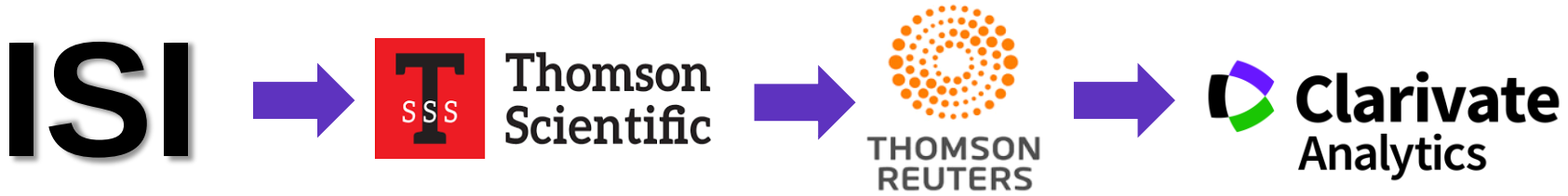

Web of Science Group
A Clarivate Analytics company
Web of Science –
The First Stop to Research Discovery
Find, Read and Publish in High Impact Journals

# The Web of Science Group

**The Web of Science Group has been pioneering the world of research for more than 60 years**, and powering innovation across the research ecosystem with best-in-class data, discovery, analytics, and tools




Web of Science Group

Time

Accuracy

Novelty

Impact

# How do you explore the literature?

- You read a paper that's useful to you. Then?

OPEN ACCESS Freely available online PLoS BIOLOGY

A Role for Parasites in Stabilising the Fig-Pollinator Mutualism

Derek W. Dunn[1,2,3], Simon T. Segar[1,2], Jo Ridley[3], Ruth Chan[1], Ross H. Crozier[4], Douglas W. Yu[3], James M. Cook[1,2,5]*

1 Division of Biology, Imperial College London, Ascot, United Kingdom, 2 School of Biological Sciences, University of Reading, Reading, United Kingdom, 3 School of Biological Sciences, University of East Anglia, Norwich, United Kingdom, 4 School of Marine and Tropical Biology, James Cook University, Townsville, Queensland, Australia, 5 Natural Environment Research Council (NERC) Centre for Population Biology, Imperial College London, Ascot, United Kingdom

**Mutualisms are interspecific interactions in which both players benefit. Explaining their maintenance is problematic, because cheaters should outcompete cooperative conspecifics, leading to mutualism instability. Monoecious figs (*Ficus*) are pollinated by host-specific wasps (Agaonidae), whose larvae gall ovules in their "fruits" (syconia). Female pollinating wasps oviposit directly into *Ficus* ovules from inside the receptive syconium. Across *Ficus* species, there is a widely documented segregation of pollinator galls in inner ovules and seeds in outer ovules. This pattern suggests that wasps avoid, or are prevented from ovipositing into, outer ovules, and this results in mutualism stability. However, the mechanisms preventing wasps from exploiting outer ovules remain unknown. We report that in *Ficus rubiginosa*, offspring in outer ovules are vulnerable to attack by parasitic wasps that oviposit from outside the syconium. Parasitism risk decreases towards the centre of the syconium, where inner ovules provide enemy-free space for pollinator offspring. We suggest that the resulting gradient in offspring viability is likely to contribute to selection on pollinators to avoid outer ovules, and by forcing wasps to focus on a subset of ovules, reduces their galling rates. This previously unidentified mechanism may therefore contribute to mutualism persistence independent of additional factors that invoke plant defences against pollinator oviposition, or physiological constraints on pollinators that prevent oviposition in all available ovules.**

Citation: Dunn DW, Segar ST, Ridley J, Chan R, Crozier RH, et al. (2008) A role for parasites in stabilising the fig-pollinator mutualism. PLoS Biol 6(3): e59. doi:10.1371/journal.pbio.0060059

**Introduction**

In a biosphere driven by selection at the level of the individual gene [1], explaining the existence of cooperation, such as mutualism, is a major scientific challenge. Mutualisms are interspecific ecological interactions characterised by reciprocal benefits to both partners [2] that usually involve costly investments by each. What factors thus prevent one partner from imposing unsustainable costs onto the other to enable mutualism stability [3–7]? In some mutualisms, the larger, more sessile partner, manipulates the other by directing benefits to cooperative individuals and costs to cheaters [4–7]. However, a general consensus on mutualism persistence has only recently been formulated, and this clearly shows that a high benefit-to-cost ratio of cooperating is one important factor [8,9].

Fig trees (*Ficus*) and their host-specific agaonid pollinator wasps are a classic example of an obligate mutualism [10,11]. The wasps pollinate the trees, and the trees provide resources for wasp offspring. In monoecious *Ficus*, female wasps push their way through a specialised entrance into receptive syconia (colloquially, "figs"), which are enclosed inflorescences. The wasps then pollinate the tree while depositing their eggs individually into ovules. Thus, each egg laid costs the tree one seed, but upon emergence, the female wasp offspring disperse that tree's pollen. Trees need to produce both wasps and seeds for the mutualism to persist, but natural selection should favour wasps that exploit the maximum number of fig ovules in the short term, resulting in a conflict of interest between wasp and tree. However, the mutualism has persisted for at least 60 million years and has radiated into more than 750 species pairs [12]. The mechanisms preventing wasps from overexploiting figs remain unknown, despite intensive study over four decades.

Within receptive syconia, the lengths of floral styles are highly variable [13,14], and ovipositing pollinators (foundresses) favour flowers with shorter styles for their offspring [15–18]. Style and pedicel lengths of flowers are negatively correlated. Short-styled ovules develop into seeds or galls (when a wasp is present) near the syconium inner cavity, while most long-styled ovules develop into seeds near the outer wall [19,20] (Figure 1). These patterns have been shown to reflect the oviposition preferences of foundresses, and are unlikely to be the result of greater elongation of pedicels containing eggs during syconial maturation, because in receptive syconia, pollinators' eggs are mainly present in short-styled inner ovules [16]. These widespread observations have been tied to four, not necessarily mutually exclusive, mechanisms that have been proposed to stabilise the fig-pollinator mutualism: (1) Unbeatable seeds—outer ovules may be defended biochemically or physically against oviposition or larval development [21]. However, no mechanism has yet been identified. (2) Short ovipositors—pollinators' ovipositors may be too short to fully penetrate the long styles of

**Academic Editor:** Anurag A. Agrawal, Cornell University, United States of America

**Received** September 14, 2007; **Accepted** January 22, 2008; **Published** March 11, 2008



**Abbreviation:** s.e., standard error

* To whom correspondence should be addressed. E-mail: james.cook@reading.ac.uk



**References**

Achenbach, T. M., & Edelbrock, C. (1983). *Manual for the Child Behavior Checklist and revised Child Behavior Profile.* Burlington: University of Vermont.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Berkson, J. (1946). Limitations of the application of fourfold table analysis to hospital data. *Biometrics Bulletin, 2,* 47–53.

Burke, J. D. (2007). Antisocial personality disorder. In A. Bell & M. Reinecke (Eds.), *Personality disorders in childhood* (pp. 429–494). New York, NY: Wiley.

**Key Question for all scholars:**

How do you find other **related** (new and old) papers?

**But** you can only find older papers, never newer ones.

Web of Science Group

# Keywords search is easy but often less robust than you think

ter

ang


Same plant but different names!

# What is a citation?

OPEN ACCESS Freely available online PLoS BIOLOGY

A Role for Parasites in Stabilising the Fig-Pollinator Mutualism

Derek W. Dunn[1,2,3], Simon T. Segar[1,2], Jo Ridley[3], Ruth Chan[3], Ross H. Crozier[4], Douglas W. Yu[5], James M. Cook[1,2,3]*

1 Division of Biology, Imperial College London, Ascot, United Kingdom, 2 School of Biological Sciences, University of Reading, Reading, United Kingdom, 3 School of Biological Sciences, University of East Anglia, Norwich, United Kingdom, 4 School of Marine and Tropical Biology, James Cook University, Townsville, Queensland, Australia, 5 Natural Environment Research Council (NERC) Centre for Population Biology, Imperial College London, Ascot, United Kingdom

**Mutualisms are interspecific interactions in which both players benefit. Explaining their maintenance is problematic, because cheaters should outcompete cooperative conspecifics, leading to mutualism instability. Monoecious figs (*Ficus*) are pollinated by host-specific wasps (Agaonidae), whose larvae gall ovules in their "fruits" (syconia). Female pollinating wasps oviposit directly into *Ficus* ovules from inside the receptive syconium. Across *Ficus* species, there is a widely documented segregation of pollinator galls in inner ovules and seeds in outer ovules. This pattern suggests that wasps avoid, or are prevented from ovipositing into, outer ovules, and this results in mutualism stability. However, the mechanisms preventing wasps from exploiting outer ovules remain unknown. We report that in *Ficus rubiginosa*, offspring in outer ovules are vulnerable to attack by parasitic wasps that oviposit from outside the syconium. Parasitism risk decreases towards the centre of the syconium, where inner ovules provide enemy-free space for pollinator offspring. We suggest that the resulting gradient in offspring viability is likely to contribute to selection on pollinators to avoid outer ovules, and by forcing wasps to focus on a subset of ovules, reduces their galling rates. This previously unidentified mechanism may therefore contribute to mutualism persistence independent of additional factors that invoke plant defences against pollinator oviposition, or physiological constraints on pollinators that prevent oviposition in all available ovules.**

Citation: Dunn DW, Segar ST, Ridley J, Chan R, Crozier RH, et al. (2008) A role for parasites in stabilising the fig-pollinator mutualism. PLoS Biol 6(3): e59. doi:10.1371/journal.pbio.0060059

**Introduction**

In a biosphere driven by selection at the level of the individual gene [1], explaining the existence of cooperation, such as mutualism, is a major scientific challenge. Mutualisms are interspecific ecological interactions characterised by reciprocal benefits to both partners [2] that usually involve costly investments by each. What factors thus prevent one partner from imposing unsustainable costs onto the other to enable mutualism stability [3–7]? In some mutualisms, the larger, more sessile partner, manipulates the other by directing benefits to cooperative individuals and costs to cheaters [4–7]. However, a general consensus on mutualism persistence has only recently been formulated, and this clearly shows that a high benefit-to-cost ratio of cooperating is one important factor [8,9].

Fig trees (*Ficus*) and their host-specific agaonid pollinator wasps are a classic example of an obligate mutualism [10,11]. The wasps pollinate the trees, and the trees provide resources for wasp offspring. In monoecious *Ficus*, female wasps push their way through a specialised entrance into receptive syconia (colloquially, "figs"), which are enclosed inflorescences. The wasps then pollinate the tree while depositing their eggs individually into ovules. Thus, each egg laid costs the tree one seed, but upon emergence, the female wasp offspring dispense that tree's pollen. Trees need to produce both wasps and seeds for the mutualism to persist, but natural selection should favour wasps that exploit the maximum number of fig ovules in the short term, resulting in a conflict of interest between wasp and tree. However, the mutualism has persisted for at least 60 million years and has radiated into more than 750 species pairs [12]. The mechanisms preventing wasps from overexploiting figs remain unknown, despite intensive study over four decades.

Within receptive syconia, the lengths of floral styles are highly variable [13,14], and ovipositing pollinators (foundresses) favour flowers with shorter styles for their offspring [13–18]. Style and pedicel lengths of flowers are negatively correlated. Short-styled ovules develop into seeds or galls (when a wasp is present) near the syconium inner cavity, while most long-styled ovules develop into seeds near the outer wall [19,20] (Figure 1). These patterns have been shown to reflect the oviposition preferences of foundresses, and are unlikely to be the result of greater elongation of pedicels containing eggs during syconial maturation, because in receptive syconia, pollinators' eggs are mainly present in short-styled inner ovules [16]. These widespread observations have been tied to four, not necessarily mutually exclusive, mechanisms that have been proposed to stabilise the fig-pollinator mutualism: (1) Unbeatable seeds—outer ovules may be defended biochemically or physically against oviposition or larval development [21]. However, no mechanism has yet been identified. (2) Short ovipositors—pollinators' ovipositors may be too short to fully penetrate the long styles of

Academic Editor: Anurag A. Agrawal, Cornell University, United States of America

Received September 14, 2007; Accepted January 22, 2008; Published March 11, 2008



Abbreviation: s.e., standard error

* To whom correspondence should be addressed. E-mail: james.cook@reading.ac.uk



**References**

Achenbach, T. M., & Edelbrock, C. (1983). *Manual for the Child Behavior Checklist and revised Child Behavior Profile.* Burlington: University of Vermont.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Berkson, J. (1946). Limitations of the application of fourfold table analysis to hospital data. *Biometrics Bulletin, 2,* 47–53.

Burke, J. D. (2007). Antisocial personality disorder. In A. Bell & M. Reinecke (Eds.), *Personality disorders in childhood* (pp. 429–494). New York, NY: Wiley.

- A **citation** is a reference to other published materials
- A **citation index** is a database that captures all references of items, allowing the user to easily establish which later documents cite which earlier documents

**What this means to you:**

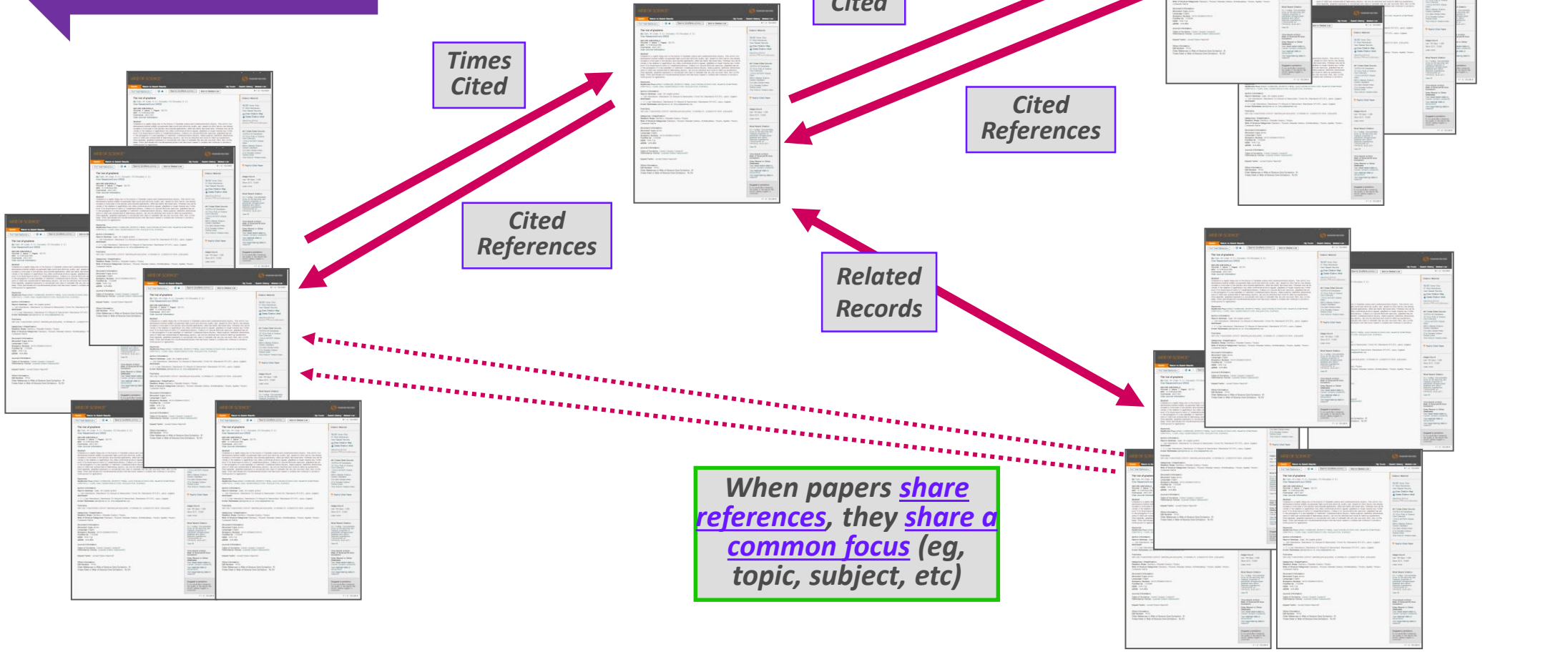
Using the citation index, you can easily find older and newer RELATED papers.

Web of Science Group

# Citation linkages help you find related materials efficiently

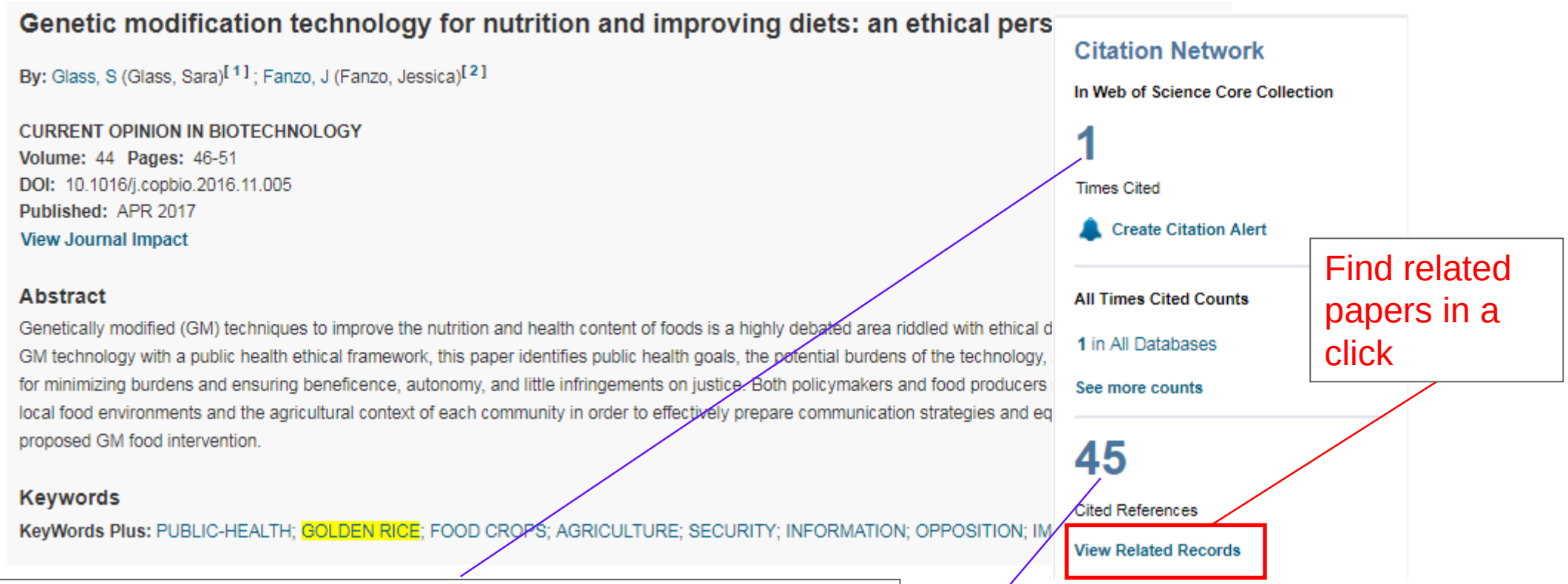
*Look back through Cited References on how this idea was developed*

*Look forward through Citations to see how this paper lead to new ideas*




Web of Science Group

# Example of how using citation index helps you retrieve better information




Find related papers in a click

This item has been referenced by 1 other paper.

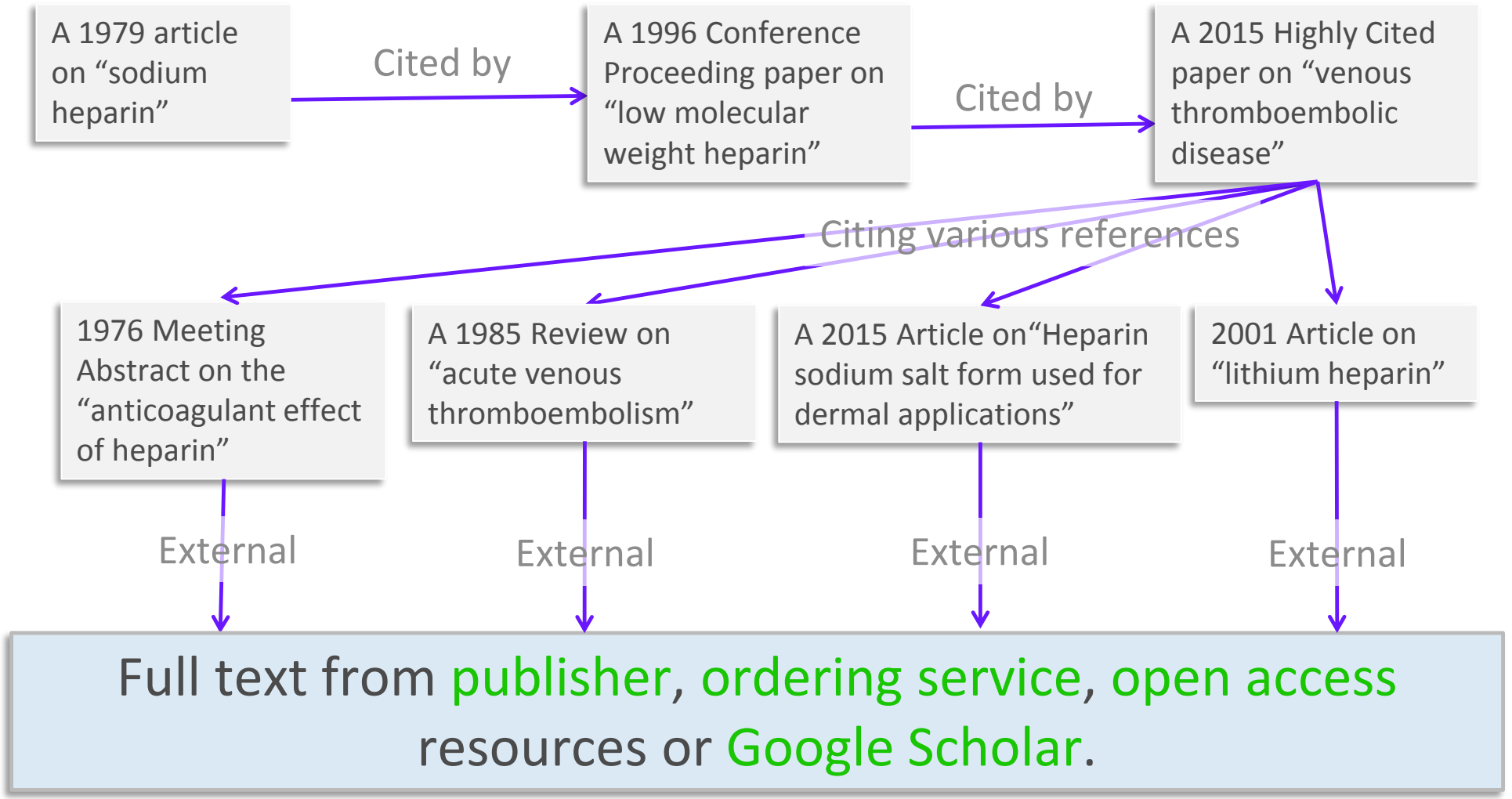
**What this means:**

A more recent paper has used this paper in some way. You should find out!

Look at the bibliography of the papers quickly without reading the full paper.

Web of Science Group

# Using a citation index, you can navigate BOTH forward and backward in literature



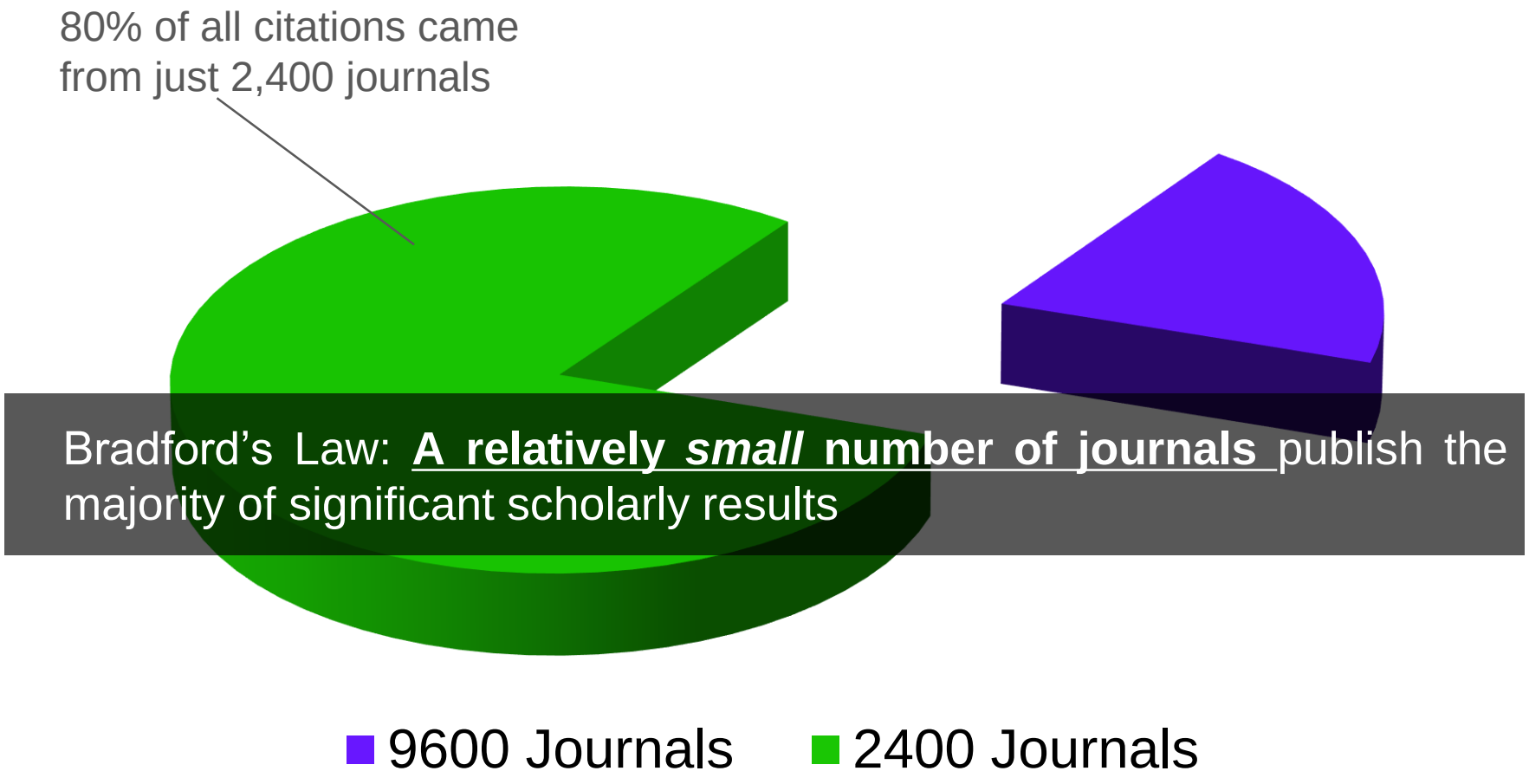

Web of Science Group

# What do these have in common?

**All of them exists in overwhelming numbers!**


Web of Science Group

# How many journals do you need?




Bradford, S.C., *Sources of information on specific subjects.* Engineering: An Illustrated Weekly Journal 1934. **137**: p. 85-86.

# The Web of Science Core Collection

A trusted, high quality selection of journals, books and conference proceedings

# The Web of Science Core Collection is designed to be selective in coverage


**~21,000**

Total journals in *Core Collection*

**65 Million**

Source Items

**200,000+**

Conference records

**1 Billion+**

Cited References

**100,000+**

Books

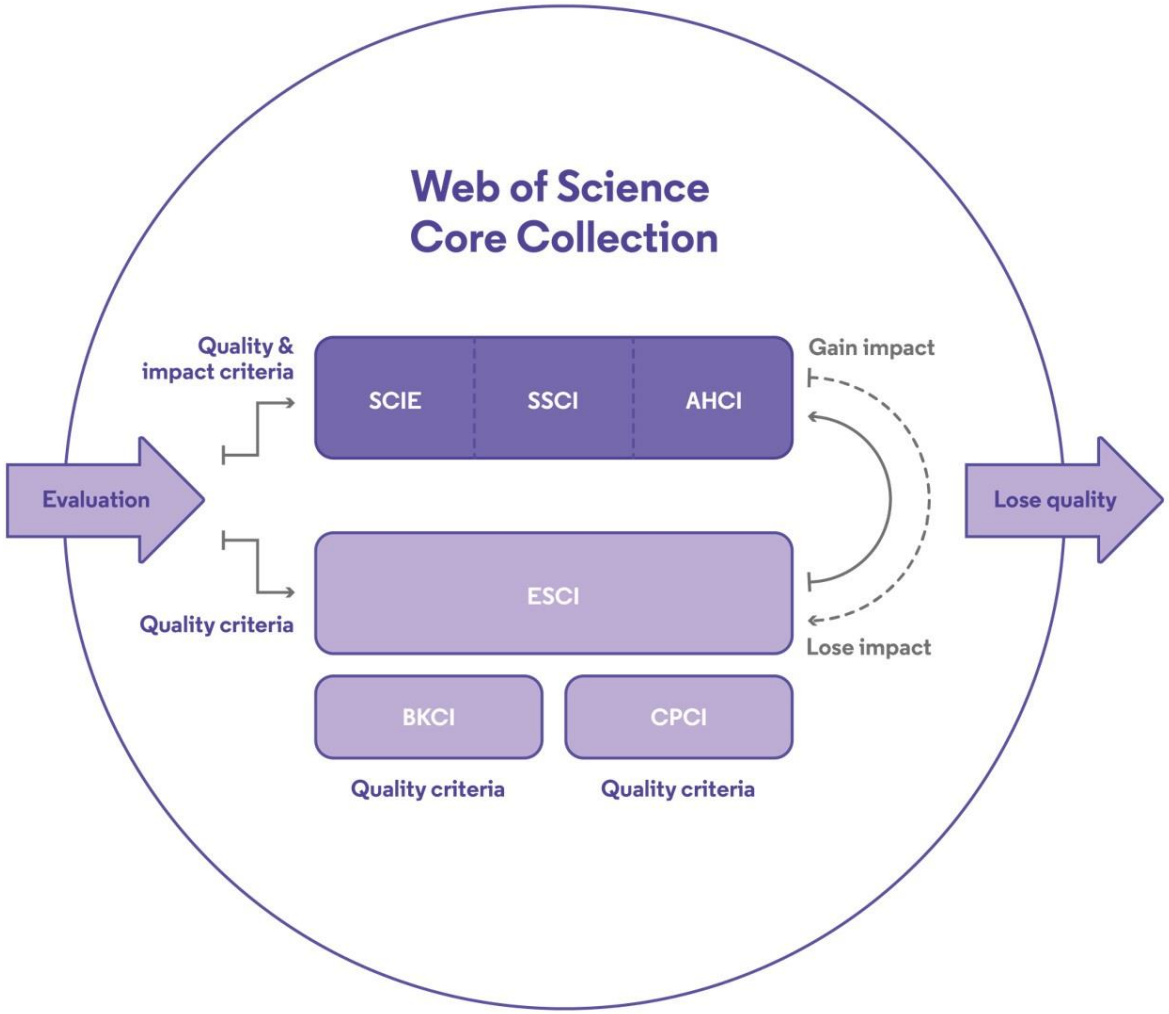
**Backfiles to 1900**

With cover-to-cover indexing

# The Web of Science Core Collection

## The Heart of the Web of Science Platform

**The Web of Science Core Collection is a trusted, high quality collection of journals, books and conference proceedings**



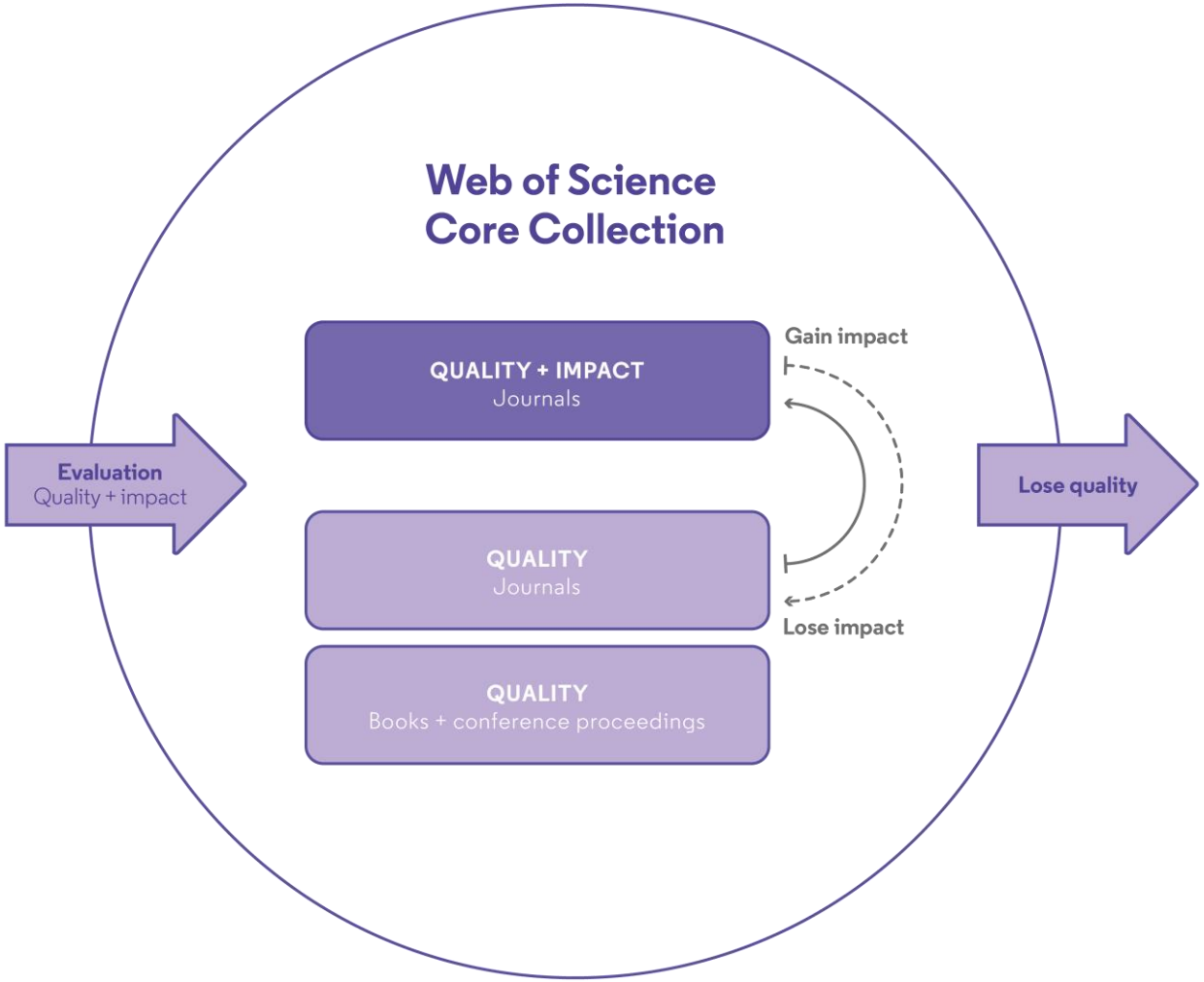

*Curated by a professional and publisher-neutral expert team of in-house Web of Science editors*

Web of Science Group

# The Web of Science Core Collection

## The Heart of the Web of Science Platform

**The Web of Science Core Collection is a trusted, high quality collection of journals, books and conference proceedings**

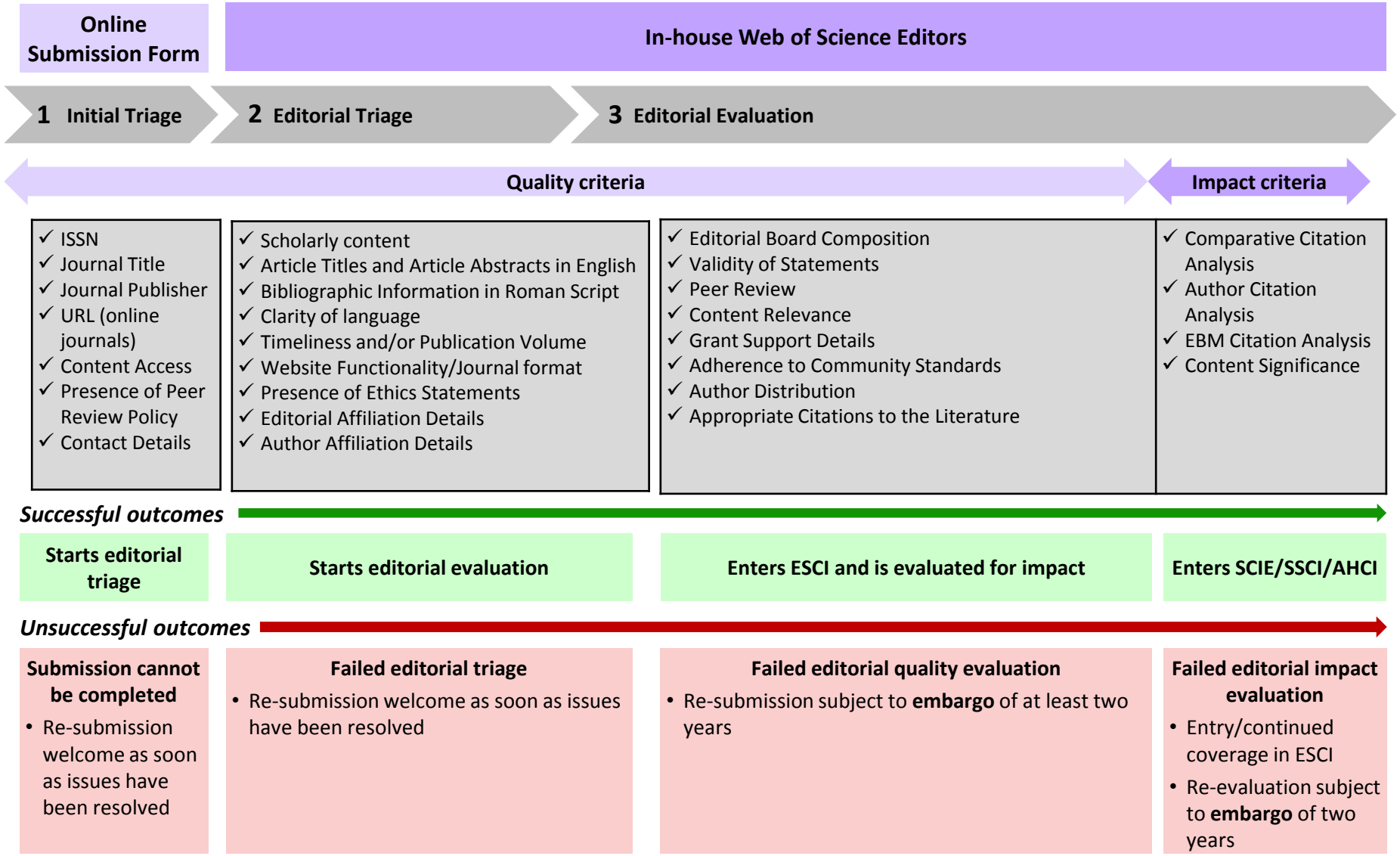



**From a researcher perspective this significantly reduces search costs**

Web of Science Group

# Editorial workflow

Improving speed and transparency through an updated journal evaluation process



# The definitive resource for trusted Open Access

Helping the research community discover, evaluate and access high-quality Open Access content

## An unbiased view of Open Access

**Discover and access trusted peer-reviewed OA with confidence** – and find non-predatory OA journals to publish in

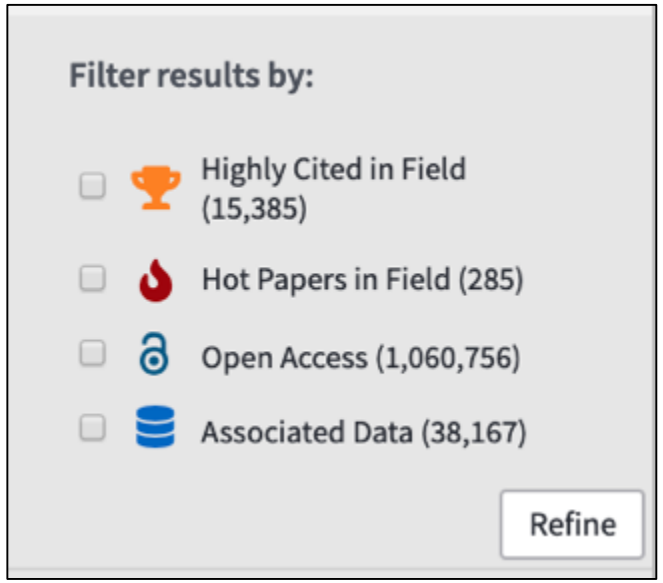
**Extend your full text budget** with seamless access to millions of OA articles

Understand the **impact of your institution's investment** in Open Access

Clarivate provided initial grant to non-profit Impactstory to improve their OA detection and versioning technology **for Web of Science users and the community**

Impactstory

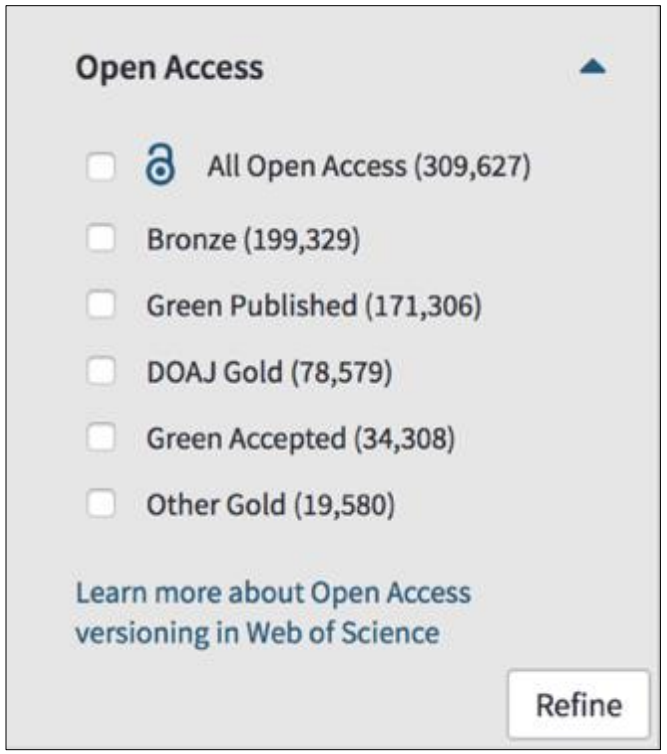
December 2017 - Discovery







October 2018 - Assessment



# Demo
# www.webofscience.com

# Researchers Use Cases

- **Find additional keywords to search**
  - Use “Keywords” and “Keywords Plus” from a related paper
- **Finding Related Information**
  - Use “View Related Records” Function
- **Finding Classic Important Papers**
  - Sort search results by “Times Cited”
- **Finding Recently Popular Papers**
  - Sort search results by “Usage Count Last 180 Days”

# Researchers Use Cases

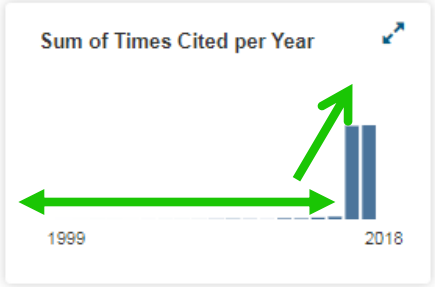
- **Find right journals for your papers**
  - Analyze topic search results by “Source Titles”
- **Finding potential collaborators**
  - Analyze topic search results by “Author” or “Organizations-Enhanced”
- **Improve your efficiency**
  - Create “Citation Alert”
  - Save “Marked Lists” for important documents

# Librarian Use Cases

- **Tracking Institution research output**
  - Search using “Organization-Enhanced”
  - Create “Alert” to be informed of new papers
  - “Create Citation Report” to see trends and citation performance
  - Records can be saved in “Marked Lists” or downloaded into text/excel files
- **Find journals important for your institution**
  - Search using “Organization-Enhanced”
  - Analyze search results by “Source Titles”

# Simple Analytics with WoS

# WoS comes with simple analytical tools


*h*-index
82

Average citations per item
9.08

Sum of Times Cited
28,321

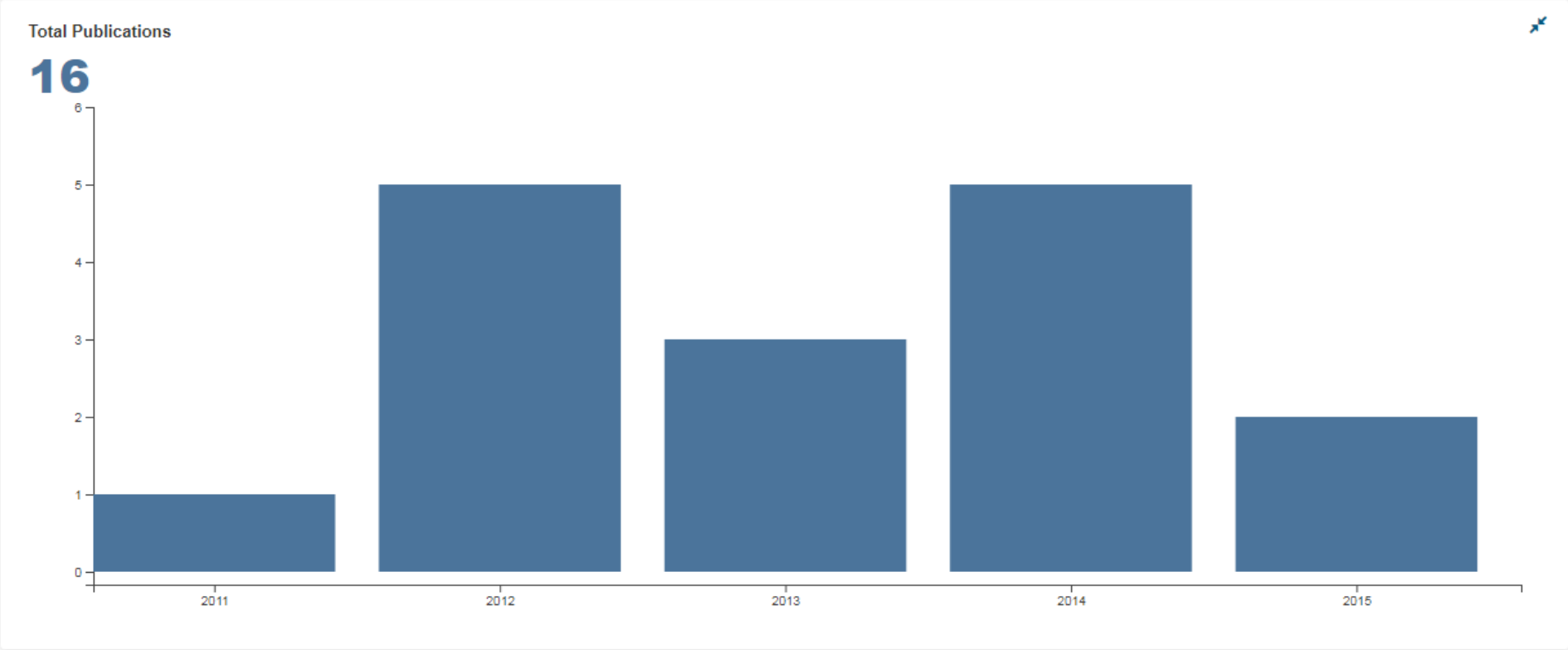
Without self citations
2,914

Citing articles
4,521

Without self citations
2,148

Web of Science Group

# Citation Report Can be Used to Analyze Your Own Publications




Sum of Times Cited per Year

1999 2018

*h*-index
11

Average citations per item
72.81

Sum of Times Cited
1,165

Without self citations
1,154

Citing articles
1,118

Without self citations
1,113

Web of Science Group

# Analyze your search results

## Institutions publishing on the topic “Zika”:

# Analyze your search results

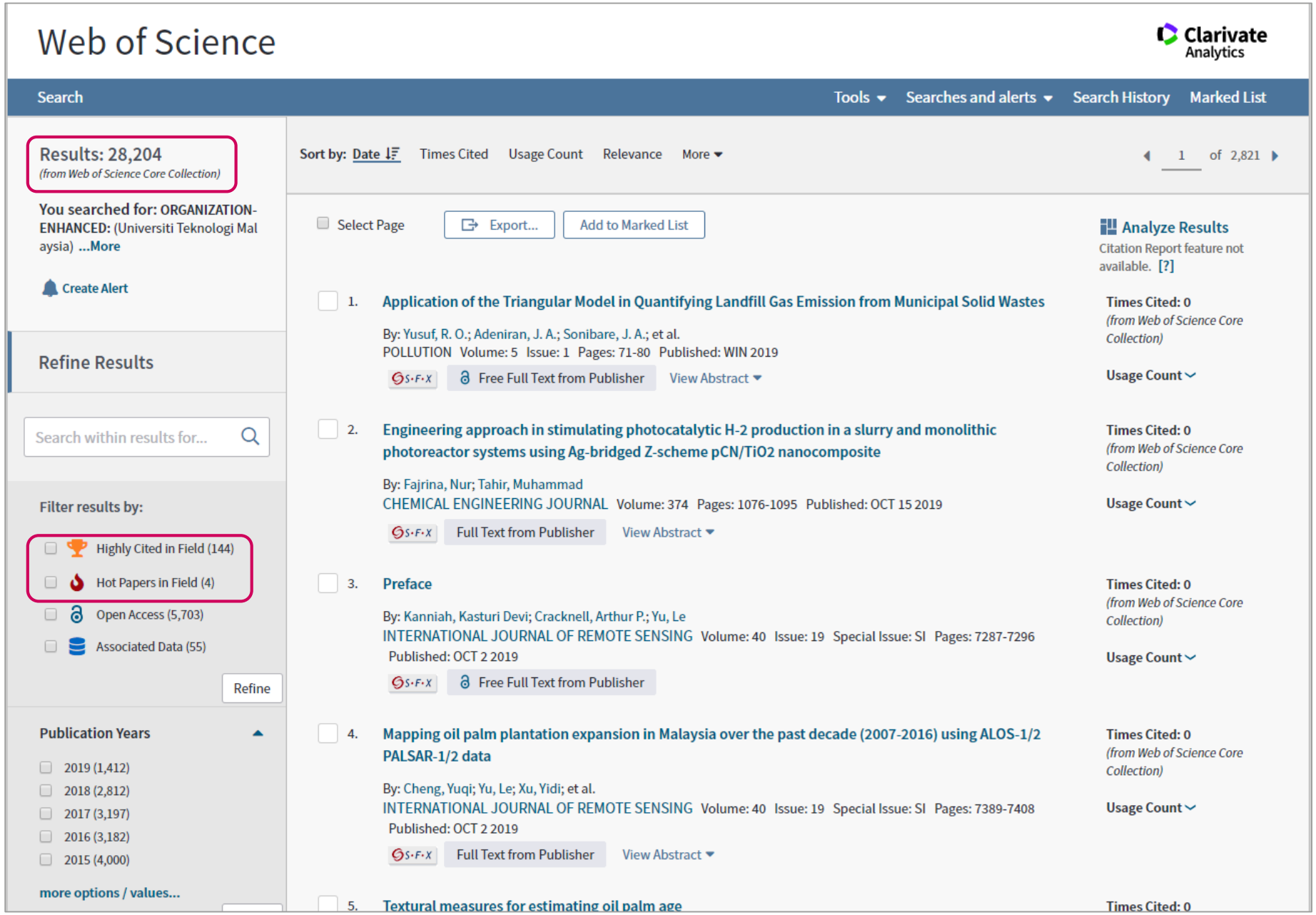
## Authors publishing on the topic “Zika”:

| Select | Field: Authors | Record Count | % of 4629 | Bar Chart |
|---|---|---|---|---|
| ☐ | WIWANITKIT V | 132 | 2.852 % | |
| ☐ | ANONYMOUS | 82 | 1.771 % | |
| ☐ | MUSSO D | 51 | 1.102 % | |
| ☐ | BENELLI G | 50 | 1.080 % | |
| ☐ | JOOB B | 49 | 1.059 % | |
| ☐ | DIAMOND MS | 42 | 0.907 % | |
| ☐ | QIN CF | 39 | 0.843 % | |
| ☐ | HARRIS E | 38 | 0.821 % | |
| ☐ | JAMIESON DJ | 38 | 0.821 % | |
| ☐ | WEAVER SC | 38 | 0.821 % | |
| ☐ | HONEIN MA | 37 | 0.799 % | |
| ☐ | SHI PY | 35 | 0.756 % | |
| ☐ | RODRIGUEZ-MORALES AJ | 34 | 0.734 % | |

# Universiti Teknologi Malaysia's Research Performance

on the Web of Science

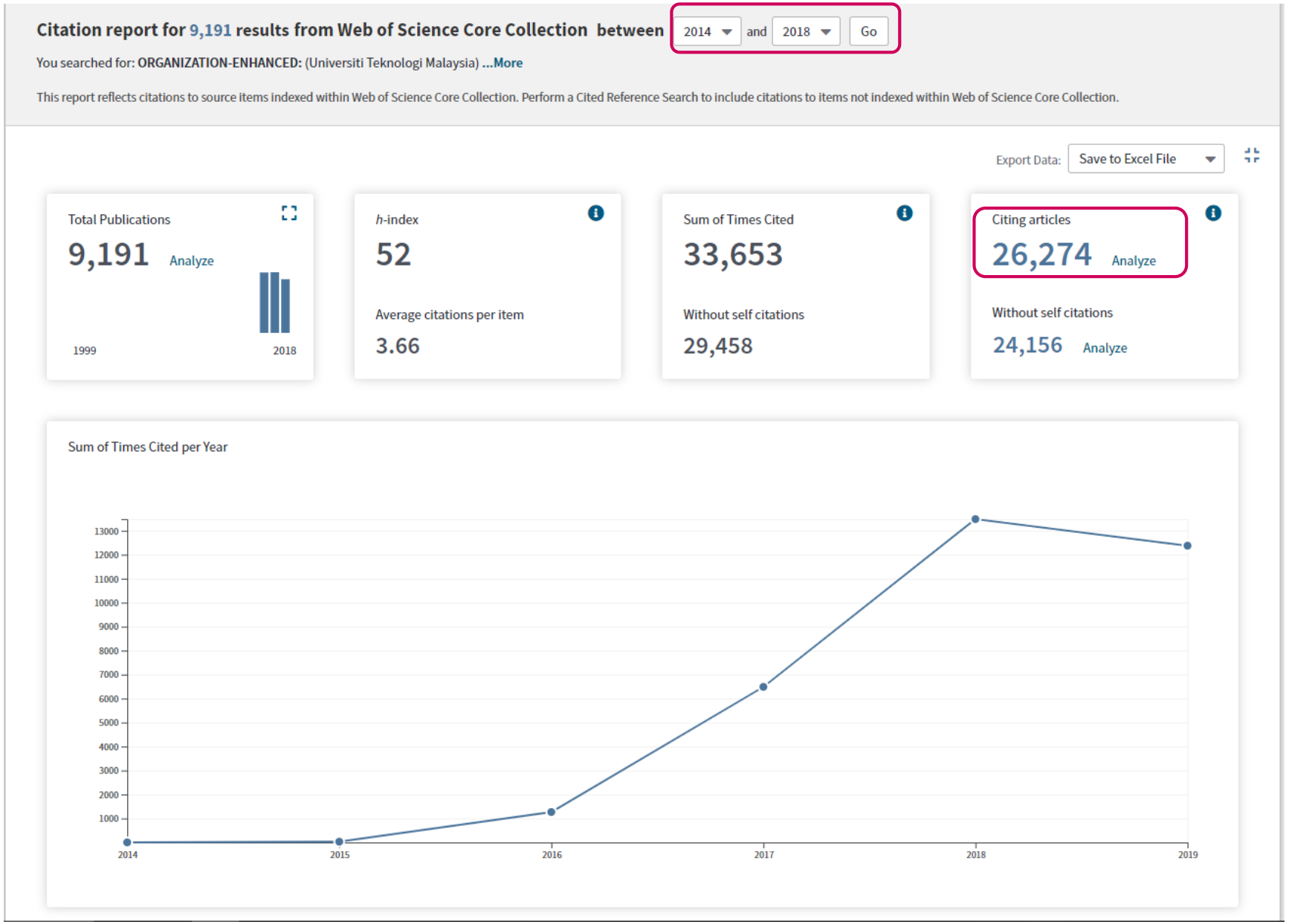
# UTM's Research Output



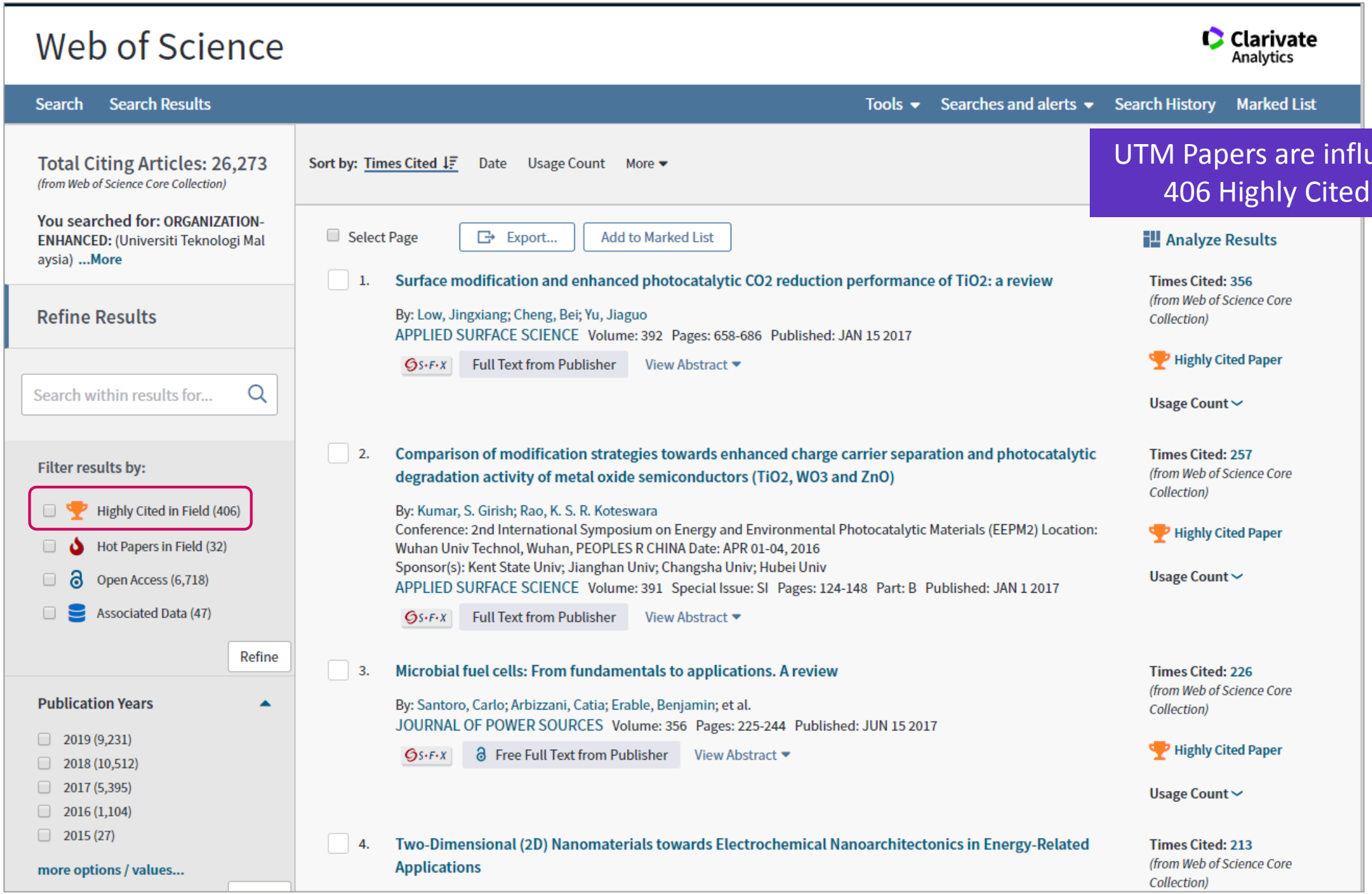

Web of Science Group

As of 13 Aug 2019

# Citation Report




Web of Science Group




UTM Papers are influencing 406 Highly Cited Papers

Web of Science Group

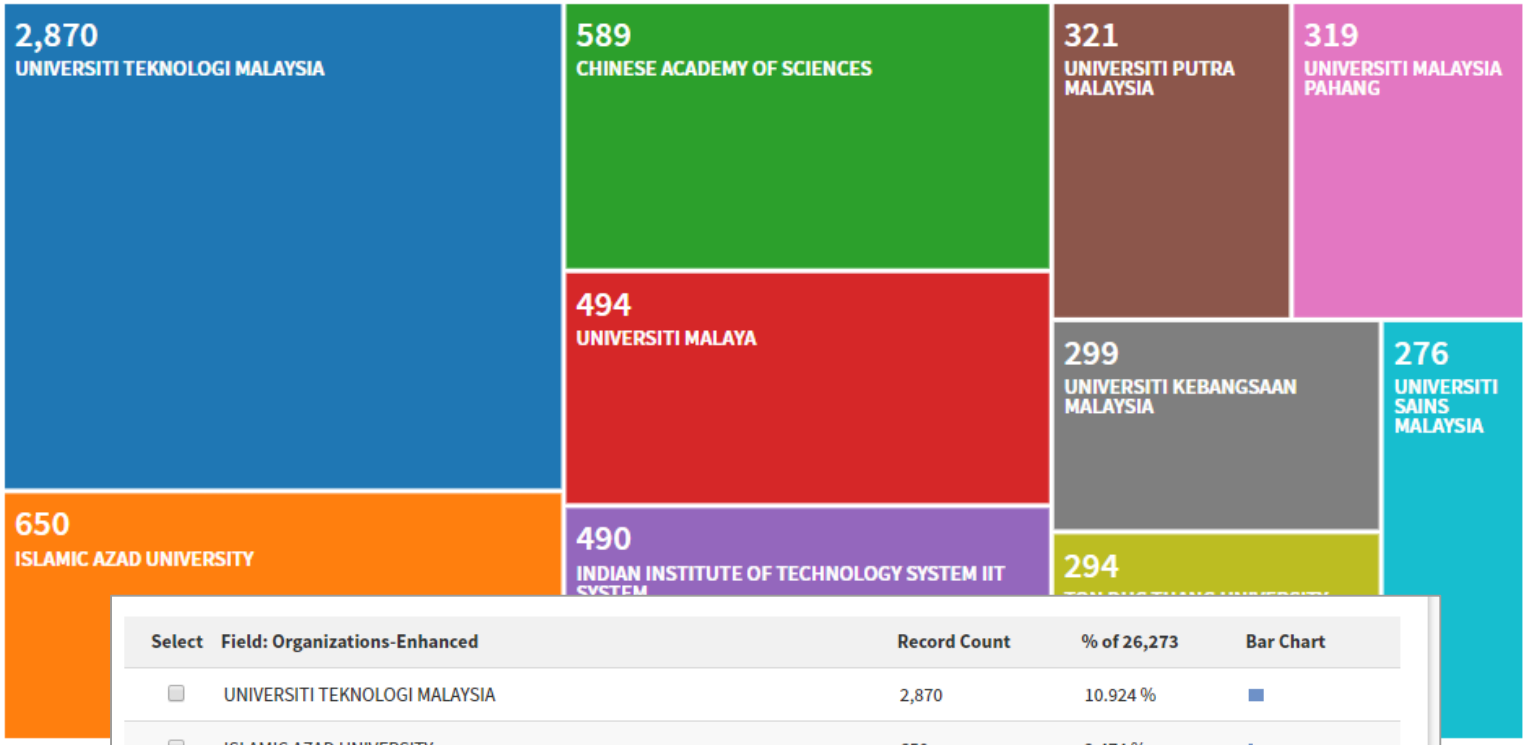
**Results Analysis**
<<Back to previous page

- Web of Science Categories
- Publication Years
- Document Types
- Organizations-Enhanced
- Funding Agencies
- Authors
- Source Titles
- Book Series Titles
- Meeting Titles
- Countries/Regions
- Editors
- Group Authors
- Languages
- Research Areas
- Grant Numbers
- Organizations

**Showing 26,273 records for** Total Citing Articles: **ORGANIZATION-ENHANCED:** (Universiti Teknologi Malaysia)
...More

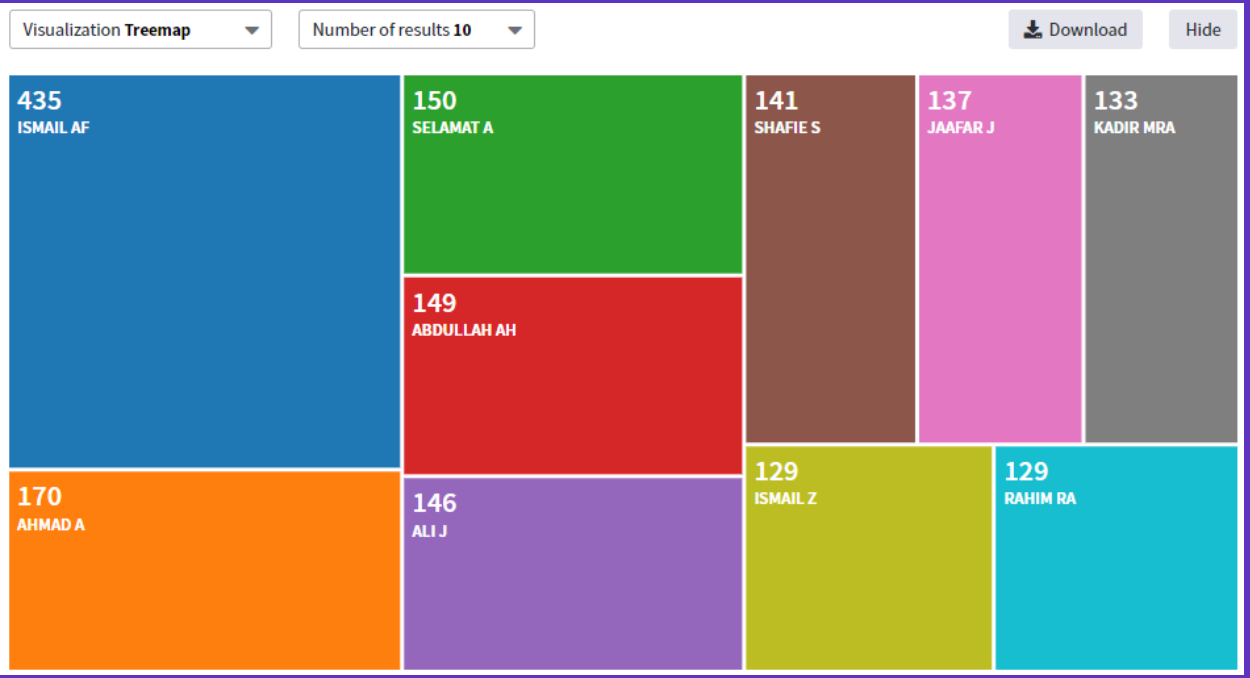
Further analyse which Institutions are citing your papers

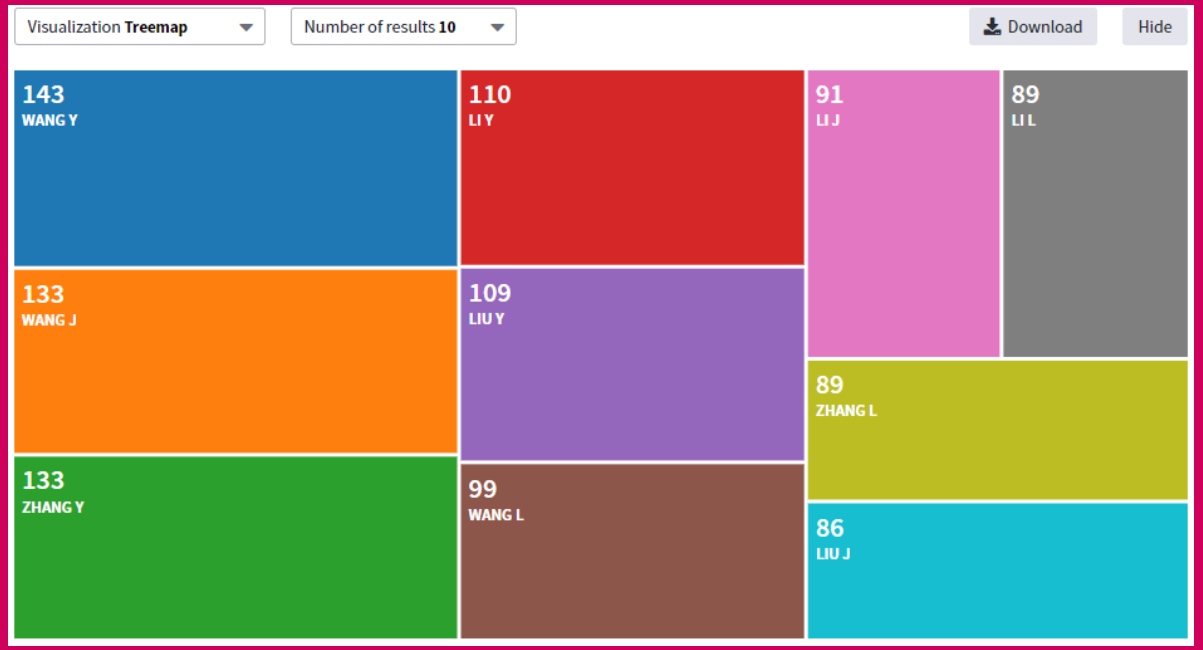
Visualization **Treemap** | Number of results **10**




| Select | Field: Organizations-Enhanced | Record Count | % of 26,273 | Bar Chart |
|---|---|---|---|---|
| ☐ | UNIVERSITI TEKNOLOGI MALAYSIA | 2,870 | 10.924 % | |
| ☐ | ISLAMIC AZAD UNIVERSITY | 650 | 2.474 % | |
| ☐ | CHINESE ACADEMY OF SCIENCES | 589 | 2.242 % | |
| ☐ | UNIVERSITI MALAYA | 494 | 1.880 % | |
| ☐ | INDIAN INSTITUTE OF TECHNOLOGY SYSTEM IIT SYSTEM | 490 | 1.865 % | |
| ☐ | UNIVERSITI PUTRA MALAYSIA | 321 | 1.222 % | |
| ☐ | UNIVERSITI MALAYSIA PAHANG | 319 | 1.214 % | |
| ☐ | UNIVERSITI KEBANGSAAN MALAYSIA | 299 | 1.138 % | |
| ☐ | TON DUC THANG UNIVERSITY | 294 | 1.119 % | |

# UTM Top Authors



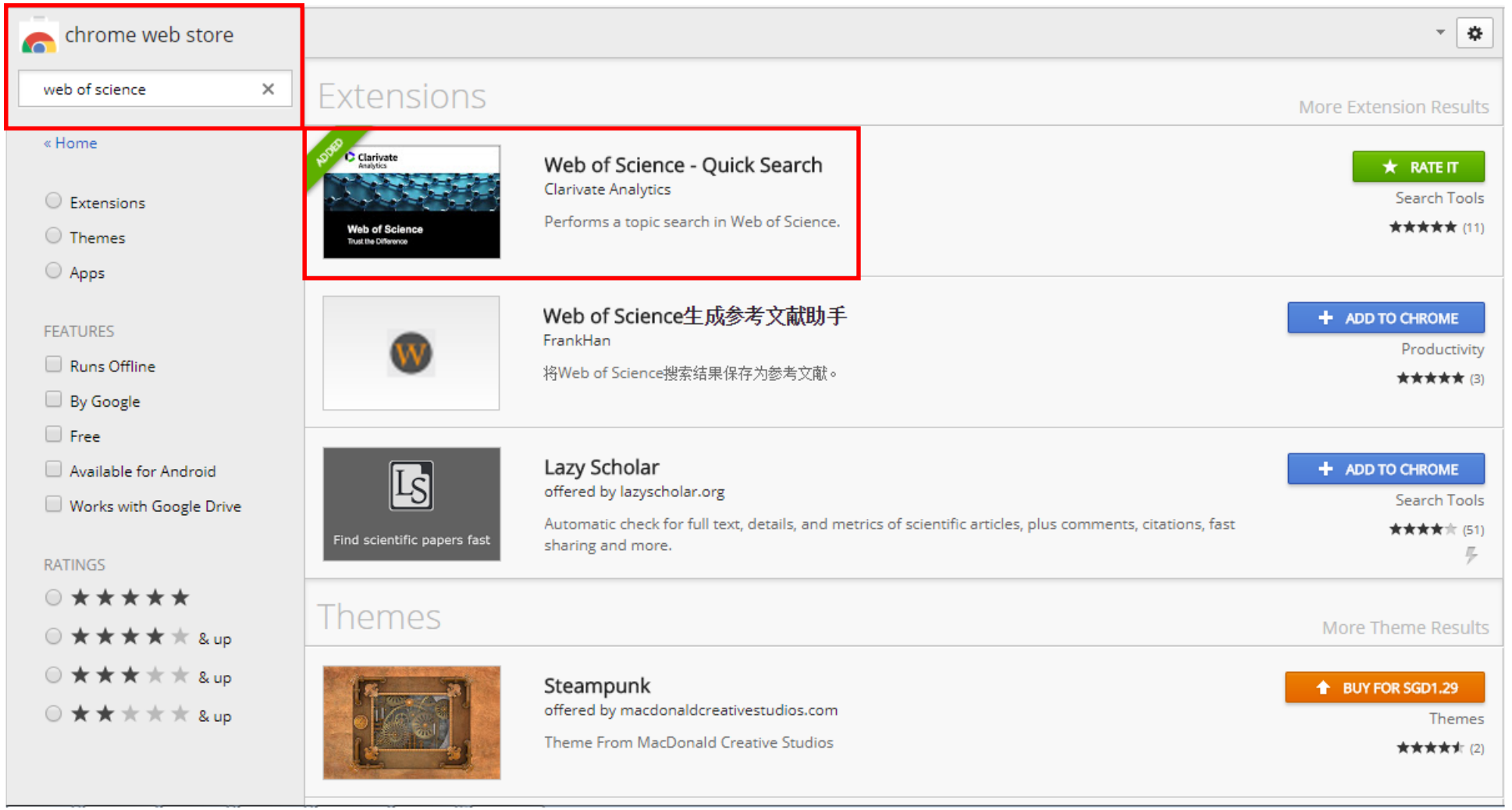

# Top Authors Citing UTM Papers

Web of Science Group

# Add-On Tools

# You can install the Chrome Extension and search WoS from anywhere

https://chrome.google.com/webstore/search/web%20of%20science

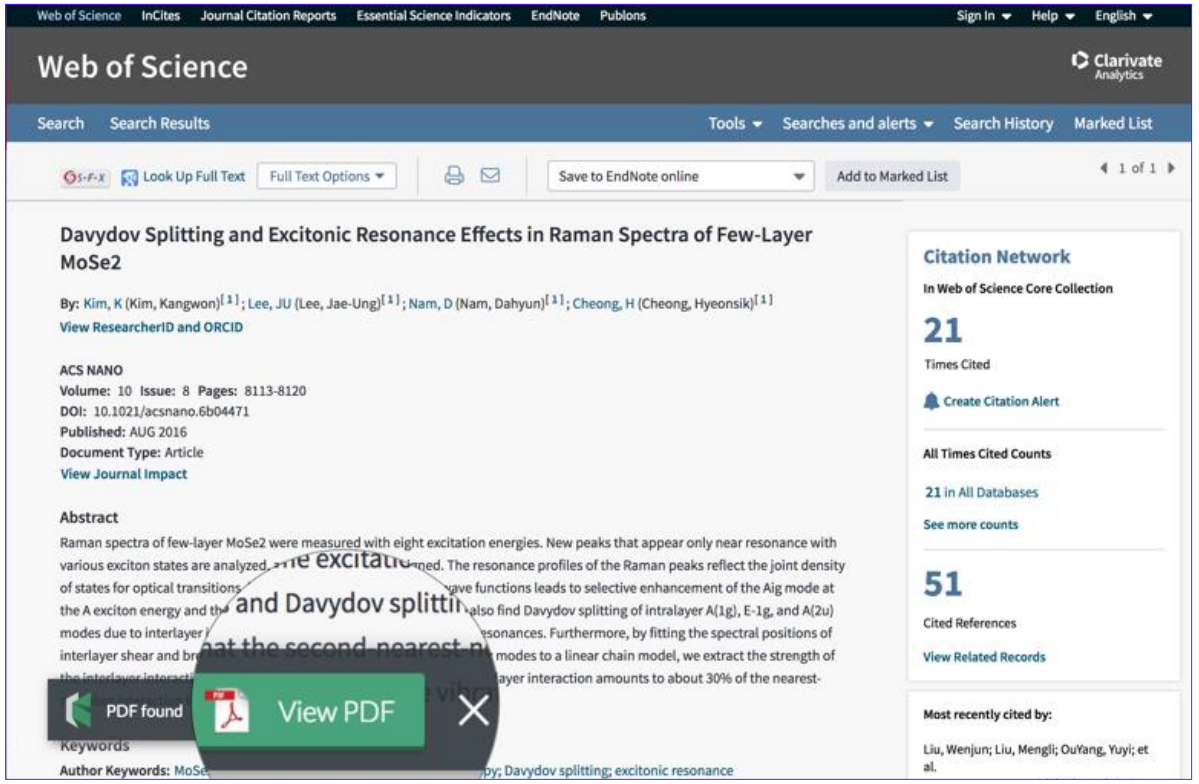



Web of Science Group

# Kopernio provides one-click access to legal PDFs

**Kopernio is a browser plug-in that delivers the best available PDF at your point of need, based on your library's subscription.**

- You can install and use Kopernio for free.
- Workflow automation tool finds PDFs as you browse the internet.
- Integrates with over 20 thousand scholarly sites, including Google Scholar and Pubmed.
- Always attempts to point you to the final published paper.
- Records usage in your COUNTER reports.
- Increases reach and impact of your institutional subscriptions.




[Install in Chrome](#)

[Firefox Extension](#)

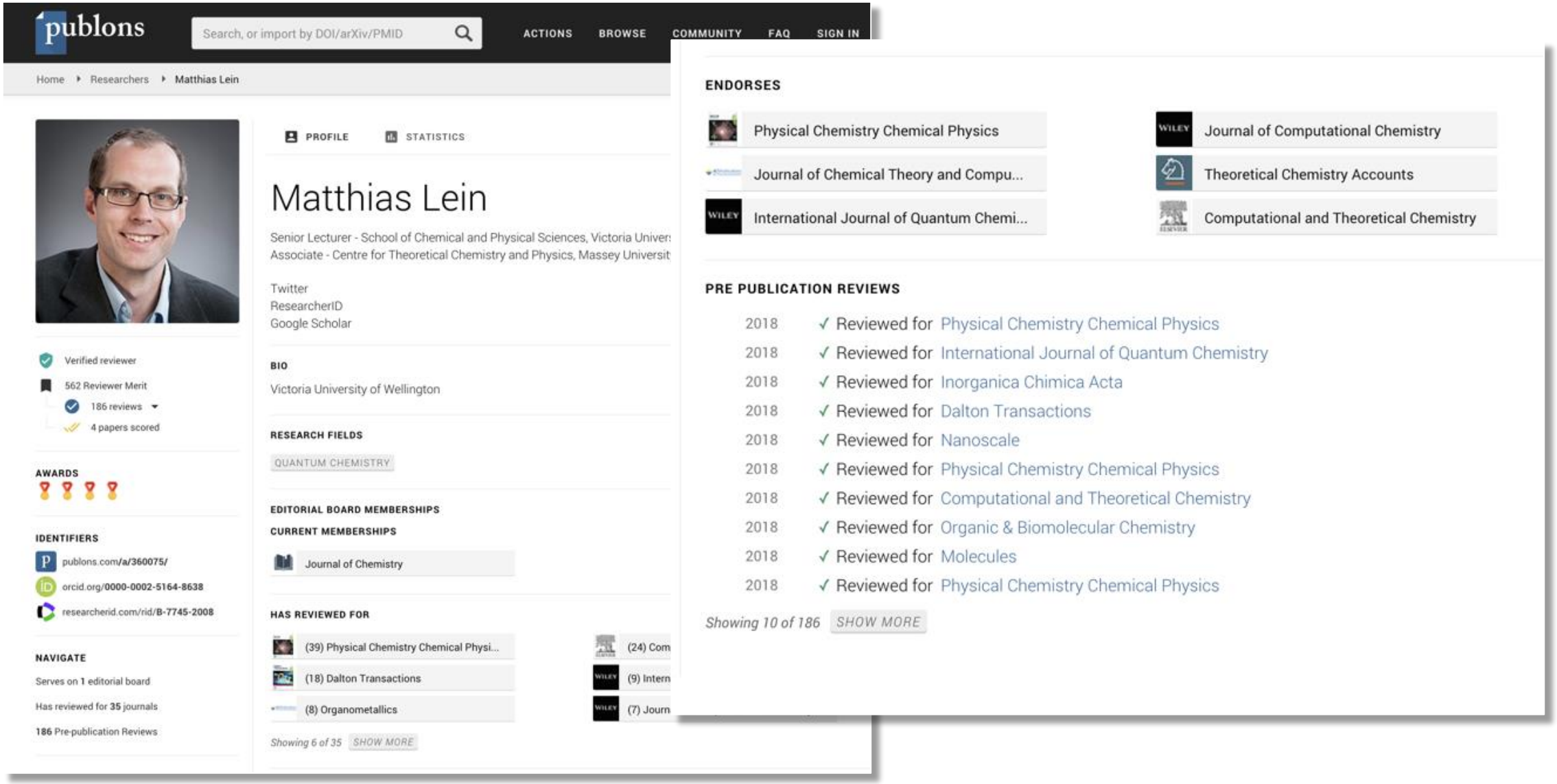
[More information for libraries](#)

Clarivate Analytics

# Publons

To Track Researchers’ Reviews and Publications

# Visibility and discoverability of peer reviews via Publons



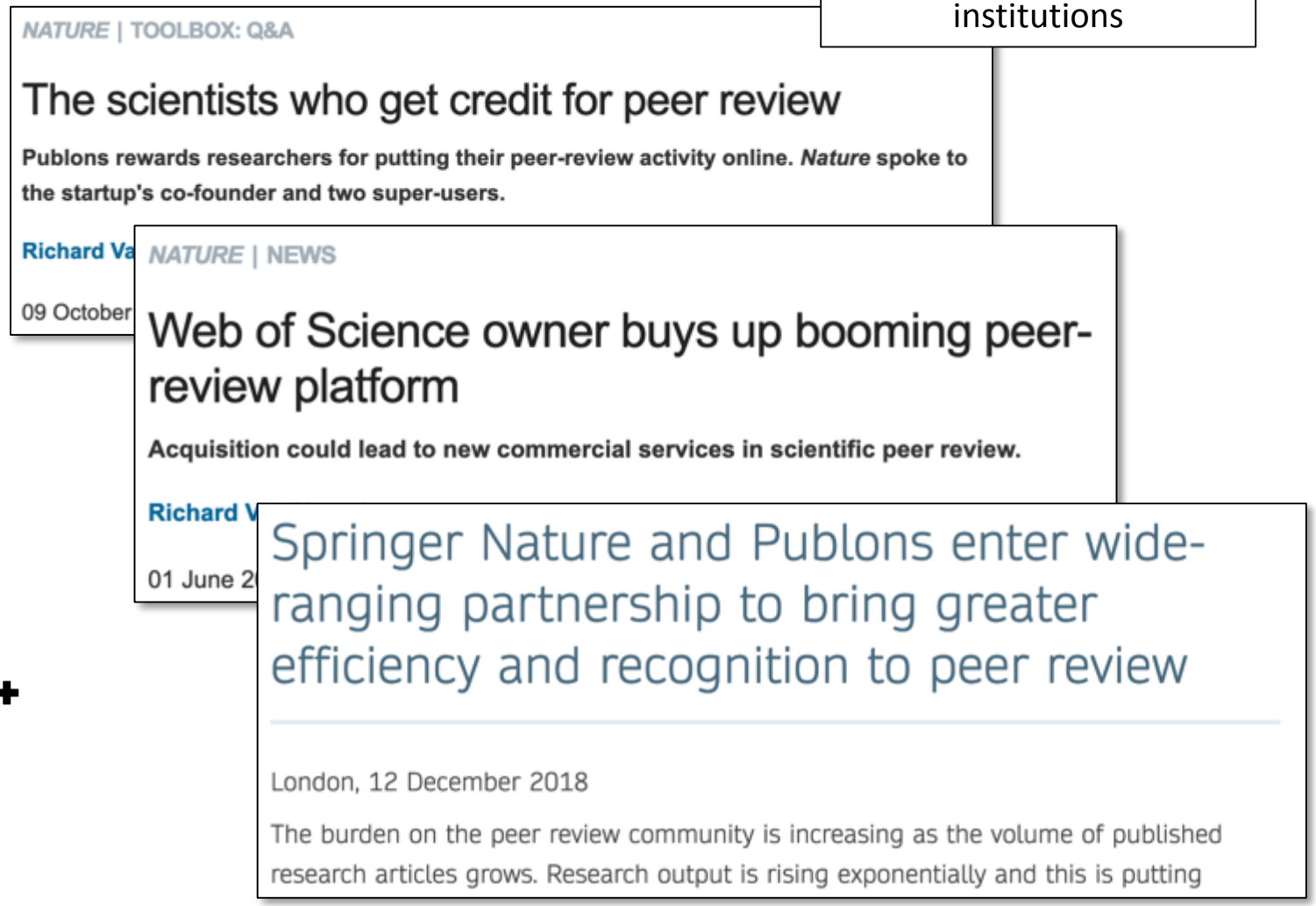

Web of Science Group

# What is Publons?

Helping researchers get credit for peer review activities

**253**
Users with profiles at your institutions

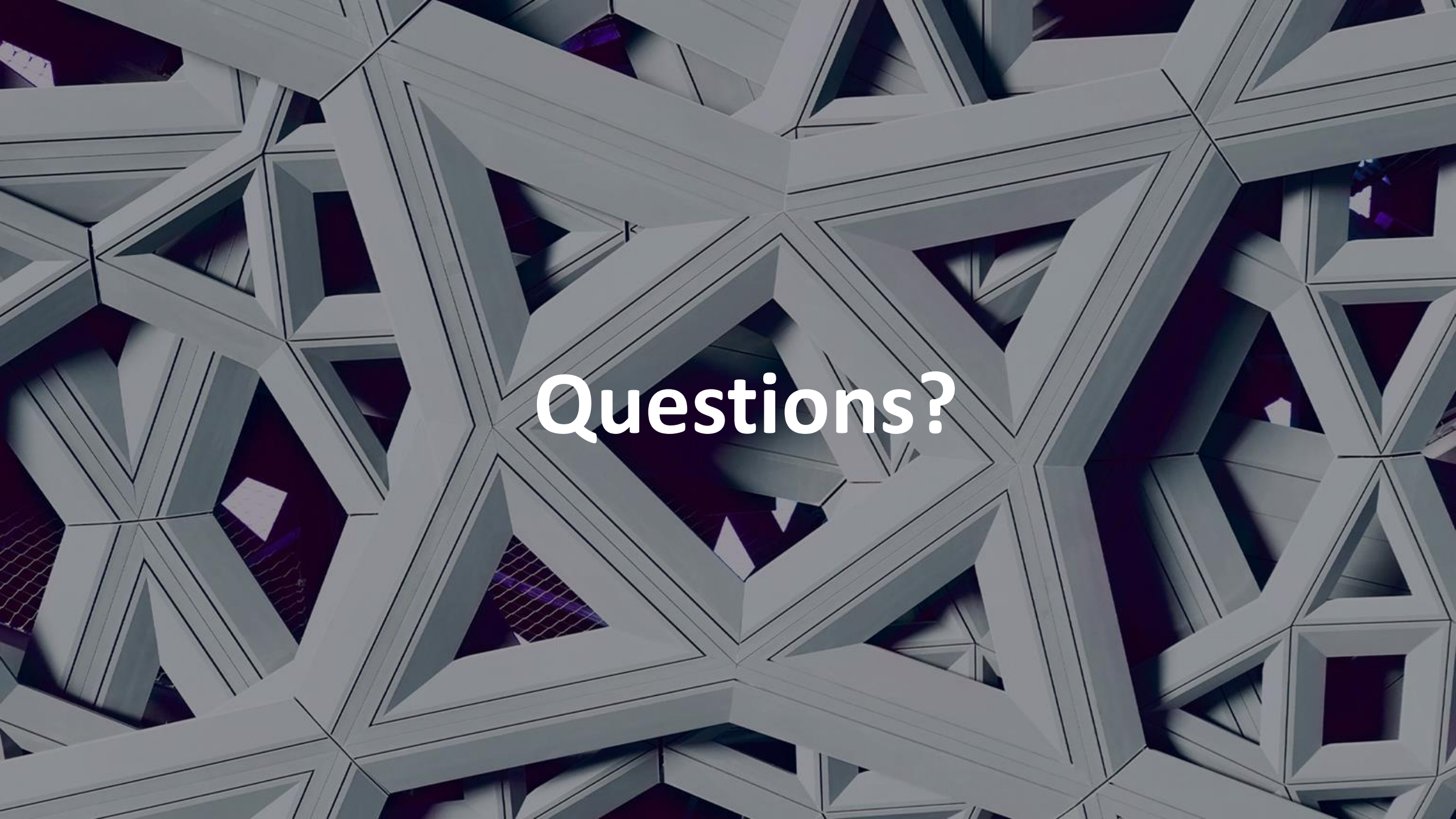
publons




**600,000**
Researchers

**3 million+**
Reviews

**25,000+**
Journals


Questions?

Web of Science Group

A Clarivate Analytics company

# Thank you

Dju-Lyn Chng, Solution Consultant (ASEAN)
Dju-lyn.Chng@Clarivate.com
+65 9772 1176