



**NISO RP-15-2013**

# **Recommended Practices for Online Supplemental Journal Article Materials**

**January 2013**

*A Recommended Practice of the  
National Information Standards Organization and  
the National Federation of Advanced Information Services*

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### Foreword

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#### About These Recommended Practices

This project began with an informal survey conducted by Alexander (Sasha) Schwarzman, then of the American Geophysical Union, in October 2009 on how publishers handle supporting materials in scientific journals. The survey results were distributed to the CrossRef and eXtyle mailing lists and generated quite a bit of interest and feedback. In recognition of the importance of this topic the National Information Standards Organization (NISO) and the National Federation of Advanced Information Services (NFAIS) co-sponsored a roundtable discussion in January 2010 to discuss the need for standardized bibliographic and publishing policies for supplemental material. (The previous year the National Federation of Advanced Information Systems (NFAIS) had published a related recommended practice on publishing journal articles.) More than 60 people in attendance participated in a very lively discussion; among the group's recommendations was the formation of a working group to develop recommended practices addressing the business, policy, and technical issues surrounding supplemental materials. The NISO/NFAIS Working Group on Supplemental Journal Materials was formally convened in August 2010, and this document is the result of their work.

In 2012, although the trend toward large numbers of Supplemental Materials being released with journal articles was continuing, no recognized set of practices existed to guide selection, delivery, aids to discovery, or preservation plans. With no commonly accepted guidelines, authors and readers encountered a confusing array of practices, and editors and publishers had no industry basis for decision-making. Related parties such as librarians, publishers of abstracting and indexing services, and repository administrators likewise dealt with disarray in what previously had been a relatively structured scholarly environment. In response to this growing problem, the members of a joint NISO/NFAIS Working Group developed this set of recommended practices. They are intended to help publishers and editors guide authors and peer reviewers in their work and to provide a common ground for delivery of supplemental materials. They are intended to be prospective, not to deal with previously published works.

Some caveats are in order. First, readers will find that the practices are directed mostly to primary publishers, who are the gatekeepers for publishing scholarly journals. However, working group members hope that other related parties will find the document informational. Second, some may find the connotation of Integral Content (see A.1.5, *Definitions*) within Supplemental Materials contradictory; however, this seeming oxymoron reflects the situation in 2012. Publishers have sometimes put essential content that they cannot accommodate within the traditional article into a Supplemental Materials category out of necessity. Although technology will no doubt solve this problem in the future, working group members believed it was important to address the handling of Integral Content as Supplemental Materials as they are treated now. Finally, members have been cognizant of the differing cultures and practices across scholarly publishing and aware of the fact that different fields have different requirements. Consequently, the recommendations include many gray areas.

To work most efficiently and to take advantage of specialized skills and knowledge, the working group formed two subgroups: business and technical, who developed Parts A and B of this Recommended Practice respectively.

Part A begins with terms and definitions and includes the recommendations of the Business Working Group for such business practices as selecting materials, editing them, managing and hosting them, and ensuring discoverability. It also discusses referencing Supplemental Materials, maintaining links, providing good metadata, providing context, and preserving the materials. The roles and responsibilities of various parties as related to Supplemental Materials are outlined and there are recommendations for rights management.

Part B offers recommendations providing metadata for Supplemental Materials, assigning persistent identifiers to them, and ensuring their preservation. It concludes with packaging and exchange considerations. Non-normative supporting documentation to Part B contains an example DTD for Supplemental Materials, a tag library, and examples.

As Part A of these Recommended Practices makes clear, Integral Content and Additional Content are likely to be treated differently throughout the entire lifecycle of a scientific article: peer review, copyediting, markup, citation, and preservation. To enable this differentiation, recommendations in Part B endeavor to make the functional distinction between essential and nonessential elements explicit—regardless of their physical location—by applying unambiguous metadata. Thus, what a reader of a print article could infer from the physical layout, the user of an electronic article, human or machine, will be able to ascertain explicitly through the metadata.

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### NISO Topic Committee Members

The Content and Collections Topic Committee, which had oversight for this project, had the following members at the time it approved this Recommended Practice:

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### NFAIS Approval

This Recommended Practice was endorsed by a vote of member organizations of the National Federation of Advanced Information Services (NFAIS™). NFAIS was a co-sponsor of this project.

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### PART A: BUSINESS POLICIES AND PRACTICES

## A.1 Introduction

### A.1.1 Purpose and Scope

These recommended practices are intended to help the scholarly publishing community develop a more standardized approach to publishing what has become known as Supplemental Materials for Journal Articles in a rapidly changing technology environment. The intent is to lessen the burden on all of the parties engaged in the publishing process, to ensure that Supplemental Materials delivered in connection with journal articles add substance to the scholarship, to make Supplemental Materials more discoverable, and to aid in preserving them.

Existing Supplemental Material may predate electronic publishing. For example, older journals, which have been digitized post-publication, may have had microfiche supplements. In an ideal world, all would be digitized; however, available resources may preclude applying these recommendations to older materials. Consequently, publishers may wish to concentrate their efforts only on future articles.

### A.1.2 Background

Over the more than 350 years since scholarly journal publishing began, the basic protocols for writing and publishing journal articles became fairly standard across the many disciplines. In the past two decades, however, technology has enabled an increasing number of options for which there have been limited or no universal standards or best practices.

One such option entails offering authors the opportunity to expand or support their published articles with Supplemental Materials. In 2012, Supplemental Materials often include multimedia—text, tables, and figures that would occupy too much space or would interrupt the flow of the narrative in a traditional print article—as well as data and computer programs. These vary in the level of importance to supporting the article’s conclusions. Some may be absolutely essential, whereas others may be useful, but not critical.

Traditionally, when the printed page was the medium, the functional distinction between essential and nonessential elements was unambiguously reflected in the article’s layout. Essential elements were incorporated into the body of the article, and nonessential items were placed in an appendix. There was an implicit understanding that anything in the appendix was nonessential. Often nonessential items were simply omitted because of page limits.

Electronic media changed the nature of what could be delivered and altered the implicit understandings. Publishers began including dynamic components, such as videos and 3-D materials that could not be printed, and elements that would be impractical to print, such as datasets and computer code, in online Supplemental Materials. As authors work with these new materials, their mix includes both items essential to the understanding of the work and nonessential ones. However, the clear intellectual distinction between the two is not neatly reflected physically. In 2012, it is not unusual to find both essential and nonessential content in the same files placed under the rubric Supplemental Materials.

From publisher to publisher and from journal to journal, Supplemental Materials can vary in both content and treatment. For many journals, more supplemental content has been added over time—to the extent that it can be difficult for readers to understand what the information actually supplements. Further, content that is a critical part of the evidence for the article’s conclusions can be lost to future readers if it

is indiscriminately grouped with other less crucial materials surrounding the article. Thus, it is important for authors and editors to think carefully about Supplemental Materials.

This document was written in the context of the potential options available in 2012, but technology, readers' needs, and information overload are speeding the evolution of the journal article. The group believes that in the future articles are likely to be presented and used in modules, rather than in the linear fashion generally used in 2012. The various modules, which will likely include content that is considered supplemental today, collectively may be considered the article. As Emilie Marcus, *Cell's* Editor-in-Chief, wrote when *Cell* changed its approach to supplemental Materials starting in 2010: "...over time, the concept of Supplemental Materials will gradually give way to a more modern concept of a hierarchical or layered presentation in which a reader can define which level of detail best fits their interests and needs."<sup>1</sup> The article is likely to be distributed, that is, not delivered in one linear document. This distributed model may apply to both location and who has curatorial responsibility for the various modules.

### A.1.3 General Principles

In coming to agreement on recommended practices, the Working Group articulated a number of broad principles related to publishing and the technical environment.

- 1) Respectful of the wide variance in issues across disciplines and types of content, the recommendations are intended to be guides, not edicts.
- 2) Published articles constitute the scholarly record; therefore, practices must reflect the information future researchers will need to understand and build on articles published today.
- 3) Online Supplemental Materials are intended to provide useful and relevant content. Editors and their publishers should ensure that all Supplemental Materials are tightly pertinent to the article they accompany and should strive to avoid publishing redundant or extraneous content.
- 4) The determination of which materials should be considered supplemental to an article should be the responsibility of the Journal.<sup>2</sup>
- 5) Readers of any single article and its Supplemental Materials may vary substantially in what portions of an article they consider necessary for their personal comprehension and use. Therefore, packaging the materials and providing clear signals about what it contains is a key concept.
- 6) These recommendations are intended to reflect best practice and to look to the future rather than being limited by paradigms from the past.
- 7) Technology continues to change rapidly; consequently, this set of recommended practices should be considered a living document that will need regular review and updates.
- 8) These recommended practices are primarily intended to address content owned, published, and hosted by the journal publisher (or the journal's contracted publisher or online platform host), although there are some references to content hosted by external repositories.
- 9) Business models are beyond the purview of these practices.

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<sup>1</sup> Marcus, E. "Taming Supplemental Material." *Cell*, 2 October 2009, 139(1): 11. doi:10.1016/j.cell.2009.09.021. <http://www.cell.com/retrieve/pii/S0092867409011817>

<sup>2</sup> Journal, when capitalized, is used throughout this document to substitute for the specific decision maker, who might be the editor or the publisher depending on the organization.

- 10) Publishers should make their best efforts to provide the same level of accessibility to Supplemental Materials, in compliance with national laws governing access for persons with disabilities, as they do for their journal articles.
- 11) The focus of this set of recommendations is on Supplemental Materials at the article level, not at the issue or journal level.
- 12) Data constitute a unique emerging category of content. The scope of these recommendations does not extend to the management of data in general; instead, they address the inclusion of data when they are published as Supplemental Materials.

### A.1.4 Comment on Evolving Ecosystem

The world of scholarly publishing is changing rapidly along many dimensions. What is published outside the article as Supplemental Materials today may well be incorporated into a new type of article tomorrow. One example is how data are treated. Over the past decade, more funding bodies and more journal publishers have set forth an expectation that the data underlying a research report be made publicly accessible. In 2012, journals and scholarly articles devoted to data are emerging. Consequently, data, which have up to now been placed outside the article, may be incorporated into some articles. Presenting datasets with an article requires that authors take the time to provide clear metadata and explanations of how the data were used in their study, such as special coding instructions. Another example is multimedia, which until recently, was of necessity placed in Supplemental Materials. It is possible that evolving technology will enable better integration of these materials into the article.

### A.1.5 Terms and Definitions

The following terms, as used in this Recommended Practice, have the meanings indicated.

#### A.1.5.1 General Definitions

<b>article</b>	An original publication that appears in a scholarly journal. An article is a complete, coherent work that provides all materials necessary for a reader to comprehend the scholarly work described.
<b>data</b>	Attributes of a variable or set of variables that may be qualitative or quantitative; may represent facts, figures, or ideas; and may be expressed in numbers, words, or images. Generally, data represent information gathered for analysis or decision making. Raw data are attributes that have not been processed and analyzed.
<b>metadata</b>	Additional information or context about other data. For example, machine readable metadata headers tell what elements the document contains, when it was created, when it was changed, who created it, size of the file, title, author, type of content, and so on. (See Part B for more on metadata.)
<b>multimedia</b>	Multiple forms of media (or content) that may include any of the following: text, images, audio, and/or video, with or without interactivity between the user and the content. Previously used to distinguish print from other media, it is increasingly seen as a combination of multiple forms. Technology is now enabling the incorporation into the article of multimedia content that earlier was consigned to Supplemental Materials.

### A.1.5.2 Definitions for Supplemental Materials

Supplemental Materials is a broad term that, in practice, has been applied to materials found outside the article. In 2012, the materials can be separated into two types of content that differ in their functional relationship to the article. However, the first type (Integral) is expected to be a temporary category that will disappear in time, as technology enables its better integration into the article.

**integral content** Supplemental Material that is essential for the full understanding of the work by the general scientist or reader in the journal's discipline, but is placed outside the article for technical, business, or logistical reasons. Examples include descriptions of methods needed to evaluate a study, review, or technical report; detailed results required to comprehend a study, review, or technical report's outcomes; and tables, figures, or multimedia files that provide primary data or information required to verify the work or to fully understand the work. In general, the publisher maintains responsibility for hosting and curating this content in the same way the article itself is treated. (For some specialized journals, content held in an external repository may be considered integral.)

**additional content** Supplemental Material that provides additional, relevant, and useful expansion of the article in the form of text, tables, figures, multimedia, or data, and that may aid any reader to achieve deeper understanding of the current work through added detail and context. Additional Content will expand the reader's understanding of the subject area, but is not essential to the understanding of the article. Examples include expanded methods sections; extended bibliographies; additional supporting data or results; copies of instruments/surveys; and multimedia and interactive representations of additional, relevant, and useful information. Generally, the author has created this content and the publisher hosts it or places it on the open web.

Determining whether Supplemental Material is Integral or Additional is the purview of the Journal. Best practice is for publishers to ensure that authors and peer reviewers have instructions to guide them in submitting and reviewing content that may fall into either category.

### A.1.5.3 Comment on Related Content

The Working Group spent considerable time discussing other content the author wishes to make the reader aware of because it may add to the understanding of the work, or aid the replication or verification of the results. Examples include data, gene sequences, protein structures, digital recordings, 3-D images, and chemical compounds used, created, or deposited by authors and held in external repositories. This Related Content generally resides in an official data center or institutional repository. The author may or may not have been the creator, and the publisher has no responsibility or authority over this content and does not host it. Journals treat references to this content differently: many expect it to be listed as another cited reference, and others link to it outside the citation list. Because the publisher lacks any authority over content in external third-party repositories, no recommended practices are offered for editing or managing Related Content.

Related Content is a separate entity and is referenced within the text in similar fashion to other cited references. Practices for linking to this content vary from journal to journal with some Journals requiring that citations to repositories be listed with their unique identifiers and accession numbers within the text and linked from there. Others include the reference and the link in the citation list. If the repository

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enables links to a specific item and such a citation fits within the style system the journal uses, listing the citation in the reference list would facilitate export to a reference management system. In 2012, we are seeing repositories take active steps to provide the necessary infrastructure for linking to “items” as opposed to just a general reference to the whole repository.

Generally, the repository provides a linking syntax for materials they maintain. In providing the citation, the author should include the identifier or accession number specified by the repository so that the publisher can include it. Bidirectional links are recommended, and authors should be encouraged to post their materials in repositories capable of accommodating the journal article DOI.

### A.2 Roles and Responsibilities Related to Supplemental Materials

Many parties play a role in maintaining the record of scholarship and supplemental material. For convenience in this document, we have separated the parties into two segments: Primary Publishing and Related Parties, and described their responsibilities in the two tables below.

#### A.2.1 Primary Publishing

Publisher	Editor	Peer Reviewer	Author(s)
Educate other parties about requirements for posting and curating content.	Set editorial policy.	Follow journal guidelines for reviewing Supplemental Materials.	Be aware of Journal expectations and follow them to the best of their ability.
Provide appropriate resources for managing supplemental content.	Make final decisions on content.	Inform the editor in a timely fashion if unable to review any content.	Provide context and demonstrate that the Supplemental Materials add substance to scholarship in the field.
Provide systems and policies to facilitate the decision-making process.	Determine whether supplemental content is integral to the article. <sup>3</sup>	Alert the editor to instances in which integral data are not provided, but are needed to understand the manuscript.	Be responsible for providing Supplemental Materials at the same level of quality as the article.
Be clear about the level of delivery and preservation that can be provided.	Set expectations for acceptable content with an understanding of what is entailed in vetting, delivering, and preserving content.		Be aware of trusted repositories in the field and knowledgeable about their practices.

<sup>3</sup> In some organizations this responsibility may be shared with the Publisher.

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Publisher	Editor	Peer Reviewer	Author(s)
Encourage authors to post Additional Content in endorsed archives that ensure good preservation and provide bidirectional linking to the journal. <sup>4</sup>	Encourage authors to post Additional Content in endorsed archives that ensure good preservation and provide bidirectional linking to the journal. <sup>4</sup>		Be aware of and adhere to policies of your institution and funder for sharing of research data.

### A.2.2 Related Parties

Libraries	Abstracting and Indexing Services	Repository Administrators
May serve as a repository for the research done by university researchers.	Indicate the availability of Supplemental Materials if the journal publisher has provided clear indication they exist.	Make deposited content accessible by assigning persistent identifiers, such as a DOI or another unique identifier.
Include Supplemental Materials with journal article interlibrary loan when the journal publisher has provided clear indication they exist.	Include the formats and file types of Supplemental Material if the publisher has provided identifiable metadata.	Include DOIs for any journal articles that link to content in their repository.
	Include the publisher-provided DOI or other identifier.	Manage bidirectional links between the deposited content and the article.

### A.3 Recommended Business Practices

This section will cover a number of different issues concerning Supplemental Materials. These are treated here at a high level, and with a policy perspective in mind. A more detailed discussion of the technical and implementation considerations is included in Part B of this document, where consideration will be given to the information and metadata required to ensure that the context, linking, archiving, and preservation recommendations outlined in this section can be achieved.

#### A.3.1 Selecting Supplemental Materials

The costs of vetting, delivering, and maintaining Supplemental Materials can be considerable. Consequently, particular care in accepting content is warranted, and the publisher should provide written guidelines for accepting these materials. Careful editorial evaluation according to the Journal's practices is essential. In all cases, it is helpful to both authors and readers if the Journal sets forth clear expectations that Supplemental Materials be relevant to the article and provide useful additions to the scholarly record.

This section refers to editorial evaluation of manuscripts.

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<sup>4</sup> This is in lieu of posting to the author's homepage or other websites that may not be preserved, and it may serve as assurance in the event that the publisher is not in a position to ensure migration and preservation.



**Integral Content** Best practice is to review any materials deemed essential to the full understanding of the article, but treated as Supplemental Materials for other reasons, at the same level as the article. The decision to publish Integral Content separately from the article may occur after the article is accepted; in that case, the reviewer has seen the content within the manuscript. However, if it is submitted as a separate file, either at original submission or at request following editorial evaluation, reviewers should receive the full set of article and Integral Content and should be expected to review both at the same level.

**Additional Content** Ideally, these materials should be reviewed at the same level as the article. However, Additional Content may be so voluminous that resources simply are not available for full review. In some instances, a reviewer may request these materials to allow a more thorough review of the article itself, and the request should be honored. The content may or may not be published at the discretion of the editor in coordination with the author.

### A.3.2 Editing Supplemental Content

The level of technical or copyediting of content following acceptance may be determined by the type of content.

**Integral Content** Editing of Integral Content should be determined by the publisher and the editor. Best practice is to edit this content at the same level as the article. If the Integral Content is not edited, the fact that it is included as the author provided it should be noted within the content or on the landing page that leads to the content.

**Additional Content** Editing of this content should be determined by the publisher and the editor. Journals may not have the resources to handle editing Additional Content. If the Additional Content is not edited at the same level as the article, the fact that it is included as the author provided it should be noted either within the content or on the landing page that leads to the content.

### A.3.3 Managing and Hosting Supplemental Materials

In general, publishers both manage and host their Supplemental Materials. However, that is not universally the case, nor should it be. A publisher may assume responsibility for ensuring content viability without actually managing it. For example, many publishers do not host their own content. Publishers may, in fact, outsource any aspect of delivery or archiving. These arrangements are governed by contractual agreements, which should be crafted to ensure the level of protection needed. If journal content is hosted by an aggregator or other host, that host should also deliver Supplemental Material.

Some Journals designate data that are hosted by an external repository as Integral Content. It is essential for a publisher who does not retain responsibility for hosting the content to preserve the link between the article and the Integral Content. It should also be noted that repositories may not be stable. Even large, important repositories have moved, resulting in broken links. In those cases, the publisher will need to replace links with ones that work. Therefore, best practice calls for the use of persistent identifiers, preferably DOIs. An author's website should never be considered an appropriate place for the sole posting of Supplemental Materials, as no individual's website can be considered stable, nor can the publisher maintain it in any way.

### A.3.4 Ensuring Discoverability and Findability

In early 2012, one of the biggest problems with Supplemental Materials for end users and librarians is finding them. Journals may provide indications of associated Supplemental Materials that are inconsistent or not easily seen. As a result, readers may miss important content, including Integral Content. One example is that librarians requesting or sending articles via interlibrary loan (ILL) may discover that the reader received the article, but not the Supplemental Materials, most likely because the Supplemental Materials were not readily visible to the sending librarian. The following guidelines address improved discoverability.

#### A.3.4.1 General Consistency

Standardization helps human readers and machines to find the content, and it is also an important aspect of ensuring that abstracting and indexing services will find the materials. Publishers should use consistent naming conventions for the Supplemental Materials—both in the online table of contents and in the article—to aid the reader. Likewise, the Supplemental Materials should consistently reference the article. If the format of the Supplemental Materials precludes inclusion of a reference, the reference should appear on a landing page. Finding content serendipitously is enhanced when pointers to the Supplemental Materials are always located in the same place. Streamlining the navigation also helps the reader return to where they started. Publishers should practice consistency from one article to others *and* from one issue to others, as well as across all journals published by the same entity.

Consistency is important in three key areas of presentation:

- *Tables of Contents* – Best practice is to indicate the presence of Supplemental Materials for any article supported by Supplemental Materials in the online journal table of contents. The listing in the table of contents should include words such as “supplemental materials” or specific supplemental file names such as “supplemental methods” or “eMethods,” “supplemental table” or “eTable,” “video,” and so on, along with the article title and authors. Use of the naming convention should be easy to understand and consistent within all journals produced by the publisher.
- *Display in the Article* – Best practice is to locate links to the Additional Content near the top of the first page or screen view of the article in all electronic versions. The links should be clearly visible at first glance. Placement should be consistent within all articles, across all issues of a journal, and across all journals from a publisher. As Integral Content is a component of the article, best practice would be link to that content from within the article. Best practice calls for publishers to ensure that any links within their own content work. In addition, it is important to maintain a standardized approach so that the named content and the links are readable both by machines and by humans.
- *Display in the Supplemental Materials* – Best practice calls for the navigational elements within the Supplemental Materials to match those used at the article level. As much as possible, the elements should follow consistent locations and naming conventions.

#### A.3.4.2 Abstracting and Indexing Coverage

Abstracting and indexing coverage is essential for optimal discovery. Even in these days of multiple discovery service engines, scholars still rely on abstracting and indexing services to ensure that their approach to discovery was comprehensive. Another reason for ensuring accurate abstracting and indexing coverage is preservation: the more evidence that content exists, the more likely the content will be used and preserved.



Standardization is also important for ensuring abstracting and indexing coverage. This is particularly true for abstracting and indexing services that ingest electronic feeds from the primary publisher. In addition to standardizing placement and naming conventions, best practice is to include descriptive metadata that indicate the purpose and file format of the Supplemental Materials and the link or links that will take the end user to them. For more detail, see section A.3.8, *Providing Context*.

In 2012, many abstracting and indexing services do not indicate the presence of Supplemental Materials. The reason most reported is that they are difficult to find. Another reason for lack of coverage could be that abstracting and indexing services may not currently have fields in their databases for noting Supplemental Materials in journal articles. To encourage more coverage (and hence more use for the published content), journal publishers need to make it very easy to pick up the requisite information. Abstracting and indexing services should note the availability of Supplemental Materials if the journal publisher has indicated clearly that they exist. If the primary publisher supplies clearly identifiable metadata, including file types, it is recommended that notice of the content and formats be included in the abstracting and indexing record.

### A.3.5 Referencing Supplemental Materials

In scholarly works, authors are expected to acknowledge the work of others and to provide accurate references to the published materials. The same expectation holds for use of Supplemental Materials. However, citing Supplemental Materials and handling cited references within Supplemental Materials can be confusing. A variety of systems for citation styles exist across disciplines. However, two common attributes are accurate representation of the content and a combination of elements sufficient to identify a unique document.

#### A.3.5.1 Reference within the Article

Best practices call for Supplemental Materials to be described (cited and linked) at the same level as a table or figure that is contained within the article. Providing an in-text citation and link to Additional Content at the appropriate point in the text—rather than adding either or both only at the end of the article—offers the reader context and immediate access. Journals handle these references differently.

Some add a prefix so that the reference is “eTable 1” or “Figure S2.” Some use a parenthetical statement such as “(supporting online text).” Others spell the reference out as in “Supplementary Figure 1.”

Integral Content is considered part of the article. Consequently, there should be an in-text link to it, but it should not be cited in the reference list.

#### A.3.5.2 Reference in Other Publications

##### **Integral Content**

Any citation to Integral Content should cite the article as a whole. Citing the content separately is not good practice.

##### **Additional Content**

Additional material is more of a separable entity, and this content may be used for multiple purposes in multiple ways. Decisions about referencing Additional Content separately may depend upon the content itself. In some instances, this material may stand on its own. Subsequent authors, who have used this content extensively in their own research study, may wish to cite the Additional Content specifically. Some style systems advise authors to include the words “Supplemental Material” in the citation for the article. It is essential that there be sufficient elements to create a true citation that informs the reader about what is being cited.

### A.3.5.3 Citations within Supplemental Materials

Often Supplemental Materials will include bibliographic references; examples are references in an extended methodology section, additional reading, and long bibliographies for literature reviews. Authors should ensure the accuracy of these references. If Journal resources and technology permit, references in Supplemental Materials should be tagged and linked to bibliographic databases.

References in Supplemental Materials should be treated differently depending on what they are supporting:

<b>Integral Content</b>	If the style system permits, it is preferable to integrate references necessary for the support of Integral Content into the reference list of the article rather than create a separate list. However, in numbered reference systems, preparing a separate reference list may be less confusing for the reader.
<b>Additional Content</b>	In contrast, references necessary for the support of Additional Content should be delivered in lists separate from the article reference list, and placed within the Additional Content files. Some citations may be found in both the article reference list and in the Additional Content reference list.

### A.3.6 Metadata and Packaging

An article package comprises the article, all Supplemental Materials—Integral and Additional if both exist—and descriptive metadata. The recommended best practice is to use a standardized packaging format designed to support disk-based or network-based storage and transfer of digital content. The packaging is particularly important for data transfers such as interlibrary loans.

Metadata required include the publication title, the article title, publication date, a persistent link such as a DOI to the article, a persistent link or links to the Supplemental Materials, and a manifest. The latter describes the objects contained in the package and the total file size of the package. Other elements in the manifest are file name and description, detailed copyright information, and any executable information. See Part B for more detail.

### A.3.7 Maintaining Links

In an electronic journal, links enable the reader to navigate seamlessly from one item to another; however, if a link breaks, the reader is left with little recourse for access. Any link in an article must work at the time of publication. If the link is to information owned, published, or contracted by the publisher, the publisher has an obligation to maintain link functionality. Links to external information over which the publisher has no control present more difficulties: best practice is for the publisher to maintain the link and resolve broken links when discovered. Use of DOIs will minimize the problem of broken links. Best practice would also call for publishers to deactivate links to materials not under their control when they learn the links no longer work. If possible, the publisher should indicate where alternative access might be found.

Bidirectional linking is important for both Integral and Additional Content. The reader must be able to move back and forth between the article and the Supplemental Materials with no difficulty, whether the link from the article goes directly to the content or it takes the reader first to a landing page. (The latter may be necessary for some formats or multiple documents.) DOI registration for the content can ensure persistency and findability; consequently, it is recommended. It is important to provide separate DOIs for

Integral and Additional Content as structurally distinct types of content to enable separate linking. Publishers should also update the DOI metadata when necessary to maintain the persistence of the DOI.

### A.3.8 Providing Context

Within the article, an in-text citation provides context for the Supplemental Material. However, it is important to provide context within or attached to both Integral Content and Additional Content. Readers can find these materials without navigating to them from the article. Even if readers navigate directly from the article to the content, they will benefit from a reminder about what they are seeing or hearing. Consequently, some indication of the nature of the content and its connection to the article to provide context are important. Including the following elements, either on a landing page or within the content itself, is recommended:

- Article citation and DOI
- Title of document and/or succinct statement about the content
- For multimedia files, a file extension and indication of size
- If there are multiple files, a list of all the relevant files
- Player information for multimedia
- DOIs or other identifiers for the Supplemental Materials if used

Although these elements can be contained in a ReadMe file, experience has proven that readers generally ignore them. Simple lists, as noted above, are generally more useful.

### A.3.9 Preserving Supplemental Materials

Recommendations for archiving and preserving Supplemental Materials are based on their importance and relationship to the scholarly record. There may be competing priorities between presenting innovation and cutting edge material and preserving content for future scholars. One option may be to deliver multiple views, in which one view presents preservable content, but perhaps is not fully functional, and one view offers fully functional content that may not be preservable. With archiving evolving from a purely library function to one that may be dependent on the publisher, preservation potential is now very important.

#### **Integral Content**

Because the article is functionally incomplete without its Integral Content, preservation of the article must include preservation of Integral Content at the same standard. Responsibility for this preservation lies with the publisher. Consequently, best practice for these materials is that they receive the same metadata markup as the article does and are included in migration plans. For multimedia files, the accompanying text, which should include clear metadata, should be tagged appropriately.

### **Additional Content**

These materials can constitute a large and diverse set of content. Publishers should take preservation into consideration when accepting materials. If they are uncertain whether they can preserve the materials, a best practice would be to request that the author submit the content to a trusted repository so that the publisher can link to it there. To the extent possible, the Additional Content should receive the same tagging and markup the article does and should be included in migration plans. For multimedia files, the accompanying text, which should include clear metadata, should be tagged appropriately.

Supplemental Materials, if selected well, constitute an important part of the scholarly record, and their long-term viability is of concern. In developing a preservation plan, publishers may wish to consider distributed repositories, as redundancy can be a useful safeguard. As a best practice, publishers should either specify the repositories they deem acceptable for depositing data and other content or outline criteria by which a repository would be evaluated for acceptability. Some possible criteria would include accessibility (open to all scholars), commitment to and capability of archiving in perpetuity, and commitment to managing bi-directional linking with publications at the level of specific data sets.

### **A.3.10 Rights Management**

How publishers approach rights for the intellectual property of an article varies significantly. In general, publishers who ask for a copyright transfer or license as a condition of publication also expect the author to transfer rights for both Integral Content and Additional Content. Publishers who use some form of the Creative Commons document also generally treat Supplemental Materials as they do the article. Best practice is to treat rights for Integral Content in the same manner that the publisher treats rights for the article. Determination of rights for Additional Content may differ but should be transparent to users.

Another issue related to rights management is access. Anyone who has rights to have access to the online article should also be given access to the Integral Content. Of particular concern to librarians is the ability to get both the article and the Supplemental Materials through ILL. The recommended practice is for libraries to provide both the article and the Supplemental Materials for which the publisher is responsible in ILL.

# PART B: TECHNICAL CONSIDERATIONS AND IMPLEMENTATION RECOMMENDATIONS

## B.1 Introduction

### B.1.1 Purpose and Scope

Part B discusses the technical considerations regarding the Supplemental Materials policies and practices described in Part A. It offers recommendations on metadata needed to manage the Supplemental Materials throughout their lifecycle. It provides recommendations on persistent identifiers and on preservation and packaging of Supplemental Materials. Some of the metadata is considered to be required in order to enable linking and to provide context. Other metadata is considered optional, such as elements that would be helpful in improving discoverability.

### B.1.2 Supporting Documentation

While the Recommendations do not specify a particular format for the metadata, we recognize that XML will be a format of choice for many publishers. Supporting documents are available from the NISO website ([supplemental.niso.org](http://supplemental.niso.org)) to meet the needs and XML expertise of different readers who would like to understand the Recommendations in greater detail or to implement the Recommendations in an XML environment. The intent, however, is that an organization could implement these best practice Recommendations without referring to the supporting documents.

Supporting documentation available at the time this Recommended Practice was issued includes:

- **A non-normative DTD** to express the metadata Recommendations in much greater detail than Table 1 in Part B – Non-normative means that while the DTD will work within XML applications, it is intended to be a base that publishers could use to develop a metadata schema and associated validating applications, such as Schematron, that are customized to their own environment. Because some required metadata elements could be applied at the level of all Supplemental Material or at the level of a single object, the DTD defines them as optional in both locations. This is a case where some other validation tool would be necessary to make sure the element appeared somewhere. Thus, the DTD can be used as a starting point for organizations who would like to implement these Recommendations using XML and who have individuals who are conversant in XML.<sup>5</sup> (Target Audience: Technical Staff and Developers; Goal: Implementation in a DTD environment).
- **A tag library** that serves as an easy guide to the DTD – In addition to the browsable lists of elements and attributes, the element context table, and the index, the tag library also includes a visual schema representation of the DTD and an HTML representation of the DTD. This guide is more human-readable than the DTD and is best suited to someone who understands XML and who wants to understand the Recommendations in more detail than Table 1 in Part B. (Target Audience: Technical Staff; Goal: Detailed Understanding, Decision to Implement).

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<sup>5</sup> Note that since the DTD is non-normative, other vocabularies could also be used to express the recommended metadata. For example, [METS](#), [OAI-ORE](#), and [DataCite](#) are metadata vocabularies that are focused on environments that are complementary to journal article publications, or that focus on datasets. Insofar as these vocabularies cover the recommended metadata elements, they could be used to implement this recommendation. The DTD included in this recommendation corresponds most closely to the journal publishing environment.

- Several **examples of metadata markup** using the non-normative DTD – Each of the examples is shown with a minimal level of tagging as well as a more detailed level of tagging, illustrating the range of tagging that can be done using what at first glance may appear to be a rather complex DTD. (Target Audience: Management; Goal: High Level Understanding).

### B.1.3 General Considerations

Conceptually, Supplemental Materials can be viewed as a series of objects related to the article. In the simplest case, this relationship can be envisioned as a hierarchical arrangement, where all Supplemental Materials objects have equal ranking in their relationship to the article. While this simple case may cover the majority of Supplemental Materials, and while a relatively small set of metadata elements are needed to describe these cases, there are many cases that are more complicated. The following list is not intended to be complete, but simply demonstrates the range of supplemental materials that publishers encounter. A number of optional metadata elements are described to handle these more complex cases.

- The fundamental notion of Integral and Additional Supplemental Materials introduced in Part A divides the objects into two categories. There could also be, for example, supplemental spreadsheets, supplemental CIF (Crystallographic Information File) files, and supplemental PDF files. PDF files, as well as ZIP files, present an interesting case, because a single file or archive can contain both Integral and Additional Supplemental Materials.
- The same Supplemental Materials may exist in multiple formats. For example, a chemical structure might be displayed in some new program that has particularly compelling features. However, because the long-term viability of the software is not known, the author or publisher may choose to include, in addition, a less fully-featured view of the structure that would be better suited to long-term preservation. These objects are both related to the article, but they also have a relationship to each other. This complexity poses challenges both for describing such a relationship and for preservation of the objects.
- While often the Supplemental Materials are associated with an article as a whole, it is not uncommon for a Supplemental Material to be explicitly associated with a specific object of the article, such as a particular figure or table.
- In most cases, the contributors to the Supplemental Materials are the same as the authors of the article they supplement. However, this is not always the case. For example, data from some instrument may have been collected by a technician who did not otherwise contribute to the intellectual content of the article.
- The article and its Supplemental Materials may reside on different platforms, which makes it imperative to link the Supplemental Materials to the article via persistent identifiers.

In considering these complex relationships between an article and its Supplemental Materials, the Working Group has tried to strike a balance between detail and completeness on one hand and flexibility and simplicity on the other. The metadata definitions that form the core part of the Technical Working Group Recommendations support whatever approach the publisher or other content provider chooses to exercise. This allows assignment of the most detailed and granular metadata that are likely to satisfy almost all current and future environments; yet it also is suitable for those who decide to adopt a simpler approach with less detail while still realizing some of the benefits of these Recommendations for now and in the future.

## B.2 Metadata

### B.2.1 Background

Providing a framework for assigning descriptive and physical metadata to the Supplemental Materials associated with an article is fundamental for managing such materials throughout their lifecycle.

Integral Supplemental Materials should be separated from the Additional Supplemental Materials whenever possible. However, Supplemental Materials can be designated as either Integral or Additional in multiple ways. For example, each Supplemental Materials object could be identified as Integral or Additional; Supplemental Materials objects could be organized into two groups, with one group identified as Integral and the other as Additional; or a single file (like a PDF or ZIP) could contain both Integral and Additional material. If objects are packaged together in a single ZIP file, a manifest, included in the ZIP file, should designate each individual object as either Integral or Additional. The metadata DTD is flexible enough to support whatever organizational option each journal chooses.

The recommended minimal metadata for Supplemental Materials are:

- Persistent identifier (e.g., DOI) for Supplemental Materials, either for the entire set or for each individual object
- Persistent identifier (e.g., DOI) for the article
- Relationship type of the Supplemental Materials to the article (Integral, Additional, or Both)
- Descriptive metadata for the Supplemental Materials, such as a title or summary
- File name of, or an external link to, Supplemental Material files
- File format(s) of the Supplemental Materials files

The recommended minimal and extended metadata are described in Table 1. While providing the complete set of metadata may seem cumbersome in today's world, these are the kind of metadata that will likely be important in the future. Therefore, publishers and authors are encouraged to provide the minimal metadata, but also to consider a migration path to providing all of the recommended metadata.

### B.2.2 Metadata Elements

The metadata elements in Table 1 comprise the required and optional elements recommended to describe Supplemental Materials. Indentation in the table is intended to provide a visual indication of related elements. For example, the Supplemental Material Title and Supplemental Material Caption are related to each other, and fall into the general category of Supplemental Material Object Metadata. While the required metadata provides the minimal context for the Supplemental Materials, the extended metadata allows characterizing the Supplemental Materials more completely. This approach allows flexibility in how individual journals might choose to implement these Recommendations. The supporting documentation contains the non-normative representation of these metadata as a DTD, accompanied by a tag library.



## Recommended Practices for Online Supplemental Journal Article Materials

**Table 1: Quick Reference to Supplemental Journal Article Material Metadata Recommendations**

Metadata Description	R/O*	Reference to element in the non-normative DTD
<b><i>Metadata for the article to which the Supplemental Materials apply</i></b>		
<b>Article Metadata:</b> The metadata for the Supplemental Materials should contain information about the article to which the Supplemental Materials apply. This enables the user to locate the article from the Supplemental Materials.	R	<article-metadata> <sup>†</sup>
<b>Article Identifier:</b> In most cases, the article will have been assigned a DOI. If not, a DOI should be assigned prior to generation of metadata for the Supplemental Materials. That DOI should be included as the article identifier in the Supplemental Material metadata. It is possible that another identifier might also be assigned. In that case, multiple identifiers may be included, along with the type of identifier.	R	<article-identifier>
<b><i>Description of the Supplemental Materials</i></b>		
<b>Supplemental Material Descriptive Metadata:</b> The Supplemental Material metadata should include a description of the Supplemental Material itself. Because the Supplemental Material could consist of a single file containing all of the Supplemental Material, or multiple individual files, this metadata element could be applied to the entire set of materials or to an individual file.	R	<sup-mat-descriptive> <sup>†</sup>
<b>Supplemental Material Identifier (DOI or other persistent identifier):</b> While not the universal practice today, it is recommended that the Supplemental Material be assigned a persistent public identifier. This would most likely be a DOI assigned through CrossRef, since this is the common standard for scholarly publications. However, depending on the nature of the Supplemental Material, a DataCite DOI or a discipline-specific identifier, such as a Protein Data Bank ID, might be appropriate.	R	<sup-mat-identifier>
<b>Supplemental Material Object Metadata:</b> In addition to the metadata for the entire set of Supplemental Material, it is useful to specify metadata for each Supplemental Material object. In a simple case, there might just be a description of a single figure, a single table, or a single graphic. An example of a more complex case might be a ZIP file that contains many objects and could contain metadata for each of the objects, down to the desired level of granularity.	R	<sup-mat-object-metadata> <sup>†</sup>



## Recommended Practices for Online Supplemental Journal Article Materials

Metadata Description	R/O*	Reference to element in the non-normative DTD
<p><b>Relationship of Supplemental Material or of an Individual Supplemental Object to the Article:</b> The relationship of the Supplemental Materials to the article is one of the main aspects of this Recommendation. Integral Supplemental Materials include objects considered a necessary part of the intellectual work. (NOTE: Such objects are not “supplemental” in the usual sense, but many publishers, for technical, business, or logistical reasons treat them as if they were and place them outside the article.) Additional Supplemental Materials include objects that provide additional, relevant, and useful expansion of the article but do not form a part of the intellectual work. Because a Supplemental Material object might contain more than one set of Supplemental Materials, a type of “integral-and-additional” Supplemental Material may also be appropriate.</p>	R	@sup-mat-type <sup>‡</sup>
<p><b>Supplemental Material Label:</b> If the Supplemental Material object is referred to directly from the text of the article, as, for example, “Figure S1” or “Table E2,” that label should be included in the descriptive metadata.</p>	O	<label>
<p><b>Supplemental Material Title:</b> If the Supplemental Material object has been given a title, this element contains that title.</p>	O	<title>
<p><b>Supplemental Material Caption:</b> If the Supplemental Material object contains a caption, such as a table caption or a figure caption, including that element in the metadata could help increase discoverability.</p>	O	<caption>
<p><b>Supplemental Material Contributors:</b> In many cases, the authors of the Supplemental Materials will be the same as the authors of the article. However, this is not always the case. The contributor elements allow for identification of the creators of, or contributors to (such as translators or cell-line isolators), the Supplemental Materials. Including these contributors in the metadata can help improve discoverability. The contributor group metadata includes the usual contributor sub-elements, which are well defined. These would include such things as the names, role, identifier (e.g., ORCID), etc. for the individuals or groups responsible for generating the Supplemental Material.</p>	O	<contrib >
<p><b>Supplemental Material History:</b> Important milestone dates of the Supplemental Material may be significant. The Supplemental Material may have been published independent of the article, and there may have been format conversions in order to continue to render the material in future computer environments. The history could include the creation date, the publication date, an embargo date, etc.</p>	O	<history> <sup>‡</sup>
<p><b>Supplemental Material Subject Descriptor:</b> Subject descriptors for the Supplemental Material. These may include keywords, taxonomic codes with values, descriptive phrases, etc. Subject descriptors are used to improve indexing and discoverability.</p>	O	<subject-descriptor>

## Recommended Practices for Online Supplemental Journal Article Materials

Metadata Description	R/O*	Reference to element in the non-normative DTD
<p><b>Supplemental Material Summary:</b> A brief summary of the Supplemental Material could be used to describe the contents of the material prior to downloading or for assistive devices.</p>	O	<summary>
<p><b>Supplemental Material Publisher:</b> This may be an author, publisher, or other organization, and might not be the primary copyright holder or the same as the publisher of the article.</p>	O	<publisher>
<p><b>Supplemental Material License:</b> Set of conditions under which people are allowed to use the Supplemental Material, or other license-related information or restrictions. NOTE: The &lt;ext-link&gt; can be used to link to licenses that are already defined, such as a Creative Commons license.</p>	O	<license>
<p><b>Supplemental Material Provenance:</b> If the Supplemental Material came from a different source than the article, then the provenance of the Supplemental Material should be included. As an example, in image processing research, a set of images may become standard, and could be used in many subsequent studies.</p>	O	<provenance> <sup>†</sup>
<p><b>Relationship between Supplemental Material Objects:</b> There may be some relationship between the different supplemental objects associated with an article. For example, there could be alternate forms or representations of the same intellectual object, several unrelated objects could be included in the same ZIP file, or there could be a comparison between two gene sequences.</p>	O	@relationship-of-objects <sup>‡</sup>
<p><b>Supplemental Material Version Number:</b> Because of changes in software and operating systems, it may be necessary to convert Supplemental Material objects to a new format from time to time. In that case, it would be useful to record whether the object resulted from a file conversion.</p>	O	<version>
<p><b>Original:</b> An attribute to indicate whether or not a Supplemental Material object is the original one accepted for publication.</p>	O	@original <sup>‡</sup>
<p><b>Article Component Metadata:</b> In some cases, the Supplemental Material may refer to a specific object in the article, rather than to the article as a whole. If so, metadata can be used to link to the specific object of the article, e.g., a particular figure, table, or section. The label, title, id, and/or URL of the referenced object could be recorded in this element, to help a system provide a link to it.</p>	O	<article-component-metadata> <sup>†</sup>
<p><b>Supplemental Material Physical Metadata:</b> Metadata concerning the physical expression of a supplemental object should be included. These include such things as file format, creating and rendering software, preservation considerations, file names, MIME types, etc. This could also include multiple renditions of the same material (a bitmapped image, an interactive object, a movie, etc.).</p>	R	<sup-mat-physical> <sup>†</sup>

## Recommended Practices for Online Supplemental Journal Article Materials

Metadata Description	R/O*	Reference to element in the non-normative DTD
<p><b>Supplemental Material File Formats:</b> The format of the Supplemental Material files should be specified. Rather than just listing a format by name, publishers should use formats defined in formal format registries like UDFR (Unified Digital Format Registry) or PRONOM. Alternatively, publishers may define and publish their own registry (list) of object formats they support.</p>	R	<format>
<p><b>Supplemental Material Preservation:</b> The preservation elements record a commitment from a publisher or archive to carry the Supplemental Material forward. This can be different for each format type, and different for each object within a format, and can be expressed, for example, using the National Library of Medicine permanence levels<sup>6</sup>: Permanent: Unchanging Content, Permanent: Stable Content, Permanent: Dynamic Content, or Permanence Not Guaranteed. (See B.4.2.)</p>	O	<preservation> <sup>†</sup>
<p><b>Supplemental Material File Validity:</b> Indicates whether a file is valid in relation to the format it claims to be. Publishers may consider using JHOVE terminology: well-formed, well-formed and valid, not valid, not well-formed.</p>	O	<validity>
<p><b>Supplemental Material Data Fixity:</b> Fixity is a means of ensuring that a digital object has not been changed between two points in time or two events. Technologies such as checksums, message digests, and digital signatures are fixity methods used to verify a digital object's fixity.<sup>7</sup> The element should include the method used to calculate the fixity, as well as the fixity value.</p>	O	<fixity> <sup>†</sup>
<p><b>Creating Application/Rendering Application:</b> Identifies the application that created or is used to render the Supplemental Material object. Because readers of content use different operating systems and because operating systems and software change, it may be helpful to know what applications were used to create the supplemental object. It may also be useful to know what application could be used to view or render the object at the time of publication. For particular file types, reference to the file format registries referenced above could be helpful.</p>	O	<creating-application> <sup>†</sup> <rendering-application> <sup>‡</sup>
<p>Notes:            * (R/O: R = required; O = optional)            † In the non-normative DTD, these are elements that contain only elements.            ‡ In the non-normative DTD, these are attributes on elements.</p>		

<sup>6</sup> Working Group on Permanence of NLM's Electronic Information. *Developing Permanence Levels and the Archives for NLM's Permanent Web Documents*. Bethesda, MD: National Library of Medicine, November 2007. Available at: [www.nlm.nih.gov/psd/pcm/devpermanence.html](http://www.nlm.nih.gov/psd/pcm/devpermanence.html).

<sup>7</sup> From: Novak, Audrey. *Fixity Checks: Checksums, Message Digests and Digital Signatures*. New Haven, CT: Yale University Library, Integrated Access Council, Digital Preservation Committee, November 2006. Available at: [http://www.library.yale.edu/iac/DPC/AN\\_DPC\\_FixityChecksFinal11.pdf](http://www.library.yale.edu/iac/DPC/AN_DPC_FixityChecksFinal11.pdf)

### B.3 Persistent Identifiers

#### B.3.1 Background

As with the articles themselves, assigning persistent identifiers to Supplemental Materials is crucial for their long-term discoverability and citability. While internal identifiers may be assigned to every item as needed by local content management or production systems, persistent identifiers provide discoverability of and linking to content by users and systems external to a publisher's platform.

In the STM world, the DOI is the standard of choice as a persistent identifier; thus the Working Group recommends DOI as the identifier for general Supplemental Materials associated with articles. CrossRef is the registration agency most often used for assignment of DOIs to scholarly content and is recommended for registering DOIs for the Supplemental Materials. Publishers should be aware that datasets associated with an article may have been registered with DataCite, a registration agency focused on research data. If that is the case, the publisher should not re-register the dataset through CrossRef, but simply link to the DOI already assigned to the dataset. Publishers should encourage authors to include DataCite DOIs in their article if they have registered the dataset.

It is also worth noting that there are specific disciplines where other identifiers might be appropriate, for example, Protein Databank identifiers and GenBank<sup>®</sup> identifiers. If another persistent identifier has already been assigned to the Supplemental Materials, then the publisher need not feel compelled to assign a DOI. However, the alternate persistent identifier should exhibit the following characteristics:

1. **Identifier Syntax** – The syntax should have a significantly reduced character set to avoid problems where applications attempt to operate on the identifier (e.g., allowing < or > would raise havoc with XML systems). There must be a hierarchy to the structure that is consistent with the overall environment (e.g., universal registration requires some form of registration control). The identifier should be human-readable and manageable (e.g., of minimum length). While intelligent identifiers might encourage attempts at automated trolling, they help people derive some meaning about the identified object.
2. **Identifier System** – An identifier system is required. The system must support retrieval of metadata about the identified object, metadata about the identifier, and linking transport to the object. The DOI system, which satisfies these requirements, should be used as a baseline for the set of required features that include:
  - Link resolution (proxy based)
  - Object metadata
  - Multiple resolution
  - Parameter passing
  - Templates (or virtual) identifiers
  - Identifier metadata (ownership etc.)
  - Robust infrastructure (distributed, redundant)
3. **Identifier Organization** – An organization must exist that makes the identifier and the identifier system sustainable, both financially and technically. The organization must:

- define/enforce behaviors for the use of the identifier and the system, and
- provide technical and procedural support to the community.

### B.3.2 Assigning DOIs or other Persistent Identifiers

1. All Integral Supplemental Materials should be assigned a DOI or other persistent identifier, either as a group or as individual objects.

**Rationale:** Any content item that is critical to the understanding of the article but which is located and maintained separately from the article body should be uniquely identified to enhance linking reliability (e.g., hosting of the content item may diverge from that of the article).

2. All Supplemental Materials that are associated with more than one article should be assigned a DOI or other persistent identifier.

**Rationale:** Linking to the content item may need to occur from various publisher platforms.

3. Supplemental Materials that are an aggregate<sup>8</sup> of (potentially many) individual elements<sup>9</sup> or records should be assigned a DOI or other persistent identifier. It is not necessary to assign persistent identifiers to individual elements or records of an aggregate assembly when discoverability and navigation services are available for the aggregate level.

**Rationale:** The content has its own intrinsic value outside the context of the article and should be discoverable on its own.

4. Supplemental Materials that are uniquely defined by sufficient metadata—for example, description/title, author/contributor, publication/creation date, publication/collection title, and or recognized numbering (page numbers, standard numbers, etc.)—may be assigned a DOI or other persistent identifier.

**Rationale:** The content has its own intrinsic value outside the context of the article and should be discoverable on its own. Any effort expended in assigning descriptive metadata can best be exploited via an external identifier.

5. Logical wrappers around or physical containers with several individual Supplemental Materials<sup>10</sup> may be assigned a DOI or other persistent identifier.

**Rationale:** Enhances linking reliability.

NOTE: The Working Group recognizes that assigning persistent identifiers often incurs costs associated with their creation and registration. This may have an impact on the level of granularity to which persistent identifiers are assigned.

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<sup>8</sup> An example of an aggregate is a database made up of data records or a spreadsheet that has several worksheets. These are not considered to be logical “wrappers” or physical containers (see guideline #5 in this list); they are a collection simply because of their intrinsic organization.

<sup>9</sup> Assigning persistent identifiers to individual elements or records of an aggregate assembly is not necessary when discoverability and navigation services are available at the aggregate level. However, guideline #4 in this list may still apply.

<sup>10</sup> It is left to the publisher’s discretion to decide at what level of granularity the persistent identifiers should be assigned; while some may choose to stop at the level of the logical wrapper or physical container, others may decide to assign DOIs to the individual objects within.

### B.4 Preservation

#### B.4.1 Background

It is imperative to ensure that the Integral Supplemental Materials, and to a lesser degree the Additional Supplemental Materials, can be preserved as part of the scholarly record. At the same time, both authors and publishers often desire to communicate Supplemental Materials in the most meaningful way using the latest tools. Using the latest tools, however, can be somewhat risky, since it is difficult to predict whether such technologies or the associated formats will remain viable in the long term.

Both Integral and Additional Supplemental Materials should be subject to preservation considerations. However, since Integral Supplemental Materials are essential for understanding the article, they constitute the scholarly record and as such should be preserved at the same level as the article. For Additional Supplemental Materials, preservation recommendations are not as stringent.

It is important for the publisher to consider preservation of Supplemental Materials when accepting manuscripts as the choices made will affect:

- evaluation of the manuscript and its peer review,
- editing of the Supplemental Materials (if necessary), and
- access to the article.

As an example, there are image formats (AVHRR and GOES) for satellite imaging and for astronomical imaging (FITS). While it is likely that readers and reviewers of journals related to these disciplines can view these files as they are, it is unlikely that a general reader can. In a multi-disciplinary journal, including these files might cause the review process to take longer or be less complete, and may have an impact on preservation.

#### B.4.2 Preservation Recommendations

1. **Preservation strategy** – The publisher should state publicly their preservation strategy. Out of the two main approaches (migration vs. emulation), migration is recommended as the preferred preservation strategy. Migration involves converting objects, over the long-term, from one form to another that is usable under prevalent technology at the time of migration.
2. **Retention of files** – Ideally, all objects throughout the migration chain should be saved. Specifically:
  - For Integral Supplemental Materials, at least the original object plus the last two iterations of the converted objects, i.e., the latest and the latest-1 versions must be saved.
  - For Additional Supplemental Materials, publishers should save the original object and try their best to save the converted objects.
3. **Format** – Preservation techniques depend on format. Format is not equal to MIME type, which may not carry enough information for conversion and management of objects. Recognizing that certain types of data have well-established standard formats and that there may also be discipline-specific practices, no specific list of formats for the Supplemental Materials has been included in this recommendation. Instead, the following suggestions are made to help decide on and manage

a diversity of content and formats. If possible, publishers should accept Supplemental Materials in the formats defined in the formal format registries, such as UDFR or PRONOM. JHOVE could also prove useful in determining whether or not a given file actually conforms to the format specification it claims to be.

Alternatively, publishers may define and publish a list of formats they support. Publishers should use the following guidelines to choose acceptable formats for Supplemental Materials:

- Open formats are preferred over proprietary ones.
  - Widely used formats are preferred, although in some cases discipline-specific formats are appropriate.
  - Standard format of a content type is preferred.
  - When considering new format for a content type, it should have advantages over existing formats for preservation and/or rendering.
  - The format should be able to be rendered by free/ubiquitous applications.
  - The format should be able to be rendered by multiple operating systems/platforms.
  - The format should be likely to remain viable in the long run.
  - The format should be supported by open source software.
  - The format should be defined/reviewed by an international standard (formal or de facto) or a widely recognized body.
4. **Limitation of formats accepted by publishers** – While it is an acceptable practice to limit the formats of supported Supplemental Materials, authors may want to publish objects in formats outside of the publisher’s acceptable list. In that case, one of the following approaches should be taken:
- **Two-tier services** – The publisher supports a limited number of acceptable formats for Supplemental Materials. Other formats are still accepted but are not guaranteed to be carried forward. Each Supplemental Material object should have minimal metadata to inform users what kind of Supplemental Material it was originally, in case the format becomes obsolete.
  - **Conversion to archival format** – The publisher lists the formats it requires/prefers from a preservation point of view. Supplemental Materials whose format falls outside the list are converted to a supported format. Both the original and converted objects should be kept when this option is used.

## B.5 Packaging and Exchange

In an increasing number of environments, it is desirable that the article and all of its objects be easily transferred in a single package, for example, as part of interlibrary loan requests or as deposits to repositories of various types. The package should contain the article, all of its objects, all of its Supplemental Materials objects, and metadata to identify the article and the Supplemental Material. This



packaging recommendation is focused on the article level. However, it does not preclude aggregating multiple articles, each complete in its own right, into a single multi-article package. There are a number of different packaging specifications available and no recommendation is made regarding the use of any particular specifications or tools. Tools such as ZIP, tar, and Bagit<sup>11</sup> meet the requirements of collecting all the article objects. Bagit can also calculate file level checksums, which is important for preserving files and successfully transporting them.

The contents of a package are described with a manifest. The manifest is a list of all of the files present in the article package and should also include some basic information about the package, such as the tool and version used to create the package, as well as basic information about each file. The manifest should be machine-readable and encoded as UTF-8 text, which could be XML-encoded. Use of formats such as Microsoft<sup>®</sup> Word, Excel<sup>®</sup>, or PDF for the manifest file is not recommended since this will reduce the likelihood that the file will be easily preserved and read in the future. A manifest is the key to ensuring that all of the article objects are accounted for at each stage of the transmission process. The manifest should contain metadata related both to the article and to the Supplemental Materials. The metadata in the manifest could include the following:

- Journal title or identifier
- Article DOI
- DOIs, if they exist, for other article components
- DOIs, or other persistent identifiers, for the Supplemental Materials
- Supplemental Material types, i.e., Integral or Additional or both
- File names
- File sizes
- Description of each file
- Copyright information

### B.6 Location of Supplemental Material Metadata

The metadata for the Supplemental Material could be stored as a text or XML file and distributed with the article as part of an article package. Alternatively, it could be included as another Supplemental Material file for the article, and made available as any other Supplemental Material file. Publishers might also consider integrating a version of the Supplemental Materials metadata proposed in this Recommendation into the vocabularies they already use to tag the article, such as JATS or full-text article DTD.

Many users will encounter Supplemental Materials when navigating a journal website. Because of the way in which websites are organized, the Supplemental Material may provide a link back to the article and may include a description and file format on the webpage associated with the Supplemental Material. In these cases, the metadata may be included explicitly, although often untagged. When untagged, the metadata may be understood by humans navigating the site, but is less useful for discovery tools. In these

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<sup>11</sup> The Bagit specification can be found at <http://www.cdlib.org/services/uc3/docs/bagitspec.html>



cases, publishers should consider including <meta> elements within the HTML to tag the Supplemental Material metadata.

Another case where access to the Supplemental Material metadata would be useful is when a web search provides the user with a link to a specific Supplemental Material file, such as an Excel file. In order for the user, or an application, to find the metadata associated with that Supplemental Material file, the metadata could be included within the Supplemental Material file itself (for example, in the Properties fields of Word or Excel, or as XMP metadata in PDF files). Note that not all files allow metadata to be included in this way. Also, certain elements, such as the file size and value of the fixity element, would, if included in this way, change the values the elements are reporting and so should not be embedded in the file.

### B.7 Supporting Documentation

Supporting documentation for this Recommended Practice includes a *non-normative* DTD, a tag library, and tagged examples. These are non-normative, and are intended to be a starting point for publishers to develop DTDs and validation tools, such as Schematron, which are specific to their own environment. Supporting documents are available at [supplemental.niso.org](http://supplemental.niso.org).

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