Obstacles Encountered in the Implementation of Open Science Principles for the Publication of Study Findings Arising from Industrial Research Endeavors

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Introduction

Within the dynamic landscape of scientific research, industries confront unique challenges in the assimilation of open science principles, particularly within the domain of publication. In contrast to academia, where the dissemination of knowledge is intrinsic to the research process, industries contend with the intricate balance between sharing discoveries and safeguarding proprietary information.

The conceptualization of disseminating scientific research findings from industrial projects introduces a myriad of intricacies. Traditionally, industries have prospered by preserving a competitive advantage through a combination of innovation and confidentiality. The prospect of openly sharing detailed methodologies, results, and insights marks a notable departure from this longstanding practice.

The primary objective of this study is to elucidate the extant practices concerning the publication of study results in industrial research projects, probe into the anticipated challenges associated with such practices, and delineate the impediments hindering the realization of heightened openness in the dissemination of results from industrial studies. Furthermore, the study undertakes an examination of the requisite resources for achieving the anticipated or elevated level of openness in the publication of study results, providing comprehensive discussions and suggestions in this regard.

Method

In the pursuit of discerning the extant and anticipated facets associated with the dissemination of study results within industrial research projects, along with the impediments to achieving an elevated level of openness in the publication of such findings, and proposing the requisite resources for realizing the envisaged transparency or exceeding it, a semi-structured interview study was undertaken. The study involved the participation of three individuals, comprising two doctoral candidates engaged in industrial research and one industry-based project leader.

The interview protocol encompassed inquiries of a general nature pertaining to the interviewee's background within the context of their research projects, coupled with specific queries pertaining to the dimension of openness in the publication of study results. The precise interrogative framework employed during the interviews is delineated in Table 1. Notably, prior to the commencement of the interviews, explicit consent was obtained from all participants.

Table 1. The questions employed in the interview study

General questions	**What is the study area of your current study/project/supervised project?**
	How many journal/conference publications in this project so far?
	Did you submit empirical evidence/data with the paper for those journals/conferences (how many)

	Did you also submit replication/reproducible package with the paper for those journal/conference (how many)?
Specific questions	What is your recent experience on publishing study results?
	What do you think are the causes of your experience on publishing study results?
	What is your expected experience on publishing study results?
	What do you think are the causes of your experience on publishing study results?
	What do you think are the resources necessary to achieve the expected/a higher level of openness in publishing study results?
	What do you think could be the challenges to achieve the expected/a higher level of openness in publishing study results?
	What are the advantages of the current status of openness in publishing study results?
	What are the limitations of the current status of openness in publishing study results?
	What are the advantages of the expected status/a higher level of openness in publishing study results?
	What are the limitations of the expected status/a higher level of openness in publishing study results?

Result

The industrial research projects under investigation in this study pertained to battery efficiency, aerodynamics, and machine learning. The perspectives of the interviewees are succinctly presented in Tables 2–4.

Table 2 delineates that the industrial PhD candidates and the project leader expressed contentment with the prevailing state of affairs. Their perspectives posited that the extant level of openness in publishing study results may diminish collaborative efforts within the industrial sector. However, they contended that such openness would concurrently amplify the impetus for research endeavors within the industry and engender heightened financial support from industrial stakeholders.

Table 2. The current status of openness in publishing study results in the project

Questions

What is your recent experience on publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
No one share the models or raw data	✘	✘	✘
It is comfortable to just share the important results and conclusions	✘	✘	✘
The authors have choice to submit more results if they want		✘	
What do you think are the causes of your experience on publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
The confidence on study methodology	✘		✘
No compensation for shared study models and other raw data	✘	✘	
Industry competions	✘	✘	✘
Company never wants to publish negative result due to reputation issue			✘
What are the advantages of the current status of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*

	PhD 1	PhD 2	Project Leader 1
Higher motivation of research study	✗	✗	✗
Attract funding from industry	✗	✗	
Well protection of company works and intellectual property			✗
What are the limitations of the current status of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
Collabration whitin industry is lower	✗	✗	
Hardly reuseable resources		✗	
Hardly reproduce similar results as obtained in previous studies		✗	
Getting approval from industry for publishing takes time			✗

Table 3 indicates that the expected openness in publishing study results by industrial PhD candidates and the project leader was the same as the current. They preferred to have a choice in publishing raw data or models. The PhD candidates showed their worry about how to remark on the contribution of researchers and how to attract funding from the industry for a higher openness requirement in publishing study results. However, the project leader expressed his concern about the approval authority in the industry and the planning of publication under higher openness requirements in publishing.

Table 3. The expected status of openness in publishing study results in the project

Questions

	PhD 1	PhD 2	Project Leader 1
What is your expected experience on publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
The current status is good	✗	✗	✗
The authors have choice to submit more results if they want	✗	✗	✗
Other users could pay extra money to purchase the model and raw data that restored in a third party		✗	
More open source models without restriction from industry		✗	
Proper in advance planning for publishing might ease the approval process in industry			✗
The authority for allowing publishing should be more granular in industry			✗
What do you think are the causes of your experience on publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
The confidence on study methoddology	✗		✗
No compensation for shared study models and other raw data	✗	✗	
Industry competions	✗	✗	✗
What are the advantages of the expected status of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
Encourage the collabration within industry and academic	✗	✗	✗
Easier to reuse previous study results	✗	✗	
Easier to reproduce and compare with previous study results	✗	✗	
Enhance the efficiency of research study	✗	✗	
Reduce review time taken in industry before publishing			✗
What are the limitations of the expected status of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*

Harder to rermark the contribution of the researchers	✗	✗	
Harder to attract fundings from industry	✗	✗	
Harder to granularize the approval authority in industry			✗
Difficult to make publication plan always well in advance			✗

Table 4 shows that proper compensation to the researchers and proper protection methods for the companies might increase the motivation to publish raw data and models by industrial researchers. The project leader believed that increasing the authority at the managerial level and increasing the transparency regarding collaboration regulations from the industry would help to achieve a higher openness.

Table 4. The resources necessary to achieve the expected/ higher level of openness in publishing study results

Questions

What do you think are the resources necessary to achieve the expected/a higher level of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
Proper compensation to the researchers' contribution	✗	✗	
Proper protection for the companies' benefit	✗	✗	
Approval authority at managerial level rather at top level			✗
Transparency in collaboration with academia regarding the industry regulations			✗
What do you think could be the challenges to achieve the expected/a higher level of openness in publishing study results?	*PhD 1*	*PhD 2*	*Project Leader 1*
Lack of motivation for the researchers	✗	✗	
Lack of protection for the companies	✗	✗	✗
Clear and transparent plan regarding publishing study results			✗

Discussion

The findings derived from the interviews reveal a general concordance among industrial PhD candidates concerning various facets related to the existing state and anticipated progression of openness in industrial research and collaboration with academia. In contrast, the project leader articulated divergent experiences, particularly in relation to the approval process for publication across upper and lower managerial echelons. Both the cohort of industrial PhD candidates and the project leader express contentment with the prevailing state of openness, and their respective expectations regarding open science practices within the company converge on certain aspects.

While the industrial PhD candidates advocate for increased flexibility concerning the submission of supplementary research data and seek remuneration benefits for voluntarily sharing detailed outputs such as raw data and models, the project leader emphasizes the advantages of pre-planning, especially in collaborative endeavors with academia. Additionally, the project leader underscores the importance of transparency with academic collaborators regarding company regulations on openness and result dissemination prior to project initiation. Notably, the project leader observes that the current industry practices are characterized by prolonged approval processes, often attributed to decisions emanating from upper-level management. There is a discernible expectation articulated by the project leader to delegate decision-making authority to lower managerial levels for less complex projects. This strategic decentralization is deemed beneficial, particularly for expediting the publication process of less-

sensitive, straightforward research outputs that could significantly contribute to respective research communities if disseminated expeditiously.

The analysis of the obtained results holds significant implications for the broader industrial landscape, offering insights that can inform strategic decisions and improvements in industry practices. The identified challenges in adopting open science principles for publishing study results from industrial research projects underscore the need for a nuanced approach that balances transparency with safeguarding proprietary information. To address these challenges, industry stakeholders may consider implementing tailored policies and frameworks that encourage openness while addressing concerns related to competition and innovation. Additionally, fostering a culture of collaboration between industry and academia, accompanied by clear communication channels, can contribute to overcoming barriers identified in the study. Furthermore, the findings suggest the importance of streamlining the approval processes for publication, especially at the managerial level, to expedite the dissemination of research outcomes. Overall, these insights can guide industry leaders in shaping practices that align with the evolving landscape of open science, promoting innovation, and contributing to the advancement of knowledge within the industrial sector.

While the findings from the interviews offer valuable insights into the perspectives of industrial PhD candidates and the project leader on openness in industrial research, it is crucial to acknowledge the study's limitation stemming from the relatively limited number of interview subjects. The perspectives presented may not fully capture the diversity of opinions within the broader industry, and variations in organizational structures, practices, or contexts could influence the generalizability of the results. The study's reliance on a specific set of participants may limit the scope of the identified challenges and recommendations to the experiences of this particular cohort. Consequently, caution should be exercised when extrapolating the findings to the broader industrial landscape, and future research endeavors could benefit from a more extensive and diverse sample to enhance the generalizability and robustness of the conclusions drawn from the study.

Conclusion

The study reveals a cohesive understanding among industrial PhD candidates regarding the current state and anticipated evolution of openness in industrial research, while the project leader presents divergent experiences, particularly concerning publication approval processes across managerial tiers. Despite differences, both groups expressed satisfaction with existing openness. The recommendations from industrial PhD candidates for increased flexibility in data submission and the project leader's emphasis on pre-planning and transparency highlight the need for a balanced approach in industry practices. Prolonged approval processes underscore structural challenges, emphasizing the importance of decentralizing decision-making authority for less complex projects. Broadly, the study suggests implementing tailored policies and enhanced communication channels to encourage openness, fostering collaboration between industry and academia. However, limitations arising from the study's reliance on a limited number of interview subjects prompt caution in generalizing findings. Despite this, the study offers valuable insights for industry leaders to navigate the evolving landscape of open science and contribute to knowledge advancement within the industrial sector.