# A Perspective to Productive Collaboration for Machine Learning Community

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## Abstract

The main motive of this work is to provide motivation from various existing literature in STEM fields regarding best practices for collaborations and pave a path for a successful and productive collaboration. First, the work focuses on providing a relationship between collaboration and the significant throughput obtained. Subsequently, we address the barriers that might impede collaboration in the research. Next, we focus on finding the relationship between collaborating across various private and public sectors. Finally, we provide some views on the inclusivity of people of different gender and race. We believe that the inclusion of these aspects would provide a way for high productivity in a research collaboration in the field of machine learning to develop safe and robust models for future generations.

## 1 Research Collaboration and the Throughput

**Research Collaboration** The research collaboration can be viewed as a professional rapport among individuals or organizations. In one of their perspectives, some of the studies [15, 19] [6], consider the corresponding authorship in research as an index of collaboration.

The collaboration's primary target is to achieve a scientific throughput through rigorous study to contribute to the body of knowledge. This target can be achieved by the collaborators by gathering the resources and funds to carry out the experiments. Hence, co-authors of certain research are perceived as the people who contribute to the body of knowledge, and people who fund their research are perceived as patrons [9].

**Collaboration and Productivity: Generalised Outlook** Hence, by conception, a collaboration would aid research and make it more effective by adding multiple views and sharing the resources. So, one might be skeptical that research collaboration produces throughput and, if so, how far it is from an individual contributor. If the measure is in terms of publications, Lee et al. [21] analyzed the significance of collaboration and scientific productivity and depicted that the positive correlation is adequately high. Measuring the productivity by the magnitude of the research team, the research conducted by Adams et al. [2] has illustrated that scientific productivity is proportional to the size of the team. A study conducted by Beaver [7] between two countries, France and Germany, proved the country that hasn't collaborated didn't show up a better throughput. Another informative study by Abramo et al. [1] has shown that collaboration varies by the field of study and also depends on the requirement for interdisciplinary research. Biological sciences resulted in higher productivity with domestic collaborations, and application-oriented research is more prone to international collaborations. Although, their work has shown that collaboration provides fast and pervasive research in any scientific or engineering field.

Submitted to 36th Conference on Neural Information Processing Systems (NeurIPS 2022). Do not distribute.

**Collaboration and Productivity: A National (or Continental) Viewpoint** The work by Aldieri et al. [3] provides a detailed analysis of intramural and extramural collaboration in various countries across the European nations. The results depict that collaborations enhance the scientific performance of academic institutions. Also, they claim that Italian and Russian scientists have to improve their collaborations to enhance productivity. Further, a study [11] assessed the research outcome of 102 Italian universities across 20 disciplines and concluded that a higher research throughput is obtained with maximized international collaboration. A study by He et al. [16] details that domestic collaborations in New Zealand would hinder the growth of academic outcomes. Having ties with government institutions could narrow the knowledge transfer. Hence,

## 2 Collaboration Across Various Sectors

**Private and Public Sector** Collaboration of researchers between industry and government sector is one of the viewpoints to address the potential advantages. A work by [8] illustrates numerous factors involved in determining a healthy collaboration between the government and the private sector. As increasing with the magnitude of the universities' strength, research collaboration eventually increases. It is also well-established that, international collaborations could provide remarkable throughput.

Consecutively, when these collaborators have tie-ups with industry would lead to significant research throughput [5]. The analyses of Micheal et al. [13] claim that most of the research conducted in the private industry has a different perspective on the composition, Aims, and execution of research. Also, this study claims that higher property-focused collaboration tends to have a knowledge-focused phase leading to higher throughput.

Thus, we believe from the existing viewpoints that one can achieve superior research performance with *triple-helix collaborations* both with the public sector (government) and private sector (industry).

## 3 Barriers to Research Collaboration

Certain factors act as barriers to collaboration but are not limited to language, time zones, governance of each individual, research IP rights, etc. [22]. Also, a lack of specific factors such as trust and professionalism might deteriorate the relationship between individuals or firms, leading to resistance to collaboration. A theoretically refined and experimentally evaluated framework by Deepak et al. [23] justifies that having controlled provisions in a firm intensifies *competence-based trust* but decreases *goodwill-based trust*, and this eventually deteriorates the relationship among the collaborators.

So, we must ensure that these barriers are bridged with appropriate strategies. One is providing an appropriate global code of conduct among the research collaborators. This action would examine the biases and fairness in equitable partnerships [12]. Adding professional traits such as research integrity and honesty in the code of conduct would aid the relationships among the collaborators [14]. Hence, a general code of conduct for the ML research community would bridge the barrier to research collaboration. This can be achieved by amending the essential norms with empathy, integrity, and righteous consent from both collaborating parties.

## 4 Collaboration and Diversity

**Gender** The women with younger children who do not intend to collaborate with other scientists have fewer productivity [20]. The empathy towards child care and maternity problems associated with women scientists plays a crucial role in their productivity. In an empathetic view, effective strategies must be formed to balance productivity and responsibilities. The study of Zeng et al. [26] realizes that fewer women in the scientific community contribute to STEM disciplines. In a cohort of 30980 faculty, the ratio of females to a male is approximately 1:4. The lower represented females in the STEM are recommended to enhance broader collaborations because the analysis depicts that females are less likely to co-authorship. Yamamoto et al. [25] suggested that a lack of mentoring and higher cost of research are one of the barriers to the female researcher contributing to the field of Computer Science (CS). It is observed that there is a gender gap in the collaboration patterns of

certain sub-domains of the CS. As CS is highly collaborative in nature, it should be kept in mind to have gender diversity for enhanced productivity.

Holoman et al. [17] examined the gender gap in various publications like PubMed and arXiv databases across various countries over the last 15 years. Especially in the STEM fields, men are twice as females, and this gender gap is minimized by reforming education, proper mentoring, and systematic publications. Also, certain research has proven that women are highly likely to produce collaborative throughput by strategizing collaborations[10][4].

**Racial** Joshi et al. [18] proposed a new agenda for diversity research that goes beyond the discussion about the possible advantages and costs of diversity and instead focuses on the intrinsic context dependence of organizational diversity effects. We observe that poorly reporting and acknowledging context conceal the important repercussions of diversity in organizations. Still, it impedes efforts to synthesize and integrate the body of evidence from the past. Also, Richard et al. [24] suggest that racial inclusivity is one of the crucial aspects of collaborative productivity not just in the short term but it does aid in the long run.

Thus, the authors believe that *collaborative inclusivity* both for gender and race could provide higher productivity to the scientific community by providing a broader perspective and obtaining a significant knowledge base.

# 5 Conclusion

Aggregating the above facets, we would like to conclude that numerous aspects might be taken into consideration for building appropriate collaborations. In order to have appropriate collaboration, especially in the machine learning community, we suggest collaborations with people, organizations, institutions, or universities across the globe with broader inclusivity and diversity. We believe that these motivations can aid us in developing novel, trustworthy and safe models which could oblige humankind.

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