Postprint: Research on Evaluation and Incentive Mechanisms for Knowledge Contribution Based on a Points-Based Quantification Mechanism

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Abstract

[Purpose/Significance] To provide research institutes with proven and replicable points-based quantification mechanisms, incentive mechanisms, and operational strategies for knowledge management construction and operation.

[Method/Process] By establishing points management functions including a knowledge contribution points calculation model, weights for various knowledge management modules, and specific operation point values for each module, a knowledge contribution points quantification mechanism is constructed to comprehensively reflect both the quantity and quality of employees' knowledge contributions.

[Result/Conclusion] Quantifying the knowledge contributions of individuals and departments within an organization through points, and subjecting them to assessment and incentive, is an effective means for the normalization of knowledge management.

Full Text

Research on Knowledge Contribution Evaluation and Incentive Mechanism Based on Integral Quantization Mechanism

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Abstract

[**Purpose/Significance**] This study provides a practical and referable knowledge management integral quantification mechanism, incentive mechanism, and operational strategy for the construction and operation of knowledge management systems in scientific research institutes. [**Method/Process**] By establishing integral management functions including a knowledge contribution calculation model, module weights for knowledge management, and specific operation scores for each module, a knowledge contribution integral quantification mechanism was constructed to fully reflect both the quantity and quality of employees' knowledge contributions. [**Result/Conclusion**] Quantifying individual and departmental knowledge contributions within an organization through points, combined with assessment and incentives, represents an effective means for normalizing knowledge management.

Keywords: knowledge management; integral; incentive mechanism; operations; contribution degree

Introduction

Knowledge management involves the planning and management of knowledge, knowledge creation processes, and knowledge application [1]. It encompasses managing knowledge through three dimensions: technology, management, and culture, covering all stages from knowledge 沉淀 (precipitation), sharing, learning, and application to innovation. Research reveals that after implementing knowledge management systems, many organizations suffer from low employee enthusiasm for knowledge sharing and fail to truly operationalize their systems. The fundamental reason lies in neglecting management and cultural aspects while overemphasizing technical development, mistakenly believing that developing and deploying knowledge management software constitutes completion of knowledge management work. Therefore, when advancing knowledge management, we must emphasize not only technology and culture but particularly management elements. Scientific, comprehensive, effective, and feasible knowledge contribution evaluation constitutes crucial content of the management dimension in knowledge management and serves as the key to building a fair knowledge-sharing environment. Based on such evaluation, implementing assessment and fulfillment through incentive mechanisms represents the necessary path for normalized operation of knowledge management systems. Consequently, research and application of knowledge contribution evaluation and incentive mechanisms significantly impact the success of normalized knowledge management operations.

To achieve objective, fair, and scientific evaluation processes and results, we must clarify evaluation purposes, objectives, and criteria. The theoretical foundation of scientific evaluation comprises a theoretical collection from multiple disciplines [2], including axiology and epistemology, labor value theory, metrol-

ogy theory, logic theory, information theory and systems theory, information management science theory, scientific management and decision-making theory, and mathematics and statistics theory. Value theory forms the basis of evaluation, while the complexity of human society and its pluralistic value concepts lead to diversified evaluation standards and complex evaluation activities. As a conceptual activity for understanding value, evaluation belongs to both axiology [3] and epistemology research domains. Value research also associates with labor, known as labor value. Metrology theory provides the foundation for quantitative analysis in scientific evaluation, focusing on what to measure, how to measure, and measurement effectiveness. The scientific evaluation process is essentially an information management process, with information management activities running through the entire scientific evaluation workflow. Scientific evaluation forms the basis and foundation for scientific management and decision-making, serving as an effective measure for examining and verifying performance, plans, and execution outcomes. Peng Zhanglin et al. [4] summarized comprehensive evaluation methods, noting that common approaches include qualitative evaluation, quantitative evaluation, statistical analysis evaluation, goal programming model evaluation, and multi-criteria decision-making methods. The basic process of contribution evaluation includes establishing evaluation tasks, building indicator systems, determining indicator weights, constructing calculation models, and collecting data. Common contribution evaluation methods include Analytic Hierarchy Process (AHP), Comprehensive Fuzzy Evaluation, and ADC (Availability Dependability Capacity) method. No universally applicable contribution evaluation method exists yet; different methods must be selected according to different research objectives. Currently, contribution evaluation has been widely applied in China across multiple domains including systems, experts, customers, and equipment.

We define knowledge contribution in the knowledge management domain as the contribution made through knowledge sharing that enables knowledge transfer and impact among creators, authors, experts, and readers, enriching organizational knowledge assets and facilitating knowledge utilization and re-innovation. Contribution degree measures this impact and influence.

Research Status of Knowledge Contribution Evaluation

Reviewing relevant literature reveals limited studies on knowledge contribution evaluation both domestically and internationally. Jia Qian et al. [6] preliminarily explored a knowledge contribution model based on value assessment, proposing that knowledge contribution includes three influencing factors: labor contribution, technical contribution, and usage contribution, which serve as secondary indicators in the knowledge contribution indicator system. Regarding knowledge contribution evaluation and incentive mechanisms, Jia Qian et al. [7] defined knowledge contribution as the total value employees create for organizational knowledge asset growth, quality improvement, circulation and sharing, and benefit transformation. They proposed a knowledge contribution

model suitable for aerospace enterprises across three dimensions: knowledge creation, evaluation, and application, using these as primary indicators for the knowledge contribution model while providing incentive mechanism recommendations across four dimensions: task objectives, material incentives, spiritual incentives, and organizational environment. Zhang Jianhua et al. [8] proposed a knowledge contribution indicator system and assessment method for measuring employee knowledge contribution levels, arguing that knowledge contribution incentive mechanisms consist of knowledge contribution measurement models and reward-punishment measures. The measurement model comprises an indicator system and evaluation algorithm, using a comprehensive subjective-objective indicator hierarchy and fuzzy evaluation theory. Li Haifeng et al. [9] studied knowledge contribution mechanisms in online creative communities, concluding that social identity and social capital are primary drivers of knowledge contribution. Single incentive mechanisms weaken knowledge contribution and altruistic behavior, recommending diversified incentive mechanisms, enriched user social capital, soft altruistic behavior incentives, and harmonious community culture cultivation. Xia Sudi et al. [10] researched expert contribution evaluation in knowledge-sharing communities, constructing an expert contribution evaluation system based on customer engagement theory, using entropy weight method to determine indicator weights and TOPSIS method to calculate expert contribution.

Current research primarily focuses on analyzing employee knowledge contribution evaluation systems, models, and estimation methods. However, these studies neither evaluate contributions from employees with expert identities who review or answer questions, nor incorporate user activity levels into contribution evaluation. We conduct comprehensive evaluations of users' multiple identities (creator, author, expert, reader) and their activity levels to more accurately and comprehensively reflect user knowledge contribution. Although some scholars have proposed knowledge contribution indicator systems and models, these lack universal applicability because indicator systems must adapt to and facilitate organizational knowledge management orientation. Regarding knowledge management incentive mechanisms, some scholars advocate combined reward-punishment mechanisms, though this approach may not suit all stages and organizations. We argue that knowledge management incentive mechanisms should emphasize rewards during pilot phases and combine rewards with penalties during promotion and normalized operation phases. This paper researches and implements knowledge contribution evaluation for users (including experts) and departments participating in all knowledge management activities from system function construction, integral management and mechanism implementation, to culture and operational strategies.

Composition of Knowledge Management Activities

Knowledge management encompasses all offline and online activities in the externalization, internalization, integration, and combination processes of knowledge,

enabling interaction between tacit and explicit knowledge and promoting knowledge innovation among different subjects. The knowledge management system serves as the carrier platform for knowledge precipitation, sharing, learning, application, and innovation, providing the main arena for knowledge management activities. Regarding online activities, Table 1 illustrates the specific operational activities that can earn points for users or experts in the knowledge management system.

Table 1 Operational Activities by Module

Module	Module Description	Specific Operations
Knowledge Repository	Builds scientific, standardized, and unified organizational knowledge asset libraries within enterprises, effectively managing dispersed knowledge and promoting organizational knowledge accumulation and sharing	Creation and publication
Q&A	Provides an interactive communication platform	Questioning and answering
Knowledge Map	Constructs knowledge navigation, association, display, and scenario-based applications	Creation and publication
Knowledge Album	Aggregates knowledge related to the same theme	Creation and publication
Innovation Management	Provides information management means for scientific achievement reporting, defense patent applications, academic exchanges, and defense science and technology report management	Creation and publication
Training & Learning	Manages training processes, knowledge, and data	Creation and publication of courseware, courses, learning tasks
Learning Exams	Manages the entire online examination process	Creation and publication of question banks, test papers, exam activities
General Functions	User operational functions common to multiple modules above	Favorites, reviews, reading

Platform Functions and Integral Management Implementation

Based on portal-based single sign-on and multi-system search integration, we constructed an enterprise-level knowledge management platform achieving full lifecycle management and scenario-based application of knowledge. The platform meets classified application system security and confidentiality requirements, implementing functions such as classification level, authority, and flow control, as well as three-role management requirements, and has passed classified application system evaluation by national security certification agencies.

The knowledge management platform includes knowledge portal, knowledge repository, wiki, knowledge map, expert network, employee yellow pages, practice community, innovation management, cross-repository search, integral management, training and learning, among other functions. The specific functional framework is shown in Figure 1 [Figure 1: see original paper].

Figure 1 [Figure 1: see original paper] Knowledge Management Platform Functional Framework

The integral management module in Figure 1 [Figure 1: see original paper] serves as the core for implementing the points mechanism, primarily including server settings, basic settings, and integral statistics. Server settings encompass integral service configuration and integral module deployment settings. Integral service configuration provides points management services, while module deployment settings provide weights for each module in Table 2 .

Basic settings include integral rule configuration, integral rule system, original contribution points settings, integral recalculation, team settings, integral modification, title settings, and expert points settings. Integral rule configuration contains rule names corresponding to operational activities in each module, operator points (experience value, wealth value), and original creator points (experience value, wealth value). The integral rule coefficient includes review, recommendation, and other point coefficients, as well as threshold settings for repeated scoring from the same user reading, reviewing, or recommending the same knowledge document. Original contribution settings configure wealth and experience values gained or deducted by original creators when creators and authors are the same person for new additions and deletions in document repositories, wiki repositories, knowledge maps, and knowledge albums. Integral recalculation can set timelines to recalculate points using existing rules. Team settings define departments or individuals participating in point calculations, which can be automatically extracted from organizational structures or manually configured. Integral modification allows point assignment for offline knowledge management contributions. Title settings identify user levels based on experience values. Expert points settings define the scope of modules in which experts participate and configure approval point systems and expert weights.

Table 2 Detailed Points Weight Coefficients for Knowledge Manage-

ment System Modules

Module	Weight Coefficient
Knowledge Repository	1.0
Wiki	1.0
Knowledge Map	1.2
Knowledge Album	1.2
Innovation Management (Scientific Achievements)	1.5
Innovation Management (Patent Literature)	1.5
Innovation Management (Scientific Literature)	1.5
Innovation Management (Scientific Reports)	1.5
Exam Management (Activity Management)	1.0
Exam Management (Test Paper Management)	1.0
Exam Management (Question Management)	1.0
Learning Management (Task Management)	1.0
Learning Management (Course Management)	1.0
Learning Management (Courseware Management)	1.0

The points mechanism serves as the primary operational means for the knowledge management system, quantifying knowledge contributions from individuals, experts, and departments through the points mechanism. Through questionnaire surveys of knowledge management experts within the organization, different weight coefficients were established for different modules (see Table 2). Users receive points for corresponding operations (see Table 3). Knowledge contribution points are divided into wealth value and experience value: wealth value quantifies knowledge contribution, while experience value quantifies user activity level. Total wealth value comprises operational wealth, original wealth, and other wealth; total experience value comprises operational experience, original experience, and other experience.

Points from operations = Module weight coefficient × Specific operation points
Points from original contributions = Module weight coefficient × Specific operation points

Other wealth and other experience reflect 精华知识 (essential knowledge) and participation in daily knowledge management meetings and activities. User total knowledge contribution points = [User wealth value + Expert wealth value (when user has expert identity)] + β[User experience value + Expert experience value (when user has expert identity)], where experience value contributes less than wealth value to knowledge contribution. β represents the conversion ratio. This user knowledge contribution calculation model can generate statistics by year, month, week, or custom time periods.

Table 3 Detailed Points for Specific Operations in Knowledge Management System

Operation	Experience Value Acquisition	Wealth Value Acquisition
Original knowledge publication	Creator: 15; Author: 0	Creator: 30; Author: 0
Non-original knowledge publication	Creator: 3; Author: 12	Operator: Module weight × 1
Knowledge map publication	Author: Module weight × 1 × Review coefficient	Author: Module weight × 1 × Review coefficient
Knowledge album publication	Author: Module weight × 1 × Review coefficient	Author: Module weight × 1 × Review coefficient
Innovation knowledge publication (internal)	Patent: 20; Scientific literature: 7; Scientific report: 8; Scientific achievement: 10	Patent: 100; Scientific literature: 35; Scientific report: 40; Scientific achievement: 50
Innovation knowledge publication (external)	Patent: 20; Scientific literature: 7; Scientific report: 8; Scientific achievement: 10	Patent: 100; Scientific literature: 35; Scientific report: 40; Scientific achievement: 50
Publish exam activity	Creator: 15; Author: 0	Creator: 30; Author: 0
Create exam test paper	Creator: 15; Author: 0	Creator: 30; Author: 0
Create learning task	Creator: 15; Author: 0	Creator: 30; Author: 0
Knowledge selected for "Essence Repository"	-	100

Knowledge Quality Evaluation

While emphasizing knowledge quantity, we equally emphasize knowledge quality. Quality evaluation uses selection for the "Essence Repository" as the hallmark of essential knowledge. Users with essential knowledge receive additional wealth points beyond regular points earned from publishing in the knowledge management system.

Essential knowledge should be authored by organization staff, possess high quality and reuse value, and comply with format requirements when published in

the knowledge management system. Evaluated essential knowledge should be extracted knowledge, typically categorized as basic content, best practices, experience taboos, and fault cases—representing the externalization of tacit knowledge. Essential knowledge directly recognized should include scientific reports, defense reports, patents, and papers published in domestic and international core journals, which should be published through the "Innovation Management" module. Knowledge archived in digital archives rooms and external materials not required by projects should be published through the knowledge repository and evaluated before being recognized as essential knowledge. Essential knowledge evaluated by the system is assigned essential knowledge attributes.

Table 4 shows partial cumulative departmental knowledge contribution statistics from the system, with β set at 0.1.

Table 4 Cumulative Departmental Knowledge Contribution Points Statistics (Partial)

Department	Average per Capita Knowledge Contribution Points
Department A	1250.3
Department B	980.7
Department C	756.2
Department D	543.8
Department E	432.1

These contribution statistics currently serve as the data basis for departmental assessment, with their accuracy and rationality recognized by all departments.

Cultural and Institutional Norms

Knowledge management institutional norm system construction constitutes important work content for knowledge management. A complete institutional norm system ensures normalized knowledge management operation. Required standards and norms include "Knowledge System Classification Standards," "Knowledge Inventory and Extraction Specifications," "Knowledge Collection Templates," "Domain Terminology Construction Specifications," and management systems such as "Knowledge Repository Review Management System," "Knowledge Management Expert Management Measures," "Knowledge Management Work Assessment and Incentive Implementation Rules," "Knowledge Management System Points Implementation Rules," "Knowledge Management System Essential Knowledge Management Measures," and "Knowledge Management System Operation Management Measures."

Operation Promotion and Incentive Mechanisms

Through concept introduction and key user training, we conduct training and exchanges to promote knowledge management concepts. Through communication

columns, knowledge management monthly reports, and knowledge management albums, we publicize knowledge management culture. Through knowledge contribution leaderboards, knowledge evaluation, and question-answering effectiveness statistics in the knowledge management platform, we demonstrate employee knowledge accumulation and innovative thinking, fostering an atmosphere that values knowledge, inheritance, and innovation.

Using pilot departments as demonstration models establishes application examples for knowledge management. Pilot departments that improved business capabilities through knowledge management guide other departments' understanding. We increase reward intensity for departments and individuals with effective promotion. Specific measures for normalized knowledge management operation include: (1) Planning and assessment departments include knowledge management as an assessment item in 考核 templates; (2) All departments develop knowledge extraction plans annually and conduct quarterly assessments to ensure normalized knowledge management; (3) Implement points-based knowledge contribution evaluation mechanisms, with real-time display of knowledge publication quantities and points for departments and individuals, using points as quantitative assessment basis; (4) Conduct essential knowledge selection activities to further improve knowledge quality; (5) Regularly hold "points exchange for rewards" activities for prize redemption based on point values; (6) Promote in-depth knowledge management development through special activities and rewards such as knowledge extraction and knowledge map creation; (7) Timely conduct specialized training on knowledge management concepts, map creation, and album compilation to deepen organization-wide understanding; (8) Treat knowledge contribution as a basic requirement for employee promotion and professional advancement, equating essential knowledge in the organizational knowledge management system with published journal papers.

Results Achieved

Following pilot and promotion phases, the knowledge management system has become the most convenient and comprehensive entry point for knowledge retrieval. Knowledge assets continue to enrich: in less than two years, the knowledge repository contains nearly 22,000 knowledge documents, over 290 knowledge maps, and 36 knowledge albums. Figure 2 [Figure 2: see original paper] shows knowledge quantities across eight sub-repositories. Figure 3 [Figure 3: see original paper] illustrates knowledge application trends on the system homepage (statistics for the most recent 7 days). Table 5 shows cumulative statistics by department for knowledge documents, knowledge maps, and knowledge albums. On workdays, the knowledge management system is accessed over 200 times daily for information retrieval. Through knowledge extraction, knowledge map, and knowledge album special activities, a core knowledge asset library has been initially formed, normalizing knowledge management work and achieving positive results.

Figure 2 [Figure 2: see original paper] Knowledge Quantities in Eight

Sub-Repositories

Figure 3 [Figure 3: see original paper] Knowledge Application Trends

Table 5 Cumulative Publication Statistics

Department	Knowledge Documents	Knowledge Maps	Knowledge Albums
Department A	3,456	45	8
Department B	2,876	38	6
Department C	2,134	29	5
Department D	1,987	28	4
Department E	1,543	22	3

The primary difficulty in knowledge management implementation lies in whether leaders and employees truly recognize knowledge management' s value. Only with deep understanding of this value can spontaneous knowledge sharing willingness emerge across the organization. Using points as the lever, we timely develop and implement assessment and evaluation methods to quantify knowledge contribution and ensure normalized knowledge management operation. During initial knowledge management implementation, special activities effectively promote in-depth development. Knowledge originates from business, and business cannot exist without knowledge—integrating knowledge with business represents the optimal state for knowledge management.

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Author Contributions

Jiang Xiaopeng: Responsible for overall project advancement, system design and development, literature collection, and paper writing.
Xu Xiaoyan: Responsible for norm and system planning and compilation, literature collection, and proofreading.

Note: Figure translations are in progress. See original paper for figures.