from different backgrounds to easily participate in the process of building modeling and repair design.

3.3 The Specific Path of Carrying Forward the Traditional Architectural Art

Virtual reality (VR) and augmented reality (AR) are good means to apply digital models to virtual display and interactive experience, so as to enter the public view. Visitors and researchers can “visit” inaccessible or fragile architectural sites through VR devices, which not only protects physical buildings, but also provides an immersive experience. The audience can experience the historical style and cultural connotation of traditional buildings without visiting the scene. The interaction between traditional architectural art and the public has been realized, so that traditional architectural art can appear in the exhibition hall in the form of virtual reality, enter the public’s vision, and the whole people can actively participate in the protection of architectural cultural heritage. Digital modeling provides powerful technical support for the virtual restoration and display of traditional buildings. These precious cultural heritage can be presented to the public in a new way.

Through this technology, while expanding the influence of traditional architecture, it also contributes to the preservation and inheritance of traditional architectural art. At the same time, virtual reality (VR) and augmented reality (AR) can assist scholars in gaining a deeper understanding of architectural structures and historical backgrounds, serving educational and research purposes. In terms of the visualization of digital models, it makes the entire process of restoring traditional architectural art more transparent, enhancing public recognition and support for conservation efforts.

4. Style Mine Architecture and Digital Modeling Technology

4.1 Overview of Style ‘Ray Family’

In the early Qing Dynasty, Lei Fada, renowned for his superb architectural skills, and his cousin Lei Faxuan were recruited to Beijing to construct royal palaces. Due to Lei Fada’s meritorious contributions in building the Taihe Hall, Emperor Kangxi bestowed upon him the title of Chief Architect of the Ministry of Works. From then on, Lei Fada was hailed as “Shi Yang Lei” (Pattern Lei). The Shi Yang Lei family flourished during the

mid-to-late Qing Dynasty. Lei Fada participated in numerous royal architectural renovation projects, thus establishing the Shi Yang Lei family's status in royal architectural design. Over eight generations of the Shi Yang Lei family, they gradually became the backbone of royal architectural design, participating in the design and construction of buildings such as the Forbidden City, Temple of Heaven, Summer Palace, and Old Summer Palace. The establishment of the "Shi Yang Lei Drawings" by the Shi Yang Lei family serves as an important document for understanding the artistic design of traditional Chinese architecture, systematically expressing the architectural design process and standards.

The "style thunder" building is mainly made of wood structure, which is composed of tile, brick, stone and other auxiliary materials. Each building is composed of roof, columns, doors and windows, walls and bases. The main components of the building are columns, beams and purlins (Duan Wei & Zhou Yi, 2022). At the same time, the "style thunder" building has the characteristics of flexibility, seismic resistance and grade. The architectural design of style Lei family not only has high practicability, but also shows rich cultural and artistic value. These buildings reflect the traditional Chinese etiquette and Confucian philosophy, and embody these cultural concepts through architectural forms. For example, in the design of the Forbidden City, people with different identities and grades live in buildings with different sizes and decorative styles, which reflects the strict hierarchy. At the same time, the architectural design of the style Lei family integrates a large number of artistic elements, such as the painted Gallery of the summer palace. Each picture has been carefully designed to show the profound understanding of ancient craftsmen on the natural landscape and cultural stories. These artistic decorations not only enhance the aesthetic value of architecture, but also add profound cultural connotation to architecture.

The Lei architecture, a combination of traditional wood structure and symmetrical design, not only maintains the stability of the wood structure, but also can draw philosophical and aesthetic thinking from the design principles of geomantic omen. Therefore, it also shows the profound connotation and unique aesthetic interest of China's traditional architectural culture, which is widely spread in future architectural styles. Based on the traditional wood structure, relying on the symmetrical design, and supplemented by the ideas of geomantic omen, the Lei style architecture presents the core idea of important symbolic significance and value for Chinese traditional architectural culture on the basis of maintaining its own characteristics.

4.2 Chinese Names of Ancient Architectural Models “烫样”

The "style thunder" architectural drawing file is a kind of material historical data bearing important historical value. The architectural process characteristics it shows not only reflect the actual situation of the design of style houses in the Qing Dynasty, but also have important social value and cultural significance for the study of the history of the Qing Dynasty and the construction of cultural development. At the same time, it also represents the highest achievement of ancient Chinese architectural design. The "style thunder" architectural drawing file includes three parts: the "style thunder" architectural drawing, the hot sample and the document. "Style mine" architectural drawings include "style mine" construction engineering planning drawings, design drawings, mapping drawings, construction drawings, as built drawings, decoration drawings and other aspects.

Some of the patterns left by "style thunder" are hot samples, which are architectural models. Hot sample is a three-dimensional drawing of ancient architectural construction, which plays a role of specimen in ancient architectural construction. In ancient times, large-scale construction projects were mainly constructed according to hot samples, including budget, material preparation and construction. "Style thunder" is named for its hot samples. All hot samples of the middle road of the Yuanmingyuan Park are preserved in the construction of the Yuanmingyuan Park. The systematicness, integrity and scale of the "pattern mine" drawings are an important physical specimen of human memory in the field of architecture, highlighting the outstanding wisdom of the "pattern mine" architectural design theory and method. The architectural cultural heritage of "style thunder" is the condensation of the wisdom and labor of the "style thunder" family, and it is a non renewable Chinese cultural heritage (Duan Wei & Zhou Yi, 2022).

4.3 Inheritance, Development and Protection of Style Thunder Architectural Art

In the process of inheriting the architectural art of Shiyilei, the trend of combining traditional craftsmanship with modern technology has become increasingly evident. In particular, the application of 3D modeling technology, coupled with the introduction of new technologies such as virtual reality and augmented reality, has not only broken through the constraints of time and space but also provided a more intuitive understanding and appreciation of the design essence of Shiyilei for both architectural researchers and the general public.

3D modeling provides precise three-dimensional representations of the Forbidden City architectural complex, allowing researchers to visually access highly accurate data and giving visitors a more vivid and intuitive experience. The widespread application of 3D modeling technology in the Palace Museum has facilitated the acquisition of high-precision architectural data, ensuring the preservation and restoration of every detail of ancient architecture. This is of great significance for both academic research and tourism experiences.

The Old Summer Palace suffered devastating damage in a war, but with the application of digital modeling software such as 3DMAX and Maya, and the 3D virtual reconstruction technology of historical materials, future generations are able to glimpse its once glorious appearance. Additionally, the use of virtual reality technology can provide visitors with an immersive experience of touring the Old Summer Palace, enabling the integration of history and the present across time and space.

Utilizing tools such as Rhinoceros and SketchUp, precise simulations of the architectural layout and spatial structure of the Summer Palace have been conducted, further facilitating research in architecture and landscape art. Coupled with the application of virtual reality technology, remote virtual tours of the Summer Palace have been made possible, allowing more people to personally experience the beauty of its architecture and landscapes. Therefore, beyond the research in architecture and landscape art, virtual reality technology also plays a significant role in enhancing people's aesthetic experiences.

Many tang yang (scale models) face the risk of damage due to material aging or poor preservation conditions, posing a significant threat to valuable cultural heritage. Digital modeling technology, as an effective solution, enables high-precision scanning of tang yang to obtain their three-dimensional (3D) data and form digital archives. Coupled with the assistance of 3D printing technology, researchers can obtain replicas that closely resemble the originals for display and research purposes. Furthermore, augmented reality (AR) technology can integrate tang yang with real-life scenes, allowing viewers to intuitively appreciate the intricate design of these models on mobile devices. The application of digital modeling technology can effectively protect tang yang. The Palace Museum in Beijing conducted LiDAR scanning on the tang yang of the Shiyilei (a type of architectural model), generating high-resolution 3D data models. These models are not only used for digital display but also serve as important reference materials for research and preservation, facilitating the visualization of 3D models and the study of details.

Digital modeling technology has brought new opportunities for the inheritance and preservation of the architectural art of the Shiyilei style. The application of technologies ranging from 3D modeling to virtual reality and augmented reality not only enables the recreation of history but also lays a solid foundation for future research and inheritance (Xie Yang, Zhang Yan & Zhang Yifan, 2012). With the aid of modern technology, the architectural art of the Shiyilei family has breathed new life in the digital era, allowing more people to appreciate the cultural and historical charm behind it, thereby gaining a more comprehensive understanding of it.

5. The Challenge of Traditional Architectural Art Inheritance

Digital modeling technology has brought challenges and opportunities to the inheritance of traditional architectural art. It is inevitable to encounter some bottlenecks when restoring the fine carving and component details in traditional architecture. Especially in the pursuit of accuracy and complexity, modern modeling technology is difficult to meet the requirements of comprehensive display. For example, the original texture and three-dimensional effect of wood and stone carvings in traditional buildings are often missing in digital presentation. Thus, some details of traditional architecture are difficult to be fully displayed in digital modeling technology.

Wood structure is one of the important characteristics of Chinese traditional architecture. It has unique structural mechanical properties, such as tenon joint connection, which is difficult to be fully simulated with the current digital technology. Moreover, due to the natural changes of wood and the influence of temperature and humidity, it is difficult for the digital model to show the real situation. Coupled with the aging and weathering characteristics of wood structure, it is more difficult to simulate its real performance.

Digital modeling requires extensive data collection and processing, particularly high-precision data from 3D scanning, laser mapping, and other techniques. These technologies impose significant demands on equipment and computational resources, resulting in a substantial increase in project costs. Furthermore, the scale and complexity of traditional buildings mean that the data volume of models is extremely large, requiring storage and processing that often exceeds the capacity of general computing devices. The substantial demand for equipment resources and high-precision modeling technology are pressing issues that we currently face.

In the restoration of architectural form, digital technology is very good, but it is often inadequate in the transmission of traditional cultural connotation. Simple technical means are often difficult to convey the symbols, symbolic significance and cultural details in traditional architecture. Digital technology tends to be standardized and simplified, while the cultural connotation of traditional architecture needs fine inheritance, which leads to the gap between technology and culture. How to balance cultural expression and technology is the key issue in the process of digitalization of these buildings.

To sum up, traditional architectural art is facing many challenges in the process of digitalization, such as complexity, material characteristics, resource cost and cultural inheritance. How to break through these bottlenecks and integrate the inheritance and development of digital technology and traditional architectural art

is still an important issue.

6. Conclusion

By discussing the application of digital modeling technology in the style mine architectural art, it is found that the digital modeling technology has certain advantages in restoring complex structures and presenting architectural forms. Through high-precision three-dimensional scanning and modeling, the shape of traditional architectural art can be better preserved. This technology can effectively capture the basic shape, detail components, spatial layout of buildings. It is not only suitable for style thunder buildings, but also can be extended to temples, palaces, residences and other traditional architectural art fields. In the future, digital modeling technology can also carry out special research and develop more accurate modeling methods for different materials, structures and styles, and different traditional building types.

Digital modeling technology can promote the comprehensive inheritance and development of traditional architectural art, and provide more digital support for the protection, restoration and display of these buildings. Of course, there are still some challenges. How to integrate more cultural factors into digital modeling technology and enhance its ability to convey the connotation of traditional culture should be further explored in future research. In developing more intelligent modeling algorithms, while preserving the details of the building structure, taking into account the expression of cultural symbols and historical background, realize the deep integration of technology and culture, and strengthen interdisciplinary cooperation with art, architecture, history and computer technology.

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