

Innovating the scenario of scientific publishing in design: designing “living publications”

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ABSTRACT

This article presents an ongoing research project aiming at innovating the modalities and formats of scientific and academic publication of design research. The digital transformation and the open access paradigm have a considerable impact on the circulation of high-quality scientific production at global level: the challenge is to achieve innovative forms of authoritative, high-impact and effective scholarly communication, pursued with a multiscale and mixed media strategy, in order to guarantee an extended impact, while maintaining rigour and authority. In this context the scientific publication of design is taking on new forms and objectives too, so the design discipline can be a pivotal field for the experimentation and discussion of new scientific publication formats for scientific research. The article presents the preliminary findings of the project *PRODE. Scientific production in design* developed at the Design department of Politecnico di Milano: the case studies research and the proposal of *Living Publications*, that support the envisioning of future scenarios of scientific publishing and the development of an experimental prototype of *Living publications Format* in the design domain.

Keywords: Scientific Publishing, Living Publication Lifecycle, Content ecosystem.

1. THE CONTEXT OF CHANGE OF THE SCIENTIFIC PUBLICATION: OPEN QUESTIONS FOR OPEN SCIENCE

The scientific publication scenario today is going through a moment of profound change. With the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (2003) the open access paradigm has acquired great importance: according to the European Commission (2019), the future of scholarly publishing should offer researchers the possibility of participating in a distributed system of knowledge. New trends therefore emerged (Kim et al., 2018), questioning also the oligopoly of academic publishing (Larivière, Haustein, Mongeon, 2015).

At the same time, many changes are permeating the design field, and in particular the ones related to the digital transformation: the concept of *phygital* (the interaction between the physical and the digital world) is blurring the edges of design and its ambits of research, stratifying a diffuse geography of actions and processes of materialization, as well as of cultural production. In this respect, the accessibility and circulation of design research publications have a social, politic and economic impact, asking for a deep knowledge dissemination, fostering new discourses and representations on design (i. e. “viscourses”,

Bonsiepe, 2007, p.36). Nonetheless, even if design has changed, this affected its acknowledged scientific publishing processes and patterns (Gemser, De Bont, 2016) but not the format of publications.

From one side “academic journals are not known for the quality of their visual designs or the reading experiences they provide” (Barness, Papaalias, 2021, p. 540); from the other side, they show a gap in really taking the challenge of open science production often for conflicting normative and economic reasons, and the need of completely rethinking their editorial and publishing processes in respect to new formats of content, review and validation of a collectively growing and connected knowledge.

In Italy for instance, the normative system of evaluation of the quality of scientific production and publication of design research is becoming articulated and complex, due to procedures often conflicting at different institutional levels (university criteria; VQR- Research Quality Assessment; ASN-National Scientific Qualification System), in a framework of actors (ANVUR- National Agency for Evaluation of University and Research; SSD-Scientific Disciplinary Sectors boards) equally varied.

These conditions have a considerable impact on the possibility of innovating methods and formats of scientific publishing: one of the challenges is to enable new spaces for experimentation in order to achieve authoritative, high-impact and effective scholarly communication in the open science scenario, and in this regulatory constraints.

2. RESEARCH STRUCTURE, HYPOTHESES AND METHODOLOGY

In 2020 a project has been carried out within the Design Dept. of Politecnico di Milano, with the aim of discussing the contexts in which scientific design knowledge is produced and made accessible (particularly traditional academic and scientific journals, but also new typologies of articles for non-textual research products), and proposing a vision to meet the new needs and opportunities of the today scenario of design publications, through the concept design of a new publication format.

The research has been structured in four phases:

- The first phase addresses the contextualization and framing of the problem, related to the innovation of the scientific publication process, in respect to normative and economic issues.
- The second phase concerns the classification of existing innovative practice in scientific publication.
- The third phase is devoted to the envisioning, design, prototype and testing of a new publication hybrid format (digital and printable, that is *phygital*) in the field of design, eventually transferable to other disciplines.
- The fourth phase is focused on the assessment, validation and accreditation of the new publication format with publishers and the (national) regulation system for the evaluation of the quality of research.
- The fifth phase is dedicated to the dissemination and spreading across the scientific community.

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The project focuses on two key concepts related to scientific publication: the publication lifecycle and its stages and the article ecosystem of content; upon which three main research hypotheses are investigated:

- The lifecycle of a scientific publication is going to be more and more circular and iterative and should be approached designerly, enabling in an more open way the co-creation and co-contribution paradigms in the circulation, use of re-use of scientific contents. For doing this, the lifecycle stages need to be empowered by including new stages and innovative features and functionalities to support the shift from closed articles to multi-layered and growing publications.
- The size of a scientific publication is going to/can change during its lifecycle(s), due to different use, re-use and contribution on content, but various media and visual content too: this should allowing to add, mix and compose different modules and layers of contents, moving from a single discrete item to an ecosystem of mixed media and enhanced content, readable and navigable in linear and non linear/visual mode.
- *Traceability of authorship* and *assessment* of content needs to be pursued in order to maintain rigour, accreditation and impact, considering also the question of copyright transfer to publishers and of economic exploitation of scientific content.

Methodologically,

- Case studies research is used for exploring the key concepts and the hypothesis.
- Inductive reasoning is used for envisioning the new publication lifecycle (including new stages) and ecosystems of content.
- co-creation sessions with multi-role users (authors, editors, publishers) are used for concept generation and development of the features, functionalities, UX experience, and management dashboard of the new hybrid format of publication.
- mock-up, prototyping and testing are used for the production of a beta-model.

Terminologically, we adopt the comprehensive term scientific publication to encompass beyond the concept of scientific articles the various emerging typologies of published research outputs, such as non-only-textual research products, like data etc.

Since the first submission of this article, the project has advanced and various publications have and are going to be released concerning different aspects of the research and thus making cross-reference each other. In this article we present the first findings of the research, that are the theoretical background based on literature review and the collection of emerging innovative publishing practices; and the design of the new (“living”) publication lifecycle and scenario, that have been informed by the literature review and the case study analysis. For the co-creation sessions see Lupo, Radice, 2023; for the prototype, Radice 2022.

3. THEORETICAL BACKGROUND: LITERATURE REVIEW ¹

Publication is central to the making of science, but at the same time has become the measure by which researchers are evaluated for tenures, promotions, and grants (Fyfe, 2019). Most of the features we associate with the modern scientific journal – including originality of research, self-authorship, refereeing procedures, and standardized rhetoric and structure – were nineteenth-century developments, while big profits, the use of English as the international

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language of science, and the emergence of professional bodies for managing editors and publishers are largely twentieth-century phenomena (Moxham & Fyfe 2018). By 1790, at least a thousand scientific and technical journals had been established (Kronick 1976). Around a quarter of these were the transactions of learned academies and societies, but the majority were independent, set up by printers, booksellers, or editors with the hope of turning a profit from the learned and/or public culture of science. By the end of the eighteenth century, a handful of editors demonstrated that, with the right commercial skills and a good network of contacts, an independent journal could be successful (Fyfe 2000). The proliferation of scientific journals has reflected the emergence of new specialisms, the establishment of new societies, the growing number of researchers seeking to build careers, and the global expansion of the scientific enterprise in the late nineteenth and twentieth centuries.

In this context, for the past 10 years scientific publishing and journals have been under continuous discussion (Cope & Phillips, 2014; Bienfield, 2014), also regarding the university press (Pochoda, 2010) and the revision of editorial practices (Horbach & Halffman, 2020). At the same time, the scientific publishing landscape is changing (Chiriboga, 2019): scholarly discourse, which was once restricted to printed texts, is now being produced in a variety of formats, including short videos, information visualisations, and networked writing, including work that cannot exist in print (McPherson, 2010). Therefore many open access publishing platforms and infrastructures have been established and have gained scientific recognition and reliability (Open Research Europe, 2021).

The theme of new models and tools for scientific dissemination, in relation to digital transformation, besides being conspicuous on-line at a popular and technical-practical level, is widely debated in literature. Tenopir and King (2000) propose on the subject of e-journal “new, electronically mediated peer review models” while some scientific fields, such as medicine, reflecting on a scenario in which traditional metrics are flanked by the more recent ones of blogs and social media (Thoma, Murray, Huang, et al., 2018), ground the availability of sources and accessibility to dissemination channels on effective digital infrastructures. (e.g. Jama network).

Kim et al. (2018) have outlined a number of current trends in scientific publication which analyses new formats of journal articles (e.g. JAMA by American Medical Association and Nature Podcast by Springer Nature), ways of improving semantics in scientific publication, the use of research data and academic social networks (e.g. ResearchGate, Academia) and new distribution systems (e.g. PMC, F1000Research, Frontiers).

Even within the design domain, the reflection is monitoring trends in journal expansion, in the increase and acceleration of publishing, as well as improvements in the quality of publication (Cross, 2009; Atkinson, Valentine & Christer, 2021). Anyway, apart from more efficient editorial management systems, processes and patterns of scientific publishing in design have not been really affected (Gemser, De Bont, 2016) nor the journals format, or the concept of publications which remains attached to the idea of traditional articles. In addition, quality of perception, visual designs and reading experiences of design journals can be improved (Gemser et al. 2012; Barness, Papaalias, 2021).

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4. INNOVATIVE PUBLISHING PRACTICES

4.1. Methodology: a New Lifecycle for Scientific Publishing

The concept of publication lifecycle is already used in literature, especially in the publishing of traditional journal articles (Björk, 2005). Nonetheless, even recognizing that how content is reviewed, packaged, paid for, distributed, discovered, accessed, and preserved has changed over the last few years, the lifecycle is mainly intended as a linear chain of steps eventually broken down in activities (Björk, Hedlund, 2003).

Some scholars recognize it is no longer a linear process, developing new narratives about academic publications (Tulley, 2019) and designing circular lifecycles, including pre-writing stages of research with data collection and analysis and post-publication stages, like dissemination and reuse.

In order to give evidence to the new lifecycle, cases of innovative practices in scientific publishing have been selected. Cases don't belong only to the design domain, in order to promote cross fertilisation. They have been categorized according to the following parameters (Lupo, Gobbo, Lonardo, 2021):

- Lifecycle stage/s in which is mostly innovative;
- Size, that refers to the dimension of the product (see below).
- Type of actors, such as institutional main players (like publishers) or others (associations, bottom-up initiatives).

Concerning the size, or *dimension of the content of the publication*, we defined these three categories:

- A *single item* is a single, stand-alone unit with well-defined borders even if composed by a different type of media: for instance: a book, a website, an application.
- An *ecosystem* is an independent system of contents, with well-defined borders and structured by single and discrete units.
- A *platform* which is intended as a service of access, research, consultation and or production of contents.

For each case the following data have been provided: title of the project; year of publication; brief description; disciplinary field (non only design, but STEM, social sciences etc); type of accreditation; type of media supported; format; contact person.

From an initial list of around 400 cases, about 50 cases, have been chosen as more relevant to our research, taking in consideration their level and stage of innovation, trying to cover each publication stage with a balanced number of examples.

The cases have helped to envision a cyclical model, which includes all the stages present and inserts new ones. This new lifecycle has been defined as the *Living Publication Lifecycle* [fig. 01].

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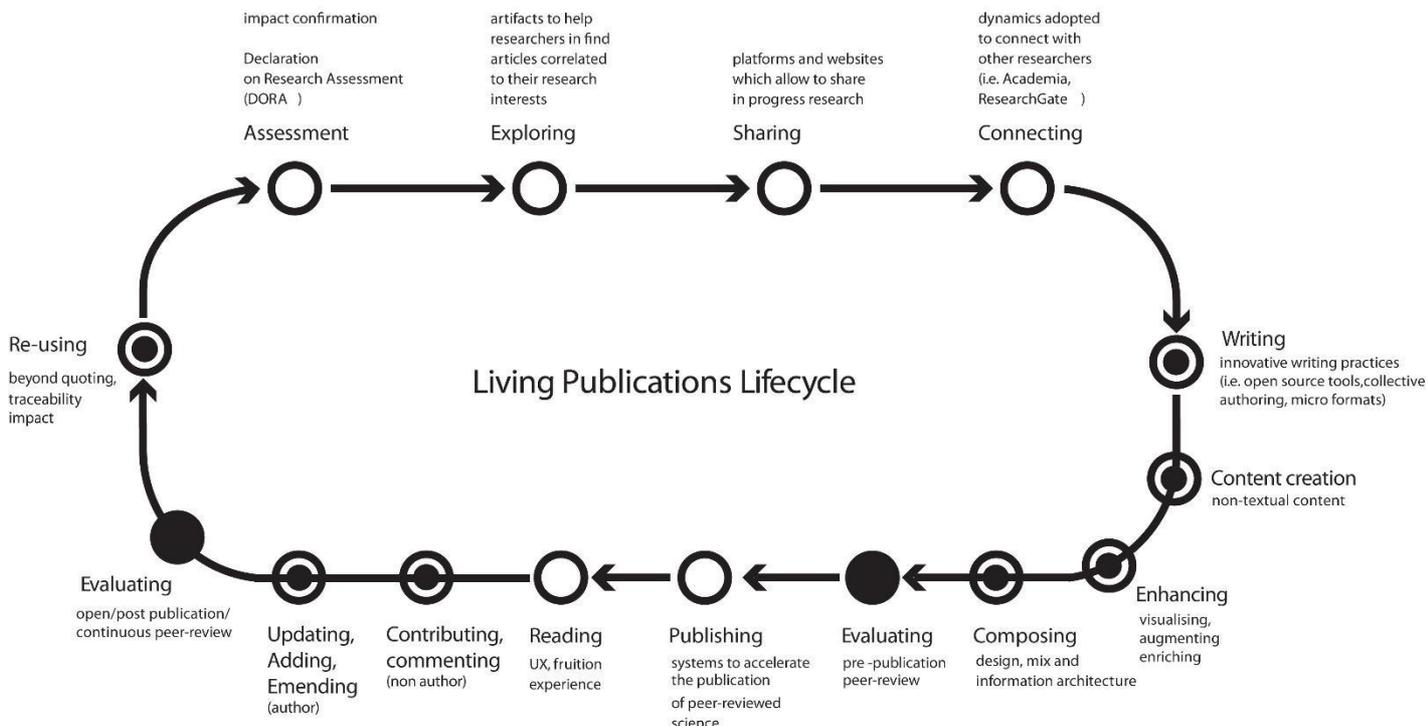


Figure 1. Living Publication Lifecycle (Lupo, 2022).

This *Living publication lifecycle*:

- Better specifies the pre-writing research in three stages: exploring, sharing, connecting;
- Unpacks the production of a scientific publication in various stages, not necessarily all present: writing, (non textual) content creation, composing, enhancing;
- Makes the lifecycle recursive considering that some publishers make regularly possible for the authors to update their articles (adding data, emending content) or to add comments and contributes by not authors;
- Reconsiders the position of evaluating as a multi position stage, according to open and post publication peer reviews;
- Includes the assessment phase that is the (mean of) scientific accreditation of the publication in the national regulation system for the quality of research and academic career (Johnson, 2012).

The table 1 lists the new lifecycle stages with the description of each stage.

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Table 1: The Living Publication Lifecycle stages

Lifecycle Stage	Sub-stage	Description
Exploring		Artefacts able to help researchers in finding articles correlated to their research interests.
Sharing		Platforms and websites help users to share in-progress research.
Connecting		Dynamics adopted to connect with other researchers (e.g. <i>Academia</i> and <i>ResearchGate</i>).
Producing	Writing	Innovative practices of writing articles: new discrete – even micro – content for publishing, and collective authoring processes.
	Content Creation	Creation of non-only- textual content, such as visual essays, video articles.
	Enhancing	Augmenting and enriching a publication, by embedding interactive media, visualisations, links, datasets.
	Composing	Articulating and structuring the final scientific publication, by creating an ecosystem of mixed media content.
Evaluating#1		Traditional pre-publication peer review.
Publishing		Accelerating the publication of peer-reviewed science.
Reading		Systems and tools that allow improving the reading experience.
Contributing		Publication systems and tools that allow authors and readers to annotate and share comments or substantial contributions like linking sources, datasets, up to becoming co-authors of content.
Updating		Processes and tools to modify an article post-publication, revising or amending data and content.
Evaluating#2		Innovative forms like open peer reviews and post-publication peer review, potentially needed after any substantial modification and new contribution to the article.
Assessment		Accreditation of the publication of scholarly research in the National regulation system for the quality of research.
Reusing	Citing	Tools and platforms aimed at tracking scientific contributions and ensuring that research is reproducible and produce a real impact.
	Embedding	
	Tracking	
	Impacting	

4.2. Discussion

In the following paragraphs we exemplify and discuss, dividing them among the main publishers and other players, a selection of cases by positioning them in the most interesting stages of the new living lifecycle. All cases are not automatically equated: some show new and interesting approaches in the editorial process (from writing, to publishing to review), some are services platforms, others are just app or browser extensions. Therefore this categorisation according to the lifecycle stages, doesn't correspond to a taxonomy about case's qualities.

In specific, here the cases are not described in detail and are presented just as examples to show the richness, circularity and connection of the different publishing stages in the current contemporary landscape of scientific publishing. The full description can be seen in the project website: www.prode.polimi.it.

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Institutional publisher and main players

It is evident that the major publishers are accompanying the process of change of scientific publishing (see table 2).

For instance, in the publishing stage, in term of size both Springer (*SpringerBrief*, 2010), Princeton University Press (*Princeton Shorts*, 2011) and Palgrave Macmillan (*Palgrave Pivot*, 2012) created new formats of short research publications, to accelerate the publication of peer reviewed research results in concise form.

To innovate the writing stage too, Elsevier created the *Microarticles*, that “allow researchers to publish interesting data that have not grown into a full piece of research, to share research result to a previously published paper” or the *Visual Case discussion*, “image-based case discussions including a question and answer set” specific for medicine.

A new content creation and publishing format is the *Visual Essay*. This is very used in sociological research (Pauwels, 2012) but it is promoted by MIT Press in the design field too (*Design Issues* journal). Visual essays use written words and quotes, but the visual element should form an integral part of the ideas expressed, rather than serve only as example, illustration or additional documentation (Sage visual essay guidelines).

A pioneer example that can be considered relevant, among the others, for the composing stage, but unfortunately realized only as a prototype, is the Elsevier project *The article of the future*. This initiative was conducted from 2010 and 2013 with the aim of transforming the traditional format of the academic paper with a user centred design approach in regard to three key elements: presentation, content and context. The main principles of the redesign were readability, discoverability and extensibility: the prototype was based on a pdf enriched by in-place content within the article, and additional supplementary content and features (like external databases) in the right side bar (Aalbersberg et al. 2012).

Simpler ways to content enhancing are provided by most publishers: both Elsevier and Taylor and Francis encourage enriching the articles with supplementary materials that are often data, visualisation or audio podcasts but even graphical abstract or video abstract.

Concerning the updating stage, Elsevier publication policies consider the possibility of amending and correcting articles, when more data becomes available, clearly visible with a “check for updates icon” of CrossMark identification service at the top right of the article, since 2013. But only recently (2021) Elsevier launched a pilot program *Appending corrections* to the original PDF when articles are downloaded, moving towards the possibility of updating the content through the concept of *Evolving Articles*, for instance in the medicine and epidemiology field.

Springer too uses *CrossMark* since 2014, the identification service from CrossRef ensures that the user always gets the latest updates and most current content.

She-Ji Journal encourages written response to articles through *Letters* that are sent to the original author for response and eventually published. Even if they are not appended to the original article, but simply refer to it, this can be considered an interesting case for promoting the stage of contributing.

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Table 2: Lifecycle stages innovation cases by main publishers

Lifecycle Stage	Sub-stage	Examples from main publishers
Producing	Writing	Microarticles, Elsevier https://www.elsevier.com/authors/tools-and-resources/research-elements Visual case Discussion, Elsevier https://www.elsevier.com/authors/tools-and-resources/research-elements
	Content Creation	<i>Visual Essay Guidelines</i> , Sage https://journals.sagepub.com/author-instructions/vcj <i>Visual Essay</i> , MIT Press
	Enhancing	<i>Supplemental Material</i> , Elsevier https://www.elsevier.com/authors/tools-and-resources/data-visualization <i>Audio Podcasts</i> , Elsevier https://www.elsevier.com/editors-update/story/publishing-innovation/content-innovation <i>Graphical abstract</i> , Elsevier https://www.elsevier.com/authors/tools-and-resources/visual-abstract <i>Supplemental Material</i> , Taylor and Francis https://authorservices.taylorandfrancis.com/enhancing-your-article-with-supplemental-material/ <i>Video Abstract</i> , Taylor and Francis https://authorservices.taylorandfrancis.com/research-impact/creating-a-video-abstract-for-your-research/ <i>The article of the future</i> , Elsevier https://www.elsevier.com/connect/designing-the-article-of-the-future
	Composing	<i>The article of the future</i> , Elsevier https://www.elsevier.com/connect/designing-the-article-of-the-future
Publishing	Short formats: <i>SpringerBrief</i> , 2010; https://www.springer.com/gp/authors-editors/book-authors-editors/springerbriefs <i>Princeton Shorts</i> , 2011 https://press.princeton.edu/series/princeton-shorts <i>Palgrave Pivot</i> , 2012	
Reading	<i>The article of the future</i> , Elsevier https://www.elsevier.com/connect/designing-the-article-of-the-future	
Contributing	<i>Letters/Authors's Response</i> , She-Ji: The Journal of Design, Economics, and Innovation, Elsevier https://www.elsevier.com/journals/she-ji-the-journal-of-design-economics-and-innovation/2405-8726/guide-for-authors	
Updating	<i>Checks for updates</i> , Elsevier/CrossMark https://www.elsevier.com/connect/authors-update/crossmark-logo <i>Appending Correction</i> , Elsevier https://www.elsevier.com/connect/journal-pilot-append-corrections-when-articles-are-downloaded <i>Evolving articles</i> , Elsevier https://www.elsevier.com/authors/tools-and-resources/research-elements <i>Checks for updates</i> , Springer/CrossMark	

Other actors and initiatives

In parallel to the cases from leading publishers, other relevant initiatives and innovative practices are promoted by other actors (see table 3).

In the stage of exploring, *Open Knowledge map* aims at improving discovery with a visual search engine and interface: searching for a topic, maps are created to provide an instant overview by showing the main areas and papers related.

In the stage of sharing, *eLife* produces podcast series to present easy-to-understand science to the general public.

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In the stage of writing, the production of synthetic content, is encouraged in some fields: *Micropublications* for instance offer in the biology field the opportunity to rapidly publish discrete – even “micro” – research results, by publishing single, validated and/or reproduced results. And it is in the 2021 the birth of *Academia Letters*, “a new, experimental online journal that publishes ultra-short research papers (800-1,600 words), such as brief reports, case studies, or “orphaned” findings and ideas dropped from previously-published work” (“Academia Letters”, accessed February 21, 2022 <https://www.academia.edu/letters/about>). The concept of *dynamic publications* is rapidly growing too: this publication model, moving from static articles to articles that can change by time, better mirrors the lively nature of the knowledge creation process. *Dynamic publication formats* can be changed quickly and easily allowing (and letting visible) changes, making possible corrections and additions, and tracking the specific contribution of individual authors in multi-authored articles (Heller, The, Bartling, 2014). But this vision should expand from the already-in-use tracking change modalities and previous versions check, towards a more visual and interactive composition of multi-layered or -authored content.

New ways of writing are inspired also by collaborative processes and systems of *collective authoring*. A pioneer example in the field of communication design was the 2005 web platform *Limited Language* (not any more online) that discussed hybrid media formats by a process of multi-authors feedbacks/responses on specific topic articles, resulting in collective texts (Davies, Parrinder, 2009).

In the stage of composing, ecosystems of content are created (e.g. mixed media articles). Many publishing platforms and journals are implementing features to pursue such publications. For instance, *Authorea* is an online collaborative writing tool whose templates allow writing documents and attaching interactive references, figures, data, and source code. The Stanford University Press launched in 2016 the initiative *Stanford Digital Projects* for the publication and consistent peer review standards for digital projects, conferring to them the same level of academic credibility as print books receive. Among the journals, *Parametric Press*, is a born-digital magazine (2018) dedicated to publish dynamic and interactive articles where the audio, visual, and interactive capabilities of dynamic media are effectively combined. In the field of machine learning, a pioneer example is *Distill*, a digital journal dedicated to clear explanations of machine learning which require explorable explanations and interactive contents, thus giving legitimacy for non-traditional research artifacts as academic contributions. In the art field, the *Journal of Artistic Research* aims to develop for artistic researchers academic publication procedures similar to the standards for the sciences and humanities, through a digital platform where multiple methods, media and articulations may function together. Specific to the field of design, *Visual Journalism* is an approach developed at the Free University of Bolzano, experimenting with innovative information and visualisation methods: this resulted in an publishing platform of research and teaching, but is not an official journal.

In the stage of publishing many initiatives focus on accelerating the process of publication of high quality content. The *Public Knowledge Project* is a multi-university initiative developing (free) open source software: they developed the Open Journal System, the world’s most widely used journal management and publishing system. *Open Research Europe* is the new publishing platform launched by the European Community to support open access, fast publication and open peer review for research stemming from Horizon 2020, without charging APC to authors. Journals too, provide new publishing types and formats for non textual content: for instance,

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JoVe Journal of Visualized Experiments is a peer-reviewed scientific journal that publishes experimental methods in video format. *Audiovisual Thinking* was a pioneer online Video Journal about Audiovisuality, Communication & Media published by University of Copenhagen.

In the stage of contributing, publications can evolve also for the possibility to add comments and contributions from other authors: the *Open Research Europe* platform encourages a constructive debate on articles published allowing posting comments. An inspirational case of annotating and sharing comments on web pages (and formal publications too) is the concept of *Open Annotation* developed by *Hypothesis* through an open source software used as an extension of the web browser that create a layer of threaded conversation across documents; it can be private or public. In this stage anyway much effort should be devoted to move towards collective authoring tools that reward contribution allowing attribution and authorship (Sivagnanam et al., 2019).

The stage of updating is taken for granted by the main actors: in the *Open Research Europe* platform articles can be updated and amended any time post publication. *CrossMark* update system is an identification service from CrossRef, a not-for-profit association of scholarly publishers that facilitates reference linking and other sustainable cross-publisher services for the scholarly community. The *CrossMark* identification service gives scholars the information that they are using the most recent and reliable versions of a document.

The stage of evaluating has been completely re-shaped too, moving towards a scenario of a process of continuous review. Traditional peer review, according to the Open Research Glossary, is “a process by which a research article is vetted by experts in community before publication” (“Peer Review”, in Open Research Glossary, accessed February 21, 2022 <http://www.righttoresearch.org/resources/OpenResearchGlossary/index.shtml>). Many publisher platforms are publicly recognizing and rewarding the reviewers’ work, e.g. *Orvium*. Others, like *Publons*, show scholars’ impact according to their review and editorial activity for academic journals, to get recognition for their often hidden peer review contributions. *Publons* also provides tools for publishers to find, screen, contact, and motivate peer reviewers and peer review training for early-career researchers. *ReimagineReview* is a registry of platforms and experiments that aim to increase the speed, quality, transparency, incentives, or fairness of peer review, employing different modalities of evaluation (free-form commenting, badges, or quantitative scores) and new patterns of communication (interaction between authors and reviewers, public commenting, or review of code or small parts of a manuscript). Among the cases is worth noticing how, beside new means of rating, the process of review is opening up or becoming more collaborative and transparent (enabling public interaction or author responses): according to Ross-Hellauer (2007) *open peer review* is in line with the aims of Open Science, including making reviewer and author identities open, publishing review reports alongside the articles and enabling direct reciprocal discussion between author(s) and reviewers and greater participation in the peer review process by the wider community. The possibility of updating and amending articles is also distributing the peer review along the whole publication lifecycle: from post publication peer review (happening after a research articles has been published) to continuous review: e.g. the *rolling review* used in medicine in advance and independently from formal marketing authorisation application, to accelerate the process in case of positive evidence.

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The stage of reusing includes citation up to the reproducibility by remixing or embedding content, tracking at the same time authorship and impact: in this new vision, new needs are emerging too. For instance, standard citation approaches are insufficient when an article may have multiple versions following revisions or updating by authors: in the *Open Research Europe* platform articles need to be cited including the version number. *Scite* is an interesting example that goes beyond the mere citation: is a smart citation index which scans articles and categorizes, by machine learning, the intent of citation indicating whether the statement provides supporting or contrasting evidence for a referenced work (thus reusing existing knowledge to enlarge reflection) or simply mentions it (Nicholson et al., 2021).

The up-to coming future here is allowing the reuse of an article by remixing or embedding content, as the above mentioned *dynamic publication formats* (Heller, The, Bartling, 2014). This implies clearly distinguishing it from scientific plagiarism with tracking of the creation process and exact labelling of the authorship and accountability of contributions, similarly to what happens to *Open Educational Resources*. It should also count on the legal and technical reusability of content, but above all on the acceptance within the scientific community. In some extent, reusing content can lead to collective authored outputs too and this asks to better date back content and support attribution. “An important feature of dynamic publications is the availability of a history functionality so that older versions of the publication are still available and referencing the older versions can occur” (Heller, The, Bartling, 2014, p. 201). Different protocols enable correct attribution for digital goods: *Blockchain for Science* is involving cryptography, to promote transparency and traceability by tracking and storing all changes made to data (Bartling et contributors, 2017). The *Open Science Chain* utilizes distributed ledger technology to store information about scientific data including its provenance. A reuse example is *ReScience C*, a journal in computational research that encourages the explicit replication of already published research: “each new implementation is made available together with comments, explanations and tests, (...) to guarantee that any researcher can reuse it” (“Re Science C”, accessed February 21, 2022, <http://rescience.github.io/>).

The impact of reuses can be measured: beside the traditional citation-based metrics, there are qualitative metrics that measure awareness and interest beyond citation. One of the most used is *Altmetric*: it includes citations on Wikipedia and in public policy documents, discussions on research blogs, mainstream media coverage, and mentions on social networks such as Twitter. Similarly, *PlumX Metrics* measures the ways people interact with individual pieces of research outputs based on 5 categories: Citations, Usage, Captures, Mentions, Social Media. *Impactstory* is an open source web application in which achievements are measured by the discussion around a research work, level of engagement and openness.

Finally, the assessment stage, in this fluid scenario, becomes crucial to state the quality of research. Formal accreditation is provided, beside recognized scientific publishers, by identification means like DOI, ORCID iDs. The quality assessment is usually provided by journal-level metrics, like the *Journal Impact Factor Index*, a scientometric index by Web of Science that reflects the yearly mean number of citations of articles published in the last two years in a given journal (similar is *CiteScore* in Scopus launched by Elsevier), or author-level metrics, such as the *H-index*. But following the controversy about the use of impact factors (Curry, 2018; Waltman, Traag, 2021), new open and collaborative ways to recognise the value of scholarly content, regardless of where it is published, have been promoted. The *San Francisco Declaration on Research Assessment* developed a recommendation, that, emphasizing the varied nature of the outputs from scientific research, denounces the Impact

Factor as tool focused only on peer reviewed journal and suggests to mitigate its use by recognizing additional products, such as datasets, as important research outputs: they need to be assessed on merit, including qualitative indicators of research impact, like influence on policy and practice. A practical example is *Plaudit*, a browser extension that offers open endorsement and recommendations for the academic community, helping to identify reliable research, preprint or not: endorsements are publisher-independent and provided by known and trusted members of the academic community.

Table 3: Lifecycle stages innovation cases by other publishers

Lifecycle Stage	Sub-stage	Examples from other publishers
Exploring		Researcher App https://www.researcher-app.com/ Open Knowledge Map https://openknowledgemaps.org/index
Sharing		Podcast series, eLife https://elifesciences.org/podcast Thinkable https://thinkable.org/ Zenodo https://zenodo.org/
Connecting		Academia https://www.academia.edu/ ResearchGate https://www.researchgate.net/
Producing	Writing	Micropublication https://www.micropublication.org/ Academia Letters https://www.academia.edu/letters/about Dynamic publication Formats, Opening Science, http://book.openingscience.org.s3-website-eu-west-1.amazonaws.com/vision/dynamic_publication_formats.html Limited Language https://www.amazon.it/Limited-Language-Rewriting-Responding-Feedback/dp/3764389346 Overleaf https://www.overleaf.com/
	Content Creation	JoVe, https://www.jove.com/
	Composing	Authorea https://www.authorea.com Stanford Digital Project, Stanford Univ. Press https://www.sup.org/digital/ Parametric Press, https://parametric.press Distill https://distill.pub/journal/ Journal of Artistic Research, https://www.jar-online.net/en/journal-artistic-research Visual Journalism https://visualjournalism.unibz.it/
Publishing		<i>Open Journal System</i> , Public Knowledge Project https://pkp.sfu.ca/ <i>Frontiers</i> https://www.frontiersin.org <i>Plos</i> https://plos.org/ <i>Open Research Europe</i> https://open-research-europe.ec.europa.eu/
Contributing		<i>Dynamic publication Formats</i> , Opening Science, http://book.openingscience.org.s3-website-eu-west-1.amazonaws.com/vision/dynamic_publication_formats.html <i>Open Research Europe Comments</i> https://open-research-europe.ec.europa.eu/about <i>Open annotation</i> https://web.hypothes.is/
Updating		<i>Dynamic publication Formats</i> , Opening Science, http://book.openingscience.org.s3-website-eu-west-1.amazonaws.com/vision/dynamic_publication_formats.html
Evaluating#2		<i>ReimagineReview</i> , http://reimagineview.asapbio.org/explore/ <i>Publons</i> https://publons.com/home/ <i>Orvium</i> , http://orvium.io <i>Science Open Reviewed</i> , https://science-open-reviewed.com/webapp/ <i>PREreview</i> - Post, Read and Engage with preprint reviews (open source v2 in development) https://github.com/PREreview/PREreview-2
Assessing		<i>Plaudit</i> https://plaudit.pub/ <i>Declaration of Research Assessment</i> https://sfedora.org/
Reusing	Citing	<i>Open Research Europe Versions</i> <i>Scite</i> https://scite.ai/

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	OpenCitation, http://opencitations.net/
Embedding	Dynamic publication Formats, Opening Science, http://book.openingscience.org.s3-website-eu-west-1.amazonaws.com/vision/dynamic_publication_formats.html RescienceC http://rescience.github.io/
Tracking	Blockchain for Science https://www.blockchainforscience.com/ Open Science Chain https://www.opensciencechain.org/
Impacting	Plum https://plumanalytics.com/ Altmetrics https://www.altmetric.com/ Impactstory https://profiles.impactstory.org/

Critical consideration about cases are:

- the innovation of specific publication lifecycle stages is often intertwined with the specificity of a disciplinary domain: for example, new publishing discrete formats are typical of epidemiology that ask for accelerating the sharing and publication of research data and findings even if not consolidated; contributory writing processes are common in the field of machine learning; augmented publications are more experimented in the field of artistic research and data humanism;
- the change trends of a lifecycle stage are often interrelated with the ones of another stage: the possibility of writing and updating or contributing to dynamic publications or mixed media content, requires new modalities of review and citation too; collective authoring and reusing processes can benefit of a more interactive content composing;
- an innovative practice often covers more than one lifecycle stage, for instance innovating at the same time writing, composing publishing and reusing modalities;
- in some cases the approach is technical and is regardless of designing a user experience both for producers of content and readers;
- a few cases come from the design field, but there is evidence that similar features for research output publishing (e.g. content of generative and multidimensional nature) can be shared among design and social and technological sciences.
- there is still not a case that offers in a comprehensive way solutions for all the features of each single lifecycle stage, so there is space for designing it.

5. ENVISIONING A “LIVING PUBLICATION” SCENARIO FOR SCIENTIFIC PUBLISHING

We urgently claim and call for the necessity of envisioning and supporting innovative (augmented, enriched, interactive, contributive and collectively-authored) forms of publication, such as *Living Publications*, the enable the whole *Living Publication Lifecycle* and transform the lifecycle stages themselves in specific processes for innovating the publication. A *living publication* should be an ecosystem of content of evolving and dynamic nature that can be composed, structured and articulated by the author and browsed by a reader.

We imagine a new open publication model that allows to explore and read in an easy, user friendly, innovative and interactive way its content *and* enables flexible and dynamic writing processes, also by editing minimum discrete units of content (textual *and* non textual) *and* by collective authoring *and* permits to augment and enhance those content *and* to reuse them, respecting authorship in a new open copyright model. We imagine this publication model

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undergoes a continuous process of open peer review *and* its assessment is rigorous but open and collaborative and not only based on citation metrics but on qualitative indicators of impact too.

We aim such a hybrid format (digital and printable) will not substitute but should complement academic and scientific journals and publications on regular basis, to promote a cultural shift in scholarly and scientific publication toward open science, learning from but non completing adhering to (or overlying) bottom-up knowledge production communities like wikis: their processes, quality and reliability differ from traditional academic references works (Konieczny, 2021). We also assume that this format can build on or implement existing projects. For example, the *Open Research Europe* platform (cited in the case study section) already promotes a dynamic and evolving nature for open knowledge in its published articles, but doesn't yet support an ecosystem of augmented content, or a non linear/visual reading experience, nor content reuse.

5.1. Designing the Scenario

According to the living lifecycle, a *living scenario* for the scientific publications has been designed by the project team and its features and potentialities have been verified, assessed and tested by a participatory and collaborative approach, involving potential authors (and in specific) early stage researchers in design in various co-creation sessions.

In analogy with the dynamic and evolving concepts already used by some publishers, here living adds some extra meanings, covering in a holistic way the innovation of the whole lifecycle chain.

Within the scenario, four trends, complementary each other, have been identified [fig. 02]:

- augmented publications;
- collective authoring;
- evolving publications;
- publications reuse.

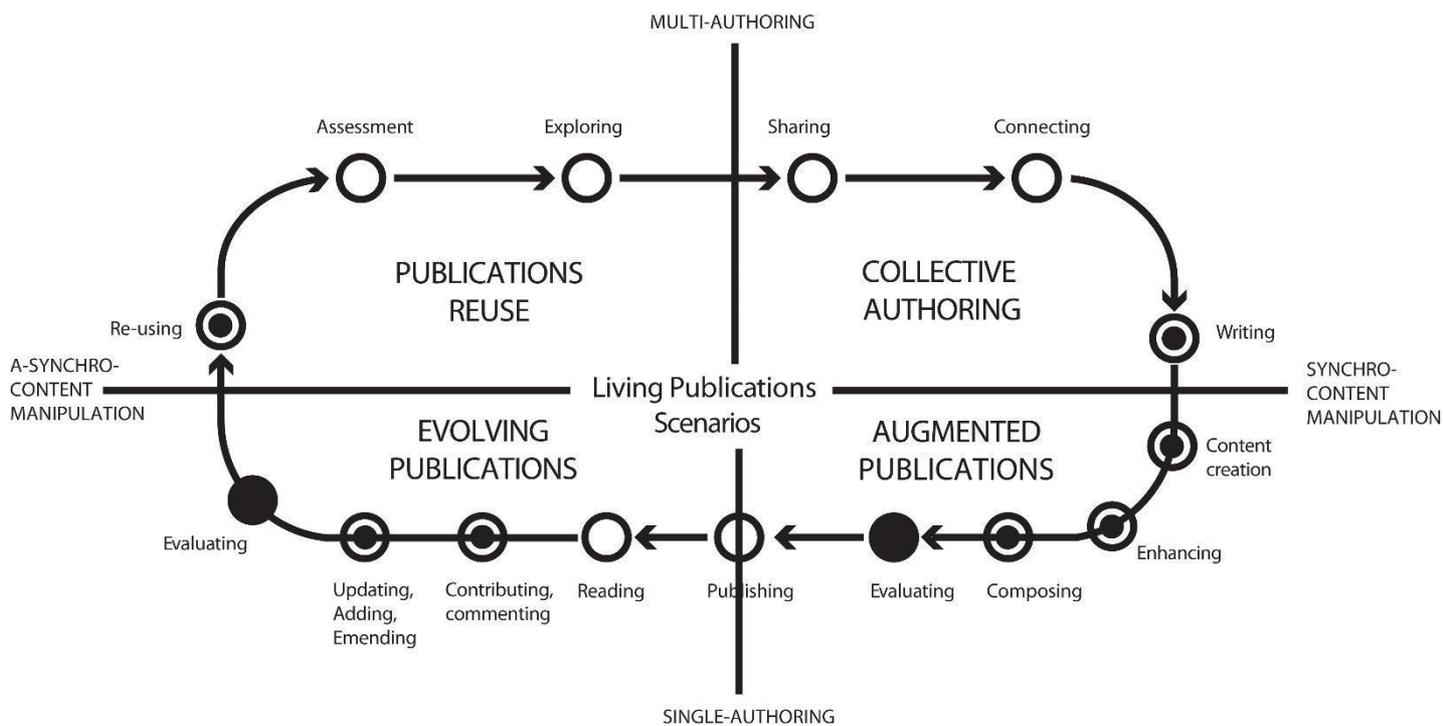


Figure 2. The four trends of the *Living Publication Scenario* (Lupo, 2022).

These trends have been chosen because they are dealing with publication lifecycle stages that imply an active role of the authors and direct impact on the content manipulation: they are the ones directly linked to author’s opportunities and responsibilities.

The assessment or validation stages, even if relevant, has not selected as the initial design goal because this would involve a deeper confrontation with the regulation systems of research quality assessment (especially at National scale for that countries in which recruitment and academic career are based on quantitative metrics of scientific production such us number and value of scientific articles published). So, a focus group with these actors is going to be organised on the released prototype, with the aim of agreeing possible common criteria and procedures to endorse such a format.

Similarly, for the evaluating processes, new reviewing procedures and rules need to be tested and established in a scenario of evolving and growing publication, in order to assure an efficient open and continuous (post-publication or multi-stage) peer review but functional to journal workflows. So in parallel with the development of the prototype, a discussion with selected main publishers is going engaged too, to support the adoption of the living article format and the possible adjustment of the reviewing procedures. The first result of this consultation is a series of interviews published in special issues of the design journal diid (Open Debate section, diid, n° 78, 2022). Publishers will be also hopefully involved in a debate on author/publisher copyright issues for the exploitation and reuse of content in the Open Access framework.

5.2. The Co-creation Sessions

In order to assess and develop the selected four trends of living publication scenario relative to author’s active role, co-creation sessions with authors have been organized: the methodology, process and result of the co-creation sessions are described in detail in (Lupo, Radice 2023). The co-creation sessions had the aim to validate the scenario and first hand

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explore with authors possible opportunities and specific features to be incorporated in the prototype of the new publishing format, in its dashboard and reading layout. Therefore, invited authors have been engaged in experimenting on a their own already published (or ready-to-publish) article for:

- co-creating tools and applications for enabling the stages of augmenting and updating the publication (first session).
- sharing their articles and working on others' publication, simulating the stages of contributing and reusing, in order to gather suggestions for increasing collective authoring process and impact creation (second session).

The sessions have been conducted on Nov., 22nd -23rd 2021 within the PhD program in Design of Politecnico di Milano. This choice has been done with the precise intention of educating and training authors such as early stage researchers in the design field about the emerging issues and trends of scientific production and publication, by using a design-driven and collaborative model of learning. From each session specific matters and critical suggestions emerged both at theoretical (authorship recognition and content time-tracking) and practical (tools, templates) level.

This experience has been successful and is becoming a regular part of the curricula of the Phd Program in Design of Politecnico di Milano, with a dedicated module within the course *Scientific Production*, and hopefully will be extended to other PhD programs and Phd candidates, through specific seminars.

The results have been further evaluated (Lupo, Radice 2023) and used for the next research phases, that are the conceptualisation of the prototype back- and front-end, its realization, testing and validation.

5.3. Prototyping the Publication Format

The design process of the publishing platform was carried out according to an approach of user-centred design and conducted in collaboration with the software development agency Inmagik (Radice, 2022). The design brief emerged from the discussion of cases of innovative practices and the co-creation sessions with real users. The formats and platform include novel features and functionalities to achieve the feasibility for living articles of being enhanced (with interactive and non-textual content), evolved (due to editing and updating) and reused (wholly or partly, over citation), in addition to the possibility of collective authoring a publication, while guaranteeing a rigorous review process and traceability of authorship in the various stages of the publication lifecycle.

The platform has been designed emphasizing two concepts:

- granularity, related to the indiscernibility of the discrete smallest knowledge pieces;
- connectedness, as knowledge enhanced by the context of the links and cross-references in the Web.

Both address the idea of scalability in scientific publishing, within the vision of content ecosystems, in an incremental and systemic perspective of knowledge production and reuse, that relies also on pruning as a strategy to reduce, in the scientific publishing landscape, the proliferation of repetition and especially self-repetition (Leavitt, Mitchell, Peterson, 2010).

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In particular the concept of Minimum Units of Content (MUC), defined as the organized, standing alone, discrete unit of content that can be reused for publication, and whose authorship is acknowledged and recognizable, has guided the development of the prototype (Radice, 2022). The final user scenarios of the platform can be seen in the project website (<https://prode.polimi.it/living-articles-publishing-platform-prototype/>).

This prototype is going to be discussed with main international publishers and institutional accreditation actors to verify technical, practical and legal feasibility regarding especially assessment, reviewing procedures and copyright issues

6. CONCLUSION: MAIN RESULTS AND FUTURE DEVELOPMENT

In this article we presented some of the findings of a research project on innovating scientific publication formats in the design domain. These are the definition of a living publications lifecycle and scenario for content ecosystems, by the discussion of relevant cases of innovative practices, and their validation through two co-creation sessions with potential authors.

A special issue in a design journal has been also published (Open Debate section, *diid* n°78, 2022), collecting and systematizing contributions from various actors and players active on the topic (and in specific some interviews with publishers and journal editors to explore and discuss the challenges and constraints of the Living Publications scenario) and in which also the platform prototype is fully presented by a dedicated article. The issue itself is an experiment of enhanced content (links accessible by Qr code; intra-textual content, accompanying the main text with secondary texts; and finally non-linear reading).

The online website (www.prode.polimi.it) provides the full consultation of the case studies, and the user scenarios of the platform prototype. All the updates and publications related to the project are reported in the news section.

The future development includes the discussion of the prototype with a main international publisher and institutional accreditation actors to verify its technical, practical and legal feasibility specially regarding assessment, reviewing procedures and copyright issues.

Promoting and disseminating it, through public seminars and events and by digital tools, we aim also at contributing to the debate on scientific publication formats at international level. In such a framework a thematic panel is going to be organised in an international design conference to call for the awareness and responsibility of the whole design community and, at national level, a network is going to be established in the scientific disciplinary sector of design, for encouraging changes and improvements in national design journals and supporting training and education in the topic.

ACKNOWLEDGMENTS

This work has been funded by the Grant FARB 2018 of Politecnico di Milano.

ENDNOTES

1. This paragraph partly re-organize content from previous publications, see: Lupo, Gobbo, Lonardo, 2021; Lupo, 2022.

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