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# Pali U.K. De Silva Candace K. Vance

# Scientific Scholarly Communication The Changing Landscape



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# Scientific Scholarly Communication

The Changing Landscape



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### Preface

The formal scientific scholarly communication system that emerged 350 years ago changed at a slow pace until the last few decades, during which we have witnessed a tremendous state of transformation over a relatively short period. During this time period, many opposing viewpoints have been heard about the direction of the scientific scholarly communication system. The call for information to be freely and openly available is heard alongside the equally strong desire to profit from it. The well-established subscription-based journal publishing model for sharing scholarly information steadily evolved, but increasing subscription rates made many stake holders of scientific information unhappy. Voices of resistance were heard and the open access movement was born, promoting the norms of free and unrestricted access to scientific information would ensure greater expansion of the knowledge base and enhance scientific progress, there are critical questions pertaining to the economics of open access publishing as well as other issues unique to unrestricted access to scientific information.

Data is considered the foundation of science, and there is growing interest in making scientific data readily accessible. The quest for "open data" is taking shape in parallel to the open access publishing movement, which will revolutionize the way science is documented. Advances in technology have made data collecting, archiving, sharing, and accessing more feasible. Although the advantages of scientific data sharing are increasingly acknowledged, it has not been adopted equally across scientific disciplines due to a variety of reasons such as the cost involved, culture, lack of data management skills, or technological difficulties. Then, there are issues unique to some types of scientific data that require an understanding of ethical and social factors, privacy, and safety and security concerns when openly sharing it.

The idea of democratization of scientific knowledge, one of the facets of the "open science" movement, is gaining attention within many scientific communities, and the benefits of sharing scientific knowledge are almost universally accepted. At the same time, the importance of transforming scientific discoveries into technologies benefiting the society at large has been similarly acknowledged. Two

contradicting ethos—the free flow of scientific information and the commercialization of scientific discoveries—have become a topic of spirited debate, which demands the attention of the scientific communities as well as the society at large.

The astounding rate of technological advancement not only shapes the way we disseminate, share, and access, but also assesses the quality of scholarly information. Quantitative tools facilitated by computer and communication technologies are combined with the traditional pre-publication peer-reviewing in measuring the impact of scientific research. While discussions and conscientious debates to improve existing time-tested measures persist, the pursuit of developing better and more efficient means also continues. There are questions not only about the effectiveness and reliability of assessment methods but also about the efficiency and the time it may take. Is faster better when assessing the quality of scientific research, and if so, at what cost? In addition to measuring scientific quality, should we also be determining the impact of science on society? And if so, how?

The changes in the scientific scholarly communication system are varied and complex, and the numerous participants involved in the debate about its future direction have different opinions. Scientists, probably the most important participants in this discussion, spend a great deal of time and effort to stay current in their respective scientific fields but may fail to stay current regarding the changes in the scholarly communication system. An understanding of the complex nature of these changes will enable them to more easily navigate this evolving landscape when seeking research funding, publishing their work, and managing issues related to their career enhancement. Beyond mere understanding, they must become advocates for the future of scientific scholarly communication—one that is inclusive and sustainable. This requires a sense of responsibility for shaping its future direction, not simply watching it unfold at the hands of publishers and commercial entities whose agendas may be at odds with the public good and the expansion of scientific knowledge.

The objective of this book is to provide scientists, science educators, university administrators, government entities, research funders, and other interested groups with an overview and critical analysis of historical and current developments and ongoing discussions regarding several important aspects of the scientific scholarly communication system based on thorough examination of the published literature on these topics. Therefore, we believe this book will provide an incentive for readers to become informed, join the conversation, and become active participants in helping transform the future of the scientific scholarly communication system that anchors the scientific endeavor, benefiting all of us and the environment in which we live.

Murray, KY, USA Murray, KY, USA Pali U.K. De Silva Candace K. Vance

## Contents

1	Scientific Scholarly Communication: Moving Forward Through					
	Oper	n Discussions	1			
	1.1	Introduction	1			
	1.2	Open and Unrestricted Access to Scientific Information	2			
		1.2.1 Concerns with Openly Sharing Sensitive Scientific Information	3			
	1.3	Sharing Scientific Data	3			
		1.3.1 Privacy and Genetic Data Sharing	5			
	1.4	Intellectual Property Rights and Scientific Scholarly				
		Communication.	6			
		1.4.1 Impact of IPR on Sharing Data	9			
	1.5	Measuring Impact of Scientific Research	10			
	1.6	Concluding Remarks	12			
	rences.	13				
2	Acce	ss to Scientific Knowledge: A Historical Perspective	17			
	2.1	Introduction	17			
	2.2	Scientific Scholarly Information Sharing: 1600–1900	18			
	2.3	Scholarly Communication Developments in the Twentieth				
		and Twenty-First Centuries.	20			
	2.4	Journal Subscription Debates	21			
	2.5	Concluding Remarks	23			
	Refe	References				
3	On t	he Road to Unrestricted Access to Scientific Information:				
		The Open Access Movement.				
	3.1	Introduction	25 25			
	3.2	Open Access to Scholarly Publications: Legislative				
		and Other Supporting Initiatives	27			
	3.3	Initiatives by Scholars, Research Funders,	- '			
	0.0	and Other "Movers"	29			

	3.4	Measuring the Impact of OA Journals	30		
	3.5	OA Influence in the Developing World	32		
	3.6	OA Publishing Models: Green, Gold, and Other Models	33		
		3.6.1 Green OA Model.	33		
		3.6.2 Gold OA Model	34		
		3.6.3 Other OA Models	36		
	3.7	Maintaining the Quality and Integrity of OA Journals	36		
	3.8	Concluding Remarks	37		
		rences.	37		
4	Shar	ing Scientific Data: Moving Toward "Open Data"	41		
-	4.1	Introduction	41		
	4.2	Policy Initiatives Supporting Data Sharing	43		
	4.3	Involvement of Funding Organizations and Journal	10		
	1.5	Publishers	43		
	4.4	Data Sharing Habits of Scientists	44		
	4.5	Data Sharing in Different Scientific Disciplines	45		
	1.0	4.5.1 Sharing Ecological Data	45		
		4.5.2 Sharing Genomic Data	47		
	4.6	Data Publication and Data Citation.	49		
	4.7	ving Toward "Open Data"?			
	4.8	Concluding Remarks	53		
		rences.	53		
5	Free	Flow of Scientific Information Versus Intellectual Property			
		ts	57		
	5.1	Introduction	57		
		University-Industry Collaborations or Commercialization			
		of Academic Research?	59		
		5.2.1 Patenting and Licensing Academic Scientific			
		Discoveries: Government Legislations	59		
		5.2.2 IPR and Academic Research: The Debate	59		
		5.2.3 Negative Effects of Patenting Scientific Research	60		
		5.2.4 Patent Documents as Source of Scientific			
		Information	60		
		5.2.5 Delay in Disclosure of Research Findings	61		
	5.3	IPR in Life Sciences.	62		
		5.3.1 IPR and Biomedical Research	62		
		5.3.2 IPR and Biotechnological Advances in Agriculture	65		
	5.4	Concluding Remarks	67		
		rences.	67		

6.1Introduction736.2History of Peer Review746.3Criticism of the Peer Review Process756.4Bias in Peer Review756.4.1Prestige or Association Bias766.4.2Gender Bias766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review: Single- Versus Double-Blind816.6.2Open Peer Review826.6.3"Nonselective" Review Process876.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.10Burden on Peer Reviewers936.11.1Taining Peer Reviewers936.12Concluding Remarks94References95957Measuring the Impact of Scientific Research1017.1Introduction1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality104 <tr< th=""><th>6</th><th colspan="6">Preserving the Quality of Scientific Research: Peer Review</th></tr<>	6	Preserving the Quality of Scientific Research: Peer Review					
6.2History of Peer Review746.3Criticism of the Peer Review Process756.4Bias in Peer Review756.4.1Prestige or Association Bias766.4.2Gender Bias766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review: Single- Versus Double-Blind816.6.2Open Peer Review: Single- Versus Double-Blind816.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.10Burden on Peer Reviewers916.11.1Training Peer Reviewers936.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References95957Measuring the Impact of Scientific Research1017.1Introduction1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Man		of Re	search A	Articles	73		
6.3Criticism of the Peer Review Process756.4Bias in Peer Review756.4.1Prestige or Association Bias766.4.2Gender Bias766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias776.4.7Conservatism796.6Different Models of Peer Review816.6.1Closed Peer Review816.6.2Open Peer Review826.6.3"Nonselective" Review826.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.10Burden on Peer Reviewers926.11.1Training Peer Review System936.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References95957Measuring the Impact of Scientific Research1017.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor Variations1067.4.1Eigenfactor Score </td <td></td> <td>6.1</td> <td colspan="3">Introduction</td>		6.1	Introduction				
6.4Bias in Peer Review756.4.1Prestige or Association Bias766.4.2Gender Bias.766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review:816.6.2Open Peer Review:826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process.876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress.916.10Burden on Peer Reviewers916.11Ways to Improve the Peer Review System926.11.1Training Peer Reviewers936.12.2Concluding Remarks936.12.2Concluding Remarks94References957Measuring the Impact of Scientific Research1017.1Introduction1017.2.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.4.1Eigenfactor Score1077.4.1Eigenfactor Score1		6.2					
6.4.1Prestige or Association Bias766.4.2Gender Bias766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review816.6.2Open Peer Review826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.11Ways to Improve the Peer Review System926.11.1Training Peer Review System926.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References957Measuring the Impact of Scientific Research1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline		6.3					
6.4.1Prestige or Association Bias766.4.2Gender Bias766.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review816.6.2Open Peer Review826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.11Ways to Improve the Peer Review System926.11.1Training Peer Review System926.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References957Measuring the Impact of Scientific Research1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline		6.4	Bias in	Peer Review	75		
6.4.3Confirmation Bias776.4.4Conservatism776.4.5Bias Against Interdisciplinary Research786.4.6Publication Bias786.4.6Publication Bias796.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review: Single- Versus Double-Blind816.6.2Open Peer Review826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.10Burden on Peer Reviewers916.11.1Training Peer Reviewers936.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References95957Measuring the Impact of Scientific Research1017.1Introduction1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with					76		
6.4.4Conservatism77 $6.4.5$ Bias Against Interdisciplinary Research78 $6.4.6$ Publication Bias78 $6.5$ Peer Review and Conflict of Interest79 $6.6$ Different Models of Peer Review81 $6.6.1$ Closed Peer Review: Single- Versus Double-Blind81 $6.6.2$ Open Peer Review82 $6.6.3$ "Nonselective" Review86 $6.6.4$ Immediate Publication with no Formal Review87 $6.7$ Manipulation of the Peer Review Process87 $6.8$ Should the Current System of Peer Review Be Continued?89 $6.9$ The Peer Review System Is Under Stress91 $6.10$ Burden on Peer Reviewers91 $6.11$ Training Peer Reviewers93 $6.11.2$ Ethical Standards for Authors, Reviewers, and Editors93 $6.12$ Concluding Remarks94References95957Measuring the Impact of Scientific Research101 $7.1$ Introduction101 $7.2$ Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles102 $7.3$ Impact Factor to Measure Quality of Journals103 $7.3.4$ Issues with Discipline-Specific Journal Impact Factor Variations106 $7.4$ Need for Other Indicators to Measure Journal Quality107 $7.4.1$ Eigenfactor Score107			6.4.2	Gender Bias.	76		
6.4.4Conservatism77 $6.4.5$ Bias Against Interdisciplinary Research78 $6.4.6$ Publication Bias78 $6.5$ Peer Review and Conflict of Interest79 $6.6$ Different Models of Peer Review81 $6.6.1$ Closed Peer Review:81 $6.6.2$ Open Peer Review82 $6.6.3$ "Nonselective" Review86 $6.6.4$ Immediate Publication with no Formal Review87 $6.7$ Manipulation of the Peer Review Process87 $6.8$ Should the Current System of Peer Review Be Continued?89 $6.9$ The Peer Review System Is Under Stress91 $6.10$ Burden on Peer Reviewers91 $6.11$ Training Peer Reviewers93 $6.11.2$ Ethical Standards for Authors, Reviewers, and Editors93 $6.12$ Concluding Remarks94References95957Measuring the Impact of Scientific Research101 $7.1$ Introduction101 $7.2$ Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles102 $7.3$ Impact Factor to Measure Quality of Journals103 $7.3.4$ Issues with Discipline-Specific Journal Impact Factor Variations106 $7.4$ Need for Other Indicators to Measure Journal Quality107 $7.4.1$ Eigenfactor Score107			6.4.3	Confirmation Bias	77		
6.4.5Bias Against Interdisciplinary Research.786.4.6Publication Bias.786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review: Single- Versus Double-Blind816.6.2Open Peer Review826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process.876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress.916.10Burden on Peer Reviewers936.11.1Training Peer Review System926.11.2Ethical Standards for Authors, Reviewers, and Editors936.12Concluding Remarks94References.957Measuring the Impact of Scientific Research1017.1Introduction1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality107			6.4.4	Conservatism	77		
6.4.6Publication Bias.786.5Peer Review and Conflict of Interest796.6Different Models of Peer Review816.6.1Closed Peer Review: Single- Versus Double-Blind816.6.2Open Peer Review826.6.3"Nonselective" Review866.6.4Immediate Publication with no Formal Review876.7Manipulation of the Peer Review Process876.8Should the Current System of Peer Review Be Continued?896.9The Peer Review System Is Under Stress916.10Burden on Peer Reviewers916.11Ways to Improve the Peer Review System926.11.1Training Peer Reviewers936.12Concluding Remarks94References95957Measuring the Impact of Scientific Research1017.1Introduction1017.2Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107			6.4.5	Bias Against Interdisciplinary Research	78		
6.5     Peer Review and Conflict of Interest     79       6.6     Different Models of Peer Review     81       6.6.1     Closed Peer Review: Single- Versus Double-Blind     81       6.6.2     Open Peer Review     82       6.6.3     "Nonselective" Review     86       6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress     91       6.10     Burden on Peer Reviewers     92       6.11.1     Training Peer Reviewers     93       6.12     Concluding Remarks     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2			6.4.6		78		
6.6     Different Models of Peer Review     81       6.6.1     Closed Peer Review: Single- Versus Double-Blind     81       6.6.2     Open Peer Review     82       6.6.3     "Nonselective" Review     86       6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal		6.5	Peer Re		79		
6.6.1     Closed Peer Review: Single- Versus Double-Blind     81       6.6.2     Open Peer Review     82       6.6.3     "Nonselective" Review     86       6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process.     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     105       7.3.3     Ability to Manipulate Journal Impact Factor     105 <td></td> <td>6.6</td> <td></td> <td></td> <td></td>		6.6					
6.6.2     Open Peer Review     82       6.6.3     "Nonselective" Review     86       6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     105							
6.6.3     "Nonselective" Review     86       6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process.     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.12     Concluding Remarks     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issue							
6.6.4     Immediate Publication with no Formal Review     87       6.7     Manipulation of the Peer Review Process.     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.12     Concluding Remarks     93       6.12     Concluding Remarks     94       References     95     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific       Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     Factor Variations     106 </td <td></td> <td></td> <td></td> <td></td> <td></td>							
6.7     Manipulation of the Peer Review Process.     87       6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Review System Sunder Stress.     91       6.11     Ways to Improve the Peer Review System.     92       6.11.1     Training Peer Reviewers     93       6.12.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References.     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality							
6.8     Should the Current System of Peer Review Be Continued?     89       6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.12     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References.     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107 <td>67</td> <td>0.0.1</td> <td></td> <td>• •</td>		67	0.0.1		• •		
6.9     The Peer Review System Is Under Stress.     91       6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107							
6.10     Burden on Peer Reviewers     91       6.11     Ways to Improve the Peer Review System     92       6.11.1     Training Peer Reviewers     93       6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107							
6.11     Ways to Improve the Peer Review System.     92       6.11.1     Training Peer Reviewers     93       6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107							
6.11.1     Training Peer Reviewers     93       6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107							
6.11.2     Ethical Standards for Authors, Reviewers, and Editors     93       6.12     Concluding Remarks     94       References     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107		0.11					
and Editors936.12 Concluding Remarks94References.957 Measuring the Impact of Scientific Research1017.1 Introduction1017.2 Citation Data as a Tool to Measure the Impact of ScientificScholarly Articles1027.3 Impact Factor to Measure Quality of Journals1037.3.1 Strengths of Impact Factor in Measuring1047.3.2 Limitations of Impact Factor in Measuring1057.3.3 Ability to Manipulate Journal Impact Factor1057.3.4 Issues with Discipline-Specific Journal Impact1067.4 Need for Other Indicators to Measure Journal Quality1077.4.1 Eigenfactor Score107					))		
6.12     Concluding Remarks     94       References.     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     104       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107			0.11.2		93		
References.     95       7     Measuring the Impact of Scientific Research     101       7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     104       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107		612	Conclu				
7 Measuring the Impact of Scientific Research     101       7.1 Introduction     101       7.2 Citation Data as a Tool to Measure the Impact of Scientific     102       7.3 Impact Factor to Measure Quality of Journals     103       7.3.1 Strengths of Impact Factor in Measuring     104       7.3.2 Limitations of Impact Factor in Measuring     104       7.3.3 Ability to Manipulate Journal Impact Factor     105       7.3.4 Issues with Discipline-Specific Journal Impact     106       7.4 Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107							
7.1     Introduction     101       7.2     Citation Data as a Tool to Measure the Impact of Scientific     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     104       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107					95		
7.2     Citation Data as a Tool to Measure the Impact of Scientific       Scholarly Articles     102       7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring     104       7.3.2     Limitations of Impact Factor in Measuring     104       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107	7	Meas	uring th	e Impact of Scientific Research	101		
Scholarly Articles1027.3Impact Factor to Measure Quality of Journals1037.3.1Strengths of Impact Factor in Measuring Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107		7.1			101		
7.3     Impact Factor to Measure Quality of Journals     103       7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107		7.2	Citation	n Data as a Tool to Measure the Impact of Scientific			
7.3.1     Strengths of Impact Factor in Measuring Journal Quality     104       7.3.2     Limitations of Impact Factor in Measuring Journal Quality     105       7.3.3     Ability to Manipulate Journal Impact Factor     105       7.3.4     Issues with Discipline-Specific Journal Impact Factor Variations     106       7.4     Need for Other Indicators to Measure Journal Quality     107       7.4.1     Eigenfactor Score     107			•				
Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107		7.3	Impact		103		
Journal Quality1047.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107			7.3.1	Strengths of Impact Factor in Measuring			
7.3.2Limitations of Impact Factor in Measuring Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107					104		
Journal Quality1057.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107			7.3.2				
7.3.3Ability to Manipulate Journal Impact Factor1057.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107					105		
7.3.4Issues with Discipline-Specific Journal Impact Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107			7.3.3		105		
Factor Variations1067.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107			7.3.4				
7.4Need for Other Indicators to Measure Journal Quality1077.4.1Eigenfactor Score107					106		
7.4.1 Eigenfactor Score 107		7.4	Need for				
			7.4.2	SCImago Journal Rank	108		

		7.4.3	Comparing Eigenfactor Score, SCImago Journal	
			Rank, and Journal Impact Factor	108
	7.5	Measu	ring the Impact of Individual Scientists or Groups	
		of Scie	entists	109
		7.5.1	Hirsch Index (h-Index) and Its Variants	110
	7.6	Conclu	Iding Remarks	111
	Refer	ences		112
8	Asses	sing the	e Societal Impact of Scientific Research	117
	8.1		rction	117
	8.2	Challer	nges in Defining Societal Benefits	118
	8.3	Research Assessment Strategies of Government Agencies		
		in Diff	erent Countries	119
	8.4	Societa	al Impact Assessment Indicators	120
		8.4.1	Alternative Metrics to Measure Societal Impact	121
		8.4.2	Strengths and Limitations of Altmetrics as Scientific	
			Research Assessment Tools	123
		8.4.3	Altmetrics as Discovery Tools	126
		8.4.4	Improving Standards and Credibility of Altmetrics	126
		8.4.5	Association Between Altmetrics and Traditional	
			Citation Metrics	127
		8.4.6	Article Readership Counts and Citation Counts	127
		8.4.7	Science Blogging, Microblogging, and Citation	
			Counts	128
	8.5		Iding Remarks	129
	Refer	ences		130
Fi	nal Th	oughts		133
In	dex .			137

## Chapter 1 Scientific Scholarly Communication: Moving Forward Through Open Discussions

**Abstract** The formal scientific communication system has continued to evolve over the last 350 years, shaped by economic factors, geopolitical events, and technological advances that are taking place at an unprecedented pace. However, throughout this evolutionary process, the discussions, debates, and deliberations that have taken place can be considered the most significant factors in improving the quality of the scientific scholarly communication system. This chapter touches on some of the discussions, debates, and conscientious deliberations that have occurred and currently taking place influencing toward a more efficient scholarly communication system needed to enhance the quality and the speed of scientific progress.

**Keywords** Scientific communication • Open access • Open data • Genetic data sharing • Scientific scholarly impact • Intellectual property rights

#### 1.1 Introduction

Formation of the first scientific society and the introduction of scientific journals in the 1660s together mark the birth of the formal scientific scholarly communication system. The evolution of this system during the three and a half centuries since then is fascinating; at times it was shaped and directed by geopolitical events, at times it was heavily influenced by economic issues, and at times it has even been in a crisis mode. However, most striking are the technological advances that have caused revolutionary changes in scholarly communication during the past few decades which are continuing and still evolving.

Formal and informal communication among scientists to exchange ideas and discuss research is a significant part of the scientific research process. Therefore, for a robust scientific research system it is essential that all researchers have access to the scientific knowledge base facilitating their active participation; any factor that restricts the dissemination of and access to knowledge impedes the progress of scientific research. Robert K. Morton, the founder of the modern sociology of science, says scientific knowledge should be considered as "public knowledge" accessible to not just scientists and students, but to the general public as well, a viewpoint that resonates among many others (Merton 1973). This idea of democratization of scientific knowledge is one of the facets of the "open science" movement, a concept which is becoming a buzzword in many scientific communities. Scientific research is becoming increasingly interdisciplinary, demanding the global collaboration of scientists, and unprecedented technological advances make these collaborations possible. More openness in sharing scientific information undoubtedly expands the "pool of researchers" and promotes cross-breeding of ideas which opens up new approaches, broadening and diversifying the scientific research process.

## **1.2** Open and Unrestricted Access to Scientific Information

After the formal system of sharing scientific research findings began with the publication of the *Philosophical Transactions of the Royal Society* in 1965, scholarly journal publishing developed into a subscription-based model controlled exclusively by commercial publishers and scientific societies. However, the domination of a few players in journal publishing caused access to scientific knowledge to become increasingly unaffordable and restricted, which alarmed scientific and academic communities. In response to these developments, challenging the traditional subscription-based model, the open access (OA) publishing movement was born toward the end of twentieth century, marking a significant milestone in scholarly scientific communication.

Another noteworthy aspect of this development is that it also sparked invigorating and open discussions related to many other aspects of scientific communication among stakeholders of scientific research. Progress in OA publishing facilitated by technological advances, gained attention and support among many groups, including policymakers and research funders. As a result, bold experimentation on different OA publishing models has produced promising options, such as the green (self-archiving) and gold (author-pay) OA publishing models. Although these models show high potential, they are still in the early stages of development. The open discussion among many stakeholders regarding the promises, limitations, and shortcomings of OA publishing is continuing and should continue. Important issues that are being discussed include the economic sustainability of these models, and, most importantly, maintaining high standards of scientific journal quality. The predatory journal publishing practices that exploit the gold OA publishing model have become a sticking point in an otherwise very promising publishing model that has reported many successes.

#### 1.2.1 Concerns with Openly Sharing Sensitive Scientific Information

Unrestricted access to scientific information has many advantages, and certainly it accelerates scientific progress. However, the current trend toward openness in scientific information sharing sometimes collides with economic interests, scientific cultures, and individual professional ambitions. Additionally, there may be instances in which the level of openness in information sharing needs to be carefully assessed. For example, sharing of certain scientific information would harm individuals (e.g., research participants) or the society at large. Research in some scientific fields (e.g., nuclear weapons) has always been considered as sensitive, and restrictions on sharing research findings have been justified on the basis of national security and the risk of proliferation of nuclear weapons. There are other instances that exemplify the need for critical assessment of potential risks versus benefits of sharing scientific information (Resnik 2013). In a notable example, a multinational debate erupted in 2011 when two groups of scientists attempted to publish their research on the H5N1 virus in Science and Nature. These two studies were conducted in two countries, and one project was funded by the National Institute of Health (NIH) in the US. The concern was that if the details of these genetically engineered H5N1 strains of avian influenza virus, which now had the capability to infect humans, were openly shared, the virus could be used as a bioweapon by terrorist groups. Although the initial recommendation was to publish the papers without the methodological details and share them only with "responsible" scientists, after a year-long conscientious debate, it was ultimately decided to publish the complete articles (Malakoff 2013). This incident persuaded NIH to impose new rules on NIH grant funding requirements, making researchers identify studies that might lead to "dual use" findings (i.e., with the potential for both benefit and harm) and, if so, to create risk mitigation plans. Additionally, NIH examination of abstracts or manuscripts is required prior to conference presentations or submission to journals resulting from such studies. These developments, some argue, not only restrict dissemination and access to knowledge, but even obstruct the freedom of scientific inquiry (Resnik 2013; Malakoff 2013). An open and honest discussion is needed about how to maintain the delicate balance of ethos of openly sharing information and controlling access to scientific information that can be misused to harm human life and the environment.

#### **1.3 Sharing Scientific Data**

As science becomes increasingly collaborative, the need for data sharing becomes more apparent, and its advantages have been greatly acknowledged in many scientific disciplines. Therefore, there is a push toward making scientific data readily and broadly available. One of the best examples that highlighted the significance of this is the human genome sequence project. Rapid release of human genomic data enabled global collaborations of scientists to work on causes of rare human diseases and find new insights into other important health conditions (Birney et al. 2009; Danielsson et al. 2014). Some data-intensive scientific fields, sometimes referred to as "big science," are equipped with data collection and management infrastructures that also support data sharing among dispersed groups of scientists (Kaye et al. 2009; Borgman 2012). However, data sharing is not prevalent in many disciplines, especially in hypothesis-driven, small-scale scientific research fields known as "small science," for reasons such as data heterogeneity, inaccessibility, lack of proper understanding of scientists regarding correct data management practices, and the absence of a data sharing culture.

In many instances, having data unavailable in accessible form is a major concern. This issue is prevalent in some scientific fields such as ecology. For example, environmental and ecological disasters are becoming more frequent and a scientific examination of the ecological impact of such a disaster requires access to a variety of datasets related to multiple disciplines including marine biology (benthic, planktonic, and pelagic organisms), chemistry (for oil and dispersants), toxicology, oceanography, and atmospheric science. Scientists study these incidents and collect enormous amounts of data in diverse forms, and these data sets may be collected to answer specific research questions. However, preserving and making them available in accessible form is important, as these may be useful in another related ecological disaster in a different location or time. Reichman et al. (2011) discussed this issue by highlighting the Deepwater Horizon oil spill in the Gulf of Mexico in 2010. According to them, most current and historical data collected by numerous studies related to oil spills are not available in accessible form or have been completely lost except for data available from a few well-organized research groups. This lack of information (or access to information) limits scientists' ability to examine the shortand long-term ecological effects of oil spills (Reichman et al. 2011). There may be many similar incidents-some that have received attention and many more that have passed unnoticed-that need to be highlighted in order to activate open discussions within scientific communities of different disciplines. Such discussions and debates will lead to increased awareness and promote the culture of data sharing within disciplines where it is lacking.

Sharing data in accessible and reusable forms allows others to recheck the validity of inferences made based on collected data. The ability to scrutinize research findings after formal publication is considered a form of peer reviewing. This post-publication review can be even more important than pre-publication peer reviewing, the traditional quality evaluation measure used in scholarly communication. The openness in data allows confirmation of research findings and self-correction of scientific mistakes. Begley and Ellis (2012) reported disturbing realities revealed through an examination of some preclinical cancer research studies. Out of 53 studies examined, the findings of only 11% could be confirmed.<sup>1</sup>

<sup>&</sup>lt;sup>1</sup>Scientists at the biotechnology firm Amgen in Thousand Oaks, California.