INFORMATION TECHNOLOGY USES IN RESEARCH: BEST PRACTICES AND RECOMMENDATIONS

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Abstract

In recent years, the research process such as searching the literature, collaborate with your team and peer review can be done simply by using internet. Today, people around the world can share ideas without even meet, published work in several places are accessible directly with seconds, experts in a field can be found with just a few typing keyword, and a lot of software as a tool to help a researcher to write a report and publish their work. Research can be done relatively faster than before, it means researcher should be more productive now. Since this technology is important to productivity of researcher, they should better know what are technologies available and what best practices they can use to stay competitive in this globalization era. The aim of this study to help researcher find the best information technology tools that fit their research. The method used is to explore and learn some research best practices and fit with software tools available. This paper categorize research tools for the nine categories and make comparison metrics for products in each category.

Keywords: Best Practices, Information Technology, Productivity, Research.

INTRODUCTION

Information technology has led us do things differently and efficiently, everything seems to go faster and easier. Globalization era involves information technology literacy in every aspect such as economy and business, government, lifestyle, education, including research and development. Research using information technology since the emergence of the internet. Back in time, researcher need to go to the library to look for literature, and they need large spaces to store and organize their literature, not to mention time and effort to write reports. Thanks to information technology and the internet, researchers are becoming more and more spoiled, everything they need right on the internet. These convenience comes with challenges: how researchers can optimize the use of information technology to increase their productivity? how to improve the quality of research? how to avoid plagiarism? This paper review some relevant literatures and suggest some research tools available online to help research process. The research process includes finding literature and other resources, manage references, collaborate and build networks, write reports, publish, benchmark research and checking plagiarism. It collects popular and most recommended online research tool in order to help researchers, especially beginners to quickly adapt to technology, so that they can contribute more to development and improvement in their field of study.

Information Technology and Its Importance for Research Activities

To complete the study in accordance with the budget time and expense, some important steps such as collecting data and the literature, collaborate with other researcher, writing reports and

publishing, should be determined outset. On this part, information technology plays an important role. Information technology especially helps in searching literature (Axford, Grunwald, & Hyndman, 1996). IT infrastructure is needed for storing and manage research data, especially in medical research (Castro, 2009) which is to turn electronic health records into a database for medical research. IT also makes improvement in productivity for R&D Department in a firm company (Mairesse, Greenan, & Topiol-Bensaid, 2001).

Research Tools

There are several tools available to researchers, most of these tools can be run online and there is also to be installed, some are free and some are not. This paper categorized the tools to 9(nine) categories, they are: online database, academic social network, reference manager, proofread and editor, plagiarism check, publishing tool, journal management software, conference proceeding management software and benchmark research (see Figure 1).
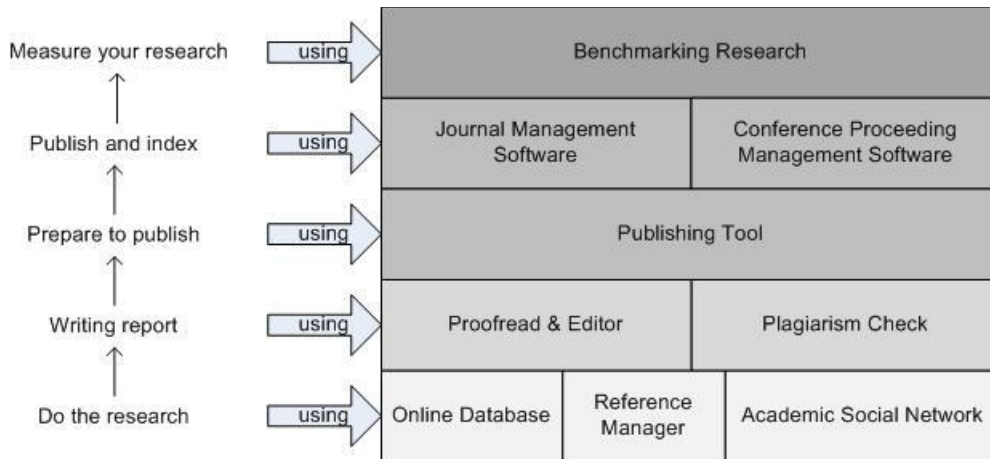

Figure 1. Research tool diagram

Online Database
We collect some online databases that have high impact factor and a free one (see Table 1). There is no specific recommendation because it depends on research need, but Google Scholar seems a cheap and easy solution.

Table 1. Online database metrics

	Google Scholar	*ScienceDirect*	*Springer*	*IEEE*	*ACM*
Membership	No	Yes	Yes	Yes	Yes
Discipline	All	scientific, technical, and medical	All	computing, electronic	computing
Support open access	Yes	Yes	Yes	No	No
Export citation	Yes	Yes	Yes	Yes	Yes
Free abstract	Yes	Yes	Yes	Yes	Yes
Product	All kind	Journal, article, book chapter	Journal, book, ref. work, protocol, database	Journal, proceeding, eBook, technical standard, course	Journal, proceeding, magazine, newsletter, book

Source(s): Data Adapted from various source from internet

Academic Social Network

Academic social network have been a new source of reading for graduate and post doc students (Haustein & Larivière, 2014) and also for interdisciplinary studies (Jiang, Ni, He, & Jeng, 2013). A survey participation has been conducted in a academic social network, and it shows that users are mostly engaged with research-based features instead of social-based features (Jeng, He, & Jiang, 2015). It can be translated that academic social network have become an important part of scholars, has helped scholars to find sources, share interest and build network. Table 2 lists some of them. Mendeley seems to have the most features compare to others.

Table 2. Academic Social Network metrics

	Google Scholar	*Research Gate*	*Mendeley*	*Academia.edu*	*ORCID*	*IEEE Collabratec*
Free	Yes	Yes	Yes	Yes	Yes	Yes
Premium license	No	No	Yes	No	No	No
Publication page	Yes	Yes	Yes	Yes	Yes	Yes
Personal Contact	Yes	Yes	Yes	Yes	Yes	Yes
Integrated with citation database	Yes (Google)	Yes	Yes (Scopus)	No	Yes (Scopus)	Yes
Collaboration	No	No	Yes	Yes	N.A	Yes
Communities	No	No	Yes	No	N.A	Yes
Literature search features	Yes	Yes	Yes	Yes	No	Yes

Source(s): Data Adapted from various sources on the internet

Reference Manager

A survey for evaluating and selecting citation management has been conducted (Butros & Taylor, 2010). The paper recommends Mendeley and Zotero for products requiring subscription.

Table 3 Reference Manager metrics

	RefWorks	Zotero	Mendeley	EndNote	EndNote Web
Free	No	Yes	Yes	No	Yes (w/ software purchase)
Premium license	Yes	No	Yes	Yes	No
Platform	Web, mobile	Web	Web, mobile, desktop	Desktop	Web
Compatible with other format	Yes	Yes	Yes	Yes	Yes
File Organizer	No	No	Yes	No	No
Duplicate checking	Yes	No	Yes	No	No
Plugin for bibliography	Yes	Yes	Yes	Yes	Yes
Standalone bibliography	Yes	Yes	No	Yes	Yes
Extract metadata	Yes	Yes (Google Scholar)	Yes (Google Scholar etc.)	Yes	Yes
Full text search	Yes	Yes	Yes	No	No
Catalog search	Yes	Yes	Yes	Yes	Yes
Store on local	No	Yes	Yes	No	No
Share	Yes	Yes	Yes	Yes	Yes (by email)

Source(s): Data adapted from Butros & Taylor 2010 and other sources

Proof Reading and Editor

Until now, there has been no survey on proofread software. We collected some popular online proofread tools from the internet. Proofread helps researcher examine their scientific writing in grammar, spelling, phrase and even scoring. Turnitin software[1] outperform others (see Table 4).

Table 4. Proofread and editor tools metrics

	Turnitin	Grammarly	Paper Rater
Free	No	Yes	Yes
Premium license	Yes	Yes	No
Spelling check	Yes	Yes	Yes
Grammar check	Yes	Yes	Yes
Paraphrase	Yes	Yes	Yes
Writing Score	Yes	Yes	Yes
Online/standalone	Online	Both	Online
Supported language	100+ languages	English	English

Source(s): Adapted from various source on the internet

Plagiarism Check

To our knowledge, there has been no literature on evaluating plagiarism tool. So we gather some popular tools from the internet (see Table 5). iThenticate[2] gives the most features and support many languages.

Table 5. Plagiarism check metrics

	iThenticate	Plagiarisma.net	Copyleaks	Grammarly
Free	No	Yes	Yes	Yes
Integrated with online database	Yes (>590 STM publisher, 30 aggregators, own search engine)	Yes (Google, Yahoo)	Yes	Yes (own database)
Online/standalone	Online	Both	Online	Online
Supported languages	100+ languages	English and 11 other languages	All	English
Supported documents	MS Word, Word XML, WordPerfect, PostScript, PDF, HTML, RTF, HWP, OpenOffice (ODT), TXT	TXT, HTML, RTF, DOC, DOCX, XLS, XLSX, PDF, ODT, EPUB, FB2, PDB	All textual format	All textual format
Support comparing own documents	Yes	No	No	No

Source(s): Adapted from various sources on the internet

Publishing Tool

Publication is a must for a researcher, the purpose is that the result can be seen by others researcher who need the relevant information. In order to index the paper properly, publisher have devised standardized format for the papers. Researcher should follow a standard format that has been set by the publisher. The most popular format for paper is Word or LaTex. Comparison between the two formats have been performed to actual environment (Knauff & Nejasmic, 2014). Suprisingly, Word has better productivity than LaTex does. It caused by document complexity of LaTex even for expert users. LaTex provides better productivity for paper with many mathematical equation (e.g., for mathematics,

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[1] see http://www.turnitin.com for detailed information

[2] see http://www.ithenticate.com, one of turnitin's product

engineering and computer science).Therefore, the selection of the tool is based more on the type of paper that is made (see Table 6).

Table 6 Publishing tool metrics

	Word	LaTex
Learning curve	low	high
Time to prepare document	long	short
Effort to format mathematical equation	high	low
Suitable for content	text only	math formula

Source(s): Adapted from Knauff & Nejasmic 2014

Journal Management Software

When the researchers finish the reports, publication is the next step. Publication is a media for researchers to share ideas, work and it becomes an academic footprint for a researcher. The credibility and competence of researcher is assessed from his publications. Thus, media for publication is very important. Types of publications include journals, proceedings or articles. Researchers can choose the suitable forms of publications and also choose whether paid or open access. Journals are usually specific to a field of science and a review process need quite long (many months from submit to publish). Proceedings publish follow the seminar that usually has a specific theme and shorter review process. Paid paper means someone has to pay a certain price for access to our paper, in contrast with the open access which is no cost to be incurred to read the results of our work.

To facilitate communication between researchers and reviewers, management and a clear path is necessary, it is the task of the publication manager. To assist the publication manager, especially for open access publication journal, open source software for managing electronic publications is available. This software facilitates researchers to send the manuscript and allows the reviewer to access it. Then, a manuscript that passes will be prepared to be indexed and published. Amenities indexing is usually included in the software package, eg indexed in DOAJ or Google Scholar. For institutions that wish to manage their own open access journal, there is available journal management software. Some of them are reviewed (Cyzyk & Choudhury, 2008), the survey shows there are 4 (four) systems (see Table 7), and recommends OJS (Open Journal System).

Table 7. Journal management system metrics

	OJS	DPubS	GNU Eprints	HyperJournal
Support multiple, discrete publications	Yes	Yes	Yes	No
Administrative roles	Complete (8 roles)	Editor and user only	Main adm., repository adm., editor, user	Author, adm., reviewer, editor
Submission	By author	Unclear	By author	By author
Editorial workflow	Not configurable	Unclear	Configurable	Customizable
Email alerts to authors, editors, reviewers	Yes	No	Author and editor	Editor and reviewer
Customized style per publication	Yes	Yes	Yes	Yes
Versioning	No	No	Yes	Yes
Archiving	Yes	No	Yes	No
Citation linking	Yes	No	No	Yes
Full-text search	Yes	Yes (Lucene)	Yes	No
Weakness	-	Complicated installation, poor documentation	Command-line installation	Complicated installation

Source(s): Data Adapted from Cyzyk & Choudhury 2008

Conference Management Software

Another type of publication is conference proceeding or call for paper. Typical workflow is author register an account, then submit an abstract, conference manager then assign the paper to a reviewer, if the abstract is accepted, the author will receive notification (usually by email), after payment, author will be asked for upload full paper to the system. Reviewer will check the full paper and make some comments on them to be revised by author. Final version of the paper (camera ready) have to be formatted according to conference's standard.

Institution that wish to hold a conference with a call for paper can use one of these free open source software (see Table 8). A survey has been conducted on five open source software, namely EDAS, Confious, OpenConf, ConfTool and PaperDyne (Jain, Tewari, & Singh, 2010), the paper recommends EDAS. We compare EDAS with two other popular systems EasyChair and Open Conference System (OCS). EDAS and OCS are installed software, while EasyChair is a web service that is more practical to use.

Table 8. Conference proceeding management metrics

	EasyChair	OCS	EDAS
Supported language	English	English, French, Spanish, Italian, Portuguese, Deutsch	English
Installation on server	No (web service)	Yes	Yes
Administrative roles	Author, reviewer, program committee, manager, chairs	Registration manager, director, track director, reviewer, author, registrant	Conference chairs, publication chairs, TPC, author, reviewer
Support multi conference	Yes	Yes	Yes
Conference website	Yes	Yes	Yes
Conference brochure	No	Yes	Yes
Conference program	Yes	Yes	Yes
License	Free, professional, executive	Free	Free
Email notifications	Yes	Yes	Yes (optional)
Online discussion	Yes	Yes (post-conference)	Yes
Plagiarism check	No	No	Yes
Online proceeding	Yes	Yes	Yes
Features	Springer LNCS	-	IEEE eCopyright

Source(s): Data Adapted from Jain, Tewari & Singh 2010 and internet

Benchmark Research

The purpose of benchmark research is to measure how significant the contribution of a research, this helps other researchers to find relevant and trusted sources easily. Along with the increasing volume of research, peer-review is not sufficient. Citation counting is useful but not sufficient, an influential work may remain uncited. Journal Impact Factor (JIF) which measures journals' average citation per article, is often incorrectly used to asses the impact of individual article (Priem, Taraborelli, Groth, & Neylon, 2010). H-index (Hirsch, 2005), it addresses many of the problems associated with impact factor. H-index is defined by how many h of a researcher's publications have at least h citations each. These significance of publication calculated by citation databases such as Web of Science, Scopus and also Google Scholar.

Scholars need alternate system to filter the most relevant and significant sources from the rest, this leads to altmetricss. Altmetricss is the future, it's not only consider count of view, download, cite, and save, but also discussion and recommendation in blog, social media and internet about a publication.

There are several altmetricss tools such as ImpactStory, ReaderMeter, ScienceCard, PLoS Impact Explorer, PaperCritic and Crowdometer[3]. Altmetricss are in their early stages, many question unanswered. It is still worth investing in, because of the rapid growth of the social web. ImpactStory for example, integrated with Twitter and ORCID account, gives rate to our publications based on user activities such as save number in Mendeley.

Table 9 Benchmark research metrics

	Peer-review	Citation count	H-index	JIF	Altmetricss
Score based on	Article	Article	Article	Journal	Article
Counts	Quality of the paper	How many citation does a publication have	how many h of a researcher's publications have at least h citations each	average citations for each article (in a journal) in 3 years	Storage, link, bookmark, comments and conversations about a publication
Advantages	Reliable, expert opinion	Easy	Can be used for comparing group of scientists, departments, programs	Helps scholars to select most influential journal	Fair, powerful, real time, crowdsource peer-review
Disadvantages	Need longer time, depends on human resources	Influential paper might be uncited	doesn't take account motivation of citation	A paper need years to be scored, secret trade, prone to manipulation	Difficult, still leaves many open question

Source(s): Data Adapted from various sources on the internet

CONCLUSION

This paper categorized research tool to 9 (nine) categories, they are 1) online database, 2) reference manager, 3) academic social network, 4) proofread and editor, 5) plagiarism check, 6) publishing tool, 7) journal management software, 8) conference management software, and 9) benchmark research. We make metrics for comparing those tools in each category and give our opinion against them.

REFERENCES

Axford, R., Grunwald, G., & Hyndman, R. (1996). Information technology in research. In *Health informatics—an overview*. incollection, Churchill Livingstone Oxford.

Butros, A., & Taylor, S. (2010). Managing information: evaluating and selecting citation management software, a look at EndNote, RefWorks, Mendeley and Zotero. In *Netting knowledge: two hemispheres/one world: proceedings of the 36th IAMSLIC Annual Conference* (pp. 17–21). inproceedings.

Castro, D. (2009). Meeting national and international goals for improving health care: The role of information technology in medical research. In *2009 Atlanta Conference on Science and Innovation Policy* (pp. 1–9). inproceedings.

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[3] see www.altmetricss.org/tools for detailed information on each tool

Cyzyk, M., & Choudhury, S. (2008). A survey and evaluation of open-source electronic publishing systems. *Unpublished Paper, Sheridan Libraries Staff Research*. article.

Haustein, S., & Larivière, V. (2014). Mendeley as the source of global readership by students and postdocs. In *IATUL Conference, Espoo, Finland, June 2-5 2014*. inproceedings.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. In *Proceedings of the National academy of Sciences of the United States of America* (pp. 16569–16572). JSTOR. http://doi.org/10.1073/pnas.0507655102

Jain, M., Tewari, T. K., & Singh, S. K. (2010). Survey of Conference Management Systems. *International Journal of Computer Applications*, *2*(2).

Jeng, W., He, D., & Jiang, J. (2015). User Participation in an Academic Social Networking Service: A Survey of Open Group Users on Mendeley. *Journal of the Association for Information Science and Technology*, *66*(5).

Jiang, J., Ni, C., He, D., & Jeng, W. (2013). Mendeley group as a new source of interdisciplinarity study: how do disciplines interact on mendeley? In *Proceedings of the 13th ACM/IEEE-CS joint conference on Digital libraries* (pp. 135–138). inproceedings.

Knauff, M., & Nejasmic, J. (2014). An Efficiency Comparison of Document Preparation Systems Used in Academic Research and Development. *PloS One*, *9*(12), e115069. article.

Mairesse, J., Greenan, N., & Topiol-Bensaid, A. (2001). *Information technology and research and development impacts on productivity and skills: Looking for correlations on French firm level data* (techreport).

Priem, J., Taraborelli, D., Groth, P., & Neylon, C. (2010). Altmetricss: A Manifesto. Retrieved September 27, 2016, from http://altmetricss.org/manifesto/

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