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An ISMS-Oriented Architecture for Intelligent Property Management Based on ISO/IEC 27001:2022

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Abstract: The digital transformation of property management has led to the increasing integration of information technology (IT), operational technology (OT), and Internet of Things (IoT) devices. However, information security management in property enterprises is often separated from daily business processes and relies heavily on manual documentation, resulting in fragmented asset management, inefficient security control implementation, and difficulties in collecting and tracing audit evidence. To address these issues, this study proposes an Information Security Management System (ISMS)-oriented architecture for intelligent property management based on ISO/IEC 27001:2022. A standard – process – function mapping method is introduced to transform information security requirements into executable business workflows and system functions. The proposed architecture integrates asset and risk management, security control implementation, supplier and outsourcing management, incident response, audit evidence management, and security metrics within a unified framework. Particular attention is given to the integrated governance of IT, OT, and IoT assets and to the traceability of security activities throughout property management processes. A prototype system is further designed to demonstrate the implementation of the proposed architecture, and functional verification is used to examine its feasibility in typical property management scenarios. The proposed approach provides a systematic method for embedding ISMS requirements into intelligent property management systems and offers a practical reference for property enterprises seeking to improve security governance, audit readiness, and continuous improvement capabilities.

Keywords: Information Security Management System (ISMS); ISO/IEC 27001:2022; intelligent property management; information security governance; IT/OT/IoT integration; audit evidence

1. Introduction

Digital technologies have become an essential part of modern property management. Daily operations increasingly depend on interconnected platforms and devices for access control, video surveillance, parking management, energy monitoring, equipment maintenance, visitor services, and other routine activities. The growing use of Internet of Things (IoT) devices and building automation technologies has further extended the boundary of property information systems from conventional information technology (IT) infrastructure to operational technology (OT) and physical facilities. Similar changes have been observed in smart buildings, where connected sensors, automation systems, and management platforms are gradually replacing isolated building subsystems (Minoli et al., 2017; Kumar et al., 2021). While such integration improves operational efficiency, it also makes information security more difficult to manage.

The difficulty is not simply caused by an increasing number of connected devices. Property management has a particular organizational and operational structure. A property project may involve management personnel,

residents or tenants, equipment operators, external maintenance teams, security contractors, software vendors, and other service providers. These parties may access different systems at different times and for different purposes. Meanwhile, information assets are distributed across business applications, cloud services, network equipment, building automation systems, cameras, access-control terminals, and numerous IoT devices. The boundary between information systems and physical operations is therefore becoming less clear. Studies of building automation and intelligent-building environments have shown that increased connectivity expands the cyber-physical attack surface and introduces security, privacy, and interoperability concerns (Graveto et al., 2022; Li et al., 2023; Llaría et al., 2021).

ISO/IEC 27001 provides a systematic approach to managing information security risks. The 2022 edition specifies requirements for establishing, implementing, maintaining, and continually improving an Information Security Management System (ISMS) and places information security within an organizational risk-management process (ISO/IEC, 2022a). Supporting guidance in ISO/IEC 27002:2022 and ISO/IEC 27005:2022 further addresses information security controls and risk management (ISO/IEC, 2022b, 2022c). For property enterprises, this provides a useful basis for managing assets, access, suppliers, incidents, operational changes, and other security-related activities.

In practice, however, applying an ISMS to property management is not only a matter of adopting a set of security controls. A considerable amount of security management work is still performed through documents, spreadsheets, approval records, inspection forms, and manually collected evidence. Business systems may record work orders or equipment information, while security management records are maintained separately. As a result, a requirement defined by an ISMS may not have a direct and traceable relationship with the corresponding business process, responsible person, system function, and implementation evidence. This separation becomes particularly inconvenient during internal inspections, corrective actions, management reviews, and certification audits.

The problem is more evident when IT, OT, and IoT resources have to be governed within the same management environment. Existing smart-building research has examined IoT architectures, device connectivity, building automation, energy management, and cyberattack detection (Minoli et al., 2017; Kumar et al., 2021; Graveto et al., 2022). Research on building automation security has also focused on vulnerabilities, attack paths, detection, and resilient operation (Li et al., 2023). These studies provide important technical foundations, but a management question remains: how can information security requirements be translated into routine property-management activities that can be executed, recorded, traced, and reviewed within an information system?

This study approaches the problem from the perspective of system architecture rather than the design of an individual security algorithm. An ISMS-oriented architecture for intelligent property management is proposed based on ISO/IEC 27001:2022. At the center of the approach is a standard–process–function mapping method. Security requirements are associated with relevant property-management processes and then connected to system functions and operational records. In this way, activities such as asset registration, risk treatment, supplier assessment, incident handling, corrective action, and evidence collection can be managed as related parts of the same system instead of as independent compliance documents.

The proposed architecture also considers the mixed IT/OT/IoT environment commonly found in property operations. It organizes asset and risk management, security controls, supplier and outsourcing management, incident management, audit evidence, and security metrics within a unified structure. The intention is not to replace the ISMS itself, nor to introduce another independent security platform. Rather, the architecture provides a way to embed ISMS-related activities into existing property-management processes and to preserve the evidence generated during their execution.

The contribution of this study is mainly architectural and methodological. It adapts an ISMS-oriented architecture to property-management scenarios in which IT, OT, IoT, and outsourced services coexist, and uses a standard – process – function mapping method to connect security requirements with executable and traceable system activities. A prototype implementation is then used to examine whether the architecture can support

representative security-management tasks in practice. The purpose of this validation is functional feasibility rather than large-scale performance benchmarking.

2. Methods

2.1 Research Design

This study adopted an architecture-oriented design approach to investigate how the requirements of an Information Security Management System (ISMS) can be incorporated into intelligent property management. Rather than treating information security as an independent technical component, the research focused on the relationship between security requirements, routine management activities, and the information systems used to support these activities. ISO/IEC 27001:2022 was used as the principal reference for defining information security management requirements, with ISO/IEC 27002:2022 and ISO/IEC 27005:2022 providing complementary guidance on security controls and risk management (ISO/IEC, 2022a, 2022b, 2022c).

The research process combined standard analysis, scenario analysis, system modeling, and prototype implementation. Requirements related to information assets, risk treatment, access control, supplier relationships, incident management, operational activities, and audit evidence were examined in the context of typical property operations. These requirements were then translated into management processes and corresponding system functions. The resulting relationships formed the basis for the proposed architecture.

Property management was considered as a mixed digital and physical operating environment, consistent with the converged IT/OT/IoT characteristics widely reported in smart-building and building-automation environments (Minoli et al., 2017; Graveto et al., 2022; Li et al., 2023). In addition to conventional IT resources such as servers, databases, networks, and business applications, the scope included OT and IoT resources used in access control, video surveillance, parking management, building automation, energy monitoring, and equipment maintenance. External service providers and contractors were also included because outsourced maintenance and temporary system access are common in property operations.

The study therefore concentrates on architectural feasibility and functional integration. Prototype implementation is used to examine whether the proposed model can represent and connect typical security-management activities. It is not intended as a large-scale performance benchmark or an evaluation of a particular security algorithm.

2.2 Standard-Process-Function Mapping Method

A central problem in applying ISO/IEC 27001:2022 to property management is the distance between a management requirement and its actual execution. ISO/IEC 27002:2022 describes a broad set of information security controls, but organizations still need an implementation mechanism that connects those controls to operational processes and evidence (ISO/IEC, 2022b). A security requirement may be clearly documented at the organizational level, while its implementation is distributed across work orders, approval records, equipment platforms, spreadsheets, inspection records, and different departments. To reduce this separation, a standard-process-function mapping method was developed.

The method contains three connected layers. The standard layer describes information security requirements and controls relevant to the organization. The process layer identifies the operational or management activities through which a requirement is implemented. The function layer represents the information-system functions required to execute or record those activities. The relationship can be expressed conceptually as: Security requirement -> Management process -> System function -> Operational record/evidence.

The mapping is not necessarily one-to-one. A supplier-related security requirement, for example, may involve supplier qualification, contract review, authorization, maintenance activities, periodic evaluation, and termination of access. These activities can involve several system functions and generate different records. Conversely, an asset-

management function may support multiple security requirements because asset identification is relevant to risk assessment, access management, incident handling, and change management.

For each mapped item, several pieces of contextual information are maintained, including the related business scenario, responsible role, applicable asset or supplier, implementation status, and available evidence. This allows a control requirement to be followed from its management origin to its actual execution rather than being represented only by a policy document.

The same principle is applied to the Statement of Applicability (SoA), which in ISO/IEC 27001:2022 is used to document applicable controls and their implementation status (ISO/IEC, 2022a). Instead of treating the SoA as an isolated document prepared mainly for assessment, the proposed method associates applicable controls with their implementation processes, responsible roles, system records, and supporting evidence. Changes in implementation status can therefore be reflected in the corresponding management records.

Table 1. Example of the standard-process-function mapping

Security area	Property management process	Supporting system function	Typical evidence
Asset management	Asset registration and classification	Unified asset inventory	Asset record and change history
Access control	User and contractor authorization	Access approval workflow	Approval and authorization record
Supplier security	Supplier assessment and maintenance management	Supplier management	Assessment and service records
Incident management	Reporting, handling and closure	Incident workflow	Incident and corrective-action records
Change management	Equipment or system change	Change approval workflow	Approval and implementation record
Internal audit	Control review and evidence collection	Evidence management	Audit record and evidence package

2.3 Overall Architecture

The proposed architecture organizes information security activities around shared assets, risks, processes, and evidence. Its layered structure also reflects the need to coordinate technical and organizational security functions across heterogeneous building systems (Graveto et al., 2022; Li et al., 2023). It does not attempt to replace existing property business systems or device platforms. Instead, it provides a management layer through which security-related information from different operational domains can be organized and traced.

Five logical layers are used in the architecture: the asset and data layer, risk and control layer, process and workflow layer, evidence and audit layer, and metrics and decision layer.

The asset and data layer provides the basic objects used by the other layers. These include IT equipment, OT facilities, IoT devices, software systems, data resources, users, suppliers, and relevant organizational information. Existing property platforms can remain responsible for their original operational functions, while security-related attributes are referenced or recorded within the ISMS-oriented architecture.

Above this foundation, the risk and control layer links assets and operational scenarios with identified risks, treatment decisions, and applicable security controls. The process and workflow layer converts management activities into executable tasks. Approval, assessment, inspection, incident handling, corrective action, supplier review, and other activities can therefore be assigned to responsible roles and followed through their life cycles.

Evidence is generated during these activities rather than being collected only before an audit. The evidence and audit layer maintains the relationship among controls, tasks, records, documents, logs, and corrective actions. The upper metrics and decision layer summarizes implementation status and selected management indicators for review.

This layered organization is intended to preserve the relationship between management decisions and operational activities. A risk identified for a particular asset, for instance, can be associated with a treatment measure, a responsible person, an implementation task, and evidence of completion. The architecture therefore emphasizes traceability across layers rather than simply storing information in separate functional modules. The overall structure of the proposed ISMS-oriented intelligent property management system is illustrated in Fig. 1.

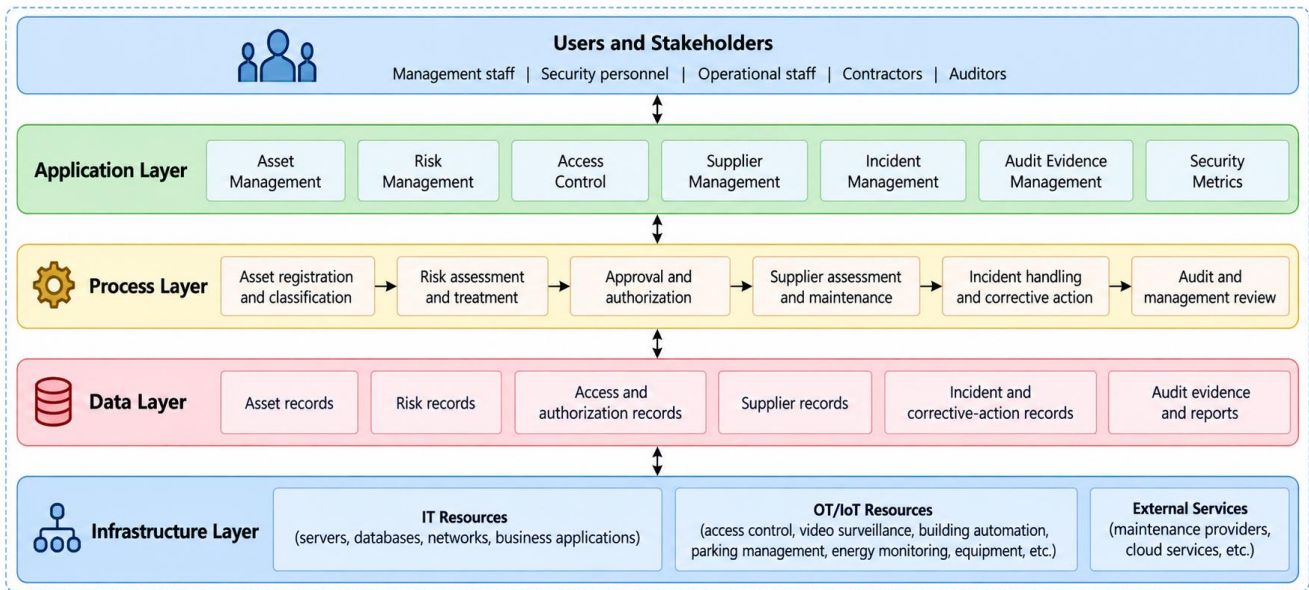


Fig. 1. Overall architecture of the proposed ISMS-oriented intelligent property management system.

2.4 Unified Asset and Risk Management

Asset identification provides the starting point for risk-based information security management and is closely related to the risk-identification and treatment principles described in ISO/IEC 27005:2022 (ISO/IEC, 2022c). In property environments, however, the asset inventory cannot be limited to computers and network equipment. Operational facilities and connected devices may affect both information security and physical services, while IoT and building-automation research has shown that these connected components expand both system functionality and attack surfaces (Minoli et al., 2017; Llaría et al., 2021; Graveto et al., 2022). Cameras, access-control terminals, parking devices, building controllers, environmental sensors, energy-management equipment, servers, applications, and cloud services may all participate in the same operational process.

The proposed architecture therefore uses a unified asset model while retaining the characteristics of different asset types. An asset record can contain its category, location, ownership or responsible department, operational status, network or system relationship, supplier information, and security-related attributes. Where relevant, relationships between assets are also maintained. This makes it possible to examine a risk not only at the level of an individual device but also in relation to the service or business process that depends on it.

Risk management is connected directly to these records. Identified risks are associated with relevant assets or processes and are recorded together with their treatment decisions, responsible roles, status, and related controls. The intention is to avoid maintaining a risk register that is disconnected from operational data.

When an asset is changed, transferred, replaced, or removed, its related security information can consequently be reviewed at the same time. This is particularly useful for property projects in which equipment and service providers change during long operating periods.

2.5 Workflow-Based Security Control Implementation

Some ISMS activities are technical, but many are organizational. This combination of organizational and technical controls is central to ISO/IEC 27001:2022 and ISO/IEC 27002:2022 (ISO/IEC, 2022a, 2022b). Training, authorization, supplier assessment, internal inspection, corrective action, emergency exercises, and management review all depend on people completing specific activities and leaving adequate records.

For this reason, workflow is used as a major implementation mechanism in the proposed architecture. A management requirement can be configured as a sequence of tasks involving initiation, assignment, approval, execution, verification, and closure, depending on the nature of the activity. Each task is associated with a responsible role and retains its status and relevant records.

Consider temporary access for an external maintenance engineer. The activity may begin with a maintenance request, followed by identity confirmation and authorization. Access is granted for a defined purpose and period, the maintenance activity is recorded, and authorization is subsequently withdrawn. From an operational perspective this is a normal maintenance procedure; from an ISMS perspective, it also provides evidence of supplier management and access control. The architecture treats these two views as parts of the same process.

Not every control requires a complex workflow. Simple controls may only require a status record, periodic confirmation, or evidence attachment. The implementation mechanism is selected according to the nature of the control rather than forcing all requirements into an identical process.

2.6 Supplier and Outsourcing Security Management

Outsourcing is especially relevant in property management. Supplier relationships and externally provided services are also recognized as important security-management concerns in ISO/IEC 27001:2022 and ISO/IEC 27002:2022 (ISO/IEC, 2022a, 2022b). Equipment maintenance, security services, cleaning, network support, elevator maintenance, parking systems, and specialized facility services may be provided by different external organizations. These suppliers can interact with physical facilities, information systems, or both.

Supplier security is therefore modeled as a life-cycle activity. Basic supplier information is linked with the services provided, relevant assets, responsible internal personnel, security requirements, assessment records, and access permissions. The architecture also records the period during which an external party requires access to a system or facility.

This approach is intended to address a common practical problem: authorization may be granted for legitimate maintenance work but remain active after the work has been completed. Linking access to a service activity and its validity period makes subsequent review and revocation easier to manage.

Supplier assessment records are retained in the same environment. When a supplier participates in multiple property projects, relevant assessment and security information can also be reused where organizational policy permits, reducing repeated collection of the same basic evidence.

2.7 Incident and Corrective-Action Management

Security incidents may originate from conventional information systems, connected devices, physical facilities, users, or external suppliers. In converged smart-building environments, this diversity of sources is one reason incident management must remain connected to asset and operational context (Graveto et al., 2022; Li et al., 2023). The proposed architecture uses a common incident record to maintain essential information about reporting, classification, assignment, handling, recovery, and closure.

Incident management is linked to assets and responsible roles. Supporting materials, handling records, and corrective actions can be attached to the incident as it progresses. Where an incident reveals a weakness in an existing control, a corrective action can be created and followed separately until completion.

The purpose of this design is not to implement a security information and event management platform or replace specialized detection technologies. Rather, it complements technical protection and detection mechanisms commonly discussed in IoT and building-security research by focusing on the management process that follows

(Bagaa et al., 2020; Kumar et al., 2021). Detection systems may continue to generate alarms and technical logs. The proposed architecture focuses on the management process that follows: who receives the issue, what action is taken, whether the problem is closed, and what evidence remains available for later review.

This distinction keeps the architecture applicable to property organizations with different technical infrastructures.

2.8 Evidence and Audit Traceability

Audit preparation can become labor-intensive when evidence is stored separately from the activities that produced it. Policies may be maintained in one location, approval records in another, device logs on individual platforms, and corrective actions in spreadsheets or communication records.

Evidence management in the proposed architecture is therefore process-oriented. Records generated during normal activities are associated with their corresponding processes and controls. Examples include approval records, supplier assessments, inspection results, incident records, corrective actions, training records, change histories, and system-generated logs.

A traceability chain can consequently be established: Control -> Process -> Task -> Responsible role -> Record -> Evidence.

The chain can also be followed in the opposite direction. An operational record can be traced back to the process and security requirement that caused it to be generated. This bidirectional relationship is useful when reviewing implementation status or preparing evidence for an internal or external audit.

Evidence validity also needs to be considered. Where appropriate, records include timestamps, responsible parties, status information, and change histories. The objective is not merely to increase the quantity of stored documents, but to make evidence understandable in its operational context.

2.9 Security Metrics and Continuous Improvement

The upper layer of the architecture provides a summarized view of security-management activities. This emphasis on governance and measurable improvement is consistent with the broader risk-management orientation of ISO/IEC 27001:2022 and the NIST Cybersecurity Framework 2.0 (ISO/IEC, 2022a; National Institute of Standards and Technology, 2024). Rather than defining a large number of indicators, the design focuses on measures that can be generated from operational processes and have a clear management meaning.

Examples include the number and status of unresolved risks, overdue corrective actions, supplier assessments, control implementation status, incident handling time, and completion of planned security activities. For incident management, commonly used measures such as Mean Time to Detect (MTTD) and Mean Time to Respond or Recover (MTTR) can be incorporated when the required timestamps are available.

Metrics are presented as management information rather than as independent performance objectives. A high closure rate, for example, does not by itself demonstrate effective security if issues are classified incorrectly or closed without adequate action. The dashboard is therefore intended to help managers locate exceptions and review trends while retaining access to the underlying records.

The architecture also supports a continuous improvement cycle, which is consistent with the continual-improvement principle embedded in ISO/IEC 27001:2022 (ISO/IEC, 2022a). Findings from incidents, audits, supplier assessments, or management reviews may generate corrective actions or adjustments to risk treatment. These changes return to the relevant processes and are subsequently recorded as new implementation evidence.

2.10 Prototype Implementation and Functional Verification

A prototype system was designed according to the architecture described above. Its purpose was to verify whether the proposed relationships among assets, risks, controls, workflows, suppliers, incidents, and evidence could be represented within an integrated information environment. The prototype was organized around functional modules corresponding to the major components of the architecture rather than around individual ISO/IEC 27001 clauses.

Verification focused on representative management scenarios. Typical tasks included registering and updating an asset, associating a risk with an asset, initiating an approval process, recording supplier-related activities, following an incident through handling and closure, and retrieving evidence associated with a management activity. For each scenario, the verification examined whether the required information could be entered, transferred between relevant functions, retained, and subsequently traced.

The verification was intentionally limited to functional feasibility. No attempt was made to use the prototype evaluation as a large-scale statistical comparison of security performance. This scope is consistent with the purpose of the study, which is to examine whether an ISMS-oriented architectural approach can translate information security management requirements into connected and traceable property-management activities.

Table 2. Functional verification design

Verification scenario	Main function examined	Verification focus
Asset registration and update	Asset management	Completeness and traceability of asset records
Risk identification and treatment	Risk management	Linkage among asset, risk, treatment and control
Contractor authorization	Workflow and supplier management	Authorization process and activity record
Security incident handling	Incident management	Assignment, handling, closure and retained evidence
Corrective action	Workflow management	Responsibility, status and closure tracking
Audit evidence retrieval	Evidence management	Traceability from control to supporting record

3. Results

3.1 Prototype Realization

The prototype followed the architecture defined in Section 2 and was organized around a limited set of management functions rather than a large number of isolated ISO/IEC 27001 clauses. Asset and risk records, workflow-driven control activities, supplier and outsourcing management, incident and corrective-action handling, audit evidence, and management metrics were linked through shared identifiers and status records. In this way, the same asset, supplier, task, or incident could remain connected across several management activities.

A practical consequence of this arrangement is that security-related records do not need to exist as a separate document set. An asset entry can be associated with a risk item; the risk item can point to a treatment action; the treatment action can be assigned through a workflow; and the completion record can be retained as supporting evidence. The same logic applies to supplier access, incident handling, corrective actions, and periodic review. The prototype therefore represents the proposed standard-process-function mapping as connected operational records rather than as a static control checklist.

The interface design was intentionally simple. Functions were grouped according to the activities performed by users, including asset registration, risk handling, approval and review tasks, supplier records, incident tracking, evidence retrieval, and status overview. This reduces the need for users to understand the detailed structure of ISO/IEC 27001 before carrying out routine management work.

Fig. 2 presents representative interfaces of the prototype system, including the asset management and risk management modules. These interfaces illustrate how security-related information and management activities can be organized within the proposed architecture.

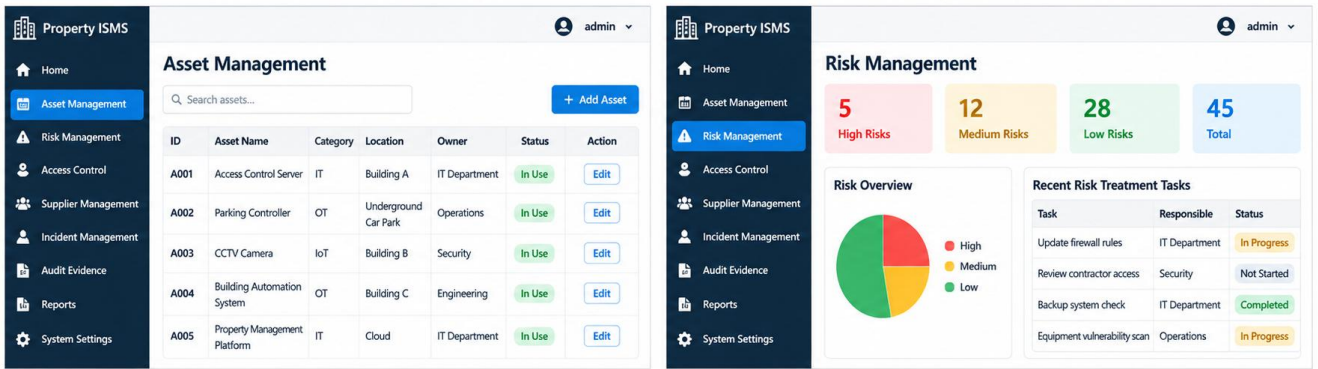


Fig. 2. Example interfaces of the prototype system.

3.2 Functional Verification

Functional verification examined whether typical property-management security activities could be represented as complete and traceable management paths. The focus was not algorithmic performance, but continuity: whether information could move from an operational event to the relevant control activity and then to a retained record.

Representative scenarios were selected from the processes described in Section 2. They included asset registration, risk treatment, contractor authorization, incident handling, corrective action, and audit evidence retrieval. For each scenario, the verification checked whether the relevant object could be created, connected to the responsible process, assigned to an appropriate role, updated during execution, and traced after completion. A contractor-authorization path, for example, was considered complete when the service request, identity information, approval, authorization period, activity record, and closure status could be followed as one chain. An audit-evidence path was considered complete when a reviewer could move from a control requirement to the related process, record, and stored evidence without relying on an unrelated document list.

3.3 Scenario-Based Results

The scenario-based review showed that different property-management activities can be handled through the same governance logic even when their operational starting points differ. Asset-related scenarios begin with an asset or risk record, while supplier and incident scenarios are triggered by service or event records. In both cases, the process ends with traceable records that can be associated with the relevant security requirement.

This is particularly useful in mixed IT/OT/IoT environments. A conventional server, an access-control terminal, a parking controller, or a building-automation device can be governed within the same management structure while retaining device-specific attributes. The architecture therefore separates the governance relationship from the technical details of individual platforms. Table 3 summarizes the main verification paths used in the initial prototype evaluation. The table is descriptive because the purpose of the present study is architectural feasibility rather than statistical comparison.

Table 3. Scenario-based functional verification of the proposed architecture

Scenario	Main functions involved	Traceability path	Verification focus
Asset registration and update	Asset management; risk management	Asset → risk → treatment → record	Whether changes remain linked and traceable
Contractor authorization	Supplier management; workflow management	Request → approval → authorization → activity →	Whether temporary access can be followed through its

Scenario	Main functions involved	Traceability path	Verification focus
		closure	life cycle
Security incident handling	Incident management; corrective action	Incident → assignment → handling → closure → evidence	Whether responsibility and handling records remain connected
Corrective action	Workflow management; evidence management	Finding → action → responsible role → verification → closure	Whether unresolved issues and closure evidence can be tracked
Audit evidence retrieval	Control mapping; evidence management	Control → process → record → evidence	Whether supporting evidence can be located from the control context

The verification paths were used only to check whether the architectural relationships could be represented and traced in the prototype. They were not treated as substitutes for long-term operational performance data.

3.4 Preliminary Internal Evaluation

The preliminary internal evaluation focused on usability and traceability. Particular attention was given to whether a user could identify responsibility, determine the current status of an activity, and retrieve the evidence generated during the process. The prototype supported these tasks across the representative scenarios described above, which was sufficient for an initial check of the proposed architecture.

This evaluation should nevertheless be interpreted cautiously. It does not provide long-term incident statistics, cross-site comparisons, or evidence of improved security performance over time. Those questions require a longer deployment period and a broader set of property-management environments. At the current stage, the result is limited to functional feasibility and traceability of the proposed management relationships.

4. Discussion

4.1 From Document-Based Compliance to Embedded Security Governance

The main value of the proposed architecture lies in the way it changes the position of information security within property management. In many organizations, ISMS activities are still handled as a parallel layer of work: policies are maintained separately, evidence is collected when an inspection approaches, and implementation status is often reconstructed from spreadsheets, email records, or individual business systems. Such an arrangement can satisfy documentation requirements, but it does not necessarily make security management part of normal operations. The architecture presented in this study addresses this gap by linking security requirements with operational processes and the system functions that support them, consistent with the process-based and continual-improvement orientation of ISO/IEC 27001:2022 (ISO/IEC, 2022a).

The standard–process–function mapping is especially important in this respect. A control requirement becomes more useful when it can be connected to an identifiable activity, a responsible role, and a record created during execution. The practical effect is modest but important: compliance information is no longer produced only for review. It becomes a by-product of routine work. An approval record, a supplier assessment, an incident closure record, or a change history can serve an operational purpose and, at the same time, provide evidence that a control has actually been performed.

This approach also changes the timing of audit preparation. Under a document-centered model, evidence may be collected retrospectively and its relationship to the original control has to be explained again. In the proposed architecture, the relationship is established earlier, when the process is configured and performed. This does not remove the need for human judgment. It does, however, reduce the amount of interpretation needed later to

determine who performed an activity, when it occurred, which asset or supplier it concerned, and whether corrective action was completed.

The distinction is relevant for property enterprises because their operating environment contains many repetitive but distributed activities. Access authorization, maintenance work, supplier entry, equipment changes, incident handling, and routine inspections occur continuously and are often managed by different departments. Embedding security requirements into these activities is more sustainable than asking staff to maintain a second, disconnected set of compliance records.

4.2 Integrated Governance of IT, OT, and IoT in Property Operations

Property management differs from a conventional office IT environment because operational services depend on a mixture of digital and physical systems. A resident application may interact with access control; parking services may depend on cameras, controllers, payment platforms, and network connections; equipment maintenance may require temporary access to a building automation platform. The security boundary is therefore difficult to define if IT assets, operational equipment, and IoT devices are managed independently, a challenge also identified in research on smart-building and building-automation security (Minoli et al., 2017; Graveto et al., 2022; Li et al., 2023).

The unified asset and risk view proposed in this study is intended to deal with this overlap. It does not assume that every device should be managed in exactly the same way. A camera, a database server, and a building controller have different operational characteristics and different consequences of failure. What they share is the need to be identified, linked to a responsible party, placed in an operational context, and considered when risks or changes are reviewed. Maintaining these relationships is more useful than forcing heterogeneous assets into a single technical classification.

This point becomes particularly visible in outsourcing scenarios. A maintenance contractor may need access to an OT platform but receive credentials through an IT account-management process. The work may concern a physical device while the evidence of authorization is stored in a business system. If these records remain separated, the organization has to reconstruct the relationship later. A common governance layer allows the activity to be viewed as one event with several technical components rather than as unrelated records.

The architecture therefore treats IT/OT/IoT integration primarily as a governance problem. Specialized security tools remain necessary for technical detection, monitoring, and device protection (Bagaa et al., 2020), but those tools do not by themselves establish responsibility, approval, treatment decisions, or evidence continuity. The proposed model is designed to sit above such technical mechanisms and connect them to management processes.

4.3 Practical Implications for Property Enterprises

The proposed architecture is most useful in organizations where security responsibilities are spread across several projects, departments, and external service providers. In these environments, the difficulty is often not the absence of security rules but the loss of context between a rule and the activity that should implement it. A structured mapping can make that context visible.

For day-to-day management, the architecture can support a clearer division of responsibility. Risks are attached to assets or processes, workflow tasks are assigned to named roles, supplier activities are linked to service periods, and corrective actions retain their own status until closure. Managers can therefore review outstanding work without relying entirely on informal follow-up. The same structure can also reduce repeated evidence collection. Where an operational record already contains the required information and can be traced to the relevant control, it can be reused for internal review or audit preparation rather than being reproduced in a separate format.

Multi-site organizations may benefit in a different way. Property companies often operate projects with similar business functions but different local equipment, suppliers, and staffing arrangements. A reusable process template

can provide a common control logic while still allowing local parameters to vary. This is particularly relevant to supplier review, temporary authorization, incident handling, routine inspection, and corrective-action workflows, which tend to recur across sites even when the underlying devices are different.

The model should not be understood as a claim that information security can be fully automated. Decisions about risk acceptance, control applicability, incident severity, or supplier suitability still require professional judgment. The contribution of the architecture is narrower: it provides a place where those decisions, their execution, and their supporting records can remain connected.

4.4 Limitations and Future Work

The present study is intentionally limited in scope. Its primary objective is to develop and examine an ISMS-oriented architecture rather than to establish statistical evidence of long-term performance improvement. The prototype and functional verification show how the proposed relationships can be implemented, but they do not demonstrate how the system will behave across a large number of property projects, organizations, or technology platforms over extended periods.

Several practical issues also require further investigation. Property environments contain heterogeneous OT and IoT devices, and the availability and quality of device interfaces vary substantially. Integration with legacy equipment may therefore require gateway services, manual data entry, or project-specific adapters. Data ownership and confidentiality may place additional limits on centralized evidence collection, especially when information is shared between a property enterprise and external contractors; related privacy and security concerns have also been reported for intelligent-building environments (Llaria et al., 2021).

Future work should extend the architecture in two directions. Broader deployment can be used to examine whether the proposed mapping remains manageable when the number of sites, suppliers, controls, and assets increases. Longitudinal evaluation would also allow more meaningful measurement of operational indicators such as audit preparation workload, corrective-action closure time, incident handling time, and repeated evidence reuse. These measures would be more informative after the architecture has been used through several normal operating and review cycles, rather than being estimated from a short prototype exercise.

A second area concerns interoperability. Further implementation work can explore standardized interfaces with building automation platforms, access-control systems, ticketing tools, log-management systems, and supplier portals. The architecture is intended to remain independent of a particular technology stack; testing that assumption across heterogeneous environments will be necessary before broader deployment can be recommended.

5. Conclusions

This study examined how the requirements of ISO/IEC 27001:2022 can be incorporated into intelligent property management without being separated from routine operations. The proposed ISMS-oriented architecture was developed for an environment in which conventional IT resources coexist with OT equipment, IoT devices, outsourced maintenance, and multiple operational roles. Its central idea is to connect security requirements with the processes through which they are carried out and with the system functions that record those activities. In this way, information security is treated as part of property management rather than as an additional set of documents prepared mainly for inspection.

The standard–process–function mapping provides the main methodological link in the architecture. It allows a control requirement to be associated with an operational process, a responsible role, and the records created during execution. On this basis, the architecture brings asset and risk management, supplier activities, access authorization, incident handling, corrective action, audit evidence, and management metrics into a common

structure. The value of the approach does not depend on introducing a new security algorithm. It lies in making existing management requirements easier to execute and trace across a mixed IT/OT/IoT environment. The prototype implementation further shows that these relationships can be represented through connected records and workflow-supported activities rather than through isolated control checklists.

The functional verification conducted in this work was intentionally limited in scope. It was used to determine whether representative management paths could be completed and traced within the prototype, not to establish a quantified improvement in organizational security performance. The results therefore support the feasibility of the architectural approach, while broader claims would require longer-term operational evidence.

Further work should focus on deployment in additional property projects and on integration with heterogeneous building and device platforms. Longitudinal use would also make it possible to examine whether the proposed approach reduces audit preparation effort, improves corrective-action follow-up, or changes incident-response efficiency over time. Such evaluation would complement the present architecture-centered study and provide a clearer view of how an embedded ISMS can operate across different property-management environments.

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Conflicts of Interest

The author declares no conflict of interest.

Data Availability

The data generated during the functional verification of the prototype are not publicly available because they contain internal system and operational information. Further information may be available from the corresponding author upon reasonable request.

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Research on the Impact of Corporate ESG on Promoting Common Prosperity— Empirical Evidence from Chinese A-share Listed Companies 2011-2023

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Abstract: Using data on Chinese A-share listed companies from 2011 to 2023, this paper examines the relationship between ESG and common prosperity at the firm level. From a theoretical perspective, corporate ESG activities can promote common prosperity through two channels: first, by improving corporate financial performance, that is, by "making the cake bigger"; and second, by optimizing the internal income distribution of enterprises, that is, by "dividing the cake well." The empirical analysis, based on a two-way fixed-effects model, yields the following results. ESG practices significantly enhance corporate financial performance, exerting significantly positive effects on return on equity, return on total assets, and operating profit, and the environmental dimension (E) has the strongest promoting effect on corporate growth. However, corporate ESG practices have not significantly optimized internal income distribution: they fail to increase the labor income share and, to some extent, even widen the pay gap between management and ordinary employees. These findings indicate that current ESG practices in Chinese enterprises play a positive role mainly in "making the cake bigger" but have not achieved the expected results in "dividing the cake well." To enable enterprises to better leverage ESG practices in contributing to common prosperity, policymakers should accelerate the improvement of ESG disclosure requirements and unified standards, strengthen ESG publicity and education, and promote the organic integration of the traditional concept of balancing righteousness and profit with ESG and common prosperity, so as to better respond to the theoretical and practical needs in related fields.

Keywords: ESG; Common Prosperity; Enterprise; Income Distribution; Financial Performance

1. Introduction

Common prosperity is one of the essential requirements of Chinese modernization. In 2020, the Fifth Plenary Session of the 19th Central Committee of the Communist Party of China proposed to "make more significant substantive progress in achieving common prosperity for all people," which is also among the long-term goals for basically achieving socialist modernization by 2035. In the current new stage of development, how to "make the cake bigger" while "dividing the cake well," so that all people advance toward common prosperity, is one of the most pressing policy issues. The goal of common prosperity is grounded in profound practical considerations. Since the 1980s, many developed economies around the world have experienced widening disparities in income and wealth,

which have led to class division and divisive social conflicts and have become the greatest crisis of contemporary capitalism. Promoting common prosperity is therefore not only a necessary choice for drawing lessons from Western countries and maintaining social stability, but also an inherent requirement for achieving high-quality development.

The "Opinions of the CPC Central Committee and the State Council on Supporting Zhejiang's High-Quality Development and Building a Common Prosperity Demonstration Zone" (2021) clearly states that common prosperity is the essential requirement of socialism and the common aspiration of the people. Common prosperity requires that all people share the fruits of reform and development, achieving the "dual unity of making the cake bigger and dividing the cake well." As micro-level entities in the market economy, enterprises are the core carriers of primary distribution, employment and income, green development, and social responsibility. In reflecting on the crises of contemporary capitalism, Western academia has proposed that enterprises should undertake greater social responsibilities, among which the ESG concept is the most classic and representative.

The concept of ESG originated from socially responsible investment in the twentieth century, and the term was formally introduced by the United Nations Global Compact in 2004. ESG holds that enterprises and investors should not only pursue profits but also pay close attention to non-financial performance along the environmental (Environmental), social (Social), and corporate governance (Corporate Governance) dimensions. The "Guiding Opinions on Central Enterprises High-Standard Fulfillment of Social Responsibilities in the New Era" (June 2024, an official document published on the China Government Network) points out that enterprises in the new era need to "effectively strengthen environmental, social, and corporate governance (ESG) work; integrate ESG work into the overall management of social responsibility, and actively grasp and respond to the opportunities and challenges brought by ESG development; promote controlled listed companies to implement high-standard environmental management requirements centered on ESG issues, actively fulfill social responsibilities, improve corporate governance, strengthen high-level ESG information disclosure, and continuously improve ESG governance capabilities and performance, thereby enhancing value recognition in the capital market; and promote overseas operating institutions to treat ESG work as an important component of overseas operations, management, and major project implementation, actively adapt to the ESG regulatory requirements of host countries and regions, strengthen ESG governance, practices, and information disclosure, and continuously enhance international market competitiveness."

The "Opinions on Improving and Strengthening the Market Value Management of Central Enterprise Controlling Listed Companies" (December 2024) calls for enterprises to "improve the environmental, social responsibility, and corporate governance (ESG) management system, and compile and disclose ESG-related reports at a high level; coordinate the preservation and appreciation of state-owned assets with the sharing of development benefits by employees, improve the market-oriented salary distribution mechanism, balance the income levels of management and ordinary employees, and use standardized ESG governance to help implement common prosperity." It is evident that ESG emphasizes that enterprises should pursue the maximization of value for all stakeholders, rather than merely maximizing shareholder profits.

From a stakeholder perspective, ESG and common prosperity are compatible in their value objectives. Both aim to "make the cake bigger" for society as a whole rather than simply to maximize shareholder profits, and both pursue a Pareto improvement that benefits all stakeholders. Enterprises, as micro-societies, are thus positioned to balance economic and social goals.

The "Opinions on Promoting the Development and Growth of the Private Economy" (2023, known as the 31 Articles on the Private Economy) states that governments should "educate and guide private enterprises to consciously undertake the social responsibility of promoting common prosperity, actively build harmonious labor relations within enterprises, and promote the construction of a community of interests for all employees, so that the

fruits of enterprise development benefit all employees more fairly; encourage private enterprises to promote green transformation, safeguard the wage rights and interests of employees, improve corporate governance, actively participate in rural revitalization and public welfare undertakings, and take sustainable operation (ESG) as the core focus for private entrepreneurs to be "rich and responsible, rich and righteous, and rich and loving." Accordingly, examining how common prosperity can be achieved through ESG from the perspective of enterprises is of particular value.

At the Symposium on the Inheritance and Development of Chinese Civilization, General Secretary Xi Jinping identified "enriching the people and benefiting the people, and balancing righteousness and profit" as important elements of the economic ethics of Chinese traditional culture. Of these, "enriching the people and benefiting the people" derives from "Guanzi" — "The way to govern a country must first enrich the people" — which takes the prosperity of the people's livelihood as the foundation of development, while "balancing righteousness and profit" originates from "The Analects" and "Mencius," which advocate restraining profit-seeking behavior with morality so as to achieve the unity of public and private interests. These ideas align closely with the stakeholder orientation of ESG and the core values of common prosperity.

Existing research has decomposed common prosperity, from an intra-firm perspective, into "making the cake bigger" and "dividing the cake well." However, the empirical evidence to date is concentrated in a relatively short period before 2020, and the heterogeneous effects of the different ESG components remain insufficiently examined^{[1][2][3]}. One study based on data on A-share listed companies from 2011 to 2019 finds that although ESG ratings improve employment efficiency, they significantly exacerbate income inequality within enterprises; the core reason is that ESG raises executive compensation and ordinary employee wages simultaneously, but the increase in excess executive compensation far exceeds that of ordinary employees, ultimately widening the internal income gap^[4]. Other studies reach different conclusions, arguing that ESG generally increases the labor income share of enterprises while having no significant effect on the executive income share, thereby narrowing the income gap between executives and employees, and that this effect is more pronounced in enterprises with high production efficiency and sound governance^[5]. Thus, no consensus has been reached on the distributional effects of ESG, with the disagreements arising mainly from differences in sample periods, indicator measurement, and industry heterogeneity^[6]. By drawing on a longer sample period, this paper provides further empirical evidence in this field. Specifically, it uses Bloomberg ESG disclosure data on Chinese A-share listed companies from 2011 to 2023, combined with financial statement, corporate governance, and cash flow data as well as the relevant literature, to examine the impact of corporate ESG engagement on financial performance and internal income distribution.

The marginal contributions of this paper are as follows. First, corporate ESG engagement improves corporate financial performance, verifying the "making the cake bigger" effect of ESG, and this effect stems primarily from the environmental dimension. Second, ESG engagement has not improved internal income distribution and has even widened the pay gap between management and ordinary employees, failing to achieve the "dividing the cake well" effect.

2. Literature Review and Theoretical Analysis

2.1 The Concept and Current State of ESG

As an investment philosophy, ESG originated in 2004 with a joint initiative launched by then UN Secretary-General Kofi Annan and a group of the world's leading investment institutions, which called for the integration of environmental, social, and corporate governance considerations into investment decisions. In 2006, the United Nations released the "Principles for Responsible Investment" (PRI) framework, guiding institutional investors to incorporate ESG factors into investment analysis and decision-making. ESG requires that firms attend not only to financial indicators such as profits and sales revenue but also to non-financial performance in areas such as

environmental protection, social equity, and corporate governance. Intellectually, the ESG concept can be traced to the ethical investment movement of the 1950s, when early investors applied moral screens by excluding tobacco, defense, and polluting companies. During the 1960s-1990s, the civil rights and environmental movements brought labor rights and ecological protection into the investment domain. In 1987, the UN report "Our Common Future" advanced the theory of sustainable development and established the triple-bottom-line logic of balancing environmental, social, and economic objectives, thereby providing the theoretical foundation for ESG. ESG differs from CSR in three principal respects. First, CSR emphasizes firms' voluntary ethical and philanthropic behavior and is largely qualitative, whereas ESG is oriented toward the capital market and constructs a quantifiable, ratable, and comparable indicator system that directly serves investment valuation and risk pricing. Second, traditional CSR covered only environmental and social issues and lacked a corporate governance dimension, whereas ESG treats governance as an independent core dimension, forming a complete three-dimensional evaluation system. Third, CSR is mostly a voluntary corporate undertaking, whereas many countries have now introduced mandatory ESG disclosure rules, giving ESG a regulatory compliance character. In 2024, China issued sustainability disclosure guidelines for listed companies, incorporating ESG disclosure into regulatory requirements^[7].

In recent years, as ESG has gained traction in China's capital market, a growing number of listed companies have begun to publish ESG reports. Domestic and international rating agencies, including Bloomberg, MSCI, FTSE Russell, Wind, and SynTao Green Finance, have also launched ESG ratings for Chinese listed companies. In our sample, both the number of Chinese listed companies receiving Bloomberg ESG disclosure scores and their average scores have risen year by year, reflecting firms' deepening engagement with ESG^[8].

Nevertheless, China still faces several challenges. First, a unified national mandatory disclosure standard has yet to be established. At present, disclosure remains largely voluntary, with inconsistent indicator definitions, a shortage of quantitative data, and limited third-party assurance coverage, which gives rise to selective disclosure and greenwashing. Second, market incentives are insufficient: investors have not yet developed a mature ESG value-investment philosophy, and firms lack intrinsic motivation to improve performance on the social dimension (e.g., income distribution and labor fairness). Third, the ESG evaluation system is insufficiently localized. Existing international ratings provide inadequate coverage of distinctively Chinese issues such as common prosperity, primary distribution, and rural revitalization, making it difficult to gauge firms' effectiveness in "dividing the cake well."

2.2 ESG and Common Prosperity: "Making the Cake Bigger" and "Dividing the Cake Well"

From a corporate perspective, promoting common prosperity is reflected mainly in two respects. First, "making the cake bigger" refers to improving corporate financial performance so that more profits are available for distribution. Second, "dividing the cake well" refers to raising the labor income share and narrowing the income gap between management and ordinary employees. With respect to "making the cake bigger," a substantial body of research documents a positive association between ESG and corporate financial performance or firm value^{[9][10][11]}.

ESG can reduce the risks firms face, including systemic risk, regulatory risk, supply chain risk, and reputational risk. Firms that engage in ESG effectively provide public goods to society and thereby accumulate "moral capital," which earns them sympathy and support from stakeholders when adverse risk events occur. ESG can also lower firms' financing costs: firms with outstanding ESG performance are more likely to attract responsible investors and to receive government subsidies and preferential loans. Accordingly, we propose the following hypothesis:

H1: Corporate ESG engagement improves financial performance, that is, it contributes to "making the cake bigger."

With respect to "dividing the cake well," the essence of ESG lies in achieving balance — and ideally mutual benefit — among all stakeholders, including shareholders, creditors, employees, customers, suppliers, and the

community. In ESG ratings, treating employees well is typically a core component of the Social (S) dimension, encompassing equal treatment of employees, greater investment in occupational safety, and more on-the-job training. Such measures help enhance employees' human capital and improve their income position. Admittedly, ESG investment raises capital expenditure in the short run and may substitute capital for labor, thereby widening the income gap between skilled and unskilled workers; moreover, the attention some rating systems pay to internal management compensation may, in effect, raise executive pay. On balance, this paper proposes the following hypothesis:

H2: Corporate ESG engagement helps raise the labor income share and narrow the compensation gap.

In theory, however, countervailing forces also exist. ESG investment raises capital expenditure in the short run and may substitute capital for labor, thereby widening the income gap between skilled and unskilled workers; moreover, the attention some rating systems pay to internal management compensation may, in effect, raise executive pay. Whether ESG can truly "divide the cake well" is therefore ultimately an empirical question.

3. Research Design

3.1 Data Sources and Sample

This paper takes Chinese A-share listed companies with Bloomberg ESG disclosure scores from 2011 to 2023 as the research sample. ESG data are obtained from Bloomberg; data on financial performance, corporate governance, and control variables are drawn from the CSMAR database; and labor income-related data are taken from listed companies' income statements and cash flow statements. Following common practice, we exclude financial-industry firms and firms designated ST or PT in a given year, and we winsorize the main continuous variables at the 1st and 99th percentiles to mitigate the influence of extreme values. This yields approximately 17,000 firm-year observations.

3.2 Variable Definitions

The core explanatory variable is the degree of corporate ESG engagement, measured by the Bloomberg ESG disclosure score (ranging from 0 to 100); we further distinguish among the environmental (E), social (S), and governance (G) sub-scores.

The dependent variables for "making the cake bigger" are financial performance measures: return on equity (ROE), return on total assets (ROA), total operating revenue (in logarithm), and operating profit (in logarithm). The dependent variables for "dividing the cake well" capture the firm's internal income distribution: the labor income share, measured as "cash paid to and on behalf of employees" divided by total operating revenue; and the ratio of management compensation to ordinary employee compensation, measured as average management compensation divided by average ordinary employee compensation, where average management compensation is approximated by one-third of the total compensation of the three highest-paid executives, and average ordinary employee compensation is computed as cash paid to employees divided by the number of employees.

Control variables include firm size (logarithm of total assets), firm age, the asset-liability ratio, state ownership status, the separation ratio between control rights and cash flow rights, ownership concentration (the shareholding ratio of the top ten shareholders), board size, the proportion of female executives, and industry concentration (the Herfindahl index).

3.3 Econometric Model Specification

To mitigate potential reverse causality, all explanatory and control variables are lagged by one period. The baseline regressions control for both firm and year fixed effects and employ robust standard errors clustered at the firm level. We specify three sets of econometric models to examine, respectively, the effect of firm characteristics on ESG, the effect of ESG on "making the cake bigger" (financial performance), and the effect of ESG on "dividing the cake

well" (internal income distribution). The three models share the same structure and differ only in their dependent variables and core explanatory variables.

First, to examine which firm characteristics affect ESG performance, we specify Model (1):

$$ESG_{it} = \beta_1 Features_{i,t-1} + \beta_2 Govern_{i,t-1} + \beta_3 Other_{i,t-1} + \delta_i + \delta_t + \varepsilon_{it} \quad (1)$$

Here, the subscript *i* indexes firms and *t* indexes years. The dependent variable ESG is the firm's overall ESG score or its individual environmental (E), social (S), or governance (G) score. Features, Govern, and Other denote the firm's basic characteristics, governance structure, and other factors, respectively. δ_i and δ_t are firm and year fixed effects, and ε_{it} is the random error term.

To examine the effect of ESG on financial performance, we specify Model (2):

$$Performance_{it} = \beta_1 ESG_{i,t-1} + \beta_2 X_{i,t-1} + \delta_i + \delta_t + \varepsilon_{it} \quad (2)$$

Here, the dependent variable Performance denotes corporate financial performance, measured by return on equity (ROE), return on total assets (ROA), total operating revenue (natural logarithm), and operating profit (natural logarithm). The core explanatory variable is the one-period-lagged ESG score. *X* is the vector of control variables, identical to that in Model (1). δ_i and δ_t are firm and year fixed effects, respectively.

To examine the impact of ESG on firms' internal income distribution, we specify Model (3):

$$Income_{it} = \beta_1 ESG_{i,t-1} + \beta_2 X_{i,t-1} + \delta_i + \delta_t + \varepsilon_{it} \quad (3)$$

Here, the dependent variable Income denotes the firm's internal income distribution, measured by the labor income share and the pay gap between management and ordinary employees; the core explanatory variable is the one-period lagged ESG score; *x* is the vector of control variables, identical to that in Models (1) and (2); and δ_i and δ_t denote firm and year fixed effects, respectively.

4. Stylized Facts and Empirical Results

4.1 Stylized Facts of Chinese Firms' ESG Participation

Table 1 Descriptive statistics of the main variables

variable	sample size	mean value	standard deviation	minimum value	maximum value
ESG total score (disclosure))	5803	31.298	11.073	12.514	63.662
Environment E score	5789	13.139	16.900	0.000	67.019
Social S score	5791	14.901	8.901	0.000	45.499
Governance G score	5782	65.819	13.221	29.651	89.284
ROE	16757	0.041	0.165	-0.993	0.331
ROA	16757	0.032	0.066	-0.268	0.197
Total operating income (logarithm)	16429	20.792	1.814	14.423	25.061
Operating profit (logarithm)	13630	18.767	1.572	9.326	24.935
labor income share	14621	0.200	0.168	0.014	0.851
Management-employee pay gap	16735	8.523	7.449	1.212	48.290
size of enterprise	16757	22.200	1.176	19.973	25.769

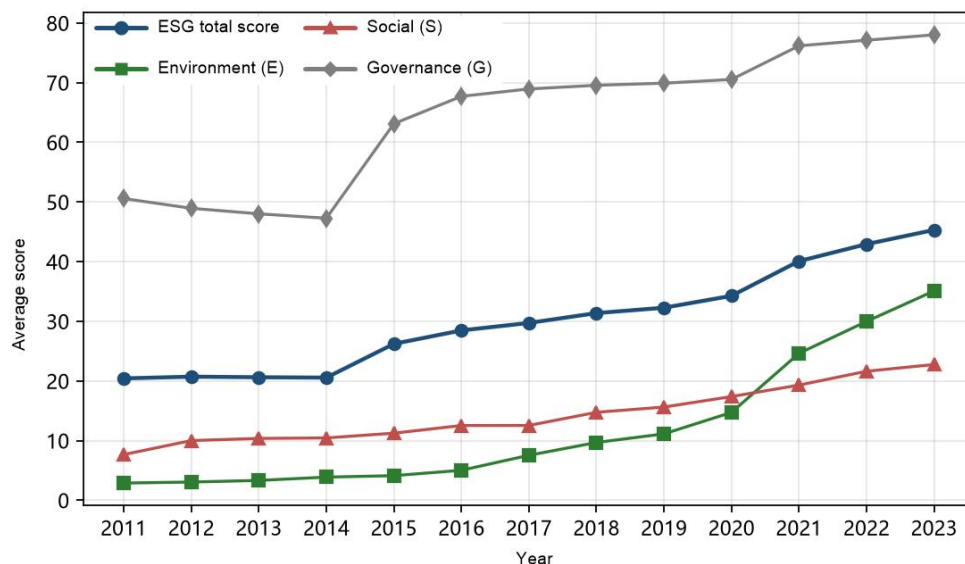
assets-liability ratio	16757	0.421	0.202	0.053	0.897
Whether state-owned enterprises	16757	0.309	0.462	0.000	1.000
ownership concentration	16757	0.563	0.152	0.226	0.882
board size	16754	2.117	0.188	1.609	2.565
Proportion of female executives	16757	0.198	0.112	0.000	0.500
Enterprise age (logarithm)	16757	2.965	0.339	1.946	3.664
industry concentration	16757	0.090	0.093	0.013	0.582

Note: All continuous variables are winsorized at the 1% level in both tails.

Table 1 reports descriptive statistics for the main variables. Over the period 2011-2023, the average ESG disclosure score of the sample firms is approximately 31.298, with substantial variation across firms. Among the sub-scores, corporate governance (G) has the highest mean, whereas the environmental (E) and social (S) scores are relatively low, a pattern broadly consistent with the "governance leading, environment and society lagging" feature of Chinese firms' ESG practice.

In terms of annual trends (see Figure 1), the average ESG score of Chinese listed companies rose steadily over 2011-2023, from 20.42 in 2011 to approximately 45.31 in 2023. Among the sub-scores, the environmental (E) score increased the most, from 2.88 to 35.08; the social (S) score improved continuously, while the corporate governance (G) score remained at a consistently high level with relatively flat growth. These patterns indicate that listed companies have attached increasing importance to ESG participation and disclosure quality, with the improvement concentrated primarily in the environmental dimension.

Figure 1 Trends in the average ESG scores of Chinese listed companies, 2011-2023



We further examine which firms participate more actively in ESG. Table 2 regresses the total ESG score and each sub-score on firm characteristics lagged by one period. The regression results show that firm size and ownership concentration have significant positive effects on ESG; that is, after controlling for firm fixed effects, increases in firm size and ownership concentration are significantly associated with higher ESG disclosure scores. The debt-to-asset ratio is significantly negatively correlated with ESG, indicating that firms with lower financial leverage perform better

on ESG, while the effects of state ownership and industry concentration are negative. At the sub-score level, the positive effects of firm size and ownership concentration are most pronounced for the environmental (E) and social (S) dimensions.

Table 2 Firm characteristics (lagged one period) and ESG scores

variable	ESG total score	Environment E	Society S	Governance G
Enterprise scale	2.0615*** (5.23)	4.0627*** (5.54)	2.4639*** (6.01)	-0.2121 (-0.48)
Enterprise age	-3.7247 (-1.08)	-2.2544 (-0.35)	-2.7461 (-0.75)	-6.2368* (-1.70)
Asset-liability ratio	-4.4453*** (-3.23)	-6.7749** (-2.46)	-4.3602*** (-2.76)	-2.2980 (-1.47)
Whether state-owned enterprises	-1.5873* (-1.79)	-3.4805** (-2.07)	-0.9452 (-0.93)	-0.2848 (-0.29)
Separation rate of two rights	0.8253 (0.24)	4.0346 (0.65)	-2.3561 (-0.54)	0.4305 (0.10)
Ownership concentration	7.0915*** (3.19)	12.7677*** (3.27)	5.1750** (2.21)	3.5307 (1.49)
Board size	-0.5061 (-0.40)	0.0121 (0.01)	-1.2420 (-0.89)	-0.2702 (-0.20)
Proportion of female executives	-0.8140 (-0.35)	1.6283 (0.38)	-1.3389 (-0.51)	-2.0821 (-0.82)
Industry concentration	-4.6804* (-1.93)	-7.3035 (-1.46)	-5.1111** (-2.07)	-1.2848 (-0.49)
Firm fixed effect	control	control	control	control
Year fixed effect	control	control	control	control
Sample size	5183	5173	5174	5168
R ²	0.832	0.760	0.687	0.829

Note: Robust t-statistics clustered at the firm level are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The same applies below.

4.2 ESG and "Making the Cake Bigger"

To examine the impact of ESG on financial performance, we specify Model (2):

$$Performance_{it} = \beta_1 ESG_{i,t-1} + \beta_2 X_{i,t-1} + \delta_i + \delta_t + \varepsilon_{it} \quad (2)$$

Here, the dependent variable *Performance* denotes the firm's financial performance, measured by the return on equity (ROE), the return on total assets (ROA), total operating revenue (in natural logarithm), and operating profit (in natural logarithm); the core explanatory variable is the one-period lagged ESG score; *x* is the vector of control variables, identical to that in Model (1); and δ_i and δ_t denote firm and year fixed effects, respectively.

Table 3 examines the impact of the total ESG score on financial performance. The results show that the one-period lagged total ESG score has a significant positive effect on the return on equity (ROE), the return on total assets (ROA), and operating profit, while its effect on total operating revenue is positive but insignificant. These findings indicate that corporate ESG participation does help "make the cake bigger," supporting Hypothesis H1 and consistent

with the mainstream conclusions in the international literature.

Table 3 Total ESG score (lagged one period) and financial performance

variable	ROE	ROA	Ln operating income	Ln operating profit
L. ESG total score	0.0024*** (4.33)	0.0008*** (3.81)	0.0012 (0.21)	0.0201*** (4.28)
control variable	control	control	control	control
Firm/year fixed effect	control	control	control	control
sample size	5030	5030	4941	4337
R ²	0.355	0.515	0.728	0.698

Table 4 further decomposes ESG into its three sub-scores: environmental (E), social (S), and corporate governance (G). The results show that the environmental (E) score is the main factor driving the improvement in financial performance, exerting a significant positive effect on ROE, ROA, and operating profit. By contrast, no robust significant relationship is found between the social (S) or corporate governance (G) scores and financial performance. The sub-score regressions indicate that the positive association between the environmental disclosure score and financial performance is the most stable, which may be related to recent changes in the institutional environment, such as the green transition, stricter environmental regulation, and increased green financial support.

Table 4 ESG sub-scores (lagged one period) and financial performance

variable	ROE	ROA	Ln operating income	Ln operating profit
Environment E	0.0018*** (5.10)	0.0006*** (4.06)	0.0012 (0.34)	0.0089*** (2.96)
Society S	-0.0005 (-0.76)	-0.0002 (-0.94)	-0.0018 (-0.28)	0.0086 (1.64)
Governance G	0.0000 (0.02)	0.0001 (0.95)	0.0011 (0.34)	0.0009 (0.28)
control variable	control	control	control	control
Firm/year fixed effect	control	control	control	control
sample size	4983	4983	4895	4290
R ²	0.361	0.517	0.731	0.698

4.3 ESG and "Dividing the Cake Well"

To examine the impact of ESG on firms' internal income distribution, we specify Model (3):

$$Income_{it} = \beta_1 ESG_{i,t-1} + \beta_2 X_{i,t-1} + \delta_i + \delta_t + \epsilon_{it} \quad (3)$$

Here, the dependent variable *Income* denotes the firm's internal income distribution, measured by the labor income share and the pay gap between management and ordinary employees; the core explanatory variable is the one-period lagged ESG score; *x* is the vector of control variables, identical to that in Models (1) and (2); and δ_i and δ_t denote firm and year fixed effects, respectively.

Table 5 examines the impact of ESG on firms' internal income distribution. Columns (1) and (2) use the labor income share and the pay gap between management and ordinary employees as the dependent variables, with the total ESG score as the explanatory variable; Columns (3) and (4) replace the total ESG score with the sub-scores. The results show that the total ESG score has no significant effect on the labor income share but has a significant positive effect on the pay gap between management and ordinary employees: the higher the ESG score, the wider the income gap between management and ordinary employees. Among the sub-scores, the social (S) score is negatively correlated with the labor income share, and the environmental (E) score is positively correlated with the pay gap. Overall, corporate ESG participation has not improved the income distribution within firms, and Hypothesis H2 is therefore not supported.

Table 5 ESG and internal income distribution

variable	Labor income share	Pay gap	Labor income share	Pay gap
L.ESG Score	-0.0010 (-1.32)	0.0509* (1.67)		
L.Environment E			0.0001 (0.28)	0.0361* (1.91)
L.Society S			-0.0014* (-1.95)	-0.0078 (-0.24)
L.Governance G			-0.0001 (-0.20)	0.0048 (0.26)
control variable	control	control	control	control
Firm / year fixed effect	control	control	control	control
sample size	4160	5019	4114	4972
R ²	0.614	0.771	0.615	0.771

5. Robustness and Endogeneity Tests

5.1 Robustness Tests

To further verify the reliability of the baseline results, this paper conducts robustness tests by replacing the measure of the core explanatory variable and adopting a stricter fixed-effects specification: year fixed effects are added on top of firm fixed effects to absorb common shocks affecting specific industries in specific years. Table 6 reports the regression results based on the Bloomberg ESG disclosure score (standardized to have a mean of 0 and a standard deviation of 1); the panel adopts a two-way fixed-effects specification with firm and year fixed effects. Each column controls for firm size, the debt-to-asset ratio, state ownership status, the separation rate of ownership and control rights, ownership concentration, board size, the proportion of female executives, industry concentration, and

firm age, and uses robust standard errors clustered at the firm level. Under the two-way fixed-effects specification, the coefficient on ESG is significantly positive at the 5% and 1% levels for ROE and operating profit, respectively, and marginally significant at the 10% level for ROA. Meanwhile, the conclusions that ESG has no significant improving effect on the labor income share and does not narrow the pay gap remain robust under both specifications.

Table 6 Robustness tests

variable	ROA	ROE	Ln operating income	labor income share	pay gap
L.ESG (standardization)	0.0022* (1.95)	0.0063** (2.28)	0.0855*** (3.39)	0.0023 (0.56)	0.0284** (2.29)
control variable	Yes	Yes	Yes	Yes	Yes
sample size	12646	12646	11013	10406	12626
Intragroup R ²	0.140	0.100	0.121	0.003	0.042

Note: Robust t-statistics clustered at the firm level are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The core explanatory variable is the standardized Bloomberg ESG disclosure score (lagged one period). Each column controls for firm size, the debt-to-asset ratio, state ownership status, the separation rate of ownership and control rights, ownership concentration, board size, the proportion of female executives, industry concentration, and firm age.

5.2 Addressing Endogeneity: The Instrumental Variable Approach

Endogeneity concerns arising from reverse causality or omitted variables may affect the relationship between firms' ESG performance and financial performance. To address this issue, this paper employs the instrumental variable method (2SLS) to further identify the causal effect. Drawing on the logic of peer effects, we use the average ESG score of other firms in the same industry and year as the instrument for a firm's own ESG: the ESG level of industry peers affects a firm's ESG decisions through industry demonstration effects and competitive pressure (satisfying the relevance condition), but is unlikely to directly affect the firm's financial performance or internal income distribution (satisfying the exogeneity condition). The core explanatory variable is consistent with Table 6, namely the standardized Bloomberg ESG disclosure score. The 2SLS results are reported in Table 7. The first-stage F-statistic is approximately 69, far exceeding the conventional critical value for weak instruments, indicating that the instrument is strongly correlated with the endogenous variable. In the second stage, ESG has a significant positive effect on ROA at the 1% level, supporting a causal interpretation of ESG "making the cake bigger"; meanwhile, the coefficient on ESG for the pay gap is significantly positive, indicating that ESG has not narrowed but rather widened the pay gap between management and ordinary employees, consistent with the baseline conclusion.

Table 7 Instrumental Variable (2SLS) Regression Results

variable	ROA	pay gap
L.ESG (standardization, 2SLS)	0.0436*** (4.58)	0.3089*** (3.10)
One-stage F value	68.7	68.3
instrumental variable	ESG mean of other enterprises in the same industry	ESG mean of other enterprises in the same industry
Firm / year fixed effect	control	control
sample size	12559	12539

Note: Robust t-statistics clustered at the firm level are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The core explanatory variable is the standardized Bloomberg ESG disclosure score (lagged one period), and the instrumental variable is the mean ESG score of other firms in the same industry and year; each column includes all control variables listed in Table 6 as well as firm and year fixed effects.

6. Influence Mechanism and Heterogeneity Analysis

6.1 Influence Mechanism: The Financing Constraint Channel

The preceding analysis shows that ESG helps to make the cake bigger; through what channels, then, is this effect achieved? A common explanation is the financing constraint channel: firms with strong ESG performance are more likely to attract responsible investors and external financing support, thereby alleviating financing constraints and improving business performance. This paper measures financing constraints with the SA index and applies a stepwise regression approach to test this channel. The results are reported in Table 8. After the financing constraint variable is added, the coefficient of ESG on ROA remains essentially unchanged, and the mediating effect of financing constraints itself is not statistically significant; that is, financing constraints are not the main transmission channel through which ESG makes the cake bigger. Combined with the sub-dimension results in Table 4, the performance improvement associated with ESG is likely to stem from the compliance benefits and reputation mechanisms brought about by improved environmental performance.

Table 8 Impact Mechanism Test: The Financing Constraint Channel

variable	Financing Constraints (SA)	ROA (total effect)	ROA (including intermediaries)
L. ESG total score	0.0023*** (5.34)	0.0008*** (3.81)	0.0009*** (3.90)
L.Financing constraints (SA)			-0.0226 (-1.48)
Control variable / two-way fixed effect	control	control	control
sample size	5030	5030	5030

Note: Robust t-statistics clustered at the firm level are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

6.2 Heterogeneity Analysis

The economic and social effects of corporate ESG may vary with ownership type, region, and industry. Accordingly, this paper conducts subsample regressions. Table 9 reports the regression coefficients of ESG on ROA and the pay gap across subsamples. The results show the following. First, with respect to ownership, both the effect of ESG in making the cake bigger and its effect in widening the pay gap are significant in the non-state-owned enterprise sample but not among state-owned enterprises, which may be because state-owned enterprises bear more social responsibilities and are subject to pay regulation. Second, with respect to region, the effects of ESG on performance and the pay gap are more pronounced among firms in the central and western regions; that is, the marginal returns to improving ESG are higher for firms in later-developing regions. Third, with respect to industry, ESG significantly improves performance in both heavily polluting and non-heavily polluting industries. Overall, the pattern whereby ESG makes the cake bigger but fails to divide the cake well is more prominent among non-state-owned enterprises and enterprises in the central and western regions, where market orientation is more evident.

Table 9 Heterogeneity Analysis (Coefficients on the Core Explanatory Variable L.ESG)

subsample	ROA	pay gap	Sample size (ROA / Gap)
state-owned enterprises	0.0002 (0.73)	-0.0344 (-1.14)	2077 / 2068
Non-state-owned enterprises	0.0009*** (3.26)	0.1249*** (2.75)	2953 / 2951
the eastern part	0.0006*** (2.65)	0.0331 (0.87)	3555 / 3554
central and western parts of china	0.0013*** (3.15)	0.1008** (2.14)	1475 / 1465
heavy pollution	0.0009** (2.45)	-0.0214 (-0.45)	1331 / 1321
non-heavy pollution	0.0007*** (2.92)	0.0857** (2.29)	3699 / 3698

Note: Robust t-statistics clustered at the firm level are reported in parentheses; each cell reports the regression coefficient on the core explanatory variable L.ESG for the corresponding subsample, controlling for all control variables and two-way fixed effects.

7. Barriers to ESG Participation among Chinese Enterprises

The above analysis indicates that Chinese enterprises' ESG participation has only partially promoted common prosperity: its contribution is mainly reflected in making the cake bigger, whereas dividing the cake well has fallen short of theoretical expectations. Drawing on the findings of this paper and the existing literature, several institutional and market-level explanations can be offered.

First, from a regulatory perspective, ESG disclosure is subject to no strict requirements or unified standards, and comparability is relatively weak; yet adequate information disclosure is a prerequisite for effective ESG ratings and investment. In contrast to the mandatory or "comply or explain" disclosure regimes generally implemented in developed countries, China currently still encourages voluntary disclosure. Most companies' disclosures are biased and inconsistent in scope and lack third-party verification, giving rise to problems such as selective disclosure and even data distortion.

Second, at the enterprise level, the concept of ESG is often misunderstood: firms tend to regard ESG as a form of "charity" or "donation". In fact, ESG is, in essence, a means of making the cake bigger by sharing benefits with stakeholders—an incentive-compatible mechanism rather than simple charitable expenditure. Indeed, the greater a firm's operating difficulties, the more it needs to mobilize stakeholders' enthusiasm through ESG in order to overcome them; this misunderstanding leaves many small and medium-sized enterprises lacking intrinsic motivation for ESG.

Third, at the market level, investors and consumers have not yet fully embraced ESG, and a mature ESG market in which participants "vote with their feet" has yet to take shape. When firms with poor ESG performance face no penalty from the capital market or the product market, their incentive to improve ESG—especially along dimensions that do not directly raise revenue in the short term—remains weak.

Finally, at the theoretical level, a unified discourse framework linking the traditional concept of righteousness and profit, ESG, and common prosperity has yet to be established. Since ancient times, China has had a tradition of business ethics that values charity and the pursuit of profit through righteousness. The four-layer logic of the traditional Confucian merchant spirit concerning the relationship between righteousness and profit can be directly connected with contemporary ESG practice: "righteousness" corresponds to the enterprise's responsibilities toward

the environment, employees, and society, while "profit" corresponds to the enterprise's financial performance. The two are not a zero-sum game; rather, through compliance gains, reputational capital, and stakeholder support, firms can achieve a "symbiosis of righteousness and profit"—honoring one's responsibilities reduces transaction costs, strengthens long-term resilience, and ultimately yields more sustainable profits. This also provides cultural-logical support for this paper's finding that ESG makes the cake bigger. At present, however, enterprises largely follow Western interpretations in their ESG discourse and lack an indigenous cultural foundation; and although common prosperity, as a policy concept, is being implemented with considerable force, whether its spiritual core is closely linked to corporate behavior remains to be further articulated—otherwise it may impose moral pressure on enterprises rather than generate endogenous motivation.

8. Conclusion

Drawing on data on China's A-share listed companies from 2011 to 2023, this paper examines, from an ESG perspective, the theoretical logic and practical effects of enterprises' promotion of common prosperity. The results show that corporate ESG participation significantly improves financial performance, with the environmental dimension exerting the largest effect on performance, thereby confirming that ESG helps make the cake bigger. However, ESG participation has not significantly increased the labor income share and has, to some extent, widened the pay gap between management and ordinary employees; the effect of dividing the cake well has yet to materialize. This implies that Chinese enterprises' ESG activities are at present mainly oriented toward making the cake bigger and have not yet produced a positive effect on dividing the cake well. These conclusions remain robust and reliable after replacing the core explanatory variable, addressing endogeneity with the instrumental variable method, and conducting subsample tests by ownership, region, and industry; moreover, this pattern is more prominent among non-state-owned enterprises and enterprises in the central and western regions, where the degree of marketization is higher.

To better enable enterprises to promote common prosperity through ESG, this paper offers the following recommendations. First, accelerate the improvement of ESG disclosure requirements and unified standards. For example, listed companies (except for a few special industries) should be subject to stricter disclosure provisions, issue ESG reports in accordance with the "comply or explain" principle, and be subject to strengthened third-party verification of ESG information so as to enhance data comparability and credibility. Second, strengthen ESG education, with a focus on enterprises and investors. Securities regulators should make ESG an important component of investor education to help foster a mature ESG market in which participants "vote with their feet", and in particular should guide evaluation systems to incorporate firms' internal income distribution into the social dimension. Third, promote the theoretical integration of the traditional concept of righteousness and profit, ESG, and common prosperity. The righteousness-and-profit ethos of ancient Chinese merchants is essentially consistent with the modern spirit of ESG. Accordingly, while absorbing the strengths of China's own culture, attention should be paid to alignment with internationally accepted ESG concepts, thereby providing institutional incentives and cultural identification for enterprises to better practice ESG and promote common prosperity.

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Frontier Technologies in Medical Image Detection: Innovation, Clinical Practice and Practical Dilemmas

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Abstract: Against the background of precision medicine, medical image detection has become a core component of early disease screening, lesion quantification and therapeutic effect evaluation. Driven by artificial intelligence, sensor hardware and computational reconstruction algorithms, advanced medical imaging technologies break through the limitations of traditional equipment in radiation dose, scanning speed and diagnostic accuracy. This paper sorts out representative cutting-edge directions including medical imaging foundation models, deep-learning-driven low-dose rapid reconstruction, cross-modal generative imaging, multi-modal image fusion diagnosis and edge-side distributed intelligent detection. Drawing on the existing technical literature, it analyzes how these technologies optimize imaging workflows, reduce hardware-dependence and relieve the shortage of radiologists. Meanwhile, this article interrogates practical bottlenecks including domain shift across devices, insufficient model interpretability, data privacy risks and clinical validation barriers. The study holds that these medical image technologies serve only as auxiliary tools for clinicians; final diagnosis still requires physician review. Exploring interpretable artificial intelligence, small-sample learning and standardized regulatory frameworks will promote the safe and popularized deployment of new-generation medical imaging solutions.

Keywords: Medical Image Detection; Artificial Intelligence for Medical Imaging; Multi-modal Fusion; Generative Imaging; Edge-side Medical Intelligence

1. Introduction

Medical imaging is an indispensable clinical tool for visualizing anatomical structures and pathological changes. Conventional detection techniques such as computed tomography (CT), magnetic resonance imaging (MRI), X-ray and ultrasound are widely applied, yet constrained by objective defects: high radiation exposure, long scanning duration, low sensitivity for tiny lesions and uneven diagnostic capacity between tier-one hospitals and resource-limited healthcare facilities. In recent years, the integration of high-performance computing and deep learning has substantially advanced medical image detection, giving rise to a series of advanced technologies reshaping diagnostic paradigms.

Different from early task-specific medical AI models which require massive annotated data for single-disease detection, contemporary imaging technologies move toward general-purpose, cross-modal and distributed intelligence. Such technical evolution bears prominent practical significance under the context of precision medicine. On one hand, new imaging methods enhance early-stage detection capacity for tumours, neurodegenerative disorders and cardiovascular diseases. On the other hand, they ease the pressure caused by insufficient radiological manpower, and support diagnostic capability sinking to primary-care sites.

Nevertheless, technical innovation does not equal immediate clinical maturity. Medical image intelligence faces multiple realistic obstacles. Heterogeneous data collected from various scanner brands creates domain shift; black-box features of deep neural networks bring difficulties in result tracing; patient privacy protection poses higher requirements for data circulation. Therefore, it is necessary to systematically sort out technical advantages, clinical values and existing dilemmas of emerging medical image detection technologies, so as to provide references for subsequent research and industrial transformation.

To facilitate an intuitive overview of the above directions, Table 1 lists several representative medical imaging models, along with their core techniques, typical applications, key advantages, and current bottlenecks.

Table 1: Representative medical imaging AI models and approaches

Research Direction	Representative Models / Methods	Core Technology	Main Functions / Applications
Medical imaging foundation models	Medical imaging foundation model (pre-training + fine-tuning, e.g., MedSAM, RadFM)	Cross-modal self-supervised pre-training	Segmentation / lesion detection / risk stratification / diagnostic report generation
Low-dose rapid reconstruction	Deep learning-based low-dose reconstruction network (e.g., RED-CNN, DU-GAN)	AI computational reconstruction algorithm	Low-dose image reconstruction, scanning time reduction
Cross-modal generative imaging	GAN / Diffusion model (e.g., CycleGAN, Stable Diffusion for medical imaging)	Generative imaging	Modal transformation, missing image completion
Multi-modal image fusion diagnosis	Multi-modal feature fusion network (e.g., Attention-based Fusion Net)	Feature fusion algorithm	Comprehensive diagnosis with multi-source image information
Edge-side distributed intelligent detection	Lightweight edge detection model (e.g., YOLO-MobileNet, Tiny-UNet)	Edge computing + lightweight inference	Real-time lesion detection, distributed deployment

2. AI-Empowered General Medical Imaging Foundation Models: Breaking Annotation Bottlenecks for Cross-modal Diagnosis

In traditional medical-image artificial-intelligence research, most models are task-oriented. A dedicated network needs to be trained separately for lung nodule detection, brain tumour segmentation or breast-lesion recognition. Such models rely heavily on large-scale manually labelled datasets, and show poor generalization performance

when facing data from new hospitals or different imaging devices. Medical imaging foundation models represent an important approach to resolve these pain points [1].

Medical imaging foundation models conduct pre-training on massive unannotated cross-modal datasets covering CT, MRI, X-ray, pathological digital slices and ultrasound. Through self-supervised learning strategies, the model automatically learns intrinsic feature patterns of human tissues and lesions without heavy manual marking. After pre-training, only a small volume of labelled samples are needed for fine-tuning, and the model can rapidly adapt to diverse downstream tasks: organ semantic segmentation, lesion target detection, risk stratification and preliminary diagnostic report generation.

From the perspective of cultural-technical analogy, the pre-training-and-fine-tuning mechanism of imaging foundation models realizes a process similar to "separation-adaptation" in ritual studies: the model departs from general original imaging feature space in pre-training phase, and enters specialized clinical-task space in fine-tuning. This greatly cuts labour costs of image annotation and mitigates the shortage of labelled samples for rare diseases.

However, limitations remain. The generalization ability of foundation models is still affected by uneven distribution of training data. If training datasets lack cases from grassroots hospitals or special ethnic populations, performance degradation will emerge in real-world deployment. Besides, the logical connection between model feature extraction and pathological mechanism is not sufficiently explicit, which hinders clinical physicians' trust in model outputs [7].

3. Deep-learning-driven Low-dose and Rapid Image Reconstruction: Reducing Physical Burdens of Imaging Examination

Radiation risk of CT and lengthy scanning time of MRI are long-standing clinical challenges. Deep-learning reconstruction (DLR) technology provides feasible solutions for these two problems, and has shown promise in early clinical applications [2].

For CT examination, traditional low-dose scanning will introduce heavy image noise and blur tiny pathological features. Deep-learning reconstruction algorithms suppress noise and restore edge details from low-dose projection data. Patients can obtain diagnostic-quality CT images under significantly reduced radiation exposure, which is especially valuable for paediatric patients and populations requiring repeated follow-up scans [6].

In MRI imaging, traditional full-sampling acquisition requires several to more than ten minutes per examination. Undersampling combined with deep-learning reconstruction techniques [2] has demonstrated promise in reducing acquisition time, with research in specific protocols indicating potential acceleration factors of $2-6\times$. However, substantial clinical validation of these approaches remains ongoing, and results vary significantly across scanner vendors, imaging protocols, and anatomical regions. Clinical implementation requires further standardization and regulatory approval.

It should be noted that reconstruction algorithms carry potential risks of artificial feature generation. Over-smoothing processing may erase real tiny lesions or create false-positive simulated textures. Clinical radiologists must remain the final decision-maker when interpreting reconstructed images.

4. Cross-modal Generative Medical Imaging: Modal Conversion and Augmented Data Simulation

Generative artificial-intelligence expands the boundary of medical image detection. Cross-modal generative imaging can realize bidirectional conversion between different imaging modalities: generating pseudo-CT images from MRI sequences for radiotherapy planning simulation, or synthesizing virtual MRI images based on CT data. Under suitable conditions, it avoids repeated multi-modality scanning for patients and lowers cumulative radiation dosage [3].

Another vital application lies in medical-dataset augmentation. Rare illnesses suffer from scarcity of real-patient imaging samples. Generative networks can synthesize high-fidelity simulated lesion images to expand training datasets, improving model recognition performance for low-incidence diseases. Moreover, generative models can simulate progressive lesion evolution, helping clinicians observe hypothetical disease progression and assess potential therapeutic responses.

Even so, generative imaging faces notable constraints. Synthetic images cannot completely replicate complex real pathological variations. There exists the risk of fabricating non-existent pathological features or concealing real lesions. Synthetic data also needs strict quality auditing before being used for model training.

5. Multi-modal Image Fusion Detection: From Single-modality Morphology to Multi-dimensional Comprehensive Evaluation

Single-modality medical images can only reflect partial properties of human tissues. CT excels at displaying bony structures and high-density lesions; MRI presents soft-tissue details; PET supplies metabolic activity information; ultrasound captures real-time dynamic changes. Multi-modal image fusion detection technology aligns and jointly analyses anatomical imaging, functional-metabolic imaging, pathological sections, laboratory test indicators and genetic data [4].

By integrating multi-source information, fusion detection achieves diagnostic logic beyond simple image superposition. In oncological diagnosis, it assists tumour staging and micrometastatic-focus identification; in neurodegenerative disease research, it supports early warning of Alzheimer's disease before obvious morphological damages appear. The technical core lies in spatial registration of multi-source images and multi-dimensional feature fusion algorithms, eliminating information conflicts between different modalities.

Practical barriers include high computational overhead, difficulty in time-space alignment of multi-source data, and lack of unified evaluation standards for fusion diagnostic outcomes.

6. Lightweight Edge-side Intelligent Detection and Federated Distributed Medical Intelligence: Capability Sinking under Privacy Constraints

High-performance large medical-AI models originally require cloud-side powerful computing hardware, which restricts their application in remote resource-limited healthcare sites. Lightweight network models realize model compression without severe performance loss. They can be deployed locally on portable ultrasound devices, mobile screening terminals and on-site emergency-care equipment, accomplishing real-time preliminary lesion detection on edge hardware. Through 5G transmission, local preliminary analysis and remote expert consultation form a collaborative diagnostic workflow, promoting high-quality imaging services to sink toward primary-care institutions [5, 8].

In order to resolve data-privacy dilemmas in multi-hospital joint model training, federated learning has become a critical technical route. Multiple medical institutions participate in model iterative training without exporting original patient imaging data. Only model parameter updates are transmitted externally, balancing model optimization and medical-data security.

Non-theoretical challenges cannot be ignored. Edge-device computing power differences will cause model performance fluctuation; federated learning increases communication overhead; inconsistency of data distribution among participating hospitals will influence convergence effects of joint training.

7. Conclusion

The medical-image detection technologies reviewed above — imaging foundation models, deep-learning reconstruction, generative cross-modal imaging, multi-modal fusion diagnosis and edge-side distributed

intelligence — profoundly transform traditional diagnostic workflows. Table 1 summarizes the key advantages, limitations and clinical maturity of these five technical directions. These innovations improve detection sensitivity, reduce examination burdens for patients, and alleviate the gap of diagnostic resources.

Nevertheless, technological advancement cannot bypass realistic constraints: domain shift across heterogeneous devices, insufficient model interpretability, generative-image simulation risks, data-security requirements and high thresholds of clinical verification still hinder large-scale standardized promotion. New-generation medical-imaging artificial-intelligence is positioned as auxiliary support for clinicians rather than diagnostic substitutes.

Looking forward, the development of medical-image detection should advance in three orientations: promoting interpretable medical-AI research, optimizing small-sample and rare-disease algorithm frameworks, and constructing unified clinical evaluation and regulatory standards. Only in this way can advanced technologies steadily translate into tangible clinical benefits for patients.

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The Evolution of the English Translation of the Core Concept "Tian" in the *Analects* and an Analysis of Translator Motivation

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Abstract: Confucianism is an important part of Chinese culture, and the *Analects*, as a Confucian classic, is central to understanding it. The evolution of the English translation of the core concept "Tian" (Heaven) in the *Analects* reflects the changing Western understanding of Confucian culture. Taking the English translations of the *Analects* by seven translators, including James Legge, Ku Hung-ming, and Arthur Waley, as the research subject, this paper analyzes the evolution of the English translation of "Tian," a core Confucian concept, from religious interpretation to de-religious and philosophical interpretation. The study finds that translator motivation and national orientation influence translators' translation strategies, and that the evolution of the English translation of "Tian" reflects a paradigm shift in Western Sinological research and the interplay of translator subjectivity. These findings offer implications for the cross-cultural dissemination of the Confucian classics in the context of the contemporary "going global" of Chinese culture.

Keywords: The *Analects*; Tian (Heaven); English translation; Translator motivation

1. Introduction

Confucianism is an important part of Chinese culture. As the guiding ideology adopted by successive feudal rulers for more than two thousand years, it has left a deep imprint on the Chinese mind, and Confucianism has long been closely bound to the Chinese nation. Whether in response to the current strategy of promoting Chinese culture to "go global" or in the Western world's desire to gain a deeper understanding of Chinese culture, Confucianism is a landmark that cannot be bypassed; to understand Chinese culture in depth, one must understand Confucian culture.

Throughout China's long history, Confucian culture has continuously enriched and transformed itself with the development of the times, demonstrating its vigorous vitality. This vitality is manifested not only in the adaptability of Confucian thought to the changes of the times but also in the continuous enrichment of its translated versions. The translation and dissemination of the Confucian classics have a long history. As early as more than four hundred years ago, during the translation boom of the late Ming and early Qing dynasties, missionaries in China used the *Analects* and other Confucian classics as reference books for learning Chinese culture and understanding the Chinese spirit, and translated them into foreign languages. Matteo Ricci (1552–1610) was the first to translate the *Four Books* into Latin, opening a four-hundred-year history of translating the *Analects* into foreign languages, although his translation was unfortunately not published at the time (Liu, 2020, p. 15).

The translation and dissemination of the Confucian classics constitute not only cross-cultural exchange but also a window through which Eastern and Western peoples understand each other. With the continuous exchanges between East and West, the Western world's understanding of Confucian thought has been changing, and this change is manifested in the understanding of the core concepts of Confucian thought. For instance, new English translations of the *Analects*, a classic of Confucian thought, have kept appearing, and its core concepts have been interpreted and reconstructed differently in different English versions.

This paper selects English translations of the *Analects* by different translators at home and abroad since the Opium War, examines the evolution of the core Confucian concept "Tian" across different translations of the *Analects*, and analyzes the causes of this evolution from the perspective of translator subjectivity.

2. The Core Concept "Tian" in the *Analects* and Its English Translation

2.1 The Meaning of "Tian" in the *Analects*

In the *Analects*, the character "Tian" (天) appears 49 times in total: 19 times on its own and 30 times as part of compound words. Specifically, "Tianxia" (天下, "all under Heaven") appears 23 times, "Tianming" (天命, "the Mandate of Heaven") 3 times, "Tianzi" (天子, "the Son of Heaven") 2 times, and "Tiandao" (天道, "the Way of Heaven") and "Tianlu" (天禄, "Heavenly blessings") once each (Yang, 1980, p. 233).

The interpretation of "Tian" in the *Analects* must proceed from its cultural status, historical evolution, and internal classification within the text. As the core concept of the Confucian "learning of Heaven and humanity," "Tian" runs through the fields of philosophy, religion, and ethics, and its connotations are complex and multidimensional. Etymologically, the *Shuowen Jiezi* (*Explanation of Script and Elucidation of Characters*) glosses "Tian" as "the top, the highest above," formed by combining "one" (一) and "great" (大) to symbolize the supreme existence above one's head, and it is the key to understanding Confucianism.

The intellectual origins of "Tian" can be traced back to high antiquity. The *Canon of Yao* and the *Canon of Shun* record that ancient rulers offered sacrifices to Heaven in the name of the "Son of Heaven," borrowing the authority of the celestial deity to consolidate their rule. In the *Book of Documents*, the phrase "the august Heaven cherishes and commands" reflects the "theory of the Mandate of Heaven," which regards "Tian" as the supreme lord of nature and society. During the Spring and Autumn and Warring States periods, the Daoist *Daodejing* declared that "Heaven and Earth are not benevolent; they treat the myriad things as straw dogs," treating "Tian" as a personal subject endowed with will. Confucius, by contrast, inherited the Western Zhou conception of the Mandate of Heaven and regarded "Tian" as the "sovereign Heaven," as in "he who offends against Heaven has none to whom he can pray," emphasizing its ultimate determining power over society and history, while the *Doctrine of the Mean* viewed "Tian" as the source of ethics and morality. From the Han and Tang dynasties to the Song and Ming periods, Dong Zhongshu of the Western Han proposed the theory of the "interaction between Heaven and humanity," using theology to strengthen the Mandate of Heaven's justification of royal authority. In Song–Ming Neo-Confucianism, Zhu Xi philosophized "Tian" into "principle" (*li*), stating that "principle is the substance of Heaven," highlighting its significance as both the law of the cosmos and the source of morality.

Within the text of the *Analects*, the core expressions of "Tian" can be divided into three categories. The natural Heaven (*ziran zhi tian*) refers to the natural space or phenomena opposed to "Earth," as in "Does Heaven speak? The four seasons proceed and the myriad things are born," symbolizing the natural order. The sovereign Heaven (*zhuzai zhi tian*) possesses an independent personality and will and governs the fate of all things, as in "Heaven is about to use the Master as a wooden-tongued bell," reflecting the religious coloring of Heaven's bestowal of a mission. The moral Heaven (*yili zhi tian*) serves as the source of ethics and morality, as in "at fifty, I knew the Mandate of Heaven," pointing to the moral principles that human life should follow.

2.2 English Translations of "Tian" in Different Versions of the *Analects*

This paper selects representative English translations of the *Analects* from different periods since the Opium War, summarizes the translation strategies adopted and the respective translation features of different translators, and analyzes the translators' translation behavior in subsequent sections. Altogether, seven scholars' translations are examined: those of James Legge (1861), Ku Hung-ming (1898), Arthur Waley (1938), Chan Wing-tsit (1963), D. C. Lau (1979), Roger T. Ames (1998), and Annping Chin (2014). Each of these translations has its own distinctive features and is highly representative. According to the translators' understanding of the meaning of "Tian" in different eras, the English translation of "Tian" in the *Analects* can be roughly divided into three stages:

1. The Legge Period: The Establishment of Theological Equivalence (the 19th Century)

Legge's translation (1861) tends to preserve the style of the original text, making frequent use of literal translation and attaching importance to retaining the original sentence structure. In translating "Tian," however, Legge rendered it as "Heaven," a word imbued with Christian culture, and associated it with the Christian "God" through his translation notes. This rendering was subsequently followed by many later translations and is a very typical domestication strategy. For example, in rendering "he who offends against Heaven has none to whom he can pray," Legge translated "Tian" as "Heaven" and, in his notes, cited Zhu Xi's statement that "Heaven is principle," while emphasizing the sovereign nature of "Tian" as "the One on high," thus hinting at its affinity with the Christian "God." This is inseparable from his background as a missionary, and his translation is accordingly characterized by religious interpretation.

2. The Post-Legge Era: De-Christianization and Pluralistic Interpretation (the 20th Century)

Ku Hung-ming's translation (1898): Ku Hung-ming was well versed in both Chinese and Western learning and possessed a profound command of English, and his translations exerted a tremendous influence in the Western world. He was strongly dissatisfied with the translations of the *Analects* by Western missionaries and Sinologists such as Legge, believing that they had distorted the original meaning of the Chinese classics and thus created Western prejudice against Chinese culture (Dai, 2022, p. 54). Aiming to "enable Western readers to understand the essence of Confucianism," Ku adopted a highly domesticating translation strategy. He deliberately connected Confucian concepts with Western religious and philosophical systems and translated "Tian" as "God," attempting to help Western readers understand the sovereign nature of "Tian" and its significance as the source of morality through Christian cultural imagery.

Arthur Waley's translation (1938): Compared with the translations of Legge and Ku Hung-ming, Waley's translation pays greater attention to the receptivity of its target readers and has been acclaimed as "the standard translation in the English-speaking world," combining scholarly rigor with readability. He followed Legge in using "Heaven" but invested it with connotations of "ancestor worship," emphasizing the polytheistic attributes of "Tian" and thereby weakening the monotheistic tendency of Legge's rendering.

Chan Wing-tsit's translation (1963): Chan Wing-tsit was a Chinese-American Sinologist who specialized in the study of Confucian thought and Zhu Xi's philosophy and had a profound understanding of "Tian" in Confucian thought. He interpreted "Tian" philosophically, rendering "Tianming" as "the Mandate of Heaven" and emphasizing its universality as the fundamental law of the cosmos. He also translated "Tian" as "Heaven (Nature)," stressing the connotations of "Tian" as "the Heaven of law" and "the Heaven of nature."

D. C. Lau's translation (1979): D. C. Lau was a renowned Hong Kong translator. His translation emphasizes being "text-centered" and attends to the coordination of context and cultural differences. For example, he distinguishes between the "Heaven of virtue" and the "Heaven of fate," interpreting them as "Heaven" and "Destiny" respectively, and through the associative interpretation of "Tian-ming-tianming" highlights the duality of "Tian" as both the source of morality and the master of fate.

3. Defamiliarization and Cultural Subjectivity (from the Late 20th Century to the Present)

Roger T. Ames's translation (1998): Roger T. Ames is a renowned contemporary Sinologist and philosopher. Together with Henry Rosemont Jr., he translated the *Analects* into English. His translation interprets the concepts of the *Analects* from the perspective of Western philosophy, correcting the religious interpretations left by Legge's translation, and adopts the combination of transliteration plus the Chinese character "Tian 天," resisting associations with Western Christianity.

Annping Chin's translation (2014): Annping Chin is a Chinese-American historian. Her translation, published in 2014, takes historical interpretation as its main approach, attaches importance to returning to the intra-lingual interpretive tradition of the *Analects*, and strives to restore "the authentic Confucius." She continues the mainstream rendering of "Tian" as "Heaven" but weakens its religious connotations through annotation.

3. The Evolution of the English Translation of the Core Concept "Tian"

In the history of translating the *Analects* into English, different translators' interpretations of the concept of "Tian" each have their own distinctive features, reflecting differences in their historical backgrounds, cultural positions, and academic ideas. These interpretations have played an important role in promoting the dissemination and understanding of the *Analects* in the English-speaking world and have built a bridge for Sino-Western cultural exchange. The following is a detailed account of how these seven translations interpret the concept of "Tian" in the *Analects*.

3.1 Religious Interpretation

James Legge's translation: As an important early translator, Legge translated "Tian" as "Heaven" and frequently cited the commentaries of Zhu Xi and other exegetes of successive dynasties in his notes, seeking common ground between Confucianism and Christianity. He sometimes interpreted "Tian" as a willful sovereign similar to the Christian "God," holding that "Tian" in Chinese culture and the Western "God" bear similarities in conceptual connotation and cultural status, both possessing connotations of sovereignty and origin, thereby realizing a Confucian-Christian dialogue. To a certain extent, this approach helped Western readers understand the important position of "Tian" in Confucian culture and exerted a far-reaching influence on later translators, but it also gave rise to controversies concerning cultural colonization because of its excessive association with Christian ideas.

Ku Hung-ming's translation: Ku adopted a highly domesticating strategy, rendering "Tian" as "God" on a large scale in order to enable Western readers to understand Confucian thought through familiar Christian concepts. Although this approach helped Western readers quickly establish a cognition of the concept of "Tian" and promoted the dissemination of the *Analects* in the West, it sacrificed the pluralistic connotations of "Tian" in Chinese culture: meanings such as the natural Heaven and the moral Heaven were weakened, and the uniqueness of Chinese culture was to some extent lost in translation.

3.2 De-religious Interpretation

Arthur Waley's translation: Waley's translation reflects a tendency toward the de-religious interpretation of "Tian." He mainly used "Heaven" to translate "Tian." Through tracing the etymology of the term and studying early Chinese classics, he pointed out that "Tian" has similarities across different civilizations while also emphasizing its differences across cultures, thereby both preserving its connection with Chinese culture and, to a certain extent, conforming to the cognitive habits of Western readers, thus providing Western readers with a richer perspective for understanding the concept of "Tian."

Chan Wing-tsit's translation: As a scholar with a deep understanding of Chinese philosophy, especially Song-Ming Neo-Confucianism, Chan followed the use of "Heaven" in translation, but in some passages he added pinyin romanization and English glosses, such as "Heaven (Tian, Nature)," to display the multiple connotations of "Tian." Chan's rendering indirectly confirms the continuous enrichment of the concept of "Tian" in the Western world, which was no longer simply equated with Christian culture. This interpretation helps Western readers understand

the concept of "Tian" at the philosophical level and has also influenced the subsequent practice of Sinologists in translating the *Analects* into English.

D. C. Lau's translation: Lau's translation likewise enriched Western readers' understanding of "Tian" as a core Confucian concept. With the development of translation theory and in-depth research on the text of the *Analects*, the English translation of "Tian" has also shown an increasingly rich and diverse trend (Wang, 2024, p. 107). This trend has persisted for a long time and has influenced later translators to keep exploring the philosophical connotations of Confucian thought.

3.3 The Philosophical Interpretation of "Tian"

Roger T. Ames's translation: In the English translation jointly produced by Ames and Rosemont, "Tian" is rendered as "tian 天," in the form of transliteration plus the Chinese character. The greatest difference between the Ames–Rosemont translation and earlier translations lies in the fact that the translators interpreted and translated the text from a philosophical perspective and with philosophical methods. They regarded the *Analects* as a philosophical text different from Western philosophy and strove to penetrate its literal meaning to unearth the profound philosophical significance embedded therein—that is, to interpret and translate the text in a philosophical manner (Yang, 2020, p. 141). They held that the conventional rendering "Heaven" carries strong Christian imagery and cannot accurately convey the original philosophical connotations of "Tian." In their view, "Tian" in Chinese philosophy has unique connotations: it is both the creator and the basis of existence of the world, and also the existential field and existence itself of what is created—an existence in which "the one and the many are not separated."

Annping Chin's translation: In her English translation of the *Analects*, Chin's interpretation of the concept of "Tian" has a distinctive perspective and significance. Aiming to return to the intra-lingual interpretive tradition of the *Analects*, she presents an understanding different from that of other translators through her translation of and annotation on content related to "Tian." Chin interprets "Tian" as the master of fate. In her view, the "Tian" of the *Analects* determines individual fate and even the fortunes of history, and "Tianming" is the arrangement of fate that an individual must accept after having done his or her utmost. She points out in her notes that the connotations of "Tianming" vary across eras and schools, and that the "Tianming" of the *Analects* is "the fate bestowed by Heaven."

4. Analysis of Translator Motivation

From the analysis of the seven translations above, it can be seen that the English translation of "Tian" in the *Analects* has undergone a long evolutionary process: from Legge and Ku Hung-ming, who began by domestically rendering "Tian" with the Christian cultural terms "Heaven" and "God," through Waley, Chan, and Lau, who continuously enriched the connotations of "Tian" and reduced its religious referents, to Ames and Chin, who analyzed and studied this core concept of Confucian thought from a philosophical perspective. It can be seen that the connotations of "Tian" in the *Analects* have been continuously enriched, and that there has been a marked shift of perspective in its understanding and interpretation—from the initial religious reading to the present philosophical study—and the Western world's understanding of "Tian" and even of Confucian thought has been deepening. This shift of perspective has been influenced by multiple factors, and below the author explores its causes from two aspects: the translator and the state.

4.1 Translator Subjectivity

In the process of translating the classics into English, translators usually choose appropriate translation methods and strategies according to their translation motivation and their own cultural identity, giving creative play to their subjectivity so as to better achieve their translation purposes (Yang, 2020, p. 142). The translators of the seven versions selected in this paper have different identities—missionaries, Chinese scholars, and Sinologists—and their translations also date from different periods, the earliest going back to the Opium War era and the most recent being published in 2014. The different identity backgrounds of these translators influenced them to produce

different translation motivations. These seven translators can be roughly divided into two motivational types: those attracted by Chinese culture and spontaneously driven by interest to translate the Confucian classics, such as the missionary Legge and the Sinologists Waley, Ames, and Chin; and those who hoped to disseminate Chinese culture to the Western world and change Western views of China, such as the scholars Ku Hung-ming, Chan Wing-tsit, and Lau.

To a certain extent, this division sketches the motivational spectrum of the translator community, yet it also implies more complex cultural contestation and identity tensions. The missionary Legge, for instance, although bearing the mission of religious propagation, was by no means driven toward Chinese culture purely for instrumental purposes—in the course of administering Ying Wa College in Hong Kong and systematically translating the *Four Books* and *Five Classics*, he gradually shifted from the "superiority of Christian civilization" to a deep empathy with Confucian ethics. His translation practice, driven by such interest, in fact concealed an academic curiosity about a heterogeneous civilization beneath its religious mantle. The Sinologists Arthur Waley and Roger T. Ames exhibited a purer scholarly interest: Waley, taking "the pursuit of truth" as his goal, stripped "Tian" of its theological coloring through textual research on the evidential-scholarship (*pu xue*) literature of the Qing dynasty and restored it to "a composite of natural order and ancestor worship," a motivation deeply rooted in early twentieth-century European Sinology's pursuit of "de-ideologization." Ames, as an adherent of process philosophy, was motivated to translate the *Analects* by his exploration of the possibility of dialogue between Chinese and Western philosophy, and his deliberate adoption of the transliteration "Tian 天" is precisely an interest-driven ontological tribute to the "correlative thinking" of Chinese philosophy.

The translation practices of Ku Hung-ming, Chan Wing-tsit, and Lau, by contrast, carried a weightier mission of cultural dissemination. Amid the cultural upheavals of the late Qing and early Republican periods, Ku used his English translation of the *Analects* as a defense of "the spirit of the Chinese people," and his radical domesticating strategy of rendering "Tian" as "God" was essentially aimed at enabling the West to understand the universality of the Confucian "Mandate of Heaven" through the Christian discourse system—behind this dissemination motive lay anxiety about, and a defense of, the subjectivity of Chinese culture. Chan Wing-tsit, as a representative figure in overseas studies of Neo-Confucianism, deliberately strengthened the "moral law" attribute of "Tian" in his translation, implanting the "Heavenly principle" (*tianli*) of Zhu Xi's philosophy into his interpretation of "Heaven"—an act that implied the deeper intention of incorporating Confucian philosophy into the Western discourse framework of "humanism" and, through conceptual translation, of breaking the Western academy's stereotyped perception of Confucianism as "ethical dogma." It is worth noting that the two motivations often appear in an interwoven state in individual translators: Legge's religious interest and scholarly dissemination, Ku's defense of culture and the influence of missionary translations, and Ames's philosophical exploration and reflection on Orientalism all show that the history of translating the *Analects* into English is by no means a linear narrative of a single motivation. This very complexity constitutes the vitality of cross-cultural interpretation—when interest-driven translators deconstruct cultural prejudice through academic curiosity, and when dissemination-oriented translators reconstruct cognitive frameworks through strategic translation, the English translation of core concepts such as "Tian" in effect becomes a microcosmic battlefield on which Chinese and Western civilizations probe, contest, and merge with each other at the conceptual level, ultimately transforming the *Analects* from an Eastern classic into a text of dialogue common to human civilization.

4.2 National Orientation

The influence of the state on translator motivation is mainly manifested in political strategy, academic policy, and cultural dissemination. Taking the four translations after Arthur Waley as examples, during the Cold War the United States incorporated Sinology into "area studies" to serve its Far East strategy, neglected the translation of classics such as the *Analects*, and even interpreted Confucianism within a Christian framework. Consequently,

although the English translation of the *Analects* in this period was shifting from religious to de-religious interpretation, most translations still followed the rendering of "Tian" as "Heaven."

Influenced by contemporary trends in Western Sinological research, contemporary English translations of the *Analects* appeared mainly after the 1990s, and their translation methods and features also differ to some extent from earlier versions (Wang, 2010, p. 24). With the shift in academic policy, the United States promoted the institutionalization of Sinology as an academic discipline and set up special funds to support the translation of the *Analects*. Lau's translation, for example, served research and teaching in higher education, while Ames's translation responded to the academic turn of "de-Western-centrism." At the same time, the state regarded the English translation of the *Analects* as a means of cultural soft-power competition, funding cross-cultural dialogue projects and prompting translators to explore the modern value of Confucianism.

Furthermore, state ideology constrains translation strategies: in the early postwar period, translators, influenced by the "tradition – modernity" dichotomy, regarded Confucian thought as a factor hindering modernization, whereas in the post-Cold War era, China's image was reconstructed through translation, as exemplified by Ames's use of transliteration to highlight the uniqueness of Chinese philosophy. The United States also integrated Sinological resources by funding transnational projects, promoted dialogue between translators and Chinese academia, and competed for the right to interpret the *Analects*.

It can thus be seen that state-level orientation affects the English translation of the classics. Under the call for Chinese culture to "go global" in the new era, the strategy of preserving the original cultural connotations of the classics and promoting mutual learning between Eastern and Western civilizations has become the mainstream, and an increasing number of translations of the *Analects* render "Tian" directly by transliteration, preserving the unique charm of Chinese culture.

5. Conclusion

The translation and introduction of the Confucian classics is in essence a dynamic history of cross-cultural interpretation, and the evolution of the English translation of the core concept "Tian" in the *Analects* is precisely a microcosm of this process. From the religious interpretation of the Legge period to the flowering of diverse contemporary translations, the concept of "Tian" has, across the English versions of different eras, undergone a complex metamorphosis from religious conceptual equivalence to de-religious reconstruction, and from structural dichotomy (such as Lau's distinction between the "Heaven of fate" and the "Heaven of virtue") to philosophical innovation (such as Ames's transliteration "tian 天"). This evolution reflects not only the paradigm shift in Western Sinology from "area studies" to a "China-centered perspective" but also the multiple negotiations of translator subjectivity amid national strategy, academic currents, and cultural identity. In the strategic context of the contemporary "going global" of Chinese culture, the translation of "Tian" is no longer confined to the conversion of linguistic signs but carries the deeper mission of civilizational dialogue.

The history of translating the *Analects* into English testifies to the vigorous vitality of Confucian thought—it can be reinterpreted within heterogeneous cultures while always retaining its own cultural subjectivity. In the future, the translation and introduction of the Confucian classics must further break the shackles of the "othering" imagination, preserve the subjectivity of its own culture, and construct a more inclusive paradigm of cross-cultural interpretation in the interaction between translator motivation and national orientation.

Competing Interests Statement

All authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Declaration of Generative AI in Scientific Writing

No use AI tools in my article.

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A Study on the Evolution of English Translations and Multidimensional Interpretations of 'Cheng', a Core Concept in the Doctrine of the Mean

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Abstract: This study focuses on the evolution of the concept of 'Cheng' in English translations of the Doctrine of the Mean, conducting a textual analysis and comparative study of seven representative translations from different periods. Using a four-dimensional analytical framework comprising ethics, ontology, cosmology and genesis, the study finds that, in the process of translation into English, the strategies employed for 'Cheng' have gradually shifted from an early, singularly moral dimension towards diverse expressions that take into account both its metaphysical connotations and its dynamic, generative significance, reflecting the translators' deepening understanding of the concept's multi-layered philosophical implications. The differentiated presentation and selection of connotations of the concept of in cross-cultural communication are the result of the interplay of multiple factors, including the translator's subjectivity, the purpose of translation, the needs of the target audience, and the socio-cultural environment, embodying the process of dynamic selection and reconstruction of Confucian philosophical concepts within cross-cultural contexts. This study has deepened our understanding of the core ideas of the Doctrine of the Mean and the comprehensive philosophical system of 'Cheng', providing a refined analytical paradigm for research into the translation of Confucian classics into English. It facilitates in-depth exchange between Chinese and Western philosophy and culture, whilst also offering valuable guidance for the translation of traditional Chinese classics into foreign languages.

Keywords: The Doctrine of the Mean; Cheng; Conceptual Evolution; Sincerity

1. Introduction

As a Confucian classic, the Doctrine of the Mean is counted among the 'Four Books' alongside the Great Learning, the Analects and the Mencius, and occupies a pivotal position within the Confucian philosophical system. Within this system, the concept of 'sincerity' is one of the core categories of Confucian philosophy and serves as a vital cornerstone of the Confucian worldview. In Confucian classics, 'Cheng' is imbued with profound significance; it represents both the highest realm of moral cultivation and the fundamental attribute of the existence of all things in the universe. As Feng Youlan pointed out in *A History of Chinese Philosophy*: '“Cheng” holds an extremely high philosophical status in Confucian thought, its implications permeating personal self-cultivation, social interaction, and the laws governing the operation of heaven, earth and all things.' [1] In today's world of increasingly frequent cross-cultural exchange, the emergence of English translations of The Doctrine of the Mean has opened a window for the world to understand Confucian culture, whilst the translation and evolution of the concept of 'sincerity' in these translations have become a significant manifestation of the collision and fusion of Chinese and Western

cultures. By examining how the four-dimensional connotations of 'Cheng' are presented, omitted or obscured in various English translations, we can gain deep insights into the dynamic changes in Confucian thought during cross-cultural transmission, as well as the multi-layered motivations behind translators' subjective choices in the process of cultural transformation. Consequently, conducting a comparative analysis of translations based on a four-dimensional analytical framework-comprising ethics, ontology, cosmology and genesis-holds significant academic value and practical relevance. With the aid of this multi-layered analytical framework, it is possible to interpret more comprehensively the agency of the translator during the translation process, as well as the multiple and complex constraining factors-such as the target audience and the socio-cultural context of the era-underlying the act of translation.

This study aims to explore in depth the evolution of the concept of 'Cheng' in English translations of *The Doctrine of the Mean*, analyzing its characteristics and the underlying factors driving this evolution. By analyzing various translations, this study reveals the process by which the multi-layered philosophical connotations of 'Cheng' are reconstructed in a cross-cultural context. This research is significant in several respects. Firstly, it contributes to a deeper understanding of *The Doctrine of the Mean* as a Confucian classic, unearthing the comprehensive and multifaceted philosophical implications of the concept of 'Cheng' within the Confucian philosophical system, and providing theoretical support for the transmission and development of Confucian culture. Secondly, by analyzing the evolution of the concept of 'Cheng' in English translations, it offers valuable insights for cultural exchange between China and the West, thereby promoting cross-cultural understanding and mutual learning. Furthermore, this paper evaluates translation phenomena using a four-dimensional framework, thereby enriching the analytical approach to the translation of classical texts into English and providing a viable analytical paradigm for similar research into the translation of Confucian classics. In terms of methodology, this study employs a combination of textual analysis and comparative analysis, selecting seven representative English translations of *The Doctrine of the Mean* for in-depth analysis. These include translations by Ku Hung-ming, James Legge, David Hall and Roger Ames, Pu An-di, Xiu Zhongcheng, Chen Rongjie, and Daniel Gardner. These translations span different historical periods and translation styles, and are of high research value.

2. The Essence of 'Cheng'

The term 'Cheng' appears 25 times in the text of *The Doctrine of the Mean*. Given that the text comprises fewer than 5,000 characters, this frequency of usage is exceptionally high. This single indicator alone demonstrates the importance of 'Cheng' in *The Doctrine of the Mean*[3]. A preliminary comparison of several English translations of the *Doctrine of the Mean* reveals marked differences in the rendering of the term 'Cheng'. These differences stem from variations in the translators' understanding of the concept's depth of meaning and their respective choices regarding what to include or omit in the translation. To explain such differences objectively and systematically, one must go beyond a superficial comparison of the translations and instead conduct a comprehensive analysis of the multi-layered philosophical implications of 'Cheng' and the historical context of its interpretations. To this end, this paper elucidates the full significance of 'Cheng' by distinguishing four dimensions: ethical, ontological, cosmological and generative. On the one hand, it restores the composite connotations inherent in the text of the *Doctrine of the Mean*-which encompasses practical virtue, metaphysical ontology, cosmic order and dynamic creation-and clearly traces the divergences in interpretation of this concept among Confucian scholars throughout history; on the other hand, it establishes a unified set of evaluation criteria, providing a basis for subsequently comparing and assessing the extent to which different translations preserve or obscure the various layers of meaning of 'Cheng', thereby freeing the subsequent analysis of translations from vague and subjective commentary and ensuring that the entire argument is grounded in a solid theoretical foundation.

2.1 The Ethical Dimension

The ethical dimension represents the most fundamental aspect of ‘sincerity’ -one that is closely aligned with people’s daily practices. Its core focus lies on authenticity and sincerity in the realm of personal self-cultivation and interpersonal relationships; it is also the level of meaning first expounded by pre-Qin Confucianism. The Mencius: Li Lou I states that ‘To strive for sincerity is the way of man’, defining ‘striving for sincerity’ as the moral duty that people ought to practise. It requires one to be truthful within one’s heart and to ensure consistency between words and deeds, to be applied across all aspects of human relations, including self-cultivation in solitude, interactions with others, and the governance of the state[4]. Zhu Xi, in his Collected Commentaries on the Four Books, expounds on this, arguing that ‘sincerity’ (Cheng), as a principle of human conduct, serves as the fundamental standard of cultivation for the gentleman in establishing his character, managing his household and governing the state; only through continuous self-discipline and self-cultivation can one preserve the virtue of utmost sincerity within the heart[5].

From the perspective of scholarly divisions, the school of Xunzi retained only the ethical connotations of ‘sincerity’, stripping it of its metaphysical content relating to heaven and earth, and viewing it purely as the psychological foundation for educating the people and adhering to rites and laws; the Lu-Wang School of Mind, likewise centring on the ethical dimension, maintained that ‘sincerity’ is rooted in one’s inner moral intuition, and that all the principles governing the transformations of heaven and earth arise from the manifestation of the human heart’s moral nature[6]. This dimension focuses on moral relations between people and was also the aspect of the concept that early Western translators found easiest to grasp and prioritized in their translations.

2.2 The Ontological Dimension

The ontological dimension constitutes the metaphysical core of ‘sincerity’ (Cheng), signifying that ‘sincerity’ is the objective and constant ultimate basis of existence for all things in the world, existing independently of human subjective consciousness. Zhou Dunyi, in his Tong Shu, states: ‘Sincerity is the foundation of the sage. ‘How great is the Primordial Force of the Creative! It is the source from which all things originate; it is the source of sincerity’ ” , thereby establishing “sincerity” for the first time as the fundamental ontological basis for the generation and continuation of all things in the universe, with all actual existence-be it heaven and earth, or human beings and things-rooted in “sincerity” [7].

Cheng-Zhu Neo-Confucianism further refined this interpretation, equating ‘sincerity’ with objective Heavenly Principle, and holding that the reason all things are true and not illusory lies in ‘sincerity’ at the ontological level; In contrast, the Lu-Wang School of Mind downplayed the objective ontological nature of ‘sincerity’ and denied the existence of a cosmic principle independent of the human heart; these two schools thus formed a significant interpretative divergence within Song and Ming Neo-Confucianism[8]. This layer of meaning possesses purely metaphysical attributes; most translations aimed at the general reader deliberately simplify or obscure this dimension, resulting in a loss of philosophical depth.

2.3 The Cosmological Dimension

The cosmological dimension builds upon the ontological dimension, focusing on elucidating the objective order governing the stable operation of Heaven and Earth, Yin and Yang, the four seasons and all things under the guidance of ‘sincerity’, thereby establishing an intermediary link between ontological truth and human ethics. Zhou Dunyi proposed that ‘The Way of the Supreme Ultimate brings about change, establishing the true nature and destiny of all things; it is through sincerity that this is realized.’ The ontological ‘sincerity’ manifests externally to form a set of constant laws governing the operation of the cosmos; the cyclical interplay of Yin and Yang and the birth and growth of all things all adhere to the order established by ‘sincerity’ [7].

The passage in the Doctrine of the Mean- ‘Sincerity is the Way of Heaven’ - encompasses both ontological and cosmological dimensions: the ‘Way of Heaven’ refers not only to the origin of all things but also to the operational laws governing the cyclical interplay between Heaven and Earth and the communion between Heaven and humanity. Confucianism holds that humanity and the cosmos share the same order of ‘sincerity’ ; by cultivating oneself with utmost sincerity, one can align with the laws governing the operation of Heaven and Earth and realize this communion between Heaven and humanity[3]. Constrained by Christian ideas of creation, 19th-century missionary translators found it difficult to comprehend a cosmic order independent of the divine; most merely touched upon the concepts of Heaven and Earth at a superficial level, failing to fully convey the cosmological implications of ‘sincerity’ .

2.4 The Generative Dimension

The generative dimension highlights the dynamic nature of “sincerity,” distinguishing it from the static existence and order found at the ontological and cosmic levels. At its core, it explains the process of creation and transformation through which all things rely on “sincerity” to grow continuously and renew themselves ceaselessly. The Doctrine of the Mean states, “Sincerity is self-realization,” directly elucidating the essence of generation: the heavens, the earth, all things, and human virtue all rely on the power of inner utmost sincerity to perfect themselves and develop continuously; “sincerity” is an unceasing creative force[3].

The Commentary on the Changes states, “To renew oneself daily is called supreme virtue; to bring forth life ceaselessly is called the ‘Yi’ ,” providing the theoretical foundation for this dimension. Based on this, Zhang Dainian proposed that the core vitality of “sincerity” lies in ceaseless creation; the alternation of the old and the new, as well as the evolution of all things, are all the result of the force of supreme sincerity[8]. In modern and contemporary times, comparative philosophy scholars such as Roger Ames and David Hall have specifically explored this dimension, which had previously been overlooked by Western sinology. They have adopted “creativity” as the core translation to highlight the dynamic generative nature of “Cheng,” but in doing so, they have significantly reduced its ethical, ontological, and cosmological dimensions, resulting in a one-sided interpretation[9].

In summary, “sincerity” (Cheng) in the Doctrine of the Mean is a comprehensive and multi-layered philosophical category that can be broken down into four core principles: ethical self-cultivation, ontological existence, cosmic order, and the generation and transformation of all things. Through successive interpretations and evolutions-from pre-Qin Confucianism to Song and Ming Neo-Confucianism, and on to the context of modern and contemporary translation and exchange between Chinese and Western thought- “sincerity” has consistently upheld its original definition of authenticity and truthfulness, while also being imbued with the intrinsic qualities of dynamic evolution and ceaseless vitality. This concept is not only a key pillar of the Confucian system of thought on the relationship between Heaven and humanity, but also provides a solid theoretical foundation and intellectual depth for the translation of Confucian classics, cross-philosophical dialogue, and the construction of contemporary cultural values.

3. Factors Driving the Evolution of the Concept of 'Cheng'

As a core concept of Confucian thought, 'Cheng' has undergone constant evolution in its meaning through translation and interpretation in the context of Sino-Western cultural exchange. The following analysis examines the factors driving this evolution from three perspectives: the translator’ s subjectivity, the purpose of translation and the target audience, and the cultural and social context.

3.1 Factors relating to the translator’ s subjectivity

The translator’ s intrinsic characteristics—such as their cultural stance, academic background, and long-held translation philosophy—directly determine how they balance the multiple connotations of “Cheng” and choose

the appropriate translation. From a young age, Ku Hung-ming was well-versed in both Eastern and Western cultures and deeply immersed himself in traditional Confucian scholarship; his underlying cultural stance always centered on indigenous Chinese Confucianism. In the preface to his 1906 translation of *The Universal Order or Conduct of Life*, he described his original motivation for the translation: to present the Confucian moral system in its entirety to Western readers, thereby revealing the intrinsic order of self-cultivation inherent in traditional Chinese civilization[10][11]. Rooted in his profound grounding in Chinese classical studies, Ku Hung-ming's understanding of "Cheng" centered on the cultivation of personal character within the context of human relationships. His intrinsic value orientation led him to deliberately emphasize its moral implications; he chose "true to himself" to interpret "Cheng," focusing on how inner morality constrains individual behavior. This translation choice stemmed entirely from his personal, culturally grounded philosophy of translation[3].

James Legge had long been educated by Western missionaries and in classical humanities; his personal academic framework was grounded in Christian virtue ethics, and this internal system of knowledge profoundly influenced his interpretation of Confucian concepts[12]. Constrained by his inherent Western moral framework, he found it difficult to comprehend the essence of the universe apart from the divine. His ingrained cognitive habits led him to adopt the Western moral term "sincerity" as the equivalent of "Cheng," retaining only the meanings related to human ethics. This translation stemmed from the inherent interpretive perspective shaped by his personal academic background[13].

Roger Ames and David Hall have long been deeply engaged in the study of comparative philosophy between China and the West, with process philosophy as their core area of research. This intrinsic academic framework has shaped their interpretive logic regarding Confucian concepts. In the preface to their translation, they state that the focus of their research lies in exploring the process-oriented thought unique to Chinese philosophy, which distinguishes it from Western static ontology[9]. Drawing on their academic background in comparative philosophy, the two scholars have captured the unique, dynamically generated connotations of "Cheng" and have chosen "creativity" as the translation, highlighting the generative and processual attributes of "Cheng" and reflecting the distinctive interpretive approach stemming from their personal academic perspectives[9].

Pu Andi's primary area of research is classical Chinese narrative literature. His long-standing literary research has shaped his reading and translation preferences, which prioritize textual aesthetics over purely metaphysical speculation[14]. Influenced by the intrinsic academic orientation of his own literary research, he does not employ a fixed, uniform translation for "Cheng"; instead, he flexibly adjusts the expression based on the literary context of the text, prioritizing the restoration of the text's literary texture while downplaying complex philosophical ontological interpretations. This diversity in translation methods is a direct reflection of his personal literary research orientation.

Xiu Zhongcheng possesses academic experience in both Chinese and Western traditions; his long-term cross-cultural studies have shaped a translation philosophy characterized by compromise and harmony. In the afterword to his translation, he describes his personal translation preference as balancing Chinese and Western perspectives to avoid excessive bias toward any single cultural system[15]. Based on a principle of compromise, he balances both the ethical dimension and the superficial ontological dimension, simplifying abstruse cosmological and generative concepts and opting for neutral terms such as "true and real" and "realness" to convey only two basic layers of meaning; this makes it difficult to fully capture the cosmological and generative ideas embodied in "Cheng."

Chen Rongjie devoted his entire life to the specialized study of Confucian philosophy. His personal translation philosophy centers on fully restoring the original meaning of ancient philosophical texts, and he advocates for the complete preservation of all the multi-layered connotations of Confucian terminology[16]. Drawing on a

well-established framework of Confucian scholarship, his translation simultaneously addresses the four layers of meaning—ethics, ontology, cosmology, and genesis—using “Cheng” and “sincerity” as the foundational terms, supplemented by numerous footnotes that provide layered explanations of these four philosophical dimensions. Among the seven translators, his version best preserves the full philosophical significance of “Cheng.” Daniel K. Gardner’s personal research focuses on the popularization and dissemination of Confucianism; he has long been explaining classical thought to general readers, and his translation philosophy leans toward accessible and simplified expression [17]. Constrained by this popularization-oriented approach, he retained only the easily understandable ethical dimension, directly omitting all abstract metaphysical content related to ontology, cosmology, and the theory of generation. He simplified the interpretation by using the colloquial term “truthfulness,” resulting in a translation that conveys only the basic moral meaning while losing the metaphysical and cosmogonic core of “Cheng.”

3.2 The Impact of Translational Intent and Readers

The translator’s tendencies to select or omit elements of the four-dimensional connotations of “Cheng” — which are shaped by their personal agency — are further constrained and regulated by two external factors: the purpose of the translation and the target audience. This section analyzes the logic of external influences by comparing the established characteristics of each translation’s target audience with the unified four-dimensional classification criteria outlined earlier, without repeating the discussion of the translator’s personal motivations, thereby avoiding overlap with the content of the previous subsection.

Ku Hung-ming's goal in translation was to promote the complete Confucian moral order to the Western intellectual class; his translations were intended for a group of Western elites with a certain level of humanistic literacy[3]. This audience was familiar with the Western moral discourse system but had no understanding whatsoever of Chinese ontological thought or theories of cosmic transformation. Constrained by these gaps in their understanding, even though Ku Hong-ming himself was well-versed in the four-tiered, comprehensive meaning of “Cheng,” in his translation practice he could only focus on the ethical dimension to complete the textual adaptation, thereby consciously omitting the three layers of abstract philosophical content: ontology, cosmology, and the theory of generation.

James Legge undertook the translation of classical texts through church-sponsored academic programs; his translations were intended for missionaries and early Western sinologists[12][13]. This audience had long interpreted the order of the world through the lens of the Christian divine system and could not accept the notion of a cosmic ontology existing independently of deities or the idea that all things arise spontaneously. Constrained by the audience’s established cognitive framework, James Legge could only translate “Cheng” by selecting ethical dimensions that could be compared with Christian virtues, while all other metaphysical dimensions were deliberately downplayed.

Roger Ames and David Hao adopted the principle of fostering an equal dialogue between Chinese and Western comparative philosophy as the guiding principle of their translation, targeting professional philosophy researchers both in China and abroad[9]. This group possesses theoretical knowledge of process philosophy and is capable of understanding philosophical concepts related to the dynamic evolution of things. Building on the audience’s theoretical foundation, the translators focused on exploring and highlighting the intrinsic value of the generative dimension, while correspondingly simplifying the textual interpretations of traditional ethics, ontology, and cosmology.

Pu Andi’s translation is rooted in his research on classical Chinese literature, and the target audience for his translation consists primarily of literary scholars and literature enthusiasts[14]. This audience places greater emphasis on the literary and aesthetic value of the text and has no need to delve into the metaphysical theories of

Neo-Confucianism; therefore, Pu Andi only selectively extracts the superficial ethical meaning of “Cheng” based on contextual clues, and ontology, cosmology, and the theory of generation are all excluded from the scope of the translation.

Xiu Zhongcheng’s intention was to lower the barrier to reading the Doctrine of the Mean by creating a translation aimed at beginner students of Sinology from cross-cultural backgrounds[15]. Beginner readers need only grasp the basic meaning of the concept of “Cheng” and are not expected to understand the obscure laws governing the workings of the universe or the logic of the creation of all things. To this end, the translator struck a balance by retaining the ethical dimension and accessible ontological meanings while significantly simplifying the cosmological and generative content, thereby balancing the readability of the translation with the preservation of the concepts’ essential form.

Chen Rongjie’s translation serves professional research on Confucianism both domestically and internationally, targeting scholars deeply engaged in the history of Confucian thought[16]. This audience has systematically studied the Song-Ming Neo-Confucian system and is capable of fully interpreting the four layers of content—ethical norms, the ontology of Heavenly Principle, cosmic order, and the cycle of generation and transformation — without encountering cognitive barriers. Consequently, the translator is able to fully restore the full connotations of all four layers and, through annotations, bridge the gaps in philosophical discourse between China and the West.

Daniel K. Gardner aimed to make Confucianism accessible to the general public through his translation, positioning it as a general-interest text for ordinary readers with no background in Eastern philosophy and for college students in general education courses[17]. To accommodate his audience’s level of understanding, the translator omitted all abstract concepts related to ontology, cosmology, and the theory of generation, using only accessible vocabulary to convey the most fundamental ethical meanings.

3.3 Cultural and Social Contextual Factors

The cultural landscapes and dominant social ideologies of China and the West at different historical stages form the overarching external backdrop against which the translator addressed the four philosophical dimensions of “Cheng.” The translator’s decisions regarding which ethical, ontological, cosmological, and generative concepts to include or exclude would inevitably align, even unconsciously, with the cultural and intellectual climate of the era. Modern Sino-Western exchanges took place during a period when Western culture held the dominant discourse. James Legge operated within a social context marked by the flourishing of missionary Sinology. At that time, Western academia generally relied on the Christian theological framework to interpret foreign Eastern thought, and society as a whole did not accept concepts of a cosmic ontology or natural generation that were detached from divine sovereignty. Swept up by the cultural environment of his era, James Legge could only anchor his translation of “Cheng” to the ethical dimension that aligned with Christian virtue, setting aside the ontological and cosmological philosophical implications inherent in the Doctrine of the Mean[12][13]. Later, against the backdrop of the cultural confrontation between China and the West during the modern era, indigenous scholars began to actively defend the values of traditional Chinese culture, and Ku Hong-ming’s translation practice was a concrete manifestation of this social trend. At that time, Western society generally disparaged the moral system of Chinese civilization; the historical context prompted Ku Hong-ming to deliberately emphasize the ethical and self-cultivating qualities of “Cheng,” relying on its moral dimension to convey the unique values of indigenous culture, without exporting the deeper metaphysical connotations of “Cheng” to the outside world[3][10]. As globalization deepened in the modern era, academic exchanges between China and the West gradually evolved into a dialogue of equals. Western scholars began to reflect on the one-sided interpretations of Confucian concepts found in traditional missionary translations. Roger Ames, David Hao, capitalizing on this more open cross-cultural research environment, broke free from the entrenched paradigm of a singular moral interpretation. They delved deeply into the generative

implications of “Cheng” and employed “creativity” in their translation, thereby seeking a point of dialogue between Chinese and Western process philosophy and rectifying the long-standing obscuring of its dynamic and creative dimensions in past translations[9].

The evolution of mainstream social values across different historical periods has also continuously influenced the emphasis translators place on the four dimensions of “Cheng.” In modern Western society, which championed individualistic moral principles, most mainstream translations at the time limited their interpretation of “Cheng” to the ethical dimension of individual conduct. As modern academia began to reflect on the limitations of individualistic values, greater attention was paid to the communal order and the concept of the harmonious coexistence of Heaven and humanity inherent in Confucianism. The academic environment in which Chen Rongjie operated emphasized the holistic social value and comprehensive philosophical system of Confucian thought. The prevailing trends in social research prompted him to incorporate all dimensions-ethics, ontology, cosmology, and genesis-into his translation, thereby fully elucidating the multi-layered value of “Cheng” for individual self-cultivation, cosmic order, and social stability[16]. From the perspective of the laws governing the cross-cultural transfer of knowledge, translation is essentially the reconstruction of philosophical knowledge within a heterogeneous context; translators inevitably project the overall understanding of Confucianism held by the society of their time onto the translation process. Daniel K. Gardner operates within a contemporary sociocultural environment characterized by pluralism and coexistence. Today, the general public’s exposure to traditional culture largely relies on popular general-interest books, and society places greater emphasis on the popular dissemination of Confucian thought. Consequently, this translation strips away the abstruse theories related to ontology, cosmology, and genesis, retaining only the easily understandable ethical implications, thereby aligning with the current characteristics of knowledge reception at the popular level[17].

In summary, the diverse forms of English translations for “Cheng” result from the interplay and combined influence of three factors: the translator’s intrinsic subjectivity, the translation’s purpose and the objective needs of the target audience, and the broader cultural and social context. These three layers of influence operate sequentially from the innermost to the outermost, leading to the selective retention, simplification, or obscuring of the four philosophical dimensions of “Cheng” across various translations, thereby continuously driving the interpretive renewal and dynamic evolution of this core Confucian concept within cross-cultural contexts.

4. Conclusion

This study conducts a systematic investigation into the patterns of evolution in the English translation of “Cheng” -a core concept of the Doctrine of the Mean-using a four-dimensional framework of philosophical connotations-namely, “ethics, ontology, cosmology, and genesis” -as its central evaluative framework, and performs a comparative analysis of seven representative English translations of the Doctrine of the Mean from different historical periods. The study systematically examines how the multiple philosophical dimensions of “Cheng” are presented, selected, or obscured in various translations, thereby clarifying the evolutionary characteristics and underlying patterns of its translation into English. Viewing the overall history of translation and interpretation, early translations largely confined their interpretation of “Cheng” to a single ethical dimension, employing common moral terminology to render the concept, thereby obscuring its core metaphysical dimensions-such as ontology, cosmology, and genesis; In contrast, modern and contemporary translations have gradually transcended the limitations of such narrow interpretations, beginning to explore the deeper values of “Cheng” -including its dynamic creativity, cosmic order, and ontological reality. Translation approaches have become increasingly diverse and multidimensional, vividly reflecting the deepening understanding and increasingly comprehensive interpretation of the Confucian concept of “Cheng” among Western scholars and translators.

Through a multi-level comparative analysis, it becomes evident that the varied renderings of the concept of “Cheng” in English translations are not attributable to a single factor, but rather result from the interplay of three factors: the translator’s subjectivity, the purpose of translation and audience needs, and the sociocultural context. Among these, subjective factors-such as the translator’s academic background, cultural stance, and translation philosophy-determine the translator’s core preferences regarding the four-dimensional connotations of “Cheng” and constitute the intrinsic root of differences in translation approaches; Translation objectives, combined with the cognitive characteristics and reading needs of the target audience, form significant external constraints that define the depth of presentation and the boundaries of dissemination regarding the philosophical connotations of “Cheng” in the translations; meanwhile, the cultural landscapes, social ideologies, and value orientations of both China and the West across different historical periods constitute the macro-historical context, driving the overall iteration and evolution of the paradigms for translating “Cheng” into English. These three factors, progressing from the internal to the external in successive layers, have collectively shaped the forms of English translation for the concept of “Cheng” across different periods. This has enabled the dynamic interpretation and adaptive development of this core Confucian concept in cross-cultural communication, preserving the essence of traditional philosophy while meeting the cross-cultural understanding needs of different eras and audiences.

This study holds both theoretical value and practical significance. On the theoretical level, it moves beyond the academic community’s previous vague categorization of the concept of “Cheng” by constructing a refined four-dimensional analytical framework, clarifying the multi-layered significance of “Cheng” in terms of ethical practice, ontological existence, cosmic order, and dynamic generation. It addresses the shortcomings of existing research-which tends to emphasize moral interpretations while neglecting metaphysical and cosmological interpretations-further deepening our understanding of the Doctrine of the Mean and the core Confucian ideological system, and enriching systematic research on the English translation of Confucian classics. At the practical level, this study clearly reveals the causes of conceptual loss and one-sided interpretations in the translation of classical texts. It identifies the combined influence of the translator’s subjective characteristics, the audience’s communication needs, and the contemporary cultural context on the translation and dissemination of classical works, providing concrete guidance for future translations of Confucian classics and concepts of traditional Chinese philosophy into English. It underscores that translators must balance the philosophical integrity of concepts with the appropriateness of cross-cultural communication, avoid the one-dimensionality of narrow interpretations, and ensure the accurate, comprehensive, and effective dissemination of traditional Chinese culture to the international community.

At the same time, this study has certain limitations. It selected only seven representative English translations of the Doctrine of the Mean as its research corpus, failing to cover all extant English translations. The sample size is thus limited, making it difficult to fully capture all translation characteristics across different translators and eras, which to some extent affects the comprehensiveness of the research findings. Furthermore, this paper primarily relies on textual comparison and qualitative analysis; it has not incorporated quantitative data to conduct more refined empirical research, leaving room for further exploration regarding the patterns of evolution in the translation of the concept of “Cheng.”

To address the above shortcomings, future research could further expand the research corpus by incorporating more translations of the Doctrine of the Mean from different historical periods, countries, and translation approaches, thereby broadening the coverage of the research sample and enhancing the generalizability and comprehensiveness of the research conclusions. At the same time, research methods such as quantitative statistical analysis and data comparison based on corpora could be employed to conduct quantitative analyses of the distribution of translations for “Cheng,” the degree to which its connotations are preserved, and the characteristics of its semantic evolution, thereby integrating qualitative and quantitative research. Furthermore, the scope of the

research could be expanded to focus on the evolution of English translations of other core Confucian philosophical concepts, exploring the patterns of cross-cultural transmission and the mechanisms of co-evolution among traditional philosophical concepts. This would provide a more comprehensive revelation of the complete trajectory of the translation, dissemination, and reconstruction of traditional Chinese thought overseas, thereby offering more robust theoretical support and practical insights for the international dissemination of China's outstanding traditional culture.

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A Study of Localised Translation of Character Names in Black Myth: Wukong from the Transcreation Perspective

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Abstract: With the rapid development of China's cultural industry, the game industry has gradually become an important carrier of cultural communication. *Black Myth: Wukong*, a domestic AAA game adapted from the classic Chinese myth *Journey to the West*, has achieved remarkable success. As a domestic single-player game endowed with profound traditional Chinese cultural heritage, its outstanding localized translation has contributed to its global popularity. This paper takes the translation of character names in *Black Myth: Wukong* as the research object, focuses on the linguistic characteristics of the character names and the embodiment of Chinese cultural connotations, and explores the translation strategies for the game's character names from the transcreation perspective. It analyzes the translation methods and techniques adopted in the official English version and summarizes the localized translation strategies of the game.

Keywords: Black Myth: Wukong; transcreation; character name translation; game localized translation

1. Introduction

In the wave of globalization, games are not only a medium of entertainment but also an important platform for cultural exchange. In recent years, with the advocacy and support of the state, the global dissemination of Chinese culture has achieved substantial development. *Black Myth: Wukong*, a game based on *Journey to the West*, one of China's Four Great Classical Novels, has gained widespread recognition and acclaim internationally with its phenomenal popularity. The mythical figures, traditional customs and historical events in the game all carry profound cultural connotations. With the internationalization of the game industry, the quality of game translation has become one of the important criteria for measuring the global competitiveness of games. However, game translation is no easy task due to cultural differences and language barriers, so the selection of translation strategies directly affects the success of games in the global market and the effectiveness of cultural communication. By analyzing the textual characteristics of character names in *Black Myth: Wukong* and the translation methods and techniques adopted in its official English version, this paper summarizes the localized translation strategies of the game and puts forward improvement suggestions to promote the internationalization of domestic AAA games in the future.

2. Overview of the Current Situation of Game Localization

As the dividend of the domestic game market fades, the overseas market has become a focal point for Chinese game enterprises to compete. In today's global game market, localization has become a key factor for the successful release of games. However, domestic games face great challenges in going global; it is more than just a matter of

distribution, and the localization capabilities of various game developers have become a decisive factor for their success in breaking through the predicament. Localization is of vital importance and needs to be deeply rooted in the hearts of the people to take root in the overseas market. Nevertheless, most Chinese game developers currently focus on the domestic market and lack a global mindset and localized strategies. There are significant differences in cultural backgrounds, values, policies and regulations among different countries, such as ideological and religious stances, which lead to various difficulties for domestic games to enter the overseas market.

The huge cultural differences between different countries make it difficult to find accurate corresponding expressions in the target language for some culture-specific elements in domestic games. For example, there is no direct equivalent for the "Five Elements" in Chinese mythology in Western culture, and how to translate it accurately and convey its cultural connotations is a major challenge. In addition, each language has its unique grammatical structure and expression habits. Game translation needs to comply with the norms of the target language while maintaining the interest and appeal of the game text. Sometimes, in order to adapt to the expression habits of the target language, certain adjustments and innovations to the original text are required. Finally, the display of game text may also be affected by technical problems such as text length restrictions and coding compatibility. For instance, due to the limited display area of the game interface, some overly long translated texts may not be displayed completely, which requires translators to accurately convey the meaning of the original text while controlling the text length.

Take *Genshin Impact* as an example. In the process of English localization, *Genshin Impact* has adopted a variety of strategies to ensure the accurate transmission of game content and cultural adaptability. For example, each character's name in *Genshin Impact* either derives from allusions or contains profound meanings. Due to the untranslatability of culture-loaded words, the translation of *Genshin Impact* adopts the Pinyin transliteration strategy for the names of 16 characters related to Liyue. This not only reflects the regional attribution of the characters but also enables most foreigners to pronounce the character names naturally, improving the recognition of the character IP (Intellectual Property). For example, the ultimate skill of the character Zhongli, "Tiangong Wanxiang", is translated into English as "I will have order". This translation not only conveys the mystery and sense of power of the original skill but also conforms to the understanding habits of English players. In addition, *Genshin Impact* helps players better understand the Chinese cultural elements in the game by adding notes and background introductions. For example, when translating some festival activities and character lines with distinctive traditional Chinese cultural features, corresponding cultural background explanations are provided.

As players' requirements for game quality continue to rise, their expectations for game translation quality have also increased accordingly. Therefore, the external translation of domestic games should pay more attention to the accuracy, fluency and cultural adaptability of translation, formulate more stringent translation standards to meet the needs of players in different regions around the world, and provide support for more language versions. The success of *Black Myth: Wukong*, the domestic AAA game discussed in this paper, not only marks the emergence of domestic games in the global market but also demonstrates the importance of high-quality localized translation.

3. Classification and Linguistic Characteristics of Character Names in *Black Myth: Wukong*

Black Myth: Wukong features a large number of characters with distinct personalities and diverse linguistic styles. For example, the Chinese dubbing of *Tiger Vanguard* adopts a Northeast Chinese accent, while the characters in the *Yellow Wind Ridge* each use different dialects. This diversification of character linguistic styles not only enhances the realistic immersive experience of the game but also enriches its cultural connotations, yet it undoubtedly brings enormous challenges to the English localization translation work. For example, to echo the Northeast Chinese accent in *Tiger Vanguard*'s Chinese dubbing, the English translation of *Black Myth: Wukong* has designed a Cockney

accent for the character, thereby enhancing the character's three-dimensionality. Another example is the use of inverted sentences to highlight the old monkey's age and wisdom. When the old monkey says "Buddhahood he attained, yes", the image of a wise elderly monkey vividly comes alive in front of the players. In the process of localization translation, *Black Myth: Wukong* attaches special importance to portraying the linguistic styles of different characters. Based on the background, cultural level and experiences of each character in the game, the translators have designed linguistic styles that fit the characteristics of each character. From the selection of English dialects and the use of sentence structure and grammar to the choice of every vocabulary, the translation of *Black Myth: Wukong* has been carefully polished. The following is an analysis of the classification and linguistic characteristics of the character names in *Black Myth: Wukong*.

3.1 Classification by the Origin of Mythological Systems

3.1.1 Derived from Classic Traditional Myths

Names of characters such as Sun Wukong (Wukong) and Zhu Bajie (Pigsy) are directly derived from the original work of *Journey to the West*. Take "Zhu Bajie" as an example: the character "Zhu (Pig)" directly indicates his physical features, and "Bajie (the Eight Precepts)" originates from the Buddhist Eight Precepts, symbolizing cultivation and discipline, meaning that he must constantly abstain from desires and cultivate himself during the pilgrimage for Buddhist scriptures, overcome his flaws, and achieve self-redemption and spiritual cultivation. This name contains many plots in the original work. For example, Bajie was originally the Marshal of the Heavenly Reeds in the Heavenly Palace, who was banished to the mortal world for molesting Chang'e after drinking, and mistakenly reincarnated into a pig's fetus with the secular name "Zhu Ganglie". All these stories revolve around "Zhu Bajie", endowing the name with strong storytelling and cultural heritage. Readers familiar with the original *Journey to the West* can associate relevant stories with the name at first sight.

3.1.2 Integrated and Expanded from Folk Legends

Names such as the Keeper of Black Wind Mountain and the Keeper of the Flaming Mountains take the Keeper of Black Wind Mountain as an example: the character is responsible for patrolling and protecting the territory of Black Wind Mountain. On the basis of retaining the common characteristics of the "Earth God", a traditional folk deity, the character name indicates the region with a prefix. In folk legends, the Earth God is in charge of a local area, and the responsibilities of Earth Gods in different regions vary slightly. This naming method is simple and unadorned in language, directly reflecting regional characteristics and functionality, and implying the character's duty to guard a specific area.

3.2 Classification by Appearance and Ability Characteristics

3.2.2 Intuitive Presentation of Appearance

Names such as the Hundred-Eyed Daoist Master and the Skeletal Snake intuitively display the prominent physical features of the monsters. The Hundred-Eyed Daoist Master, also known as the Multi-Eyed Monster or the Centipede Demon, has "hundred eyes" depicting a terrifying image of eyes all over his body; the Skeletal Snake accurately portrays the emaciated and gloomy appearance of the snake. Such names allow players to construct a rough visual image in their minds at first sight, with vivid and graphic language and a strong sense of picture, greatly enhancing the character recognition.

3.2.2 Highlighting Ability Attributes

Names such as the Yellow Wind Sage and Searing Fire focus on emphasizing the special abilities or attributes of the monsters. The Yellow Wind Sage was originally a yellow-furred marten that attained enlightenment at the foot of the Lingshan Mountain. Its fur all over the body is golden yellow, and it can unleash the Samadhi Divine Wind that shakes the three realms. "Yellow Wind" indicates that its ability is related to the yellow violent wind, evoking the image of a powerful wind attack, which corresponds to the Yellow Wind Sage's ability to summon the divine wind. Searing Fire is a minor monster that appears in the Flaming Mountains in Chapter 5 of the game, and the character's name strengthens the heat and fury of the flame through the words "fire" and "lie lie (blazing)". The naming is concise and clear with strong functionality, facilitating players to quickly grasp the character's combat style and threat level.

3.3 Classification by Organizational Identity and Status

3.3.1 Leaders and Chieftains

Names such as the Black Wind King and the Yaksha King: the Black Wind King is the monster king of Black Wind Mountain in Chapter 1 of the game, the human form of the Black Bear Demon. Every attack is accompanied by a blue flame special effect with a wide attack range, and he can also transform into the wind to enter an invincible state to attack players. The Yaksha King is the monster king of the Flaming Mountains in Chapter 5, the second form of Red Boy. The titles of "King" clearly indicate their dominant position in the monster group. These names are solemn and majestic, implying that they possess powerful strength, absolute leadership and abundant resources, and are key opponents that players need to focus on and deal with in the game.

3.3.2 Subordinates and Minions

Names such as the Wolf Soldier and the Rat Captain: the Wolf Soldier is a guard patrolling the area where the Bull Guardian is located in the front mountain of the Grey Wolf Forest. The Rat Captain was conferred the title of Captain by the Sand King for repelling insect monsters with clever strategies, and his family was granted the hereditary title of Captain. Job titles such as "Soldier" and "Captain" indicate that they are in a subordinate position in the monster group, serving as the basic or middle-level forces responsible for executing tasks. Compared with the names of leaders, these names are more functional and hierarchical, allowing players to judge the character's position in the monster organization through the name.

4. A Study of the Translation Strategies for Character Names in Black Myth: Wukong from the Transcreation Perspective

4.1 Localized Translation Strategies for Character Names in Black Myth: Wukong

The English localization translation of *Black Myth: Wukong* faces numerous challenges, the core of which is the choice between domestication and foreignization translation strategies. The core of domestication translation is to transform cultural elements in the Chinese language into corresponding elements in English culture, which can reduce the understanding difficulty for Western players but may lose the charm of Eastern culture. Foreignization translation, on the other hand, strives to retain the original cultural elements in the Chinese language to highlight Eastern characteristics, but excessive foreignization may lead to too many obscure words, increasing the understanding difficulty and affecting the game experience.

To retain the unique charm of Chinese culture, the localized translation strategy for character names in *Black Myth: Wukong* adopts foreignization as the main approach and domestication as the supplement. This decision means that in the process of localization translation, the game will make a detailed judgment on when to adopt

domestication or foreignization strategies according to the linguistic style and cultural connotation of the character names, so as to ensure that the essence of Chinese culture can be conveyed while maintaining the playability of the game. At the same time, *Black Myth: Wukong* is also attempting to correct some erroneous domesticated perceptions of Chinese culture held by the West for a long time. For example, in translating concepts such as "Loong" and "Guai", the game does not use the erroneous domesticated perceptions long held by the West ("Dragon" and "Monster"), but instead chooses foreignization translation methods such as "Loong" and "Guai". Although this strategy may increase the understanding difficulty for players in some cases, it ensures the authenticity of Chinese culture in the game.

4.2 In-depth Analysis of the Translation of Character Names in *Black Myth: Wukong* from the Transcreation Perspective

The translation of *Black Myth: Wukong* adopts a variety of strategies to ensure the accurate transmission of traditional Chinese cultural elements contained in the game, including literal translation, free translation, transliteration and creative translation. The following is a classification and analysis of some translation examples in *Black Myth: Wukong* by strategy, as shown in Table 1.

Transcreation refers to the creative translation of the original text on the basis of understanding its cultural connotations and intentions, combined with the cultural background of the target language and the acceptability of the audience. In the translation of character names in *Black Myth: Wukong*, many names adopt transcreation. For example, "Black Bear Demon" is translated as "Black Bear Guai". "Guai" can better reflect the unique charm and connotation of the concept of "monster/spirit" in Chinese culture than "Monster". The reason for this translation is that in the Western cultural context, "Monster" usually refers to an odd, terrifying, huge creature that often has evil attributes, covering monsters of various forms and characteristics with no clear cultural orientation. In contrast, "Guai" in Chinese specifically refers to "monsters" and "spirits", a unique concept in the Chinese mythological and legendary system. As a monster character cultivated from a black bear, "Guai" can more accurately indicate its special identity in the context of Chinese mythology. In addition, "Guai" retains the Chinese pronunciation, allowing Western players to directly perceive that this is a unique expression derived from Chinese culture when encountering the Black Bear Demon, and it can better convey the profound cultural heritage and unique cultural imagery behind the "Black Bear Demon" compared with "Monster".

Another example is the translation of "Red-Bearded Loong" as "The Red Loong". Instead of following the previous translation convention of directly translating "Loong" as "Dragon", the game chooses to transliterate it as "Loong" to correspond to the Chinese "Loong". In the Western cultural context, "Dragon" is usually a symbol of evil and cruelty, which is essentially different from the "Loong" in Chinese culture that is sacred, auspicious, majestic and carries many beautiful implications. "Loong" well retains the pronunciation characteristics of the Chinese "Loong", avoids cultural misunderstandings that may be caused by the use of "Dragon", and better reflects the unique symbolic meaning and profound connotation of "Loong" in Chinese culture.

Compared with free translation, transcreation can better retain cultural characteristics and add appeal while conveying core information. For example, "Fire Spirit Boy" is transcreated as "Flamling", a compound word. The character "fire" in "Fire Spirit" is associated with flame, and "Flam" in "Flamling" is derived from the English word "flame". In Chinese, "Boy" refers to a young child with immature and lively characteristics, and the suffix "-ling" is often used in English to denote small, young or lovely things, such as "duckling" and "suckling". Combining "Flam" with the suffix "-ling" to form "Flamling" not only conveys the characteristics of flame but also cleverly reflects the image of "Boy", making it more vivid and interesting.

Compared with transliteration, transcreation enables players to understand the meaning of the name without too

many additional explanations. For example, "Zhu Bajie" is transcreated as "Pigsy", which allows players to directly understand its meaning instead of being transliterated as "Ba Jie", skillfully integrating the character's animal attributes and image characteristics and conveying them to players. The word "Pig" is closely related to Zhu Bajie's pig-like appearance, and the suffix "-sy" is often used in English to mean "somewhat like" or "having the quality of", such as "bossy". Therefore, literally, "Pigsy" means "pig-like", accurately depicting Zhu Bajie's pig-related habits such as gluttony and laziness. This translation conforms to English naming habits, avoids cultural misunderstandings, and makes the character easy to understand and remember for players from different cultural backgrounds. At the same time, "Pigsy" is simple to pronounce and spread, with an intuitive and memorable image, enhancing the character's recognition and appeal.

The transcreation strategy can grasp the cultural essence of the original text and carry out re-creation combined with the target language culture, making the translation conform to the understanding habits and aesthetic tastes of Western players while retaining Chinese cultural characteristics to the greatest extent. In the translation of character names, it can effectively enhance the attractiveness and appeal of the characters and help players better immerse themselves in the Eastern fantasy world created by the game. Transcreation enables game players to have a deeper understanding of the stories and emotions behind the characters and enhance the sense of immersion in the game. However, such translations sometimes need to be appropriately supported by English explanations and auxiliary translations to ensure the accessibility and playability of the game, allowing players from different cultural backgrounds to smoothly experience the wonderful aspects of the game. The application of this translation strategy can break the unidirectionality and untranslatability of traditional translation. An ideal translation should be diversified, balancing cultural adherence and innovative expression. In the future, the localization translation of domestic games can flexibly use a variety of methods such as transliteration, literal translation, free translation, transcreation and annotation, and adopt differentiated processing for different types of vocabulary and scenarios. Because games are not only entertainment tools but also bridges connecting and integrating different cultures and building communication and interaction.

Table 1 Translation Strategies and Examples of Character Names in Black Myth: Wukong

Translation Strategy	Examples	Analysis
Transliteration	Ling Xuzi; Guang zhi; Guang mou; Wukong; Yuan Shoucheng; Shi Gandang	Transliteration retains the original pronunciation of the character names, allowing players to associate the mystery and transcendence of the characters through dubbing and illustrations. It preserves the Chinese pronunciation characteristics, is easy for international players to pronounce and remember, and conveys the unique cultural connotations of the names.
Literal Translation	Golden Horned King; Silver	Literal translation retains the

	Horned King; Yellow brow; Black Wind King; Bull Soldier	distinctive features of the characters such as color and identity, and uses words such as "King" to endow the characters with dignity and status, reflecting the character's identity and attributes in a straightforward way.
Free Translation	Crane Immortal; Skeletal Snake	"Crane Immortal" uses words that fit Western cognitive habits to convey the image of the immortal; "Skeletal Snake" intuitively presents the terrifying and mysterious image of the snake with protruding bones through free translation, with a strong sense of picture.
Transcreation	Elder Jinchi; Golden Lotus Guai; Lush leaf; Searing-Fire; Flamling; Palestone; Centipede Guai; Croaky; The Red Loong	It creatively combines transliteration and free translation, or creates new words and compound words. It highlights cultural characteristics (e.g., using "Guai" and "Loong"), accurately conveys the core meaning of the original name, conforms to English expression habits, and is concise, creative and easy to remember, effectively integrating Chinese cultural connotations with Western linguistic characteristics.

5. Conclusion

Rooted in traditional Chinese culture, *Black Myth: Wukong* has successfully promoted the Chinese cultural stories adapted from *Journey to the West* to the world with games as the carrier. Its translation strategy has played a key role in the balance between globalization and localization, and it is an important achievement of the overseas communication of Chinese culture in recent years. In game translation, factors such as cultural differences, linguistic characteristics and player acceptability should be fully considered, and a variety of translation strategies should be

flexibly used to achieve a win-win situation of cultural communication and player experience. At the same time, the phenomenal popularity of *Black Myth: Wukong* also provides a direction for domestic games. It is believed that in the future localization process of Chinese games going global, more developers will tend to retain Eastern cultural characteristics instead of completely catering to the habits of Western players. The success of *Black Myth: Wukong* is not only a victory for the game itself but also an important attempt at Chinese cultural export.

China is never short of culture and stories, and the popularity of *Black Myth: Wukong* is just the beginning. Looking forward to the future, it is expected that more domestic AAA games can learn from the experience of excellent localized translation cases of *Black Myth: Wukong*, continuously optimize translation strategies, integrate China's rich cultural connotations into games, and tell Chinese stories well on a global scale.

Data Availability Statement

All reference data is taken from the official translation of the game *Black Myth* and is free to use, with no copyright issues.

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Retraction Notice

Reference of the retracted article:

Yundong Wu, Weijian Kong, Tingting Lv, Xiaoqing Xi, Bowei Liu, Ruofan Lin, & Jintao Li. (2025). The influence of college students' views on entrepreneurial success, failure, and market prospects on their entrepreneurial intentions. *Global Academic Frontiers*, 3(2), 73-84. DOI: <https://doi.org/10.5281/zenodo.15582227>

The publishers of *Global Academic Frontiers* have received a formal request for retraction from the authors regarding the aforementioned article.

Following a routine post-publication self-audit, the authors identified an unintentional data coding discrepancy during the dataset formatting phase. While the overall theoretical framework and primary methodologies remain sound, this technical oversight affects the precise numerical outputs reported in the paper. To uphold the highest standards of scientific integrity and academic transparency, the authors have proactively chosen to retract the publication.

We sincerely apologize for any inconvenience or confusion this retraction may cause to our readers and the wider academic community. We appreciate your understanding and cooperation in this matter.

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