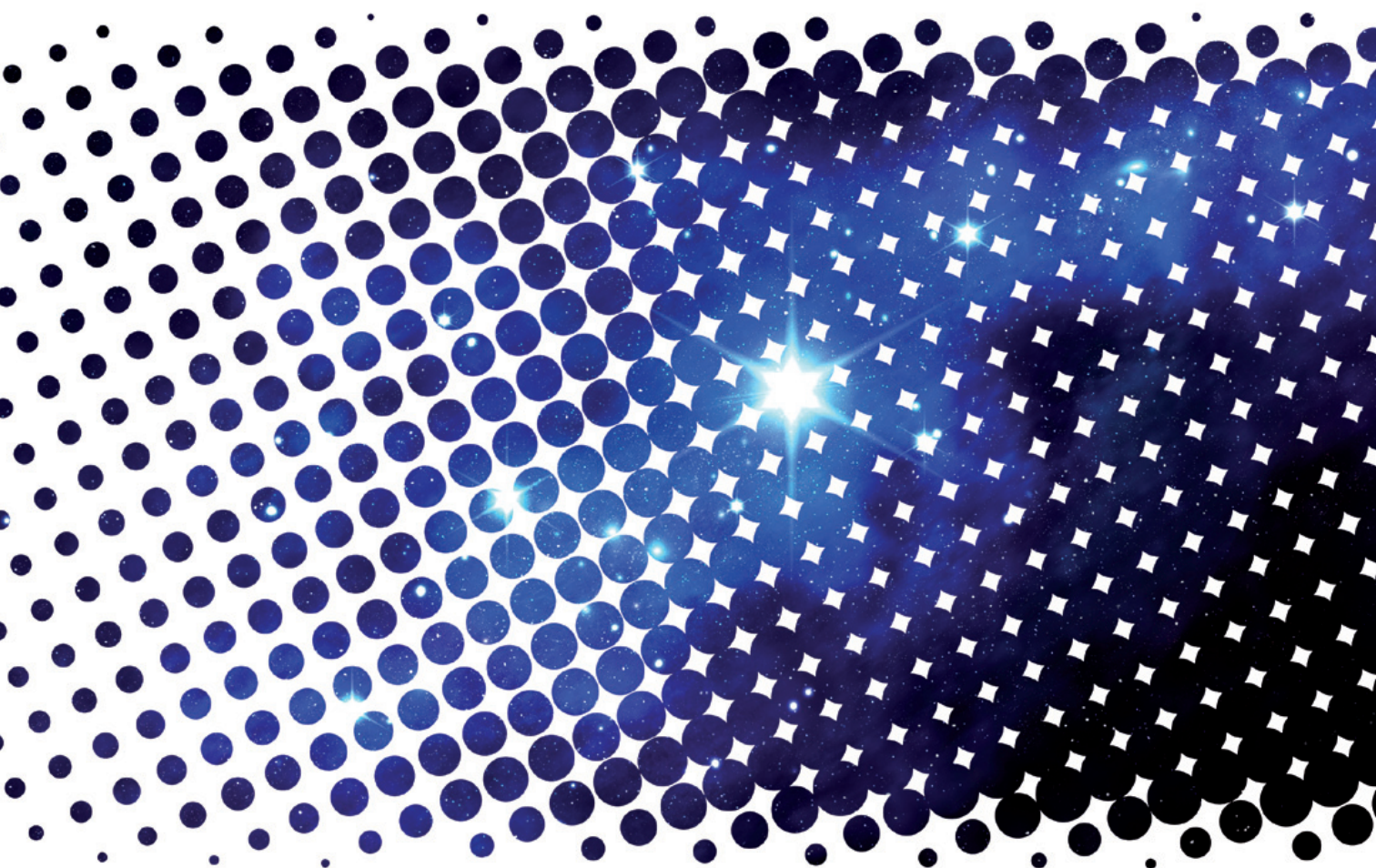


Perspectives

Identifying Multidisciplinary Researchers
to Support Internal Collaboration



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Abstract

Hoping to encourage interdisciplinary collaboration at their institution, university leaders may benefit greatly by identifying highly-connective researchers that are using fusion or diffusion to advance multidisciplinary research.

By analyzing the top authors in a multidisciplinary competency of an institution's map, a university leader may define the relationship between faculty members as well as their research contributions and possible influence in supporting interdisciplinary research initiatives. The successful identification of these authors will aid a university's efforts to foster multidisciplinary collaboration, and this will hopefully lead to larger and more successful research projects and funding for the institution.

Introduction

Research has taken on a more flexible and dynamic structure as the strict divisions between faculties are disappearing.

It travels beyond the historic scope of departments and subject areas as contemporary researchers are looking to expand and connect their studies in unique ways. Researchers aim to broaden their skill sets and success through multidisciplinary collaboration and acknowledge that problem-solving often requires comprehensive, interdisciplinary methodology. **As the research landscape evolves dynamically, a holistic approach is needed to evaluate researchers working in these overlapping areas.** All the while, the inherent competition for research funding is increasing, and this interdisciplinary collaboration becomes imperative.

Although there are clear benefits to multidisciplinary research, historically, it has been very challenging to recognize growing areas of interdisciplinary research and in particular, to identify the authors who are supporting multidisciplinary initiatives. Recognizing the need for a more insightful, multidisciplinary perspective on research performance, Elsevier created SciVal Spotlight based on a more detailed model of the current structure of science. The Wheel of Science was created through a meta-analysis of over 20 existing maps of science,¹ and SciVal Spotlight creates a map upon the Wheel of Science that illustrates for which specific research topics an institution has unique competencies. Thereby, SciVal Spotlight reveals the research strengths of a university that are considered highly interdisciplinary as well as those strengths that reference literature from a single discipline. To ensure that an institution's map represents the broadest coverage of research output, SciVal Spotlight relies on abstracts and citations from over 16,000 peer-reviewed journals.² The precision of author and affiliation matching ensures that Spotlight is able to accurately assess a university's research output and identify its specific research strengths.

Following the methodology outlined in this paper, a dean, vice rector, or vice chancellor may use SciVal Spotlight to **find researchers who are working across multiple faculties to develop innovative problem-solving methods.** This study relies on actual data from a premier research institution. For the requisite privacy of the university, this large and publicly-funded institution will hereby be referred to as "Panthalassa University". Using Panthalassa University as our model, we analyzed the Distinctive and Emerging Competencies (DC and EC) visualized on its 2007 map. We looked for authors working in competencies that are considered multidisciplinary and assumed that a competency incorporating papers from more than one subject area can be defined as multidisciplinary.

Once the researchers were identified, we manually mapped the relationships between authors and their corresponding competencies to identify researchers who seem integral in connecting research areas in a multidisciplinary way.³ **We were able to define two modus operandi in multidisciplinary research that a university can support – the fusion of disciplines and the diffusion across disciplines.** Subsequently we make several recommendations on ways to identify and understand these two types of multidisciplinary research so an institution may support its pioneering research, attract supplementary funding, and maintain an overall competitive advantage.

¹ Klavans, R., & Boyack, K. W. (2009). Toward a Consensus Map of Science. *Journal of the American Society for Information Science and Technology*, 60(2), pp.455 - 476.

² Scopus was used as the underlying data source.

³ Through our analysis we looked at the individual author's Scopus Author Profile pages and the university's website to verify the authors' faculty associations, publications, and awards.

Methods

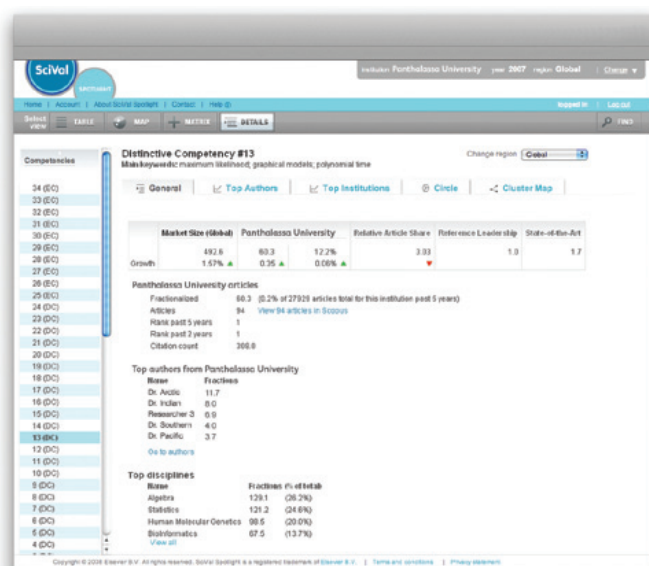
Our initial assessment of Panthalassa University suggests that it has a large number and assortment of research strengths, as indicated by the quantity of circles on its 2007 map.

Many of these competencies are located within the interior of the Wheel of Science, and this spatial distribution indicates that Panthalassa University excels in multidisciplinary research.



Hoping to identify a strong multidisciplinary researcher, we began by looking for a competency that incorporates several subject areas⁴ and where the university is a leader.⁵ We chose Distinctive Competency 13 (DC13) because it met these criteria and was of average size (global market size between 345 and 515 articles, as this represents the 40-60% range of the university's competencies). This research problem (DC13) incorporates literature from algebra, statistics,

human molecular genetics, bioinformatics, chaos fractals and complexity, and molecular biological evolution from journals including *Lecture Notes In Computer Science*, *Bioinformatics*, *Journal Of Symbolic Computation*, *Genetic Epidemiology*, and many others.



We determined that this is a growing area of research globally (1.57% growth in article output per year), but the university's leadership may be at risk in this area because it is not growing as quickly (0.06% growth per year). Panthalassa University has a Relative Article Share⁶ of 3.03, meaning it is the publication leader for this topic of research. With a Relative Reference Share⁷ of 1.0, its work is cited the most frequently, and with a positive State-of-the-Art⁸ (SotA is 1.7), its authors are citing relatively recent papers. **Observing these metrics in combination, we surmise that the university helped establish this area of research, continues to have a large impact, quickly builds upon its discoveries, and actively publishes.**

⁴ A multidisciplinary competency is indicated by its proximity to the center of the wheel and the presence of several colored rays.

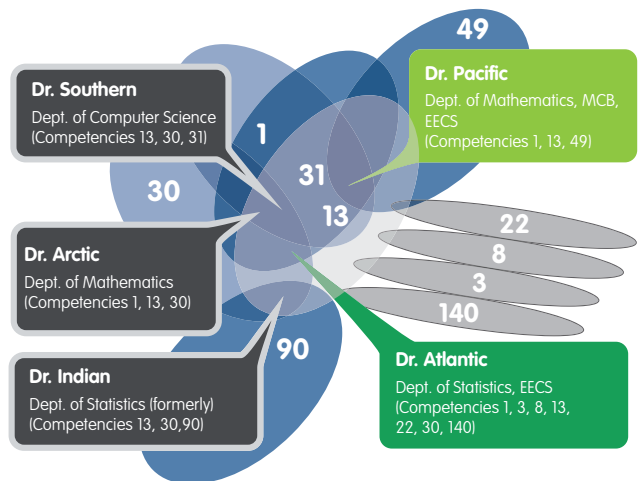
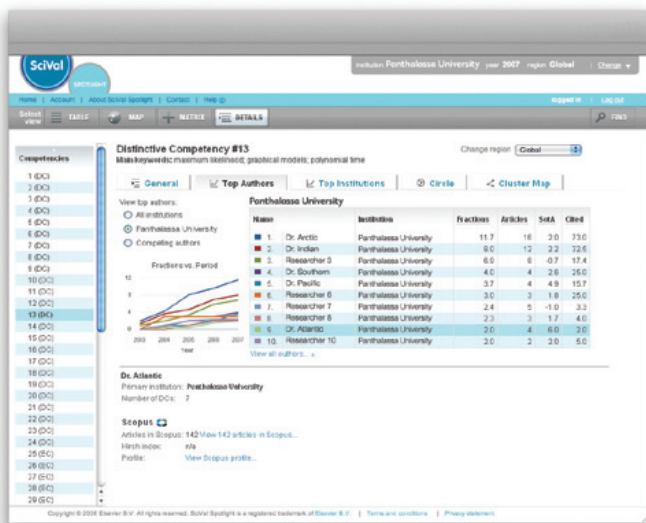
⁵ Distinctive Competency: the university is a leader in at least one of the following: publications, citations, or State-of-the-Art.

⁶ Relative Article Share: RAS is defined as the number of publications authored by an institution, divided by the number of publications authored by the institution's largest competitor within a particular DC, during the 5-year publication window (2003-2007).

⁷ Relative Reference Share: The calculation for RRS is performed in the same way as the Relative Article Share but is done using highly-cited reference articles rather than current articles from the publication window (Reference Leadership).

⁸ State-of-the-Art: SotA is a measure indicating the recentness of articles cited by the institution's articles within a competency. The state-of-the-art measure varies around zero. Positive values indicate that the institution is citing more recent work within the competency than the world as a whole; while negative values indicate that the institution is citing older work than the world as a whole. The calculation is done by taking the median reference year for each individual article within a competency and comparing the average value of an institution to the average of the whole of the competency.

After analyzing the publication and citation data within DC13, we investigated the top authors from Panthalassa University who were involved in this competency.

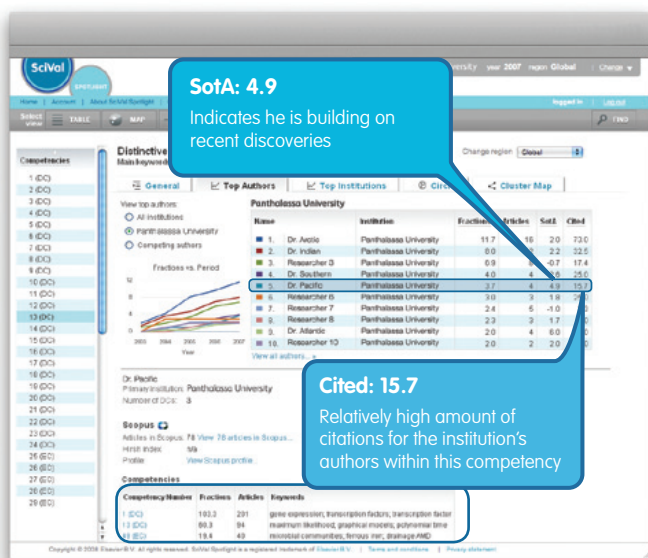


Of the ten authors listed, approximately half were former post-doctoral students. Of the remaining authors, we identified Dr. Atlantic, Dr. Indian, Dr. Southern, Dr. Pacific, and Dr. Arctic. To find a researcher who was connected to the most research projects, we began by looking for the author who was contributing to the greatest number of competencies on the map. Although most of the authors were contributing to between one and three competencies, we identified Dr. Atlantic as contributing to seven competencies. After listing all of Dr. Atlantic's competencies (DC1, DC3, DC8, DC13, DC22, EC30, and EC140), we recorded the competencies associated with Panthalassa University's other top authors in DC13. **Looking for overlapping competencies that would define the connectivity of the authors' work, our next step was to visualize the relationship by creating a diagram.**

Dr. Atlantic is affiliated with two of the university's faculties: Statistics and Electrical Engineering & Computer Sciences. Of the five authors under consideration, Dr. Atlantic is active in the most competencies and published a total of 8.1 articles in these competencies by contributing on average 1.2 fractionalized articles to each. His impact is strong as well; his mean citation count was 7.1 citations across his competencies, and on average, Dr. Atlantic's papers account for 7.5% of the citations received by Panthalassa University. Further examination indicates that he references relatively recent papers, as his average SotA is 1.0. He is a Distinguished Professor, his research interests are quite diverse, and he is the recipient of many awards. In general, Dr. Atlantic contributes to an extensive number of competencies (i.e., more than 3) with a small number (between 0.0 and 3.4) of fractionalized papers, and **he is clearly active, innovative, and influential.** Overall, he seems highly-connective and his work seems to be essential in supporting cross-disciplinary collaboration.

In an attempt to understand more about the complexity of faculty publication patterns and interdisciplinary collaborations, we began with an ellipse representing DC13 in the center. We then drew ellipses overlapping one another to represent the relationship of the authors within the competencies.

Upon further review of the authors, we observed that Dr. Pacific is the only researcher of the group who is a top ranking author in each of his competencies. He is actively publishing and over the five year publication window, he contributed a high number of fractionalized papers (averaging 5.1) to each of his three competencies. Additionally, his work has significant impact as he has a consistently high relative citation count and averaged 107.6 citations for his three competencies and received on average 11.9% of the citations received by the university. Lastly, **he is building upon recent discoveries more quickly than most of his colleagues as indicated by a consistently high SotA** (averaging 4.9 across DC1, DC13, and EC49).



He is currently an Associate Professor and his passionate contributions to the area of mathematical biology are quite extensive. We found further confirmation that he is actively publishing and is frequently cited, and he is also the recipient of several prestigious early career awards and writes frequently about merging areas of science. With consistent activity, impact, and innovation, we conclude that Dr. Pacific is also a highly-connective researcher.

Conclusion

In 2007, Panthalassa University published nearly 28,000 papers,⁹ and it was one of the top 20 federally funded universities¹⁰ in the United States.

Both Dr. Atlantic and Dr. Pacific are advancing interdisciplinary research in unique ways and are certainly contributing to the publication and funding success of the university.

Dr. Atlantic and Dr. Pacific are highly-connective researchers influencing internal collaboration across disciplines, but they play different roles in supporting multidisciplinary research.

	Dr. Atlantic	Dr. Pacific
Total number of competencies	7	3
Average number of fractionalized articles	1.2	5.1
Fractionalized contribution	3.1%	7.5%
Multidisciplinary approach	Diffusion	Fusion
Tactics	Developing portable concepts that may be applicable to several subject areas	Actively merging two or more subject areas to inform a specific area of research

With a low number of fractionalized articles in a high number of competencies, Dr. Atlantic has a minor fractionalized contribution to each.¹¹ His work in statistics and computer science can be seen as a more organic spreading of methodology or theories, as his concepts are portable and transferred across disciplinary boundaries without strong external force. **Because his theories spread outward naturally, we consider this approach to be diffusion across disciplines.** Conversely, Dr. Pacific has a high number of fractionalized papers in a small number of competencies and therefore a major fractionalized contribution to his competencies. He is actively engaging and connecting research from biology and mathematics to solve problems in the area of genetics, and **by uniquely combining research fields, this interdisciplinary approach is a fusion of disciplines.**

Discussion

Increasing transparency across faculties and improving internal collaboration has positive implications for a university and its researchers.

Funding agencies like the National Institutes of Health (NIH) encourage “interdisciplinary and multidisciplinary research”,¹² so supporting cross-disciplinary initiatives may benefit a university by way of increased funding and publication success. As research evolves, identifying multidisciplinary collaborators becomes essential, but the ensuing challenge rests in determining the best way to support them and relay their accomplishments.

It is essential to recognize that interdisciplinary research may take several forms, and merely identifying researchers with multiple faculty affiliations will no longer suffice. Accepting the multifaceted nature of multidisciplinary research, we propose a more comprehensive examination of how individuals successfully contribute to cross-disciplinary projects. For an institution interested in encouraging internal collaboration, this entails thoroughly understanding the nuances of how interdisciplinary research is evolving at its institution. We recommend a closer look at how its faculty interact and produce research with one another, because as our analysis suggests, there are at least two distinct approaches to interdisciplinary research.

By examining how internal collaboration came about and how researchers are currently supporting it, a university leader may take a more informed approach on how best to support it going forward. A university leader may want to bring their highly-connective researchers together to discuss the various approaches they are taking in their interdisciplinary work (i.e., fusion, diffusion, or another). This group of researchers could share better practices and advise effective ways to cultivate their multidisciplinary efforts and scale them across the entire institution. **Overall, successful collaboration will improve the quality of research and ensure strong standing and lasting achievements for the university.**

⁹ Scopus

¹⁰ National Science Foundation

¹¹ Fractionalized contribution is calculated by dividing the number of fractionalized papers contributed by the author by the total number of fractionalized papers written by the university for each competency and then taking the average across all of the author's competencies.

¹² Research Project Grant (RO1) is the “original and historically oldest grant mechanism used by NIH” (<http://grants.nih.gov/>)

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