



13th International Conference on Current Research Information Systems, CRIS2016, 9-11 June 2016, Scotland, UK

Snowball Metrics – providing a robust methodology to inform research strategy – but do they help?

Anna Clements^a, Peter I. Darroch^b, John Green^{c*}

^a *University of St Andrews, St Andrews, Fife, KY16 9AL*

^b *Elsevier B.V. Radarweg 29, 1043 NX Amsterdam, The Netherlands,* ^c *University of Cambridge, The Old Schools, Trinity Lane, Cambridge, CB21TN*

Abstract

Universities and funders need robust metrics to help them develop and monitor evidence-based strategies. Metrics are a part, albeit an important part, of the evaluation landscape, and no single metric can paint a holistic picture or inform strategy. A “basket of metrics” alongside other evaluation methods such as peer review are needed. Snowball Metrics offer a robust framework for measuring research performance and related data exchange and analysis, providing a consistent approach to information and measurement between institutions, funders and government bodies. The output of Snowball Metrics is a set of mutually agreed and tested methodologies: “recipes”. These recipes are available free-of-charge and can be used by anyone for their own purposes. A freely available API: the Snowball Metrics Exchange service (SMX), acts as a free “broker service” for the exchange of Snowball Metrics between peer institutions who agree that they would like to share information with each other and any institution can become a member of the SMX. In this paper, we present a use case where the University of St Andrews reviewed its institutional level KPIs referring to the Snowball Metrics recipes. In conclusion, quantitative data inform, but do not and should not ever replace, peer review judgments of research quality – whether in a national assessment exercise, or for any other purpose. Metrics can support human judgment and direct further investigation to pertinent areas, thus contributing to a fully rounded view on the research question being asked. We suggest using a “basket of metrics” approach measuring multiple qualities and applied to multiple entities.

© 2017 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the Organizing Committee of CRIS2016

Keywords: Snowball Metrics; Metrics; research metrics; basket of metrics; Snowball Metrics Exchange; metric recipe; research evaluation; metric methodology; research impact; research quality


* Corresponding author.

E-mail address: jtg11@cam.ac.uk

1. Introduction

The use of metrics is already an integral part of many universities processes and are a part, albeit an important part, of the evaluation landscape. Universities and funders need robust metrics to help them develop and monitor evidence-based strategies. However, no single metric can paint a holistic picture or inform strategy and so a ‘basket of metrics’ is required to enable useful metrics-based input^{1,2,3}. Indeed, Colledge and James recently described the application of a “basket of metrics” for the metric-based component of understanding journal merit, alongside other evaluation methods such as peer review³.

That having been said, there is then the challenge of ensuring that any metrics and the data from which they are derived can be used with confidence. This is the challenge that Snowball Metrics⁴ solves. Snowball Metrics offer a robust framework for measuring research performance and related data exchange and analysis, providing a consistent approach to information and measurement between institutions, funders and government bodies. This results in a decrease in duplication and an increase in efficiency across the sector.

Eight high-profile UK universities⁵ started working together on Snowball Metrics in 2010 to enable informed, evidence-based decision-making. The goal was to agree a single method to calculate metrics that would provide input to institutional and funder strategies, thereby ensuring that apples are compared with apples. These metrics are based on all the data sources available, including institutional, third party and commercially available sources. Snowball Metrics do not depend on a particular data source or supplier, and are owned by the sector. Snowball Metrics, recognised by their snowflake kitemark , aim to become the international standard that is endorsed by research-intensive universities to enable them to understand their strengths and weaknesses, so that they can build and monitor effective strategies (e.g. in which areas to invest, in which to divest, effectiveness of collaborations, engagement with industry).

The output of Snowball Metrics is a set of mutually agreed and tested methodologies: “recipes”. These recipes are available free-of-charge and can be used by anyone for their own purposes.

Snowball Metrics have now been defined across the entire landscape of research activities (funding, collaboration, publication, commercialisation); there are 32 recipes available for free to the sector as detailed in table 1. The Steering Group has also been working closely with CASRAI and euroCRIS to extend community participation and provide standards-based representations of the metrics to support interoperability between research systems.

The UK Snowball Metrics Steering Group has worked with a US Snowball Metrics Working Group comprising seven large US universities and has successfully enhanced many of the existing Snowball Metrics with national data and intelligence. This should enable global benchmarking using national data mapping to national denominators for cross-country compatibility thereby driving Snowball Metrics towards global standards.

2. How can anyone use the Metrics?

A freely available API: the Snowball Metrics Exchange service (“SMX”) acts as a free “broker service” for the exchange of Snowball Metrics between peer institutions who agree that they would like to share information with each other such that:

- any institution using Snowball Metrics can become a member of the Snowball Metrics Exchange
- the institutional members are responsible for generating their own Snowball Metrics according to the recipes, whether they are calculated using a bespoke system, in a spreadsheet, or in a commercial tool
- each institution can choose to be a member of one or more benchmarking clubs: groups of institutions which have agreed to exchange metrics with each other

Table 1. Snowball Metrics defined across the research landscape and available for free to the sector.

	Research Inputs	Research Process	Research Outputs and Outcomes
Research	Applications Volume	Income Volume	<i>Publications and citations</i>
	Awards Volume	Market Share	Scholarly Output
	Success Rate		Citation Count
			Citations per Output
			<i>h</i> -index
			Field-Weighted Citation Impact
			Outputs in Top Percentiles
			Publications in Top Journal Percentiles
			<i>Collaboration</i>
			Collaboration
			Collaboration Impact
			Collaboration Field-Weighted Citation Impact
			Collaboration Publication Share
			Academic-Corporate Collaboration
			Academic-Corporate Collaboration Impact
			<i>Impact</i>
			Altmetrics
			Public Engagement
			Academic Recognition
Enterprise Activities/Economic Development	Academic-Industry Leverage	Contract Research Volume	Intellectual Property Volume
	Business Consultancy Activities		Intellectual Property Income
			Sustainable Spin-Offs
			Spin-Off-Related Finances
Postgraduate Education*	Postgraduate Research Student Funding	Research Student to Academic Staff ratio	Time to Approval of PhD
			Destination of Postgraduate Research Student Leavers

- institutions may choose to accept or decline requests to share all or some Snowball Metrics; this is entirely under their control
- as the service develops, institutions will be able to use the “I’ll show you mine if you show me yours” facility in order to exchange equivalent Snowball Metrics with each other; only metric values will be exchanged. Data underlying the metrics will never be exchanged and will remain behind the institutions’ firewalls

The Exchange service is made of three components, namely; the Snowball Metrics Uploader (Uploader) which allows an institution to upload/provide metrics from their own institution to the Snowball Metrics Exchange (SMX), the SMX which acts as the ‘broker’ and allows an institution to manage the entitlements for each institution that has agreed to share metrics with them, and the Snowball Metrics Downloader (Downloader) which allows each institution to retrieve or update the shared metrics from participating institutions. Figure 1 shows some screenshots of each component for illustrative purposes. It is important to reiterate that the Snowball Metrics Exchange service does not rely on any metrics provider and how a user chooses to calculate the metric values is up to them. In addition, at no point is data shared within the exchange service and the metric values are encrypted by the service so that only the entitled institution can decrypt them.

Screenshot 1: Snowball Metrics Uploader

Metrics
The Snowball metrics Uploader currently supports the following metrics

Input Metrics

- **Applications Volume**
Applications Volume calculates the number and price of research grant applications that are submitted to external funding bodies.
 1. Count of applications
 2. Count of applications per FTE
 3. Price of applications
 4. Price of applications per FTE
- **Awards Volume**
Awards Volume calculates the number and value of awards from external funding bodies.
 1. Count of awards
 2. Count of awards per FTE
 3. Value of awards
 4. Value of awards per FTE
- **Success Rate**
Success Rate calculates the proportion of research grant applications, submitted to external funding bodies, which have been successful.
 1. Percentage of successful applications by count
 2. Percentage of pending applications by count
 3. Percentage of successful applications by count
 4. Percentage of successful applications by value
 5. Percentage of pending applications by value
 6. Percentage of rejected applications by value
- **Academic Industry Leverage**

Output Metrics

- **Scholarly Output**

Annotations:
Institutions add metric values to the Uploader for encryption
Scholarly output = 1,376

Screenshot 2: Snowball Metrics Exchange

Metrics entitlement: Test institution A
is responsible for this institutions metrics and has been verified.

The ticks and crosses on this page indicate which metrics you have entitled this institution to access. Clicking a cross turns it into a tick and entitles the institution to mutually share the chosen metric.

You can entitle the institution to mutually share a group of metrics (e.g. all input metrics) or to all metrics by clicking the radio buttons next to the metric group title. Remember to click on the blue 'save' button to save your changes!

Once you have made the selected metrics available in your 'Snowball Metrics uploader', this institution will be able to download and view them through their 'Snowball Metrics Downloader'.

You can remove an institutions entitlement by clicking a tick which changes it to a cross. This will prevent any future download of the selected metric by this institution. Note that if you have previously entitled and uploaded the corresponding metric then the institution may have already downloaded the metric.

Metric Entitlements	Test Institution A	Institution B
Input Metrics	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Count of applications	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Count of applications per FTE	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Price of applications	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Price of applications per FTE	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Annotations:
Institutions agree to share encrypted metric values and manage entitlements in the SMX
Scholarly output = 1%\$*

Screenshot 3: Snowball Metrics Downloader

Institution details: Institution B
On this page you can see which metrics you have retrieved, when you have retrieved them and which metrics you are entitled to.

Responsible for this institutions metrics: Bernard Boolean, this user has been verified.

Metric	Entitled	Available	Action
Count of applications	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Count of applications per FTE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Price of applications	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Price of applications per FTE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Count of awards	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Count of awards per FTE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Value of awards	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve
Value of awards per FTE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Retrieve

Annotations:
Institutions retrieve or update metric values in the Downloader
Scholarly output = 1,376

Fig. 1. Screenshots of the components of the Snowball Metrics Exchange service

3. Use Case: KPI development using Snowball Metrics Recipes

The University of St Andrews recently reviewed its institutional level KPIs adopting Snowball Metrics where relevant. This allowed the University to take advantage of the tried and tested definitions or ‘recipes’ which had been arrived at as a result of an expert group from leading research universities discussing, debating, agreeing and then trialling each recipe. It also positions the University ready to benchmark with peer institutions and departments also using Snowball Metrics recipes.

Examples of Snowball Metrics used include Outputs in Top Percentiles and Success Rate. The full Snowball Metric recipe for Success Rate can be found in Appendix A.

The Success Rate definition, in particular presents a variety of options to consider :

- What actually do we count? Applications that we know have been successful, applications we know have been unsuccessful ... but what about those that we haven’t had a definite ‘yes’ or ‘no’?
- This leads to the question of over what period we should assume an application is unsuccessful (write-off)? Also, should we vary this for different funders?
- What amount do we consider: the original requested price or the final (negotiated) price awarded ?
- When do we count an award (or rejection or write-off) – in the year of the application or the year of the award/rejection/write-off?

The Snowball Metric definition or “recipe” provides the answers to all these together with the reasons why a particular decision was made. For example, with the case of the amount to use, the partners confirmed that the final price was always available in their internal systems, whereas not all retained the requested price. In this case the final price was chosen as a pragmatic response to what data were actually available. For the write-off period there was considerable discussion within the Planning Group in St Andrews on the write-off period. For example, should it be different for different funders or funder types. Here Snowball specifies a 12 month period for all funders which is what has now been adopted at St Andrews. The final decision was whether to count the award (or rejection/write-off) in the year of award (rejection/write-off) or the year of application. Traditionally our Finance department counted in the year of award arguing that we should not modify financial values retrospectively. However, the argument here is that we are not working to accounting rules, where obviously altering figures after end of year is not normal practice. Here we are considering metrics for indicating performance against strategic objectives and against peers. A success rate is a percentage and should therefore range between 0 and 100. To make sense therefore, the success or failure of an application needs to be counted against the application itself.

4. Conclusions

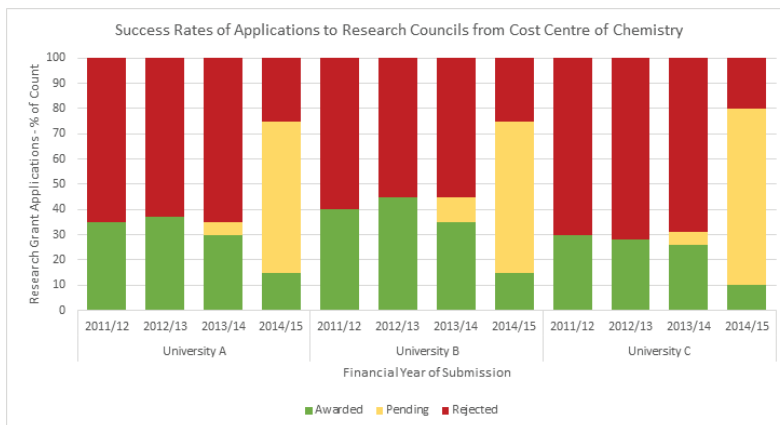
Snowball Metrics are tried and tested and the definitions are available **now** to support Institutions developing and updating their KPIs to inform strategic decision-making. The introduction of the SMX service to facilitate benchmarking will encourage the adoption of Snowball Metrics more widely. It is important always to remember that quantitative data inform, but do not **and should not ever** replace, peer review judgments of research quality – whether in a national assessment exercise, or for any other purpose. Metrics can support human judgment and direct further investigation to pertinent areas, thus contributing to a fully rounded view on the research question being asked. We suggest using a “basket of metrics” approach measuring multiple qualities and applied to multiple entities.

Appendix A: Snowball Metric Success Rate

Definition: Success Rate calculates the proportion of research grant applications, submitted to external funding bodies, which have been successful.

The read-outs / **y-axis values** agreed were

- % of successful applications wrt count
- % of pending applications wrt count
- % of rejected applications wrt count
- % of successful applications wrt value
- % of pending applications wrt value
- % of rejected applications wrt value



Success Rate by count is calculated according to whether submitted applications have been awarded or rejected, or whether a decision is pending.

Success Rate by value is calculated according to the proportion of the total requested price associated with awarded or rejected applications or whether a decision is pending.

Note - The price used should be the most up-to-date available. For example, if the price is revised by the funder or in negotiations with research partners, this new price should be used as the basis for this calculation.

x-axis: application year

Normalise: no

Denominators: institution, HESA cost centre, funder-type

Details

- The set of awards considered in this metric is different to the set of awards counted in the Awards Volume metric
- Awards that are not tied to an application do not count towards Success Rate
- If an application is added retrospectively into institutional systems (“dummy application”) in order to improve record keeping, then this application and its outcome will be counted
- Year – year of success is the date of submission to the funder. If someone applied for an award in 2012, and it was awarded in 2013, the Success Rate will be tied back to the original 2012 application year
- The following awards are not considered in Success Rate

- Donations that were not applied for
- Awards that were transferred in from other institutions when a researcher moves (note that this *would* be included in Awards Volume metric)
- Open access grants such as those provided by RCUK from time to time, and similar
- Not all systems enable exclusion of donations and transfer-ins, or inclusion of OA grants. It is expected that the volume is low and will not have a significant effect on the metric, so this more technically correct definition will be used. Add a note when exchanging metric that it is as per the definition but e.g. does not exclude donations
- Just like Applications Volume, Success Rate addresses new applications only. It avoids double counting of the same applications by excluding prior submissions in a multi-stage application process such as outlines and expressions of interest
 - In situations where Expressions of Interest etc. are not recorded in the Awards Management System, it is difficult to always avoid double counting. Experts agree to flag this situation in a note associated with the metric, but to continue with this technically correct definition
 - Competitive renewals are considered to be new applications
- Success Rate must allow for amendment of the metric (and must be considered independent of Award Volume).
 - Supplement is to be included in the calculation. If a supplement is applied for, then this counts as a new application in its own right and is assigned to the year in which it was applied for (not the year that the original award was applied for e.g. grant applied for in 11/12, it's awarded, and receive a supplement in 12/13 – supplement goes into 12/13 not 11/12)
 - Underspend / returns are not considered. The institution was awarded the money regardless of whether it was spent or not. Adjustments for Wakeham or similar are not included
 - No cost extensions are not included
- HESA cost centre denominator, via prorated mapping of departments to HESA cost centres. This mapping is done on the basis of the HESA cost centre assignment of the application's principal investigator at your institution.

The Success Rates calculated by this method will change over time, and this was of concern to colleagues in finance who are used to year end numbers being absolute. This method will only provide absolute values when decisions have been received on all applications submitted in a given year. The method of tying Success Rate to application year rather than to award year has been selected to avoid the problem of values being greater than 100%.

Write-off period: the definition assumes that an application has been declined where no decision has been entered into the system after 12 months. The reasons are:

- In order to be able to compare 'like with like' with external peers, the Snowball Metric needs an agreed write-off period. Institutions are still at liberty to use their own rules for internal views of the metric.
- It is important that there is a consistent time per funder, discipline and geography

Example:

- Consider an institution that has made 7 applications in a given year:

Application ID	Price	Successful?	Budget
1	1,000,000	Yes	850,000
2	500,000	Yes	500,000
3	750,000	No	N/A
4	200,000	No response 14 months after submission	N/A
5	500,000	No	N/A
6	25,000	Yes	25,000
7	50,000	No response 9 months after submission	N/A
TOTAL	3,025,000		1,375,000

- **Success Rate by count**

- 42.9% (3/7) successful
- 42.9% (3/7) rejected
- 14.3% (1/7) pending
 - Note – recommend that App.7 is considered pending, and App.4 is considered rejected. If recommendation is not followed, then 42.9% (3/7) successful; 28.6% (2/7) rejected; 28.6% (2/7) pending

- **Success Rate by value**

- 50.4% (1,525,000 / 3,025,000) successful
- 47.9% (1,450,000 / 3,025,000) rejected
- 1.7% (50,000 / 3,025,000) pending

Future opportunity: this recipe is pragmatic and uses requested price, since almost everyone can calculate the metric using this method. Ideally it should use awarded value and we recommend that this is revisited in the future when institutions are better able to link between applications and awards systems

References

1. Green J. Snowball Metrics response to the HEFCE independent review of the role of metrics in research assessment. Available from: www.snowballmetrics.com/reports.
2. Colledge L. Elsevier's response to HEFCE's call for evidence: independent review of the role of metrics in research assessment. Available from: <http://bit.ly/hefceresponse>.
3. Colledge L. and James C. A "basket of metrics" – the best support for understanding journal merit. *European Science Editing* 2015; **41(3)**: 61-65.
4. Snowball Metrics. Available from: www.snowballmetrics.com.
5. University College London, University of Oxford, University of Cambridge, Imperial College London, University of Bristol, University of Leeds, Queen's University Belfast, University of St Andrews.