

Evaluating Scholarly Impact Through Altmetrics: Postprint Analysis of the NISO AMMP Project

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Abstract

[Purpose/Significance] This study examines the “Recommended Practice for Altmetrics” (AMMP) released by the National Information Standards Organization (NISO) to promote in-depth understanding of the AMMP project within China’s library community, transcend the limitations of traditional academic evaluation, foster the domestic application of altmetrics, and facilitate the construction of a new scientific communication evaluation system. [Method/Process] The paper introduces the background, development, main content, and characteristics of AMMP, while summarizing the promotion of this recommended practice and its application by relevant organizations. On this basis, it proposes recommendations for the future development of altmetrics in China, the construction of first-class journals, and the development of research dataset platforms. [Results/Conclusion] AMMP analyzes the common needs of stakeholders, clarifies the types of outputs applicable to altmetrics, and proposes a series of recommended implementation practices regarding research data, persistent identifiers, data quality, and other aspects, thereby providing a basis for the practices of data providers or data aggregators and benefiting the standardization of altmetrics evaluation indicators.

Full Text

The Impact Assessment of Academic Output in the Altmetrics Perspective: NISO AMMP Analysis

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Abstract:

[Purpose/Significance] This study examines the “Outputs of the NISO Alternative Assessment Metrics Project” (AMMP) issued by the National Information Standards Organization (NISO) to promote deeper understanding of the AMMP within China’s library community, overcome limitations of traditional academic evaluation, and foster the application of altmetrics and the construction of a new scientific communication evaluation system in China.

[Method/Process] The paper introduces the background, development, main content, and characteristics of AMMP, while summarizing its promotion and organizational application. Based on this analysis, recommendations are proposed for the future development of altmetrics in China, the construction of first-class journals, and the development of research dataset platforms.

[Result/Conclusion] By analyzing the common needs of stakeholders, AMMP clarifies the types of outputs suitable for altmetrics and proposes a series of recommended implementation practices regarding research data, persistent identifiers, and data quality, providing a basis for data providers and integrators while promoting the standardization of altmetrics evaluation indicators.

Keywords: AMMP; Altmetrics; Research Data; Data Quality

1. Background and Overview of the NISO AMMP Project

1.1 Origins: Breaking Through Traditional Academic Evaluation Limitations

Traditional academic evaluation has long relied on citation counts of journal articles. While citation data reflects scholarly impact to some extent, academic papers may be mentioned, shared, or utilized through multiple channels beyond journal publication, including news reports, forums, blogs, reference managers post-publication, and download metrics. Traditional evaluation methods fail to measure such influence and cannot track citations for non-traditional outputs like datasets and software tools. Altmetrics (alternative metrics) has attracted significant researcher attention for its ability to transcend traditional evaluation limitations and address challenges in new online scholarly communication. Publishers and community enthusiasts have developed various measurement tools attempting to construct new scientific communication systems from multiple approaches.

International theoretical research on altmetrics has a long history. Early studies focused on altmetrics theory, evaluation indicators, data sources, advantages, and tools, while later work by J. Bar-Ilan, J. Priem, L. Bornmann, Z. Zahedi and others emphasized empirical research on data collection, long-term maintenance, updates, limitations, and quality monitoring, with data sources primarily from blogs, Wiki, Mendeley, Facebook, Crossref, Twitter, and other tools. In

terms of promotion, J. Priem, D. Taraborelli, P. Groth, and C. Neylon formally created the Altmetrics website and published the Altmetrics Manifesto in 2010, and since 2011, the International Conference on Scientometrics and Informetrics (ISSI) has held in-depth discussions on altmetrics themes annually. In application, traditional publishers like PLOS and community enthusiasts have developed and improved various altmetrics tools through API development, with ALMs, Altmetric.com, Impactstory, and PlumX being mainstream market tools. Publishers including Springer Nature, PLOS, PMC OA journal platforms, BioMed Central OA platforms, Scopus database, and EDS discovery systems have adopted altmetrics tools to monitor the scholarly impact of each scientific paper, while academic institutions such as the Smithsonian, MEDWave, VIVO, Pacific Research Institute, Sanford-Burnham Medical Research Center, Autism Speaks, Coimbra Hospital and University Centre, and University of Pittsburgh have also implemented altmetrics tools.

As research deepened, altmetrics limitations gradually emerged. Measurement results from different altmetrics tools showed inconsistencies. Altmetrics data are susceptible to gaming, reducing credibility—for example, the company Social Media Likes openly sold Twitter favorites and blog mentions. Different tools employ varying query methods, update frequencies, and collection approaches in data sources, lacking unified best practice standards. Without standardized definitions, calculation methods, data sharing, and quality monitoring standards recognized by the academic community, inconsistent evaluation data standards would prevent third-party data auditing. In June 2013, with funding from the Alfred P. Sloan Foundation, NISO (National Information Standards Organization) officially launched a community-based research initiative to develop altmetrics standards and recommended practices to promote altmetrics application.

1.2 Phase I Focus: Identifying Key Issues and Establishing Phase II Direction

The AMMP project invited delegations to discuss 25 action items through three meetings and 30 interviews, each involving 50-100 participants in Twitter, Wiki, and email conference interactions to broadly collect opinions. Collaborating with organizations including the Coalition for Networked Information (CNI), American Library Association (ALA), COUNTER (Counting Online Usage of Networked Electronic Resources), CASRAI (Consortia Advancing Standards in Research Administration Information), and JISC (Joint Information Systems Committee), the project established initial issue forms and planned subsequent workshop processes. In June 2014, NISO released the AMMP Phase I White Paper, “Alternative Metrics Initiative Phase 1 White Paper,” presenting Phase I research results and next-step action plans.

1.3 Phase II Focus: Developing Standards and Recommended Practices

In June 2014, NISO launched Phase II of AMMP. To establish credible and applicable new academic impact evaluation methods, the AMMP working group was divided into three subgroups (Working Group A, B, and C). Working Group A reviewed altmetrics literature and examined stakeholder perspectives and needs; Working Group B handled external communication and recommended practice documentation; and Working Group C addressed data quality issues. Through virtual online meetings and offline collection of stakeholder feedback, the groups disseminated AMMP drafts while collecting revision suggestions for continuous improvement. In 2016, NISO officially released the recommended practice “Outputs of the NISO Alternative Assessment Metrics Project” (NISO RP-25-2016). The recommended practice clarifies the importance and use cases of altmetrics for different stakeholders, provides a more comprehensive output type list for currently under-evaluated academic outputs, conducts data altmetrics analysis for research data, emphasizes the role of persistent identifiers in scholarly communication, and proposes data quality improvement recommendations. Developed jointly by scholars, librarians, university administrators, research funders, and academic publishers, AMMP holds considerable authority. By providing specific definitions for common terms in altmetrics evaluation indicators, AMMP eliminates ambiguous understanding of the same terms among scholars and facilitates comprehension of related terminology and altmetrics research.

2. Main Content and Characteristics of the NISO AMMP Project

AMMP aims to enhance trust and acceptance of altmetrics analysis in academia, recommending that data providers or integrators offer uniformly formatted reports to ensure data consistency and enable accurate data exchange across publishers or platforms. The recommended practice elaborates its purpose and scope, defines relevant terminology, and focuses on altmetrics data measurement, persistent identifiers, and data quality control, supplemented by data provider self-reporting forms as case validation. Data measurement constitutes the core content, with the practice offering practical recommendations for data providers and integrators on data formats, exchange methods, and update frequencies, while proposing citation standards for open datasets. It also provides evaluation methods and reference standards for applying altmetrics analysis in library resource allocation, institutional return on investment, and researcher promotion.

2.1 Emphasis on Common Stakeholder Needs

Stakeholder diversity and multiple forms of academic influence mean that for stakeholders adhering to traditional scholarly communication methods, citation metrics alone suffice as impact indicators. However, for those interested in aca-

demic sharing and development, citation metrics alone are insufficient, and they desire broader dimensions to measure their output impact. AMMP emphasizes stakeholder needs, recognizing that individuals may serve multiple roles with overlapping interests. To further explain stakeholder relationships, Working Group A categorized stakeholders into eight roles, each with three themes of interest: output showcase (presenting one or more scholarly outputs), research evaluation (assessing output impact or reach), and discovery (finding or increasing exposure of outputs and/or researchers), providing several use cases for each theme. Table 1 details use cases for eight primary stakeholder groups applying altmetrics.

Taking the “librarian” role as an example, librarians wish to use altmetrics to encourage scholars to deposit academic outputs in institutional repositories, enabling them to intuitively understand personal output impact and select journals with greater exposure. Altmetrics can objectively and multi-dimensionally demonstrate institutional academic performance beyond total publications and citations, whether applied to institutional repositories or other platforms. Librarians can generate impact analysis reports to assist with personnel promotion, provide consultation on enhancing author impact, and make journal subscription decisions based on journal activity, engagement, and influence. As shown in Table 1, different stakeholders have distinct priorities in altmetrics application. Although Working Group A identified diverse user needs through surveys, altmetrics application should extend beyond these three aspects, and the group recommended expanding stakeholder scope for deeper discussions on new academic evaluation methods.

2.2 Detailed Altmetrics Output Types

The white paper mentioned output types including traditional literature such as journal articles, books, and book chapters, as well as emerging types like research datasets, scientific software, conference posters and presentations, theses, film or music performances, blogs, lectures, online courses, and teaching activities. AMMP, for the first time, lists applicable output types for altmetrics analysis in a form, categorized by focus areas: basic science, software and code, communications, data, education and training materials, events, grey literature, images, charts and videos, industry, instruments, equipment and inventions, methodology, publications, and standards. These output types help better determine the depth, breadth, and novelty of influence for various researcher or team outputs and enable timely understanding of institutional or individual academic contributions. Organizations such as EuroCRIS, VIVO, OpenAIRE, and IRUS-UK (Institutional Repository Usage Statistics UK) have completed altmetrics output type classification. Research datasets and scientific software are recognized as valuable research outputs by stakeholders, though definitions for other types remain to be provided.

2.3 Establishing Research Data Metrics Standards

In the context of open science, research data has become an important component of scholarly communication. Research data metrics concepts include datasets, data citation, and data usage. A dataset refers to a publicly accessible or downloadable data management collection, such as interview records or digital images. Data citation provides formal structured references to entire datasets, while data usage refers to accessing or publicly downloading research datasets. Data altmetrics are conceptually and technically equivalent to altmetrics for journal literature. It should be emphasized that the research data discussed here refers not to unprocessed data streams created and managed by large data centers, but to discrete datasets that have been made public.

Since many repositories cannot provide download activity data and lack download count standards, these have become major obstacles affecting data usage. Therefore, it is necessary to develop and adopt robust reporting tools and standards in AMMP to guide practice. AMMP recommends the following best practices for research data metrics to address the urgent need for formal evaluation of data reuse:

- (1) Create and maintain data on research datasets and associated data usage for the broadest possible access and utilization.
- (2) Follow the “Joint Declaration of Data Citation Principles” (JDDCP).
- (3) Provide data citations with “a persistent identification method that is machine-actionable, globally unique, and widely used in the community.”
- (4) Provide minimum metadata for data citation in human- or machine-readable form through dataset landing pages.
- (5) Include identifiers in data citations that point to landing pages or sets of pages rather than the data itself.
- (6) Include data citations in the metadata of cited resources, as references provide more detailed metadata.
- (7) Comply with COUNTER standards for data usage statistics, but calculations should have two formulas: one counting only “human” downloads and another including machine agent downloads identified as genuinely research-oriented.
- (8) As altmetrics recognition for datasets increases, research content should be further deepened.

COUNTER standards primarily address usage statistics for journals, databases, books, and reference tools, excluding machine downloads to avoid inflating re-

sults from web crawlers and malicious behavior. However, given the increasing prevalence of machine agents in scientific data reuse—such as using CURL commands, file processing software to download datasets, indexing and searching research datasets, and crawler products—these can be considered legitimate cases of data downloads. Therefore, COUNTER standards that only examine “human” downloads appear inadequate. COUNTER has launched the “Making Data Count” project covering approximately 150,000 research datasets, but AMMP still proposes that research data metrics require standards beyond existing COUNTER standards to adapt to this trend.

2.4 Proposing Persistent Identifiers for Research Outputs

Using persistent identifiers is an important step toward enhancing recognition of non-traditional scholarly outputs, capable of changing the modern academic landscape and promoting broad data interoperability and exchange. Persistent identifiers enable unique identification of any known research output type, including links, dataset subsets, and aggregated content. Working Group B focused on how to apply persistent identifiers in academic environments to clearly identify and track research outputs and their relationships. Among the 33 members of Working Group B, fewer than half came from academic institutions and libraries. Through persistent identifiers, various academic outputs can be accurately located, data duplication effectively avoided, and scholarly impact tracked in real time. After resolution, persistent identifiers can link to one or more data points, connecting people, organizations, and scholarly outputs, enhancing data usability and laying the foundation for altmetrics promotion. AMMP’s proposal to use persistent identifiers aims to increase awareness of the scope and complexity of persistent identifier usage across systems to publicize and promote their adoption.

2.5 Recommendations for Data Quality Specification Reporting

Data quality has always been a critical factor affecting altmetrics development. Due to heterogeneous data structures and susceptibility to gaming, scholars have largely adopted a wait-and-see attitude toward altmetrics application, and altmetrics has faced considerable skepticism. AMMP recommends evaluating data quality across three dimensions: transparency, reproducibility, and accuracy, with its data quality indicator system shown in Figure 1 [Figure 1: see original paper].

AMMP attempts to summarize issues from different levels to solve data quality problems, proposing to trace back to the source from the data lifecycle perspective. By examining the entire process of data generation, collection, and aggregation, the project analyzes factors affecting data quality at each stage from a dynamic perspective and adopts appropriate strategies to avoid data quality issues. Since related research is still in its infancy, AMMP’s approach to solving data quality problems remains a long-term endeavor. This requires not only government departments or international agencies to promote various

standardization details and transform them into specific implementation plans but also requires data providers or integrators to consciously comply.

AMMP encourages and recommends that altmetrics data providers or integrators provide a public report detailing how they comply with the recommended practices, with examples listed in AMMP appendices. The appendices include data quality specification report examples from Altmetric.com, Crossref, PLOS Article Level Metrics (ALM), Facebook, Mendeley, Plum Analytics, Twitter, and Wikipedia. Table 2 presents a partial example of Altmetric.com's 2016 data quality specification report.

This example provides multiple information items:

- (1) Lists all available data sources and metrics, including altmetrics data providers. Altmetric.com collects data from Twitter, Facebook, Google+, policy documents, mainstream media, blogs, Mendeley, CiteULike, PubPeer, Publons, Reddit, Wikipedia, Stack Exchange (Q&A), F1000, and YouTube.
- (2) Provides clear definitions for each metric. Altmetric.com uses a weighted algorithm to calculate attention scores, providing metrics for the attention received by specific research outputs.
- (3) Describes data generation, collection, and maintenance methods. Altmetric.com collects data via data provider APIs, third-party APIs, text mining, and RSS feeds.
- (4) Notes potential issues in data acquisition, collection, and maintenance. Data for articles published before January 2012 may be incomplete.
- (5) Provides record tracking notes. Altmetric.com had no audit trail mechanism before January 2016.
- (6) Notes data integration methods. Altmetric.com aggregates and maps online events about research outputs via external persistent identifiers (DOI, Handle, PMID, arXiv ID).
- (7) Notes data update frequency, which varies by source from real-time to daily.
- (8) Describes data access methods. Altmetric.com provides data access through end-user interfaces and APIs, offering snapshots of datasets for research purposes upon request.
- (9) Notes whether different users receive identical data. Altmetric.com provides the same data to different users, though access levels are product-specific and limited by data caching.
- (10) Notes whether different search methods lead to different data. Altmetric.com's different search methods can lead to the same data.
- (11) Describes data quality monitoring implementation. Altmetric.com monitors suspicious activity through manual control of data sources, monitoring potential cheating and spam, and automatic flagging with threshold settings.
- (12) Notes whether independently verifiable data processes are provided. Altmetric.com provides tools and service APIs.
- (13) Notes whether data correction channels are provided. Altmetric.com allows users to send reports to support@altmetric.com.

Through interpretation of AMMP's main content and characteristics, it is ev-

ident that the recommended practice has explored and improved the current academic evaluation mechanism to some extent, providing a new impact evaluation system for stakeholders across sectors and enhancing multi-stakeholder awareness and participation in altmetrics.

3. Promotion and Application of AMMP Recommended Practices

After the release of AMMP recommended practices, the project was transferred to a NISO standing committee for continued promotion and revision based on stakeholder feedback. Shortly after its release, AMMP received widespread attention from stakeholders, with project teams, librarians, publishers, funding agencies, and data providers or integrators actively responding and promoting AMMP implementation through multiple channels. These include publishing articles in renowned journals such as *NISO Information Standards Quarterly*, *Information Services and Use*, *Serials Librarian*, and *Serials Review* to introduce and recommend AMMP; promoting AMMP at high-level conferences including ISSI and the International Society of Managing and Technical Editors; distributing surveys to promote AMMP and collect suggestions; and continuing communication with other data source platforms to invite compliance.

Through these promotional channels, AMMP has been gradually adopted by multiple altmetrics data providers or integrators who actively participate in discussions and feedback, even developing new products (e.g., Paperbuzz.org). Crossref participated throughout the AMMP project, aiming to create an open and transparent dataset for diverse community members including researchers, application developers, publishers, funders, and third-party service providers. ImpactStory uses Crossref data to track online trending topics in academic articles, and its founder J. Priem noted that Crossref's event data is completely open, believing this will change the rules of altmetrics.

In December 2017, NISO held a virtual conference "Advancing Altmetrics: Best Practices and Emerging Ideas," featuring guests from publishers, data providers, and university libraries to continue promoting AMMP. Core themes included demonstrating the rationality of library investment in work and space, explaining institutional return on investment with data, and using altmetrics to ensure scientific datasets' discoverability, usability, and reproducibility. Concurrently, NISO published the 100 most popular journal articles of 2017 on its website, ranked by Altmetric.com's Attention Score as of November 15, 2017. The most discussed research in 2017 reflected broader social zeitgeist themes such as addressing gender discrimination, workplace robots, and climate change impacts, with 53% of articles being medical journal papers or targeting medical readers. The top-ranked article, "Associations of fats and carbohydrate intake with cardiovascular disease and mortality in 18 countries from five continents (PURE): a prospective cohort study," had an altmetrics score of 5,876, with its data source composition shown in Figure 2 [Figure 2: see original paper], including 168 news stories, 21 blog posts, 8,313 tweets, and 441 Facebook posts about the

article. Among the 100 papers, seven involved Chinese research institutions, including Renmin University of China, China University of Geosciences, Institute of Vertebrate Paleontology and Paleoanthropology (Chinese Academy of Sciences), and Institute of High Energy Physics (Chinese Academy of Sciences).

On November 15, 2018, Altmetric.com released the 100 most popular journal articles of 2018. Altmetric.com categorized these articles by topic, open access status, and country distribution, tracking why the public discussed each paper from different angles. By topic, 44% were medical and health sciences, 17% earth and environmental sciences, and 11% social sciences, with additional papers in physics, history, biology, and information/computer science. Regarding open access, 41 articles supported open access, 13 were free access, and 46 were not open access. By country, the United States (72 articles), United Kingdom (29), and Australia (17) ranked top three, with China fifth, having 11 articles involving Chinese institutions distributed across medical and health sciences (5), earth and environmental sciences (2), research and reproducibility (2), history and archaeology (1), and biology (1), with two each in open access and free access and nine being international collaborations.

In 2018, the *Journal of Altmetrics* was launched as the first open access journal in the altmetrics field, aiming to promote public understanding of altmetrics indicator development and impact. Published articles are assigned DOIs, and all metadata is available through OAI-PMH indexing services. The journal's establishment undoubtedly promotes substantive research and problem-solving in altmetrics.

From a practical application perspective, some data providers or integrators have begun providing unified standard reports according to AMMP and monitoring data quality, though implementation efforts need strengthening. This relates to stakeholders' awareness of altmetrics and the non-mandatory nature of AMMP. AMMP remains imperfect, with many practical dilemmas requiring solutions, such as inconsistent coverage across altmetrics tools leading to measurement result deviations for the same output, lack of standards for research data usage statistics, and the impact of different platform data openness policies that exclude some academically influential communication platforms (e.g., ResearchGate) from altmetrics data sources.

4. Implications for Altmetrics Development in China

The burgeoning application of altmetrics also presents opportunities and challenges for China. Since its introduction to China in 2012, altmetrics has rapidly attracted domestic scholars' attention, with research focusing on definition analysis, significance, measurement tools, applicable scope, and correlation with traditional indicators, while a few scholars have conducted empirical studies demonstrating the feasibility of constructing altmetrics-based impact evaluation models. Following AMMP's release, domestic research enthusiasm for altmetrics has surged, with research hotspots shifting toward how libraries can use

altmetrics tools to develop services, exploring comprehensive scholar influence evaluation based on altmetrics, focusing on data quality issues, and constructing quality evaluation systems. To better promote altmetrics development in China, libraries and publishing institutions have organized multiple thematic seminars, inviting domestic and international experts to share altmetrics research findings and discuss development issues, further strengthening library service capabilities.

Many institutions have also embedded altmetrics tools in institutional repositories or other platforms to comprehensively evaluate academic papers, scholars, journals, books, datasets, and websites. However, compared to rapid altmetrics development and achievements abroad, China's development lags slightly, with no mature domestic altmetrics tools yet available and research largely dependent on foreign tools. Regarding data sources, only Sina Weibo embedded Altmetric.com tools in 2014, with no other domestic social platforms integrated as altmetrics data sources, directly affecting the representation of Chinese academic outputs in altmetrics.

Limitations of using foreign altmetrics tools include:

Due to network security considerations, some foreign altmetrics tool data sources are inaccessible in China, resulting in low altmetrics data coverage and poor visibility for academic papers and journals, making it difficult for users to objectively evaluate and select journals based on altmetrics indicators.

Research shows altmetrics favor academic outputs from developed countries. Although Chinese academic outputs possess high scholarly value, foreign altmetrics tools are unsuitable for revealing the impact of Chinese-language outputs due to language barriers, necessitating the development of domestic altmetrics tools tailored to China's national conditions.

Domestically developed altmetrics tools should support data collection from multiple domestic platforms including CNKI, Wanfang, NSTL, CALIS, policy platforms, news media, blogs, Weibo, academic forums, ScienceNet, WeChat, Zhihu, and Douban, while also collecting accessible foreign data sources like Wikipedia and scientific data websites. By integrating multi-channel scholarly communication data, these tools can monitor academic output impact in real time, follow AMMP to demonstrate data quality specifications through scientific calculation methods, tracking audits, and standardized reports, avoiding data fabrication and enhancing transparency, accuracy, and reproducibility. Following AMMP also provides important reference significance for domestic social platforms to apply as data sources for foreign altmetrics tools. Parallel approaches of "going out" and "bringing in" can achieve objective, fair, and transparent academic output evaluation for Chinese altmetrics services.

In August 2019, the China Association for Science and Technology, Publicity Department, Ministry of Education, and Ministry of Science and Technology jointly issued the "Opinions on Deepening Reform to Cultivate World-Class Scientific and Technological Journals." China is already a major journal publisher (second only to the United States), but lacks influential world-class jour-

nals, placing it at a disadvantage in global scientific competition with quality manuscripts flowing abroad. AMMP provides direction for developing characteristic Chinese scientific journals, which can enhance journal visibility through multi-channel strategies, display research hotspots, scope, and influence, optimize network dissemination capabilities, and adopt regular or irregular journal promotion strategies to increase altmetrics values, attract high-level authors, and effectively enhance international dissemination impact.

Compared to traditional citation metrics, altmetrics represents a completely new scholarly communication evaluation system and comprehensive assessment of academic output impact. NISO AMMP explores altmetrics evaluation standards and best practices, synthesizing stakeholder needs to provide a basis for data providers and integrators, promoting altmetrics service development by improving data indicator credibility. This study interprets the NISO AMMP recommended practice to enlighten the application of altmetrics to multiple output types in China, standardization of altmetrics data submission, reform of current evaluation mechanisms, and innovative application of research data management, thereby promoting the standardization of academic output evaluation.

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

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