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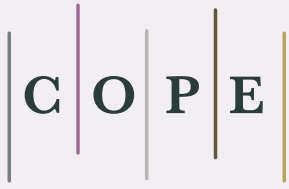


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Advancing
trusted research


Paper Mills

Research report from **COPE & STM**



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Executive summary

The subject of paper mills is currently being widely discussed by many stakeholders across the research publishing landscape. This report aims to give an overview of this topic, to explain how paper mills work, why they work and what we can collectively do about it.

We have also undertaken a study of data submitted from a variety of investigations by leading publishers to get a sense of the scale of the problem. This paper concludes that the submission of suspected fake research papers, also often associated with fake authorship, is growing and threatens to overwhelm the editorial processes of a significant number of journals. Interviews with a range of stakeholders including publishers, research investigators and Retraction Watch show a deep level of concern and a realisation that all stakeholders need to work together across the scholarly communication process to find long term solutions. This paper therefore is a call to action to those working in this area to work together to tackle the problem along the whole publication process.

Key recommendations from this research are:

Engagement with institutions and funders to change incentives for researchers so that they no longer feel it necessary to use services that will give quick but fake publication.

Continued investment in tools and systems to detect potential paper mill manuscripts at submission, with consistent and shared guidance in the use of these tools.

A major education exercise to ensure that editors and reviewers are aware of the problem of paper mills and are better equipped to help identify these papers if they encounter them.

Investigation of protocols that can be put in place to impede paper mills from succeeding in their goals.

A review of the investigative and retraction process to take account of the unique features of paper mill papers, and to speed up the process and make it more efficient for publishers when managing large-scale investigations of paper mills.

What is a paper mill?

“ the process by which manufactured manuscripts are submitted to a journal for a fee on behalf of researchers with the purpose of providing an easy publication for them, or to offer authorship for sale ”¹

There have been a number of seminars and articles covering the emergence of this phenomenon. An excellent review of the area can be found Putting a stop to the papermills² and COPE's 2021 Seminar had a session on How do we deal with the growing problem of paper mills?³ on the topic.

A paper mill is generally a commercial enterprise and clearly some of these are both sizeable and highly professional. The following screenshot comes from a commercial web site offering authorship for a fee. This is one of many that can be found on the web but this section is useful in describing how their services work.

As one of the largest providers in scientific publications, **Sci Services Publishers** offers its services to publish ready-made articles on a wide variety of topics. You can buy an author's position or an entire article. Initially, our finished articles are designed for a team of six authors. By purchasing an entire article, you can increase the number of contributors for that article. Co-authors can also make their suggestions and corrections to the text of the article.

This link [https://www.sciservicespublishers.com/](#) presents topics for articles on various aspects of education, economics, biology, political science, architecture, civil engineering, informatics, and engineering. Please note that positions in the article are ranked from highest to lowest. The publication is carried out on a turnkey basis: the articles have already been written, translated, proofread, formatted, and the journal has been selected for publication. The only thing you need is to choose a suitable topic for yourself, the desired position in the article, and pay. The price depends on the journal policy concerning publication fee: the higher it is, the higher the cost per position in the article, respectively.

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¹ <https://cope.onl/paper-mills> ↗

² <https://b.link/stop-papermills> ↗

³ <https://cope.onl/papermills-webinar> ↗

This company is based in Latvia and explains:

- 1** We are a European organization officially registered in the EU and successfully operating for many years within the framework of the legal field. Over the years, the company has never been a defendant in arbitration proceedings.
- 2** Our team has been publishing articles in scientific journals since 2012. We have published more than 12,650 articles. We are the market leader in implementing projects in co-authorship, proofreading, and publication of articles.
- 3** Clients are accompanied by a personal manager ready to advise them on all issues at each stage.
- 4** Only our company has an expert council consisting of doctors of science and international experts with many years of experience in education and science and high publication activities in highly rated international journals.

We guarantee:

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- 2** We guarantee a refund if the client refused to publish before submitting the article or if the service was not provided for other reasons.
- 3** Our company has a transparent pricing policy. The final prices of our services are indicated on our official website.
- 4** The article publication is guaranteed in compliance with the terms of the proposed options (timing, citation base, quartile).
- 5** We guarantee publication and indexing of articles in journals indexed by Scopus and Web of Science.
- 6** We guarantee provides quality and reputation-safe services to our customers. We ensure the confidentiality of your purchase of an article position. You do not need to worry that someone will determine that you bought a position in an article on our website, as we will perform a scientific rewrite of the article title and abstract during the publication process in the journal.

These companies can be found in a wide range of countries. One publisher has investigated all submissions to two journals that had been specifically targeted by paper mills and found both a high level of suspected fake submissions and also a very broad geographical base of corresponding authors. For the two journals analysed, there were 3440 submissions over a two year period and the analysis showed that as many as 1950 articles were suspected fake papers with corresponding authors from over 70 countries from around the world.

In some cases, paper mills may appear like authentic “author services” companies. Often their web sites start with offers to help with language editing or translation and then, as one investigates more deeply, they offer other services to ensure authors get published. It is somewhat ironic that publishers report that papers submitted via paper mills come with very professional looking submission letters and a lot of supporting data. “I always know I have a submission from a paper mill” said a Director of Publishing Ethics at a major publishing company, “when I ask the author a question, I get a lot of detailed information in response. Most authors don’t have the time for that amount of data”.

How do they work?

There are a number of models being used. In discussions with editorial departments across a wide range of publishing companies, the following process is the most commonly seen:

- A paper written by the paper mill staff is submitted to a number of different journals to see which one accepts it
 - Once a paper is accepted in principle or starts the revision process, the other papers are abandoned
 - The provisionally accepted paper is then listed on the paper mill site with an offer to buy one of up to six authorship places
 - Prices vary with the impact factor of the journal and the position in the list of authors with a lead author being the highest price
 - Authors are generally assigned an email address and all the correspondence is handled by the paper mill
 - In some cases the paper mill will recommend reviewers who will then provide a positive review
 - Once a journal publishes a paper, the successful paper mill will follow up with sometimes hundreds more submissions on similar topics
 - If a published paper is challenged, the “author” may sometimes back down and ask for the paper to be retracted because of data problems or they may try to provide additional supporting information including a supporting letter from their institution which is also a fake (see Retraction Watch⁴)
- Paper mills can also operate at bulk, and take over a special issue or a conference proceeding:
- A popular route to publication is through a special guest edited issue. Often journals will invite contributions to a special issue on a specific topic and this provides an opening for paper mills to submit often many publications to the same issue. One publisher found a special issue of one of their journals where the guest editor’s identity could not be verified and all of the papers had identified flaws that indicated they were fake. These have all subsequently been retracted. Another publisher undertook a review of thousands of papers it had published in special issues. Less than 5%, a small but nevertheless meaningful proportion, were identified for retraction.
 - There has been a recent example of conference proceedings also being impacted by suspected fake papers. A society recently found that the veracity of an entire conference proceedings could not be verified and therefore withdrew 300 papers.⁵

It can be hard to find a paper mill through simple searching but they can be readily found on some social networks. One publishing manager at a major scholarly publisher was alerted to the fact that an accepted paper in one of their journals was being advertised on Facebook. “When I checked back on that article when final revisions had come through, there were three new authors listed on the paper. We had no choice but to reject the paper at that point.” Retraction Watch has been listing paper mill sites when they find them, see for example: Introducing two sites that claim to sell authorships on scientific papers⁶ and revealed the inner workings of a paper mill,⁷ but that does not in any way limit their activities and both of these sites are still live and offering their services.

⁴ <https://b.link/china-hospital> ↗

⁵ <https://b.link/proceedings> ↗

⁶ <https://b.link/authorships-sale> ↗

⁷ <https://b.link/workings> ↗

What motivates authors to use them?

All academics must feel a certain pressure to publish at times but in some institutions, staff and students cannot move forward in their careers without publishing. Doctoral students in some countries are unable to graduate until they have published at least one paper in a journal, sometimes a journal with an impact factor is specified. Some students in this situation do not have the support they need to understand how to turn their research into a paper and may not even have sufficient data to produce a credible paper on their own. In some cases, the pressure to publish comes from an institution, often a hospital. A clinician in a hospital can be required to publish before they can apply for or be eligible for a promotion. For a clinician perhaps treating 30 or 40 patients a day, they may not have the time or resources to prepare a paper for publication. For both students and clinicians, it can be an easy task to find a service willing to sell them authorship on a paper and they can even choose the topic to map to their area of interest. And there are still some institutions and even funders who compensate authors for a published paper (see History below). Another incentive to buy authorship is to help a researcher boost their academic profile to increase their chances of getting a research grant.

In some regions there is little if any disincentive to use these services. The services themselves are operating legally and some authors feel this is a cost of progressing their career. An Asian publisher confirmed this: “The penalties for getting caught are not very severe except at the most prestigious hospitals”. One publisher’s representative of their ethics team said that she had had a student in tears on the phone asking her to delay retracting their paper until after they had graduated and then they had no problem with retraction.

The way that these services are viewed in different countries is clearly very different. Where such services are widely available and publicly promoted, buying an author position is not as unacceptable as it is in parts of the world where they have not been seen. Some editors and reviewers find it hard to believe a researcher would do such a thing and therefore they are not on the lookout for the signs of problems.

History

A recent article in *Science* highlighted this problem with a focus on International Publisher Ltd, based in Russia. See “Russian website peddles authorship linked to reputable journals”.⁸ The article highlights the work of Anna Abalkina who monitored 1000 advertisements on their website for papers and then tracked these to at least 419 published papers.

But this problem goes back many years. China’s Publication Bazaar,⁹ an editorial in *Science*, was published in 2013 and revealed an undercover operation by the *Science* team to expose the practice of selling authorship on papers submitted for publication. An article in the *Guardian* newspaper in February 2014, *How computer-generated fakes papers are flooding academia*¹⁰ exposed the practice of computer-generated papers appearing at scientific conferences. In the same year, Retraction Watch highlighted the problem in a piece titled: “Companies selling fake peer reviews help papers get published”.¹¹

⁸ <https://b.link/russian-site> ↗

¹⁰ <https://b.link/fake-papers> ↗

⁹ <https://doi.org/10.1126/science.342.6162.1035> ↗

¹¹ <https://b.link/help-publish> ↗

History (continued)

In 2017, an article appeared in *Tech Policy* “The Truth about China’s Cash-for-Publication Policy: The first study of payments to Chinese scientists for publishing in high-impact journals has serious implications for the future of research”.¹² This article reports on a study (Publish or impoverish: An investigation of the monetary reward system of science in China (1999-2016)¹³) to understand how much Chinese authors could be paid at that time for publishing an article in a prestigious scientific journal. These payments ranged from \$984 for *PLoS* to over \$40,000 for a paper published in *Science* or *Nature*. The payments are made to the lead author on a paper in a country where the average salary at that time was less than \$10,000.

More recently, there has been growing evidence that these “services” are becoming more widely available. An article “China’s ‘paper mills’ are grinding out fake scientific research at an alarming rate” draws attention to the fast growing number of papers from Asia and the possibility that a percentage of these are fake papers offered for sale.¹⁴

But paper mills are by no means confined to China. An article in Retraction Watch from September 2021¹⁵ highlights sites in Iran and Latvia that on close inspection offer more than help with editing and both have accepted papers offered for sale. The Russian site 123mi.ru offers two options: Buy a Publication and Buy a Place in the Article.

Where are we now?

The research for this paper included a wide range of interviews with publishers both large and small, commercial and not for profit. Everyone spoken to is very aware of the problems of papers being submitted from paper mills. Many publishers have set up teams of people whose job it is to protect the integrity of the scientific record by identifying fake or suspect papers when they are submitted or to take action as soon as they are alerted to a problem paper. Ideally, a suspect paper will be identified as it moves through the peer review process but this is not as straightforward as it might seem. Unless a peer reviewer has had experience of a fake paper in the past, they will not necessarily start reviewing a paper with the mindset “is this a genuine paper or has it been computer generated and based on fake data?”. Generally a paper submitted from a paper mill will adhere closely to the author guidelines, will be well presented in good English, will pass any plagiarism check and on the surface raise no red flags. One major commercial publisher shared their insights into how to identify a potential fake submission:

Common indicators for paper mill-contributions:

- Scientific topic: Frequently papers are in the field of cellular and molecular biology but this is changing all the time
- Experiments: Usually many Western blot experiments, cytometry assays, histology/cell staining
- Experimental data: Western blots are often “too clean” especially the background; cytometry assays are also “too clean”; molecular weight markers are usually not shown for Western blot experiments.
- Layout: The layout of these papers appears very similar (graphs, statistical error bars, fonts in figures, etc.).
- Affiliations: Authors affiliations often do not show a specific university. At times, the mentioned departments do not seem to match the topic of the paper.

¹² <https://b.link/cash-publication> ↗

¹⁴ <https://b.link/paper-mills-rate> ↗

¹³ <https://doi.org/10.48550/arXiv.1707.01162> ↗

¹⁵ <https://b.link/authorship-sale> ↗

- Authors: Papers are usually submitted by authors who have no publishing record with the specific journal, or elsewhere. Many non-institutional email-addresses are used. New ORCIDs seem to be created for each individual submission. This is a particularly challenging indicator as there are countries where institutional email addresses are rare and therefore that does not automatically mean the author is not genuine.
- Experimental design: Upon closer evaluation, flaws in experimental design are found. For instance, experimental data does not match the descriptions of experimental methods or reagents cannot be applied for the described purpose.
- Missing ethical approval for animal experiments.
- Substantial changes to the author list during revision or proof corrections.
- Image elements have been published elsewhere in a different paper (same or slightly manipulated Western blot image elements, whole cytometry assays, or microscopic cell images).

It is worth pointing out that it is usually a combination of indicators which indicate that it is a paper mill submission, rather than one by itself. One of the most challenging things to identify is when groups of authors from a single department or hospital group together to “buy” an article. This homogeneous group looks more plausible as a group who might have conducted the work and are therefore less likely to be noticed.

A number of academic “sleuths” have been working hard to uncover patterns in the published literature which indicate the presence of fake papers. Elisabeth Bik is a Dutch microbiologist and scientific integrity consultant. Elisabeth has focused her work on detecting photo manipulation in scientific publications. She has been able to identify 400 research papers published by authors in China from a paper mill. **Microbiome Digest – Bik’s Picks** (<https://b.link/microbiome-digest>)  is a useful blog edited by Bik that highlights papers that she is investigating. She was recently recognised for her work by *Nature*, winning the 2021 John Maddox Prize for “outstanding work exposing widespread threats to research integrity in scientific papers”. Here is an example of her contribution to PubPeer: (<https://b.link/pubpeer-comment>) 

Jennifer Byrne is a Professor of Molecular Oncology at University of Sydney, Australia who has published extensively on the problem of identifying fake papers.¹⁶⁻¹⁹ She has recently analysed 12,000 published papers in her field of human genetics and has identified 700 suspect fake papers.²⁰ Byrne does not believe that the research community is sufficiently aware of the potential for fake papers and this is potentially a threat to the integrity of published research. The suspect papers she has identified have been alerted to the publishers concerned. She believes the process that is needed to investigate and eventually retract these papers is cumbersome and takes far too long and needs an urgent review.

Another researcher in this space is Anna Abalkina and she recently published a paper on arXiv: Publication and collaboration anomalies in academic papers originating from a paper mill: evidence from a Russia-based paper mill.²¹ Her abstract states: “A total of 1009 offers published during 2019-2021 on the this http URL website were analysed. The study allowed us to identify at least 434 papers that are potentially linked to the paper mill including one preprint, a duplication paper and 15 republications of papers erroneously published in hijacked journals.”

¹⁶ <https://doi.org/10.1007/s11192-016-2209-6> 

¹⁷ <https://doi.org/10.1038/d41586-019-00439-9> 


¹⁸ <https://doi.org/10.1007/s11192-021-03871-9> 

¹⁹ <https://doi.org/10.1002/1873-3468.13747> 

²⁰ <https://doi.org/10.26508/lsa.202101203> 

²¹ <https://doi.org/10.48550/arXiv.2112.13322> 

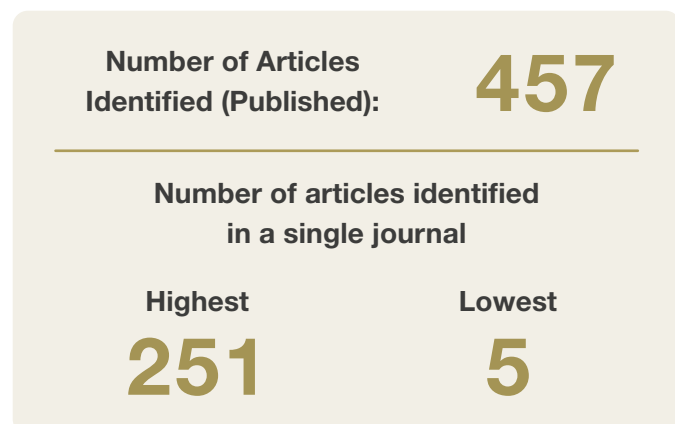
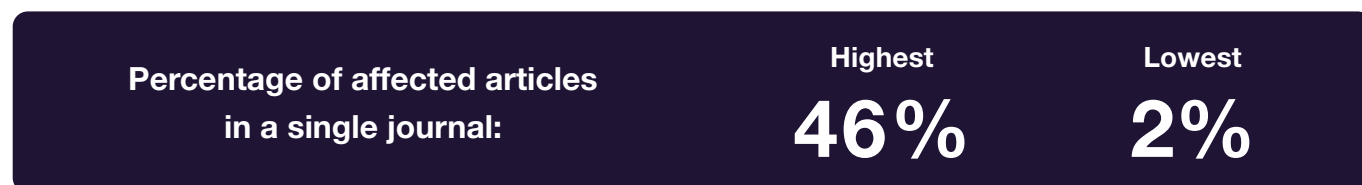
The scale of the problem

One of the major problems we have in combating these problem papers is understanding the scale of the problem. This report is based on a research exercise undertaken to collate enough data from across the publishing industry to make some quantitative estimates. The data submitted for analysis were necessarily summaries of what publishers are finding due to the need to comply with GDPR rules. Retraction of published papers is well reported by **Retraction Watch** (<https://b.link/retraction-watch>)  edited by Ivan Oransky and Adam Marcus. This analysis therefore is focused on papers submitted for publication.

Data on over 53,000 papers were analysed. This was shared by six publishers and spans a wide range of subject areas; overall the percentage of suspect papers being submitted to journals ranges from 2-46%. The analysis shows that most journals will see 2% suspected fake papers submitted and then for journals where paper mills have been successful in getting papers accepted, they see a sharp increase in suspect submissions.

Following an audit of their journals, one publisher identified that almost a quarter of its journals were at substantial risk from paper mills, i.e. routinely targeted and with fake reviewers identified in the journal peer review system.

Here is the summary submitted by another publisher:



Another publisher was aware they had been targeted by a paper mill known to publish papers in a specific area. They identified 19 journals for article by article analysis. 304 papers were retracted as a result.

Research for this paper included interviews with a number of people in the larger publishing companies who lead Research Integrity departments. The same pattern was seen across the publishers who took part in the research. All journals regardless of discipline see up to 2% of papers submitted that are identified as potential fake papers. Once a journal is targeted by a paper mill or in some instances more than one, the journal can see a very large number of suspect submissions. In these cases, the publishers need to provide the Editor with additional support from a dedicated team. The staff in Research Integrity teams are trained to identify problem papers and to reach out to author's institutions to investigate whether a paper is genuine or not. There are two areas of activity:

Pre-publication submission review: tools and processes are increasingly being used to identify suspect papers early in the submission process. Awareness training is being provided to editorial teams and their peer reviewers. Suspect papers identified by editors are referred to the research integrity team for further analysis. This helps to build a picture of what to look for that can be added to the training. A number of publishers have suggested that the details of suspect authors could be shared in some way but under GDPR rules this is not currently possible. Joint COPE/UKRI workshops have been looking at the challenges of information sharing. Further information can be found at (<https://cope.onl/fact-finding>) ↗


In December 2021, the STM Association set up a major initiative to combat the problem of paper mills. STM Solutions, the operational arm of STM, has started the development of a powerful new platform to detect integrity issues in manuscripts submitted for publication to scholarly journals. The goal is to provide a cloud-based environment for publishers to check submitted articles for research integrity issues. In this environment publishers can collaborate with other parties to develop and operate screening tools for the benefit of the entire scholarly ecosystem. For further information please see **STM Integrity Hub** (<https://b.link/integrity-hub>) ↗

Publication review and retraction: there are a number of ways that a journal can identify a suspect paper already published. Most common is an alert from a reader who notices something not right in the paper. An alert might come from one of the internet "sleuths". And comments might raise concern on sites such as PubPeer (<https://b.link/pubpeer>) ↗ and editors regularly look for comments on papers in their journals. Occasionally authors themselves will contact a journal with a request to retract their paper. There is a standard recommended process for retracting a paper published by COPE, see **Retraction guidelines** (<https://doi.org/10.24318/cope.2019.1.4>) ↗ This process requires a level of investigation and ideally outreach to both the authors and their institutions. This can take some time and in the case of a paper mill paper can result in a large quantity of additional data that then has to be reviewed. The result is a process that takes some time and there is a recommendation that these guidelines be reviewed when a paper mill paper is suspected. One publisher noted that "Requests from authors to retract papers is definitely increasing and if for example this is a PhD student they may have graduated and there is no disincentive to taking a paper down".

Areas of concern and recommended actions

A major concern voiced by everyone interviewed in connection with this report is the likely impact of fake papers currently in the published record. There are grounds to suspect that there could be hundreds if not thousands of suspect papers to be found in the scholarly record.

In all disciplines, the presence of possible fake papers is damaging to the trust that researchers can have in what they read, but in clinical medicine these fake papers can be used to build more research and waste money and potentially risk the health of patients. One researcher interviewed said “I teach all my students that they cannot believe anything they read in the literature and they should check the veracity of anything they decide to use in their research.”

Another challenge faced by the research community as a whole is the number of places that papers are now hosted. If a publisher goes through the process of retracting a paper, a version of this paper might still be found hosted on a preprint server, a social network such as ResearchGate or a repository such as PubMedCentral. For example a paper clearly retracted on the original publisher site and on PubMedCentral can be found on ResearchGate (<https://b.link/researchgate>) . On this site, there is no notice of the article's retraction and it has 22 citations.

There is wide consensus across everyone interviewed for this paper that this is not a problem that can be solved by one publisher alone or even by the publishers working together. Submissions from paper mills impact all stakeholders in the scholarly communication process.

Researchers and funders: Researchers are the users of the scholarly literature and they need to know that a paper they are reading in a peer reviewed journal is authentic and based on real data. They use these papers to prepare their next research project and in the field of medicine, systematic reviews analyse all published papers on a specific topic to make recommendations for the best clinical treatment. For these reasons both researchers and their funders need to know that the work that they are using can be relied upon. Researchers we interviewed for this paper do not believe that Editors are sufficiently aware of this problem. What can researchers and funders do to help create incentives to publish valid papers rather than use services that will give quick but fake publication? Are there protocols that can be put in place to impede paper mills from succeeding in their goals? Researchers can also be authors, and as such have responsibilities. They make declarations at submission, and sign warranties about the integrity of the work. If they purchase authorship on a paper or have bought the paper from a third party, those warranties are void but the authors still carry the responsibility.

Academic institutions and hospitals: Some of the incentives driving researchers into the arms of the paper mills come directly from institutions including universities and hospitals. Can we engage with these institutions to help create better incentives and perhaps to penalise the use of these services? In addition, institutions and hospitals should ensure that their staff who are submitting papers understand the responsibilities of authorship.

Editors, editorial teams and reviewers: The essence of the peer review process relies on the fact that editors and peer reviewers can expect that a submission is being made in good faith from a researcher who has undertaken the work to produce the data presented. When that is not the case the extra work that the editorial team needs to undertake could overwhelm the process. Explicit training and education is needed to help reviewers to identify these papers as they are submitted. We can see in the data that paper mills move away from submitting to journals that systematically reject their papers.

Publishers: there are now more and more teams being set up in major publishing companies to help monitor and investigate suspected papers. These research integrity teams are starting to retract cohorts of published articles that have been analysed and found to be suspected as fake. These are generally highlighted on Retraction Watch and the editorial team there are keen to encourage publishers to retract suspect papers as quickly as possible. The biggest challenge here is for smaller publishers and societies who may not have the ability to set up specialist units to monitor for and detect suspect papers. One of the major recommendations from the interviews was the need for a review of the retraction process to take account of the unique features of these papers. Is there more that we can do to put in place more tools and systems to pick up suspect papers as they are submitted? Can we do more to streamline the retraction process so that suspect papers can be removed pending investigation rather than going through the process first?

Everyone interviewed for this paper was united in believing that paper mills present a real threat to the integrity of the scholarly record. And there is no doubt that collective effort is going to be needed as publishers are very clear that they cannot solve this problem alone. One publisher interviewed said: “There has to be a multi-stakeholder effort to tackle the problem as it is affecting the integrity of the literature”. The challenge is how are we going to create the momentum and urgency to work together to find solutions.

Conclusions

The paper mill industry is thriving. There is a large market of researchers who are ready to purchase authorship of a paper in order to gain promotion or to graduate. An increasing number of these fake papers from paper mills are being submitted to journals, with some journals being more heavily targeted than others. The editorial process is based on trust, with the expectation that papers are submitted in good faith and without the expectation of misconduct. Publishers and editors are making great efforts to detect these fake papers on submission, or during the review process, using technology where possible, but mainly through the use of internal editorial staff. Despite this, some papers will make it through into the published literature. When discovered, these are investigated and retracted. This again is a resource-heavy endeavour. The problem of paper mills needs to be addressed, and this cannot be done by Publishers alone. It needs to be a joint endeavour by funders, research institutions, and publishers together. This is an urgent task.

Some recommended actions include:

- A major education exercise to ensure that Editors are aware of the problem of paper mills and to train Editors and editorial staff to identify these papers as they are submitted.
- An engagement with institutions and funders to change incentives for researchers so that they no longer feel it necessary to use services that will give quick but fake publication
- Investigation of protocols that can be put in place to impede paper mills from succeeding in their goals
- Review the retraction process to take account of the unique features of papermill papers.
- Review options for the retraction process to propagate across preprint servers and article repositories to ensure the retraction notice is added to all available copies of a paper.
- Continued investment in tools and systems to pick up suspect papers as they are submitted.

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