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Damage prediction for un-coated and coated aluminum alloys under thermal and mechanical fatigue loadings based on a modified plastic strain energy approach

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ABSTRACT

In this article, a novel energy-based lifetime prediction model has been presented for uncoated and coated aluminum alloys, subjected to thermal and mechanical fatigue loadings. For this objective, isothermal and thermo-mechanical fatigue tests were performed on the A356.0 alloy, with and without thermal barrier coating systems. This model, which was based on the plastic strain energy, had three correction factors including temperature, strain and mean stress effects. The predicted lifetime showed a proper agreement with experimental data. By the present model, higher accuracy was obtained in comparison to other existed approaches. Besides, the present model had lower number of material constants.

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1. Introduction

Thermal barrier coating (TBC) systems have been applied to components of the gas turbine in order to increase the performance. Recently, TBC systems have applications in diesel engines to increase the fatigue lifetime, enhance the thermal efficiency and reduce the fuel consumption and pollutions [1–5]. In mentioned applications, TBC systems are exposed to thermal and mechanical cyclic loadings. Therefore, due to high importance of their service lifetime, scientists have presented different fatigue lifetime prediction models [6–8]. To find advantages and disadvantages of all these models, besides their formulations, a literature review has been mentioned in following paragraphs.

1.1. Sehitoglu's model

As one of famous criteria, the lifetime prediction methodology, proposed by Neu and Sehitoglu [6,7], contains a damage rate model including fatigue, creep and oxidation damages. The pure fatigue mechanism controls the lifetime at low temperatures such as the room temperature (RT). In high-temperatures (HT) low cycle fatigue (LCF) and in-phase (IP) thermo-mechanical fatigue (TMF) loadings, all three damage mechanisms operate. However, during the out-of-phase (OP) TMF test, the oxidation damage becomes significant, whereas the creep mechanism can be negligible [9].

As mentioned, in the Sehitoglu's damage rate model, the total damage (D_{tot}) is considered as the summation of fatigue (D_{fat}), creep (D_{cr}) and oxidation (D_{ox}) damages. The formulation of this model is shown as follows [8],

$$D_{tot} = D_{fat} + D_{ox} + D_{cr} \quad (1)$$

$$\frac{1}{N_{tot}} = \frac{1}{N_{fat}} + \frac{1}{N_{ox}} + \frac{1}{N_{cr}} \quad (2)$$

In which, N_{tot}, N_{fat}, N_{cr} and N_{ox} are total, fatigue, creep and oxidation lifetimes, respectively. When the total damage is equal to unity, the failure occurs. The fatigue damage is represented by fatigue mechanisms that occur at low temperatures.

The strain–lifetime relationship is utilized to estimate the pure fatigue damage component. This relation is written as follows [8],

$$\frac{\Delta\varepsilon_{mech}}{2} = \frac{\sigma'_f}{E}(2N_{fat})^b + \varepsilon'_f(2N_{fat})^c \quad (3)$$

In which, $\sigma'_f, E, b, \varepsilon'_f, c$ are material constants. These material constants can be determined from low-temperature isothermal fatigue tests.

The oxidation damage in the material is defined as follows [8],

$$\frac{1}{N_{ox}} = \left[\frac{h_c \delta_0}{B\phi^{2n} K_{pof}}\right]^{-1/\beta} \frac{2(\Delta\varepsilon_{mech})^{1+2/\beta}}{(\varepsilon_{mech})^{1-\alpha/\beta}} \quad (4)$$

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55	415	13	468

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- International Journal of Materials Lifetime

Verified reviews

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- (74) Materials Science and Engineering:... WOS
- (64) Mechanics of Advanced Composite Struc...
- (56) International Journal of Fatigue WOS
- (45) Journal of Mechanical Science and... WOS
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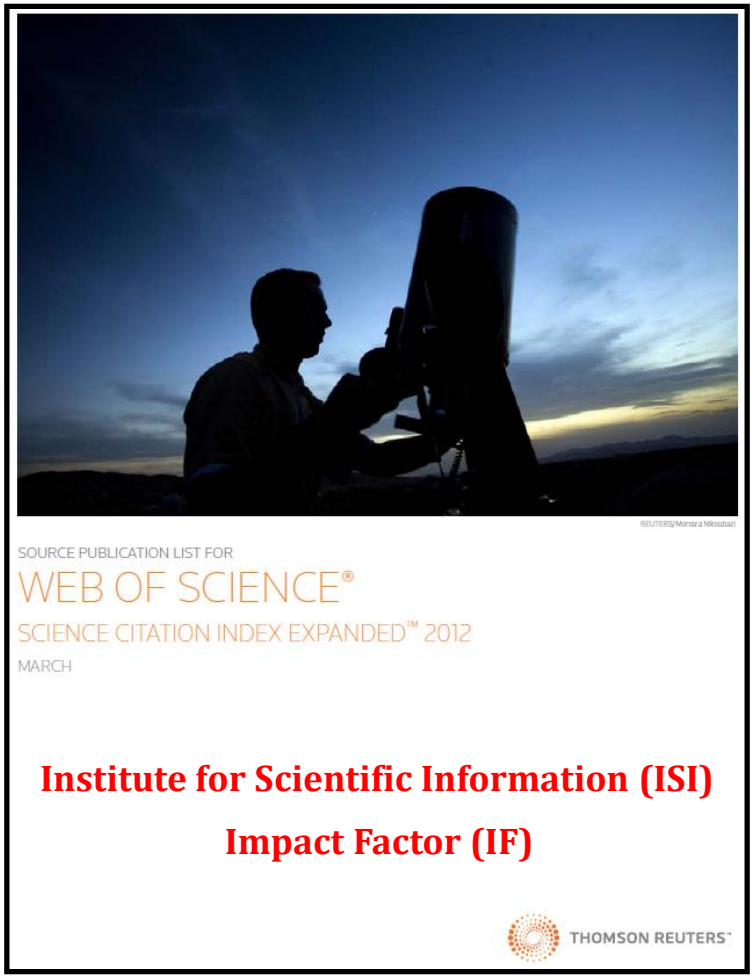

Ref.: Elsevier

Part #01

Ref.: Elsevier, 2012

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The "How to Review a Manuscript" series

#1 – Peer review

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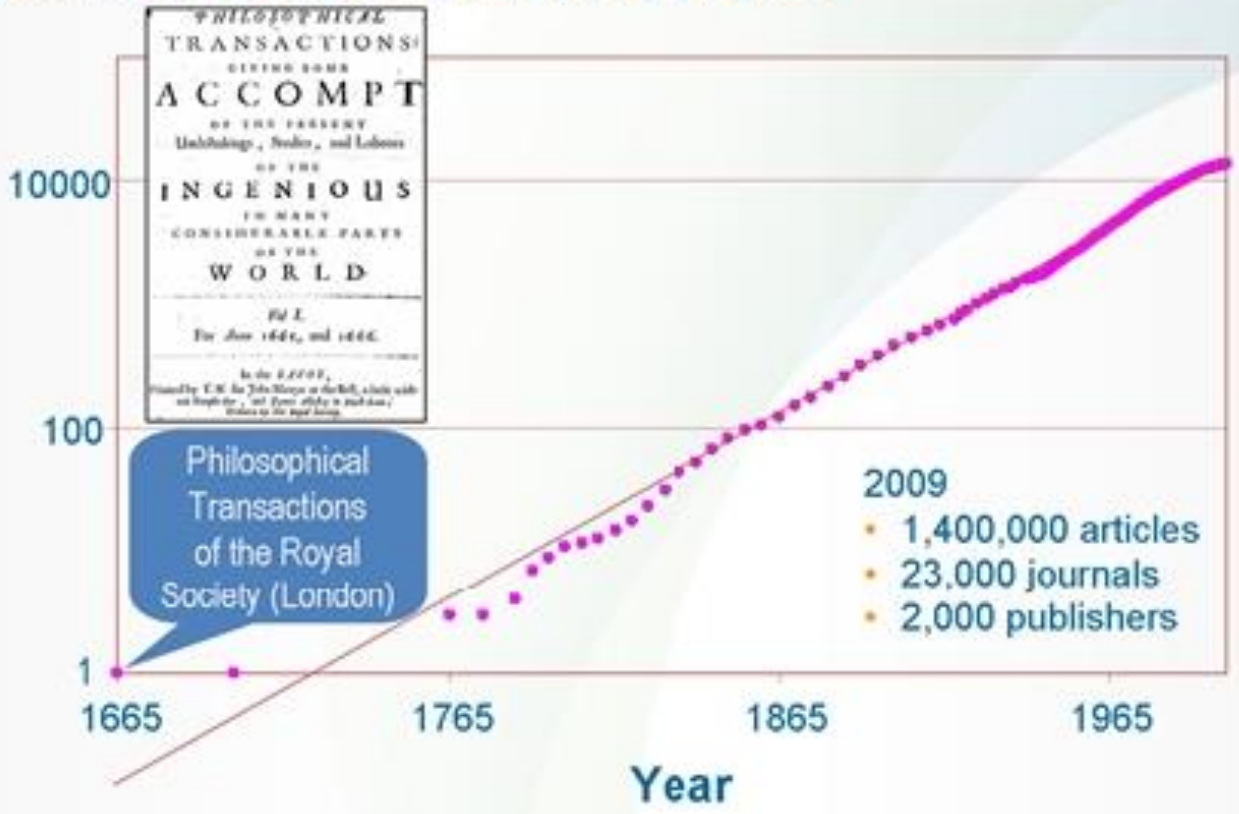
Peer-Reviewed Journal Growth 1665-2001

No of titles launched and still published in 2001



Source: M A Mabe The number and growth of journals Serials 16(2).191-7, 2003

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Trends in Publishing

- Rapid conversion from “print” to “electronic”
- Changing role of “journals” due to e-access
- Increased usage of articles
- Electronic submission
- Experimentation with new publishing models

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What do Researchers want as Authors and as Readers?

	Authors	Readers
Ownership	✓	
Certification ("Quality stamped")	✓	✓
Dissemination	✓	
Accessibility		✓
Navigation (Browsing/Indexing)		✓
Archiving (Continued access)	✓	✓

Peer Review

- The reviewer is at the heart of scientific publishing
  "…… *the lynchpin in the whole business of Science*"
- It is a testament to the power of peer review that a scientific hypothesis or statement, presented to the world is largely ignored by the scholarly community, unless it is published in a peer-reviewed journal
- Reviewers make the editorial process work by critically examining and commenting on manuscripts
- Reviewers are the backbone of this process

Principles of Peer Review

- Peer review is a **well understood concept**
- Without peer review there is no **control** in scientific communication
- Scientific communication is **greatly helped** by peer review
- It is reasonable that journal **editors evaluate and reject** a proportion of articles prior to peer review

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Purpose of Peer Review

- It selects the best manuscripts for a journal
- Determines the originality of the manuscript
- Improves quality of the published paper
- Ensures previous work is acknowledged
- Determines the importance of findings
- Detects plagiarism
- Detects fraud

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Why do reviewers review?

"Give"

- Academic 'duty'

"Take"

- General interest in the area
- Keep up-to-date with the latest developments
- Helps with their own research and/or stimulate new ideas
- Builds association with prestigious journals and editors
- Awareness of new research before their peers are
- Career development

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Reasons for Reviewing

- I like playing my part as a **member** of the scientific community
- I enjoy being able to help **improve** a paper
- I enjoy seeing **new work** ahead of publication
- I want to **reciprocate the benefit** gained when others review my papers

Reviewing Generally

- 86% - I enjoy reviewing and will continue to review
- 73% - With technological advances it is easier to do a more thorough review now than 5 years ago
- 68% - Formal training of reviewers should improve the quality of reviews
- 56% - There is generally a lack of guidance on how to review papers

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Reasons for Declining to Review

- 58% - Paper outside my area of expertise
- 49% - Too busy doing my own research, lecturing, etc
- 30% - Too many prior reviewing commitments
- 20% - Personal reasons

Purpose of Peer Review

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- Detects plagiarism
- Detects fraud

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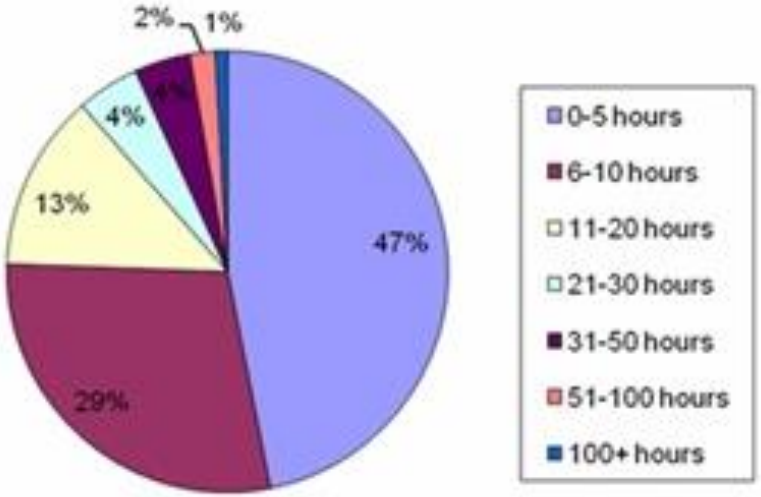
Time taken to review

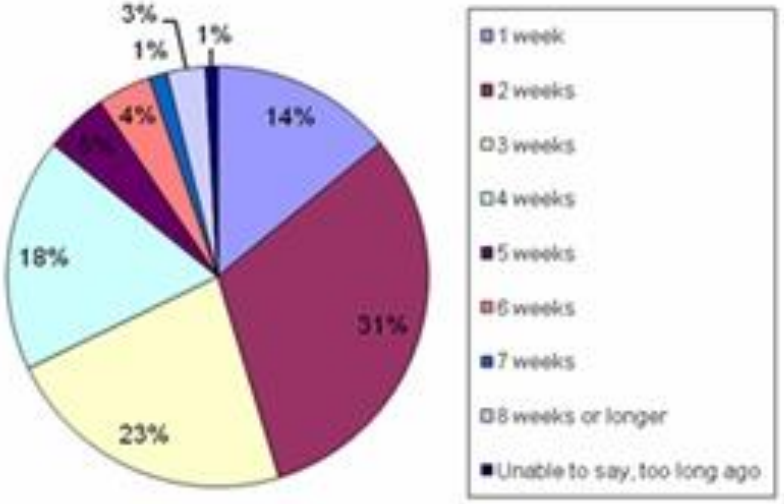
No. of hours spent on last review



Modal time spent = 4 hours

Median time spent = 6 hours

Time between acceptance of invitation to review and delivery of report



86% returned their last review within one month

(Peer Review Survey 2009)

Role of Reviewers

- The peer review process, which in essence determines the public record of science, is based on trust
- The quality and integrity of the entire scientific publishing enterprise depends largely on the quality and integrity of the reviewers

Reviewers' Tasks

- The reviewer should write reviewer reports in a collegial, constructive manner
- Treat all manuscripts in the same manner as you would like your own manuscript to be treated

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The "How to Review a Manuscript" series

#2 - The Reviewing Process

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Issues to Review as Reviewers

- Importance and clarity of research hypothesis
- Originality of work
- Delineation of strengths and weaknesses of methodology, experimental/statistical approach, interpretation of results
- Writing style and figure/table presentation
- Ethics concerns (animal/human)

Purpose of Peer Review

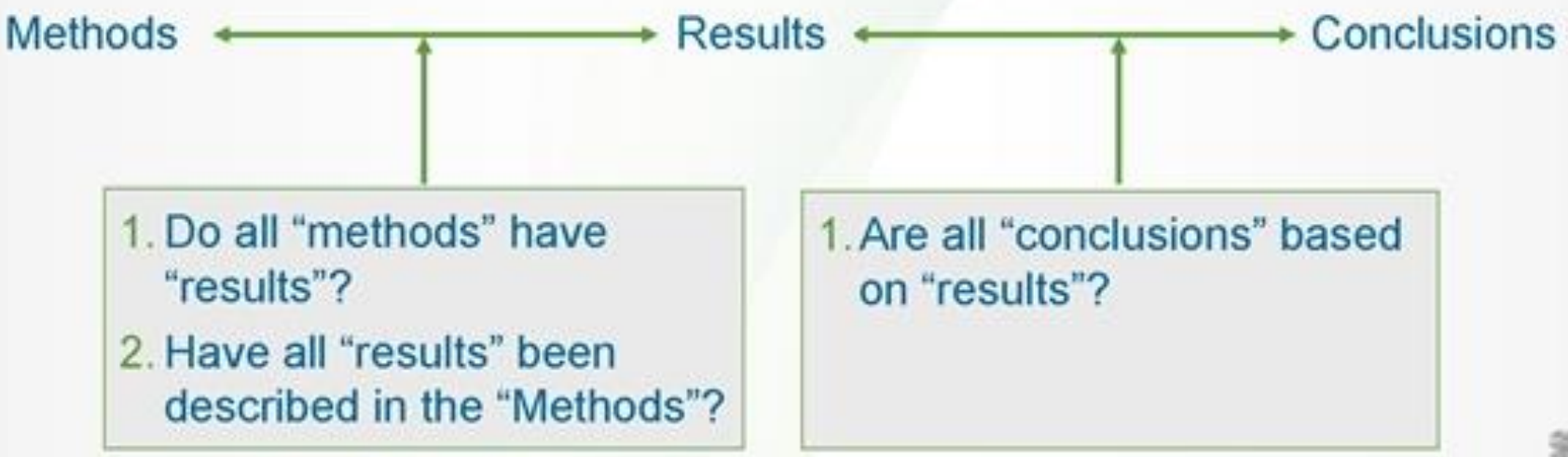
Check the manuscript for

- Mistakes in procedures or logic
- Conclusions not supported by the results
- Errors or omissions in the references
- Compliance with ethics standards
  - Has the protocol been approved by an appropriate Ethics Committee?
- Originality and significance of the work

Quality of the Work

Are the methods appropriate and presented in sufficient detail to allow the results to be repeated?

Is the data adequate to support the conclusions?



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Presentation of the Paper

Writing	• Clear, concise, English? • Reviewers should not act as a language editor
Title	• Specific, and reflecting the content of the manuscript?
Abstract	• Brief, and describing the purpose of the work, what was done, what was found, and the significance?
Figures	• Justified? Clear? Sharp, with fonts proportionate to the size of the figure? Clear and complete legends?
Tables	• Can they be simplified or condensed? Should any be omitted?
Trade names, abbreviations, symbols	• Properly used where indicated? Abused?

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Comments to the Editors

- Comment on novelty and significance

- Recommend whether the manuscript is suitable for publication, usually
  - Accept / minor revision / major revision / reject

Reviewer makes a recommendation

Editor makes the decision

- Confidential comments will not be disclosed to author(s)!

Comments to the Authors

- Provide specific comments on the design, presentation of data, results, and discussion
  - Do not include recommendations for acceptance / rejection
- Ensure that that the comments to the author(s) are consistent with your recommendation to the editors

Privileged Document

This manuscript is a confidential document. The data
- Is and remains the exclusive property of the authors
- Should not be disclosed to others

If you have printed the manuscript
- It must be kept confidential until the review process has been completed
- After final decision by the editor it must be destroyed

If you have shared responsibility for the review of this manuscript with a colleague, you should provide that person's name and affiliation to the editors

Reviewers

Should only accept to review manuscripts
- In their areas of expertise
- When they can complete the review on time

Should always avoid any conflicts of interest
- If in doubt, consult with the editor

Are not allowed to “use” the data

Must provide an honest, critical assessment

Must analyze the strengths and weaknesses of the research, and provide specific suggestions for improvement

Oversight Function: Ethics

The reviewer also has the (unpleasant) responsibility of reporting suspicion of

- Duplicate publication
- Plagiarism (including self-plagiarism)
- Data fabrication or falsification
- Ethics concerns

Ethics concerns are normally followed up by the Editors and the Publisher

Rejection without External Review

The Editor-in-Chief of a Journal evaluates all submissions and determines whether they enter into the review process or are rejected

Criteria

- Example – "Rules-of-Three" in the European Journal of Pharmaceutics and Biopharmaceutics
  - Out of scope
  - Too preliminary
  - Lack of Novelty

  } each with specific examples
- English language is inadequate
- Prior publication of (part of) the data
- Multiple simultaneous submissions of same data
- Etc.

Review Process (i)

Regular articles are initially reviewed by at least two reviewers

When invited, the reviewer receives the Abstract of the manuscript

The editor generally requests that the article be reviewed within two weeks

Articles are revised until the two reviewers agree on either acceptance or rejection, or until the editor decides that the reviewer comments have been addressed satisfactorily

The reviewers' reports help the Editors to reach a decision on a submitted paper

- The reviewer recommends; the editor decides!

Review Process (ii)

If a report has not been received after 4 weeks, the Editorial office contacts the reviewer

If there is a notable disagreement between the reports of the reviewers, a third reviewer may be consulted

The anonymity of the reviewers is strictly maintained

- Unless a reviewer asks to have his/her identity made known to the authors

Review Process (iii)

- Reviewers must *not* communicate directly with authors
- All manuscripts and supplementary material must be treated confidentially by editors and reviewers
- The aim is to have a "first decision" to the authors by 4-6 weeks after submission
- Meeting these schedule objectives requires a significant effort by all involved
- If reviewers treat authors as they themselves would like to be treated as authors, then these objectives can be met

As a researcher, you wear many hats!

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The "How to Review a Manuscript" series

#3 – The Reviewer's Role

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Role of the Reviewer – General impression and Abstract

General impression

- Short summary of the article
  - General comprehension of the manuscript
  - Its importance
  - Language/style/grammar
  - Reviewer's general level of enthusiasm
- Avoid personal remarks about the authors
  - If you must "vent", add such remarks to "Comments to Editor"

Abstract

- Is it a real summary of the paper?
  - Including key results
- Is it too long?
  - Long abstracts are cut off in Abstracting Services, such as PubMed

Role of Reviewer: Introduction

Is it effective, clear, and well organized?

Does it really introduce and put into perspective what follows?

- But the Introduction should not be a "history lesson"

Suggest changes in organization, and point authors to appropriate citations

- Don't just write "The authors have done a poor job."

Role of Reviewer: Methods

Can an interested, knowledgeable colleague reproduce the experiments and get "the same" outcomes?

Did the authors include proper references to previously published methodology?

Is the description of new methodology accurate?

- Source of solvents or reagents used can be very critical

Could or should the authors have included Supplementary material?

Role of the Reviewer – Results and Discussion (i)

Suggest improvements in the data shown

Comment on general logic, and on justification of interpretations and conclusions

Comment on the number of figures, tables, schemes - their need and quality

Write concisely and precisely which changes you recommend

- Distinguish between "needs to change" and "nice to change"
- Keep in mind that the author must be able to respond to your comments, whether it's implementation or a rebuttal

Role of the Reviewer – Results and Discussion (ii)

List, separately under one header, suggested changes in style, grammar, and other small changes

- Nowadays such comments can also be made in the PDF

Require or suggest other experiments or analyses

- Make clear the need
- But, **first** ask yourself whether the manuscript is worth to be published at all!

Role of Reviewer: Conclusions

Comment on importance, validity, and generality of conclusions

Request "toning down" of unjustified claims and generalizations

Request removal of redundancies and summaries

- The Abstract, not the Conclusion, summarizes the study

Role of Reviewer: References, Tables, Figures

- Check, if possible, accuracy of citations, and also comment on number and appropriateness
- Comment on any footnotes (text or tables) and whether they should have been included in the body of the text
- Comment on the need for figures, their quality, readability
- Assess completeness of legends, headers, and axis labels
- Check for consistency of presentation
- Comment on need for color in figures

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References: Tools for Reviewers (i)

For Editors

- Plagiarism detection tool at time of submission
- "Find a Reviewer" tool, based on "Scopus" database

Scopus

For Reviewers

- Free access to ScienceDirect
  - All content published by Elsevier

ScienceDirect

- Free access to Scopus
  - The world's largest abstract and citation database
- Reference-linking and resolution in PDF of the manuscript

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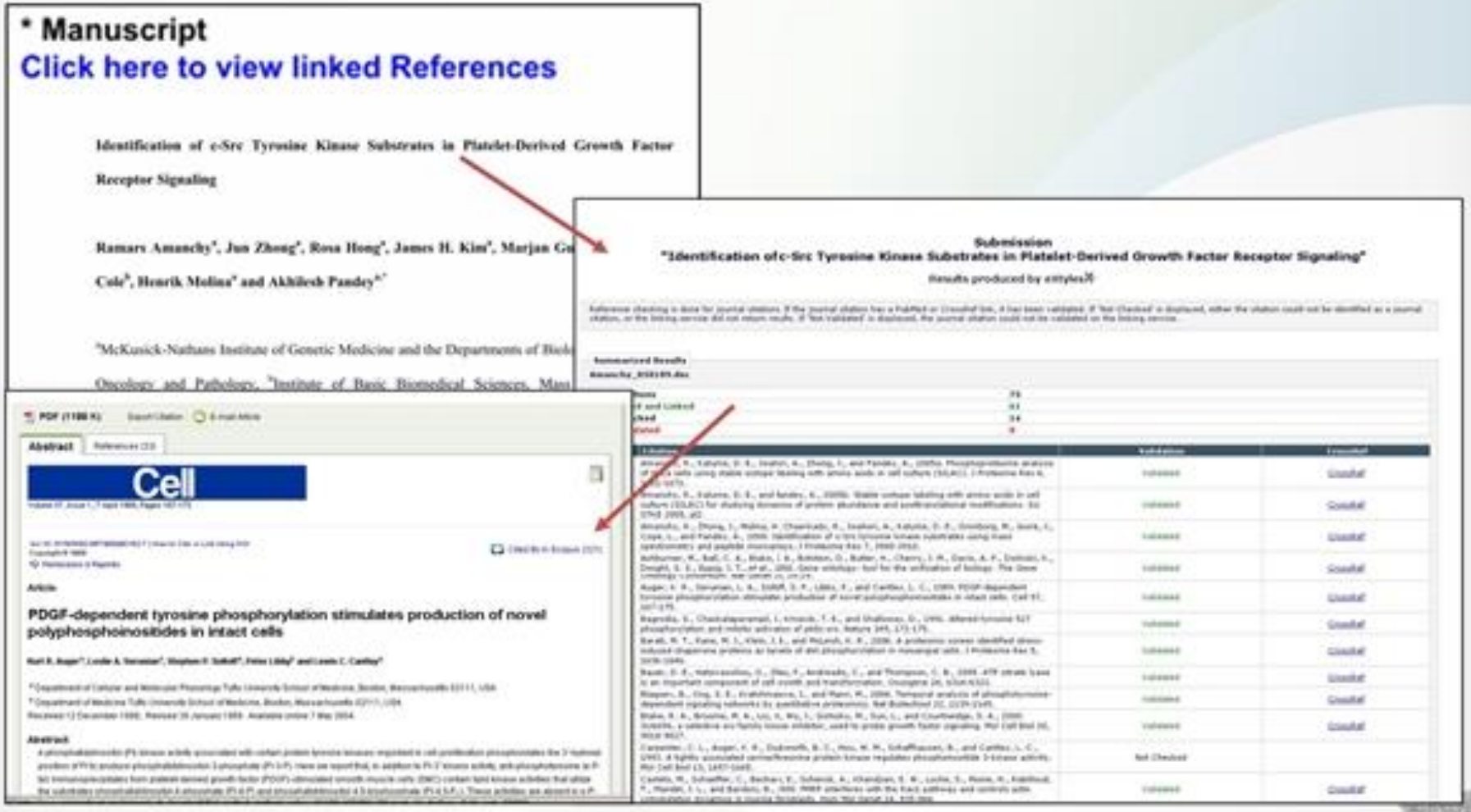
References: Tools for Reviewers (ii)



Editors' View: What makes a good reviewer?

A good reviewer

- Provides a thorough and comprehensive report
- Submits the report on time
- Provides well-founded comments for authors
- Gives constructive criticism
- Demonstrates objectivity
- Provides a clear recommendation to the Editor

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با تشکر از دغدغه شما برای یادگیری

با آرزوی موفقیت در مسیری که انتخاب کرده اید!؟

(با هدف گذاری...؟ و با برنامه ریزی برای رسیدن به هدف...؟)

Email: m.azadi.1983@gmail.com